Marine Management Organisation

Livelihood adaptation in fisheries and social resilience – a literature review and conceptual framework

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MMO1416: Livelihood adaptation in fisheries and social resilience – a literature review and conceptual framework April 2024

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Executive Summary

UK fisheries policy is explicit in its commitment to understanding and supporting fishing communities to adapt to change. The UK Joint Fisheries Statement (JFS) seeks to enable a ‘modern, resilient and environmentally responsible fishing industry’ and ‘growth, diversification and innovation’. Resilience is a central ambition in the strategic plan of the Marine Management Organisation articulated in Goal 6 to ‘Assure the sustainable and transparent management of fishing opportunities to achieve a resilient and increasingly viable fishing sector.’

Being responsive to change is an inherent characteristic of fishing, which is a highly unpredictable, risk-laden, but creative occupation. Fishers, and the households and communities in which they are embedded, pursue a myriad of adaptive strategies to maintain livelihoods and a valued way of life, whilst creating opportunities to adapt to new ways of doing things.

Fishing families in the UK (and globally) are experiencing diverse and fast-paced change, which is increasingly cumulative and intersecting (Kleisner et al., 2022). In the UK documented changes include, but are not limited to, warming seas induced by climate change (Pinnegar et al., 2020), the Covid pandemic (Kemp et al., 2020), unstable market access and catch value (worsened since leaving the EU) (Stewart et al., 2022), and intensifying competition for space (spatial squeeze) from conservation, recreation, renewable energy interests and intensified large-scale offshore fishing (NFFO, 2022). As a consequence of these stressors fishing is an increasingly unviable livelihood, this is reflected in the decline in the UK fishing fleet, which is most acute amongst smaller vessels (Coulthard et al., 2025)

Understanding the different ways that fishing households are able, and unable, to respond to change, and the factors that influence decision-making around adaptation, is fundamental to wellbeing and building resilience, addressing vulnerability, and supporting innovation in the fishing sector. Differential exposures and vulnerabilities to cumulative change, and the factors underpinning these, are important bits of the jigsaw to help managers understand who can adapt to change, and who cannot, and how this shapes resilience and sustainability of the fishery as a whole. It is also understood that one of the impacts of the industry not being resilient and unable to adapt is that compliance with regulation and management is harder.

This report provides a review of the published literature to distil current understanding about the different types of livelihood adaptation strategies that are employed in commercial fishing, and the type of factors that influence fishers’ decision-making regarding adaptation**.** The focus of this review includes geographical regions that have fisheries contexts that are comparable with the UK, in terms of climate, fishery and economy. The report also includes findings from a small number of interviews undertaken with commercial fishers in England that sought to situate findings from the review with the lived experience of fishers in the UK.

The review firstly provides a brief overview of **adaptation** in the context of fishing livelihoods, detailing how ‘adaptive capacity’ can be defined, and how it connects

with highly related concepts of vulnerability, resilience and sustainability. The review of the resilience, vulnerability, and adaptation literature and related conceptual models established that fishers' decisions whether to maintain their current practice, to adapt, or to exit fishing are driven by multiple factors which are closely intertwined and should be considered together, rather than in isolation. Fishers make decisions to adapt their livelihoods in response to some change, either a shock or pressure constituting a threat to their current operations, or in response to a new opportunity and benefit. The literature generally supports the assumption that adaptation results in reduced vulnerabilities and increased resilience.

Secondly, the different **livelihood strategies** that are evident in the literature on fisheries are presented, drawing on the social resilience concepts of coping (short to medium term, day-to-day activities that households adopt to mediate the impact of gradual or sudden change), adapting (practices aimed at systematically reducing potential harm or taking advantage of opportunities that result in long-term fundamental change, such as diversification) and transformation (radical change such as exiting fishing, either permanently or temporarily) (Béné et al., 2012; Korda et al., 2021). In addition, 'maladaptation' can occur where changes to livelihoods result in undesirable outcomes such as reduced resilience, wellbeing and sustainability.

Thirdly, the review identifies how fishers' responses to change and **decision-making in livelihood adaptation** are influenced by a wide range of demographic, psycho-social, environmental, economic, socio-cultural and governance factors (Table ES1).

Table ES1. Categories of factors that shape fisher behaviour (adapted from Andrews et al., 2021c)

Behaviour	Definition	Example references
Demographic	Age, education, income, gender, health/ illness.	Gustavsson and Riley, 2018b; Jentoft and Chuenpagdee, 2018; Szaboova et al., 2022.
Psycho-social	Identity, understanding and knowledge, morals, preferences, values, habit, place attachment, attitudes, risk, well-being.	Boonstra and Hentati-Sundberg, 2016; Coulthard, 2012; Turner et al., 2019; Winchenbach et al., 2022; Morgan, 2016; Andrews et al., 2021a.
Environmental	Catchability, stock conditions, weather, seasons, distance to port.	Lavoie et al., 2018; Maltby et al, 2021; Villasante et al., 2022; Yletyinen et al., 2018.
Economic	Vessel or gear, trip cost, poverty, livelihood dependence, occupational pluralism, financial stake in operations, access to technology and expected values for landings.	Tidd et al., 2011; Arias Schreiber and Gillette, 2021; Coulthard et al., 2011; Di Cintio et al., 2023; Jentoft and Chuenpagdee, 2018; Schadeberg et al.,2021; Szymkowiak, 2020.
Socio-cultural	Tradition, access to knowledge exchange, relationships, social capital, power,	Johnson et al., 2014; Ross, 2015; Salgueiro-Otero et

	cooperation in communities, conflict within communities, community development, social norms and gender.	al., 2022; Adger, 2009; Gustavsson and Riley, 2018a; Stead, 2005; Barnett and Eakin, 2015; Gustavsson and Riley, 2018b; Nadel-Klein, 2020 Acott and Urquhart, 2014; Martindale, 2014.
Governance	Spatial design, regulatory strength, access to fishing groups, input controls, output controls, legitimacy of rules, incentives.	Green et al., 2021; Scottish Government, 2024; Andrews at al., 2021a; Andrews at al., 2021b; Jentoft et al., 2019; Mikalsen and Jentoft, 2008; Pascual-Fernández et al., 2018.

At the household level livelihood strategies include: the role of women as income generators both within and outside the fishing businesses, which must be negotiated alongside family responsibilities such as childcare; and inter-generational continuity of the fishing business including shared vessel ownership or renumeration across the extended family.

Crucially though, research highlights that much of the literature considers fishers' behaviour to be informed by a single (usually economic) goal (Andrews et al., 2021c). This reflects a dominance of neoclassical economics theory, which is often applied across human behaviour research, and infers that a person acting rationally, with perfect knowledge, will seek to maximise personal utility through profit. A broader set of social sciences have long critiqued this theory as being overly narrow, and as Andrews et al 2021c, argue in a fisheries context, multiple goals and influencing factors (Table 2) must be considered for understanding fishers' choices and decision-making processes.

The role of individual agency, the extent to which fishers have a choice, and are able to act on the decisions they make, to employ the adaptation strategy selected is also an important factor in decision-making. Whilst there is limited detailed data in the literature about how decisions are made regarding adaptation choices (Andrews et al., 2021c), the importance of context and place-based decision-making (Fresque-Baxter and Armitage., 2012), a consideration of the interconnectedness of drivers in decision making, and being able to exert agency in carving out adaptation pathways is frequently argued for (Garcia, 2008; Galappaththi et al., 2019; Andrews et al., 2021b; King et al., 2021). Several authors argue that for any adaptation intervention to be successful in the long term, consideration of local contexts (Alban and Boncoeur, 2004; Frawley et al., 2019; Gustavsson and Riley, 2018a) and differences in fisheries business and ownership structures (Schadeberg et al., (2021), and co-designing solutions with important stakeholders (Guimarães et al., 2023; Urquhart et al., 2023) are essential, rather than making a priori assumptions about the best adaptation strategies.

Fourthly, the review distils the constraining factors (barriers) and enabling factors (enablers) that influence fishers' livelihood strategies in the face of social, economic and management change. Barriers and enablers to livelihood adaptation span intrinsic, demographic, knowledge, technical, environmental, social, financial, business and political domains. Generally, different types of barriers or enablers can be experienced simultaneously, having a cumulative effect on fishers. This, depending on the type and scale of the barrier or enabler, can influence the extent to which a fisher may be able to cope, adapt or have to transform. Social heterogeneity means that fishing policies might unintentionally advantage or disadvantage one group of fishers over another, and that these social factors should be considered in management decision making.

Based on the literature review, a conceptual framework (Figure ES1) for understanding adaptation decision-making processes, behaviours and social resilience is developed that theorises that fishers, fishing households and communities are subject to a range of pressures (shocks and stresses) on their activities. These manifest as individual or cumulative drivers (demographic, environmental, governance, economic, psycho-social, socio-cultural) that influence decision-making, alongside barriers and enablers to adaptation.

The degree of agency that an individual has in their decision-making will determine the extent to which they have capacity to cope, adapt or transform, with the ultimate desired outcome of social resilience. It is important to identify priority objectives and potential trade-offs as part of fisheries adaptation and to co-create solutions. This should lead to better understanding and compliance with regulations for the industry and the better understanding of motivation and choice for the marine regulators.

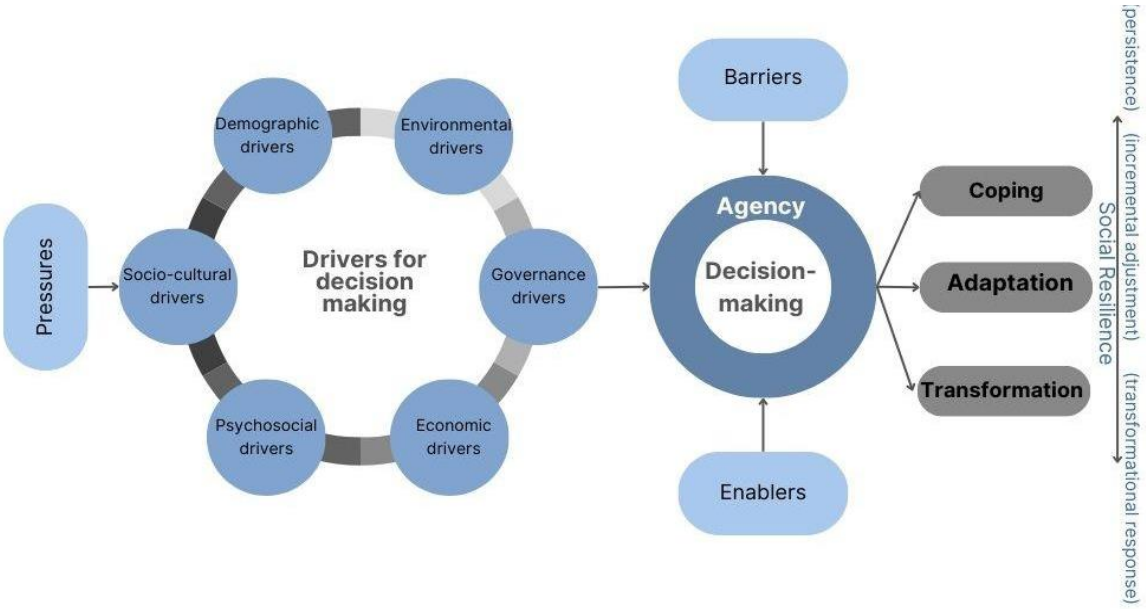

Figure ES1. Framework for understanding adaptation decision-making processes, behaviours and social resilience of fishers (inspired by Black et al., 2011)

Recommendations are provided for

- enabling fisheries managers to better recognise diversity and therefore the differentiation of impacts of and compliance and behavioural responses to management across different parts of the fleet,
- support equitable access and improve the agency of fishers to enhance and sustain the social resilience of fishers, fishing households and communities as is set out in the Joint Fisheries Statement.

Future research needs are identified, together with recommendations for the inclusion of three question sets in Defra's new social survey of fishers framed around adaptation, agency and outcomes. This would allow data to be collected to identify and monitor these elements over time and could be used as a set of social resilience indicators.

1. Introduction

Over the past few decades, coastal fishing communities have experienced considerable change including declining fish stocks, demographic changes, market and economic shifts/crises, fishery and marine conservation policy reforms and the expansion of offshore wind. In parallel, since the UK's departure from the EU and the re-design of UK fisheries policy, there is a commitment to restore and regenerate fisheries and their communities. Fishermen and their families have responded in such ways that have sought to cope, adapt or transform their livelihoods to continue fishing. However, English fishing communities have been declining and concerns over their uncertain future have been expressed by many. Some fishers have left their occupation and the sector, either through early retirement or to take up other lines of work.

UK fisheries policy is explicit in its commitment to understanding and supporting fishing communities to adapt to change. The UK Joint Fisheries Statement (JFS) seeks to enable a 'modern, resilient and environmentally responsible fishing industry' and 'growth, diversification and innovation'. Resilience is a central ambition in the strategic plan of the Marine Management Organisation articulated in Goal 6 to 'Assure the sustainable and transparent management of fishing opportunities to achieve a resilient and increasingly viable fishing sector.'

Currently, there is a lack of research evidence about how fishing households experience the pressures they face, and how this differs within households and across communities and different types of fisheries. Differential exposures and vulnerabilities to cumulative change, and the factors underpinning these, are important bits of the jigsaw to help managers understand who can adapt to change, and who cannot, and how this shapes resilience of the fishery as a whole. Evidence is also lacking on the decision-making processes that underpin the types of adaption strategy that a household adopts and, perhaps most importantly, the degree of choice, or agency, that is available. Even less is understood about the sort of outcomes that result from livelihood adaptation, in terms of improving peoples' lives, and the resilience and long-term sustainability of the fishery. Some adaptations may work against improving quality of life or sustainability outcomes. For example, when fishing longer hours increases income but erodes relationships at home (Coulthard and Britton, 2015), or when adapting to diversify gear puts pressure on a less robust stock. These are important evidence gaps to fill given that resilience is a core ambition in the strategic plan of the Marine Management Organisation, articulated in Goal 6. The ambitious outcomes for this goal are healthy commercial fish populations, a healthy ecosystem and good wellbeing of the industry.

This project aims to contribute to the MMO's understanding and knowledge base on livelihood adaptation by drawing together existing relevant evidence, with a specific focus on decision-making and agency, where available. We acknowledge that whilst the strategies of what people do in terms of adaptation are visible and quite widely documented in fisheries research, the more hidden aspects of decisions and trade-offs that have underpinned those strategies are under-researched and therefore far less available in published literature. Whilst fisheries-specific evidence on decision-

making in livelihood adaptation is limited, far greater progress has been made in terms of conceptual framing and theory around adaptation (often with origins in the literature on climate change adaptation, rather than fisheries per se), which illuminates the important role agency plays in enabling adaptation.

This project has three core aims:

1. To produce a synthesis of available literature on fisheries livelihood adaptation to demonstrate how fishers and fishing families respond to change, focussing on geographical regions that are comparable with UK fisheries. The review highlights evidence on the sort of strategies adopted by fishers, factors that impact the ability of fishers to demonstrate adaptation and, where available, insight regarding the decision-making processes that underpin adaptation behaviours.
2. Draw from (multiple) frameworks that exist on livelihood adaptation to distil a conceptual framework that is relevant to the context of UK fisheries, which can be used to inform future research on this topic.
3. To provide recommendations for operationalising the framework for fisheries management and future research areas and evidence gaps, including designing a set of questions on livelihood adaptation strategies for inclusion in Defra's national pilot of the new fisher social survey.

This report continues with a brief overview of the research methods and approach, followed by a conceptualisation of adaptation in the context of fishing livelihoods, detailing how 'adaptive capacity' can be defined, and how it connects with highly related concepts of vulnerability, resilience and sustainability. The main part of the review details the different livelihood strategies that are evident in the literature on fisheries.

The report then considers the risks of adaptation including 'maladaptation' where changes to livelihoods can result in undesirable outcomes such as reduced resilience and sustainability. We also discuss the role of individual agency, the extent to which fishers have a choice, and are able to act on the decisions they make, to employ the adaptation strategy selected. Whilst there is limited detailed data in the literature about how decisions are made regarding adaptation choices (Andrews et al., 2021c), the importance of context and place-based decision making (Fresque-Baxter and Armitage, 2012), a consideration of the interconnectedness of drivers in decision making, and being able to exert agency in carving out adaptation pathways is frequently argued (Garcia, 2008; Galappaththii et al., 2019; Andrews et al., 2021b; King et al., 2021). Based on the literature, a conceptual model for adaptation decision making is proposed towards the end of the report, followed by recommendations and avenues for further research.

2. Method and approach

The research team conducted a Scoping Review (SR) of the literature to identify fishers' adaptation strategies and the underlying decision-making processes.

To ensure manageability within the available resource, inclusion criteria for the review were agreed with the MMO (e.g., geographical focus and the inclusion of studies outside of England, timeframe of studies, publication types to include – peer reviewed, grey literature and unpublished studies, etc.). A short protocol outlining the review method was first developed (including search terms, search strategy, inclusion, exclusion and prioritisation criteria, approach to information extraction, approach to data synthesis etc). For the purpose of the scoping review, keyword/key phrases used for searches in Web of Science and Google scholar included:

*Fish*adaptation/ adaptive capacity/ diversification strategy/ policy/ regulations and barriers and opportunities*
*Fish*adaptation/ adaptive capacity/ diversification and decision/ motivation*
*Fish*resilience/ social resilience adaptation/ diversification and decision/ motivation*
Livelihood/s strategies and fish/ communities*
'Agency', 'power' and 'livelihood strategies'
Family/ gender and fishing behaviour
Fishing communities and resilience/ adaptation/ adaptative strategies
Fishing livelihood/s and social impact/ resilience
Sustain fisher/s livelihoods and strategies*

Additionally, significant and relevant papers, PhD theses and reports were reviewed following input from the project steering group. The geographical scope of the review was Europe, Scandinavia, Canada, and UK, but where relevant studies from outside these areas were considered for review. Non-English language publications were omitted.

Four semi-structured interviews were undertaken with commercial fishers (a crab potter and bottom towed gear prawn fisherman in Amble, North East England, and two mixed-gear fishers in Hastings). These fishers were known to the research team and were selected because they were willing to give their time to explore how the livelihood adaptation strategies identified in the literature review emerge in the real-world settings of fishers' lives. The interviews sought to cover a number of relevant issues arising through the literature review: (i) have fishers undertaken adaptation strategies to cope with changes over the past 5-10 years, and if so, what strategies? (ii) what influenced how the fisher made decisions about adapting and did they feel they had a choice? (iii) what has been the implication of adopting this strategy on the fisher's quality of life? and (iv) does the fisher feel more able to respond to future pressures? The interviews were recorded and transcribed verbatim and were analysed using the conceptual framework (see Section 5) developed from the literature review to sense check the framework in a real-world setting.

3. Conceptualising fishing livelihood adaptations – building on existing frameworks

Adaptive strategies are, in essence, “long-term responses or shifts in livelihood strategies in response to multiple stressors” (Marschke and Berkes, 2006). Adaptive capacity can be defined as “how a social or ecological system can adjust to *actual or expected* impacts of [climate] change and develop concurrently” (Freduah et al., 2019:87). Adaptive capacity underpins adaptive responses to change, including (but not limited to) diversification activities, which is the focus of much of the existing literature on adaptation in fisheries. How fishers respond to change is driven by individual and collective goals, and multiple factors across demographic, psychosocial, environmental, economic, sociocultural, and governance dimensions (Andrews et al., 2021b).

3.1 Vulnerability and adaptation

Adaptation is often framed in the literature in the wider context of ‘vulnerability’, which relates to the harm that can result from the lack of available adaptation options. Adger (2006:268) defines vulnerability as a “state of *susceptibility to harm* from exposure to stresses associated with environmental and social change and from the *absence of capacity to adapt*”.

The wider framing of adaptive capacity as part of vulnerability is important because it allows the drivers underpinning the need for adaptation in the first place, to be fully considered. It also creates space to consider differential vulnerabilities (Thomas et al., 2019) – different exposures and different sensitivities will shape different adaptation pathways within a diverse fishing community. Connecting all elements creates a more complete picture of why certain patterns in adaptation behaviours emerge. In their global review of literature on adaptation of fisheries to climate change, Galappaththi et al., (2021) ask two important questions: i) what are fisheries adapting to? and ii) how are fisheries adapting? Combining case studies published between 1990 and 2019, they distil three categories of adaptive responses: coping mechanisms (e.g. changing fishing location); adaptive strategies (e.g. livelihood diversification, incorporation of technology); and management responses (e.g. adaptive management, adaptation planning). This distinction between the concepts of ‘coping’ and ‘adaptation’ is common in the literature where day-to-day coping strategies become more permanently incorporated in longer-term incremental and planned adaptation, and part of the normal cycle of activities (Davies, 1996; Coulthard, 2009; DfID, 2016).

3.2 Frameworks that bridge adaptation with resilience

Fishers make decisions to adapt their livelihoods in response to some change, either a shock or pressure constituting a threat to their current operations, or in response to a new opportunity and benefit. The different livelihood strategies that are evident in the literature on fisheries are often loosely framed around coping, adaptation, and transformation. Whilst there is slight variation around how these are defined and shaped by different research and disciplinary contexts, Table 1 shows the main strategies and provides examples of how this might look in practice.

Table 1. Livelihood strategies and examples

Strategy	Explanation	Examples
Coping	Short to medium term, day-to-day activities that households will adopt to mediate the impacts of change (gradual or sudden) on their livelihoods to keep some level of stability and continuity (Béné, 2014).	Fishing alone; increasing fishing effort (fishing longer and going further); delaying retirement; reducing costs by downsizing; cutting household spending; involving household members instead of external crew.
Adaptation	Practices that are more long-term fundamental changes aimed at systematically reducing potential harm or taking advantage of opportunities (Gallopín, 2006; Smit and Wandel, 2006; Wamsler and Brink, 2014).	Adaptations involve diversification activities within the maritime economy, including i) intra-sectoral diversification within fisheries (e.g. diversify methods/species, value added activities), or ii) inter-sectoral diversification in other industries connected to maritime economies and connected to fishing (e.g. tourism, aquaculture).
Transformation	Transformation refers to a more radical change (McCormick et al., 2013) involving altering fundamental system attributes (IPCC, 2012) by addressing the root causes of vulnerability (Wamsler and Brink, 2014).	Temporary or permanent exit from fisheries.

A useful framework on 3D resilience (Béné et al., 2012) shows how the concepts of coping, adaptation and transformation connect to influence resilience outcomes. First, 'absorptive capacity' is the ability to absorb stresses using coping responses to persist in an activity. Second, when absorptive capacity is exceeded, the individual could exercise 'adaptive capacity' by undertaking incremental adjustments (e.g. diversification) in order to continue functioning without major changes in the activity.

Thirdly, if the change required is so large that it overwhelms the adaptive capacity, requiring 'transformation' of the activity involving altering fundamental functions and new ways of doing things. These three dimensions of capacity are interdependent, meaning that building resilience requires the strengthening of all three aspects combined (Béné et al., 2014). In a similar way, Korda et al., (2021), in their research on social resilience in small scale fisheries distinguish between coping, diversification and exit, whereby diversification is divided between intra-sectoral diversification of livelihoods (adapting a livelihood but remaining entirely within fisheries) and inter-sectoral diversification (adapting a livelihood that is external to fishing, but retaining some fishing) thereby adding more granularity to Béné et al's (2012) adaptive capacity dimension. Temporarily increasing fishing effort with current resources as a short-term behavioural response, for instance, can be considered coping, whereas increasing investment can be considered as adaptation (Andrews et al., 2021a).

Resilience pathways and adaptation processes are not linear and certain phases might overlap or be skipped entirely (Salgueiro-Otero et al., 2022). Béné et al., (2014:601) highlight that "adaptation is a continuous, incremental process, which is actually difficult to track or to measure". For instance, Gustavsson and Riley (2018a) conceptualised fishing life-courses as a ladder, where entry and exit points, and movement along the ladder vary depending on peoples' life-course stage and social capital accrued. Their conclusion that "fishing life-courses are not necessarily linear or uniform" (p.577) echoes research by Salgueiro-Otero et al., (2022) who highlight that fisheries adaptation might follow non-linear paths. Coulthard (2009) suggests that certain thresholds, or tipping points, may be identifiable at which point a fisher's livelihood can be transformed into an entirely different state, for example, the decision to sell up and permanently leave the fishery. Ellis (2000:56), however, argues that "[c]hoice, or lack of it, does not obey some sort of definable break point between two mutually exclusive states [...] households and individuals can also move back and forth between choice and necessity, seasonally and across years." A study on adaptive pathways of small-scale fisheries in Galicia (Salgueiro-Otero et al., 2022), considered adaptation strategies along a continuum from staying put (non-adaptation), intra-sectoral diversification, inter-sectoral diversification, to exiting the sector completely. Using declining income scenarios (i.e. increased exposure to financial pressure), the study found that not all 404 respondents would necessarily follow a gradual adaptation pathway. While about 75% of respondents follow a general remain (business as usual), adapt (continue fishing but change target species or gears), transform (in this study livelihood diversification) and exit (complete departure from fishing) pathway, only a third move between stages gradually. Over 40% jump straight from "remain" to "transform" or "exit" when presented with lower income scenarios, and about 5% would remain no matter what.

In the following section, social resilience livelihood strategies of coping, intra-sectoral diversification, inter-sectoral diversification and exit from Korda et al., (2021, see Table 1), are integrated with the 3D resilience framework developed by Béné' et al., (2012, see Figure 1) to provide a conceptual framework for the literature review. Organised around the concepts of coping, adaptation and transformation examples from the literature illustrate how these apply in practice and the potential positive and negative outcomes associated with each of those strategies. Choices are made as part of broader livelihood strategising to deliver particular outcomes. Outcomes of

livelihood adaptation can be categorised in terms of wellbeing (how the quality of life of the fisher is affected by the adaptation), resilience (capacity of the fisher to respond to change and maintain function), and sustainability (the impact of adaptation over the longer-term on both the fish resource and the fishing business).

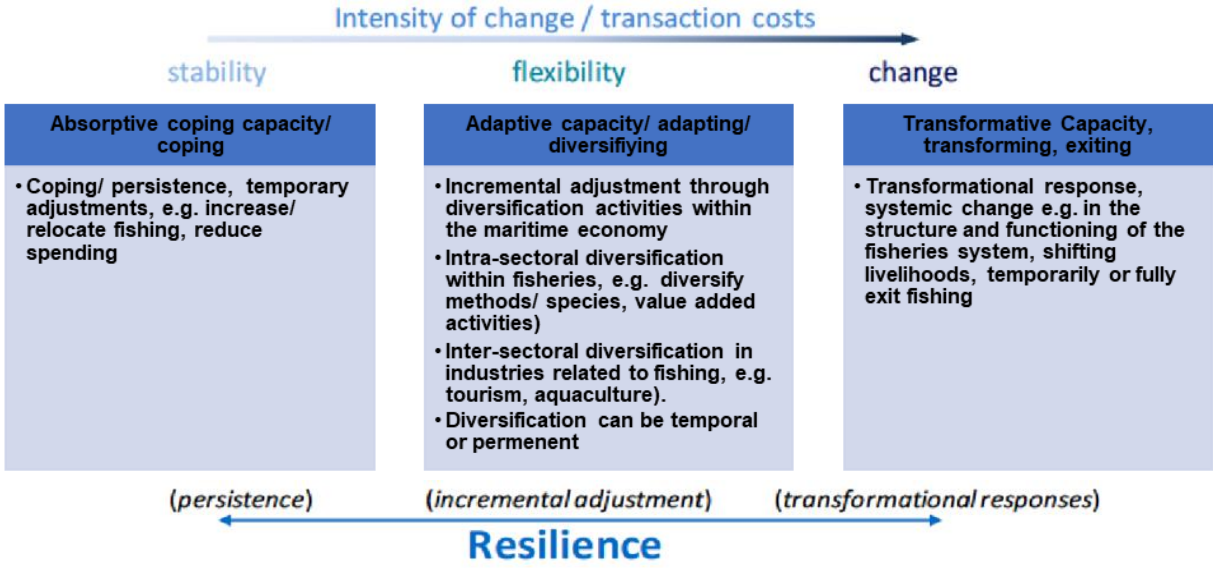

Figure 1. Fisheries resilience capacities and related activities (adapted from Béné et al., 2012; Korda et al., 2021)

4. Fishing livelihood strategies and associated outcomes

This section presents the main findings from the literature review, organised around the social resilience concepts of coping capacity, adaptive capacity and transformative capacity and the outcomes associated with these strategies. It also considers maladaptation (when adaption results in negative outcomes) and non-adaptation or exit. This is followed by factors that influence livelihood strategies, decision-making and agency, and the barriers and enablers to livelihood adaptation.

4.1 Coping capacity

Coping capacity might include employing one, or a combination of several strategies: fishing alone; increasing fishing effort (fishing longer and going further) at times when conditions are favourable; delaying retirement; reducing costs by downsizing; cutting household spending; or involving household members instead of external crew (Binkley, 2000; Korda et al., 2021; Morgan, 2016; Szymkowiak, 2020; White 2015a) (see Table 1) Traditional fishing livelihoods maintained through coping strategies support wellbeing outcomes related to people's strong attachment to fishing as a 'way of life', strong occupational and social identity, autonomy, connection to nature, and sense of pride (van Ginkel, 2001; Urquhart and Acott 2013a). However, the literature also indicates a range of challenges associated with coping strategies employed. For example, solo fishing or increasing fishing effort can result in increased stress and safety risks for fishers, and additional responsibilities and increased concern for spouses (Coulthard and Britton, 2015; Szymkowiak, 2020). More solo fishers also mean limited job opportunities for new entrants to learn the trade, which in turn affects intergenerational continuity of fishing and community resilience (White, 2015b).

Others argue that when a certain threshold of cumulative pressures is reached, fishers' ability to cope might be exceeded and their sense of wellbeing, job satisfaction and optimism decline, thereby threatening a community's social identity and ability to 'survive' (Johnson et al., 2014). This might result in fishing communities lacking hope and entrepreneurial spirit (Johnson et al., 2014). Further, the higher a community's dependency on the fishing industry, the more likely they are to keep fishing as the core industry, increasing their vulnerability (Brookfield et al., 2005).

4.2 Adaptation/diversification

Adaptation and diversification activities might be individual or collective efforts, and can occur at various levels and scales, such as within households, groups of individuals or households, within and amongst communities, regions and nations (Béné et al., 2014). Adaptations and incremental adjustments involve diversification activities within the maritime economy (Korda et al 2021), including i) intra-sectoral diversification within fisheries (e.g. diversify methods/species, value added activities), or ii) inter-sectoral diversification in industries related to maritime economies and connected to fishing (e.g. tourism, aquaculture) (see Table 1). Each

have distinct outcomes associated with the strategy employed. In contrast to coping decisions, which are usually made individually, Andrews et al., (2021b) found that adaptation decisions are mainly made at household level. Evidence about how and to what extent diversifying fishing practices increases resilience, and associated long-term outcomes of such activities, remains limited (Yletyinen et al., 2018). However, the adaptation and diversification literature generally support the assumption that adaptation results in reduced vulnerabilities and increased resilience. For instance, according to Korda et al., (2021:193) “fishers who constantly adapt to their circumstances whether by strategic or tactical choices (or both) display considerable resilience in the face of mounting threats to their survival”. They argue that diversification as a form of adaptive resilience can be seen as a sustainable option to support long term resilience, as long as the conditions are favourable and sufficiently supported (Korda et al., 2021).

Frequently cited positive outcomes from intra-sectoral diversification (Kasperski and Holland, 2013) and inter-sectoral diversification (Dwyer, 2017) are increased economic income, job creation, and recovery of fish stocks through reduction of pressure on fisheries resources (Chuenpagdee and Juntarashote, 2011). For instance, Burgess (2014) found that overall, a multispecies fleet with diversified métiers (a combination of fishing area and target species) can be more profitable and reduce pressure on weaker stocks. However, the opposite was found in a Welsh study that analysed fishing strategies of three small and medium scale fleet segments (Cambiè et al., 2017). Findings showed a negative relationship between the economic yield from fishing, and the diversity of métiers employed. In other words, those who used a limited number of métiers achieved the highest income. Another potential benefit of diversification may be greater support for sustainable marine management. For example, a study on Newfoundland and Labrador shrimp fisheries (Epstein et al., 2018) found that those fishers with a more diversified species portfolio were more likely to support selective closures of fishing grounds, thereby supporting environmental sustainability, especially when they were involved in the management of the fisheries.

Inter- and intra-sectoral adaptation and diversification might happen in combination and can provide mutual benefits. For example, culinary tourism and fish festivals can stimulate local economic value chains and strengthen community identity (Urquhart and Acott 2013b), while adding values or exploiting new distribution channels can improve financial resilience, empower fishing communities, and increase coordination and collaboration (Morgan, 2016; Penca et al., 2021; Urquhart and Acott, 2013b). Penca et al., (2021), for instance, argue that such activities strengthen the position of fishers as active agents in reconciling market-based, regulatory and collaboration challenges, and thereby hold great potential for small-scale fishers (SSF) (i.e. 10 metres and under in length in the UK) to contribute to environmental, social and economic objectives. Others argue that prioritising high-quality catch by adapting fishing practice to customer demand might support resource sustainability (White, 2015a). Positive outcomes of tourism related diversification include improved livelihoods and enhanced marine cultural heritage (Avila-Foucat and Rodríguez-Robayo, 2018; de Madariaga and del Hoyo, 2019), improvement in fishers’ mental and physical health and wellbeing, provide a sense of continuity and autonomy for fishers, influence sense of place (Urquhart and Acott, 2014) and give hope for declining fishing communities (Winchenbach, 2022. A study comparing adaptation

outcomes between those diversifying within fisheries and those outside the sector, found that fishers with a more diversified species portfolio (intra-sectoral diversification) experienced higher levels of economic well-being, whereas diversification activities outside commercial fisheries (inter-sectoral diversification), were associated with higher levels of social-well-being (Epstein et al., 2018). This is an important consideration when considering adaptive activities, linking to debates about what kind of resilience is desired and the possible trade-offs between different strategies (Meuwissen et al., 2019).

Despite possible positive outcomes, adaptation and diversification might introduce new vulnerabilities, or shift vulnerabilities between sectors. The main challenges in both inter and intra-sectoral diversification centre around higher economic risk due to financial investment (White, 2015a). Frequent adaptation requires time and money and can be stressful (Korda et al., 2021). Adaptation might also have unintended consequences and create new vulnerabilities. For example, the UK government's capped licence arrangements might mean that those who diversified species, for example from fin-fish to shellfish, risk being unable to regain a fin-fish licence, thereby becoming over-reliant on shellfish (Korda, 2019). Other examples of unfavourable outcomes of adaptation and diversification include working extensive hours and increased physical strain (White, 2015a), or reduced resilience if the target species becomes limited in future or market prices fluctuate (White and Scheld, 2024). Negative outcomes of increased tourism diversification include insecure and underpaid work, a lack of decent work (Winchenbach et al., 2019), over-tourism, pressure on local rent and housing stock, elite capital accumulation and marginalisation of disadvantaged groups (Cheer et al., 2019), thereby shifting vulnerability from one sector to the other whilst also creating new challenges. Additionally, the relationship between commercial fishers and other marine users such as tourism, aquaculture, or offshore energy operations can cause conflict due to competition for the same space and resources, also referred to as 'spatial squeeze' (Di Cintio et al., 2023). In terms of adaptation into sectors outside fishing, aquaculture diversification, for instance, has been criticised for its potential negative environmental impact (Jiang et al., 2022).

4.3 Transformative Capacity and Exit

At the individual level, transformation might include temporary or permanent exit from fisheries and is often discussed in combination with other diversification strategies and pluriactivity (Szymkowiak, 2020) (see Table 1). According to Béné et al., (2014), fisheries exit can be considered transformation rather than adaptation, and is often influenced by ill health, relational tensions and ecological impacts (Coulthard and Britton, 2015) and a lack of trust in policy and regulation (Arias Schreiber and Gillette, 2021). Studies considering the outcomes of leaving fishing often consider economic factors, with those who left reporting increased financial security compared to their previous job as fishers (Campbell et al., 2000). However, the literature highlights that non-financial outcomes play an important role in decision making in transformational livelihood strategies. For example, Coulthard and Britton (2015) found that those who exited fishing eventually returned, mainly based on relationship and psychological factors, such as the love for the job and feeling respected, boredom in alternative job, autonomy, and more time spent with family.

These findings indicate that wellbeing outcomes of working outside fishing might be less favourable for previous fishers, hence the decision to return. In relation to transformative strategies, a study by Andrews et al, (2021a) found that family members were often involved in discussions about uncertainty and relocation, jointly weighing up trade-offs between decisions. At the community level, transformation into other industries and fishing exit can negatively impact a community's social and cultural identities and is associated with the loss of traditional knowledge and heritage (Power et al., 2014). Fishing exit at a larger scale, and associated increased reliance on food imports, can have implications for food security (Ritzman et al., 2018). Fishing exit also affects other ancillary industries such as seafood processing and boat repair, whilst working harbours are considered as an important draw for coastal tourism, and the loss of fishing might result in a decline of the local visitor economy (Khakzad, 2018; Urquhart and Acott, 2013b). Nonetheless, environmental and conservation benefits from restricting or moving away from fishing have been well reported in the literature (Pascual-Fernandez et al., 2018).

4.4 Maladaptation and non-adaptation

Maladaptation is where adaptation results in negative outcomes for resilience, wellbeing or sustainability, such as increasing vulnerability and unintentionally causing harm (Barnett and O'Neill, 2010, Criddle, 2012; Reckien et al., 2023).

Korda et al., (2021) distinguish between sustainable and unsustainable adaptation strategies, of which the latter can also be considered maladaptation. Unsustainable adaptation strategies might include solo working due to financial pressures, or illegal activity. Maladaptations that erode resilience, wellbeing and sustainable outcomes feedback to further exacerbate changes and pressures, and the degrees of choice that fishers have to respond.

Trade-offs also exist between different strategies to pursue different wellbeing, resilience and sustainability outcomes, and these trade-offs occur at multiple levels and are complex (Coulthard, 2012, Chaigneau et al., 2022). For example, fishing 'harder' for longer periods at sea may be one (common) adaptative strategy to bolster income (one element of wellbeing) and improve resilience of the business, but it may also erode quality of life (also wellbeing), and resilience and sustainability of the stock. The experiences and trade-offs between outcomes will also differ across scales, such as at the individual, household or community level. For example, longer periods at sea may erode the wellbeing of the fishing family who take on additional burdens within the home to accommodate the fisher's absence, thus representing a trade-off between familial relationships and income stability (Coulthard and Britton, 2015).

Research indicates that non-adaptation (Turner et al., 2019) in fishing can lead to increased mental health issues and depression, which in turn are associated with drug and alcohol abuse, as well as family conflicts and relationship breakdowns (King et al., 2021). Cumulative stress and insecurity about the future can also affect people's mental health and lead to depression, which has been equated with a loss of agency (Lister, 2004). For example, King et al., (2021) in their Australian fishers' study found that the cumulative 'traditional' risks (e.g. physical risks, weather and

market fluctuations) as well as the unpredictability of management decisions and community conflicts resulting from privatisation policies, negatively affects fishers' mental health. Additionally, Laraqui et al., (2018) and Turner et al., (2019) highlight wider health concerns in the industry. It is important to note that blaming, shaming, and penalising those who do not adapt is only likely to make the situation worse, fuelling feelings of shame and failure (Lister, 2004). Instead, understanding the reasons behind and the factors influencing decision making will inform initiatives designed to support fishers and increase resilience.

4.5 Factors influencing livelihood strategies

The pursuit of adaptive and resilient fisheries requires careful attention to who is, and who is not, adapting to change and why. For example, the on-going decline in the number of active fishers and fishing boats (MMO, 2023) illuminates exiting fisheries entirely as a prevalent adaptation strategy, whether by choice, or by lack of any alternative. Understanding the role of agency, perception, and aspiration in shaping adaptation decisions and desirable livelihood transitions (Trimble and Johnson, 2013; Idrobo and Johnson, 2020), especially motivations to remain or leave the fisheries sector, is a critical evidence gap in the UK. Whilst there is significant published literature on the types of visible livelihoods strategies that fishers put in place to cope and adapt with change (what fishers actually do), far less is understood about the invisible nature of the decision-making processes that fishers have undergone in order to enact change (i.e., why fishers do what they do). White and Scheld (2024), for instance, argue that a better understanding of the multiple factors determining adaptation decision-making can increase fishers' and fishing communities' resilience. Identifying the attributes that underpin who can adapt and in what ways, is a core part of interpreting the adaptation responses that emerge in livelihood strategies. This also helps illuminate the heterogeneity within fishing communities and differences amongst people in their adaptive capacity to manage risk and adapt to change, which is critical to devising effective strategies that support fishers' resilience (Coulthard, 2012; Morgan, 2016; White and Scheld, 2024).

4.5.1 Decision-making in livelihood adaptation and the importance of 'agency'

Integrating consideration of agency in understanding and supporting adaptation to change is integral for effective engagement and wider fisheries management. It will not only benefit fishers and community wellbeing, but also contribute to longer term social sustainability and resilience. The importance of agency, defined as the capacity of people to make decisions and act on them, is well acknowledged in the literature (Brown and Westaway, 2011; Coulthard, 2012). For example, McLaughlin and Dietz (2008) offer a three-pronged rationale as to the importance of agency: (i) human actors are never just passive in the face of change, and as such their actions should be treated as independent variables that can influence the nature of the change as well as the responses to it; (ii) people have their own priorities, which may differ from those in management seeking to bolster adaptation, thus understanding what fishers decide to do, and why, is crucial to mitigating their vulnerability and enhancing resilience; and (iii) the realities in which people live, and act, are central to

legitimising choices that ultimately determine how change is experienced. As such, adaptation decisions and how they can be supported, need to be understood in the broader framing of peoples' whole lives. Adger et al., (2009) further emphasise the social nature of agency, questioning the ways in which society itself influences, and limits adaptive capacities, focusing on the roles of ethics, i.e., what is valued by a society, knowledge, perceived risk, and culture. This centrality of values (see also O'Brien et al., 2009) helps to define more clearly what socially acceptable levels of risk are, and to what degree adaptation is perceived as necessary and plausible. It places social choice and the negotiation of adaptive strategies at the heart of the analysis (Coulthard, 2012).

Fishers' responses to change are driven by individual and collective goals, as well as various factors across demographic, psychosocial, environmental, economic, sociocultural, and governance dimensions (Andrews et al., 2021c). Andrews et al., (2021c:489) provide a systematic review of fisher behaviour, which they define as "individual and group level action that reflects the psychological processing and social exchange of information in fisheries", involving 104 journal articles published between 2012-2017. While there is limited empirical research about drivers of long-term family adaptation strategies (Andrews et al., 2021c), the authors distil from their review of the literature the discernible factors used to explain the choices that fishers make and how these underpin fisher behaviour. Within this, the authors identified 46 factors from 747 instances that were considered to influence behaviour, which were categorised in six groups (see Table 2).

Table 2. Categories of factors that shape fisher behaviour (adapted from Andrews et al., 2021c)

Behaviour	Definition	Example references
Demographic	Age, education, income, gender, health/ illness.	Gustavsson and Riley, 2018b; Jentoft and Chuenpagdee, 2018; Szaboova et al., 2022.
Psycho-social	Identity, understanding and knowledge, morals, preferences, values, habit, place attachment, attitudes, risk, well-being.	Boonstra and Hentati-Sundberg, 2016; Coulthard, 2012; Turner et al., 2019; Winchenbach et al., 2022; Morgan, 2016; Andrews et al., 2021a.
Environmental	Catchability, stock conditions, weather, seasons, distance to port.	Lavoie et al., 2018; Maltby et al, 2021; Villasante et al., 2022; Yletyinen et al., 2018.
Economic	Vessel or gear, trip cost, poverty, livelihood dependence, occupational pluralism, financial stake in operations, access to technology and expected values for landings.	Tidd et al., 2011; Arias Schreiber and Gillette, 2021; Coulthard et al., 2011; Di Cintio et al., 2023; Jentoft and Chuenpagdee, 2018; Schadeberg et al.,2021; Szymkowiak, 2020.
Socio-cultural	Tradition, access to knowledge exchange, relationships, social capital, power,	Johnson et al., 2014; Ross, 2015; Salgueiro-Otero et

	cooperation in communities, conflict within communities, community development, social norms and gender.	al., 2022; Adger, 2009; Gustavsson and Riley, 2018a; Stead, 2005; Barnett and Eakin, 2015; Gustavsson and Riley, 2018b; Nadel-Klein, 2020 Acott and Urquhart, 2014; Martindale, 2014.
Governance	Spatial design, regulatory strength, access to fishing groups, input controls, output controls, legitimacy of rules, incentives.	Green et al., 2021; Scottish Government, 2024; Andrews at al., 2021a; Andrews at al., 2021b; Jentoft et al., 2019; Mikalsen and Jentoft, 2008; Pascual-Fernández et al., 2018.

Crucially though, the researchers highlight that much of the literature considers fishers' behaviour to be informed by a single (usually economic) goal (Andrews et al., 2021c). They argue that this narrow perspective is problematic and instead multiple goals and influencing factors (Table 2) must be considered for understanding fishers' choices and decision-making processes. Further, the demographic, psychosocial, environmental, economic, sociocultural, and governance factors occur simultaneously, while the strength of relationships between can differ. Empirical results showed that the relationships are strongest between economic, psychosocial and environmental factors, and governance and environmental factors. Relationships are weaker between governance and demographic factors, governance and sociocultural factors, and governance and psychosocial factors (Figure 2).

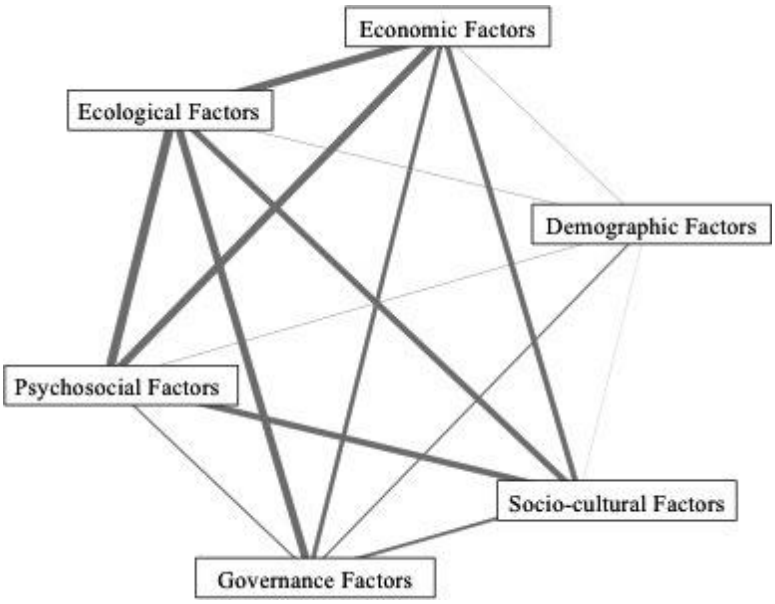

Figure 2. Co-occurrence of influencing factors and relationship strength among them (Andrews et al., 2021c)

Another recent study considered the factors influencing choices and strategies in the context of Scottish fishers (Scottish Government, 2024). They categorised the drivers underpinning decision making broadly into social, economic, governance and environmental domains, but included psycho-social and socio-cultural factors in the social category instead of using them separately. Like discussed above, their findings confirm that decision making processes are complex, and often several drivers underpin decision making. In the Scottish study, regulations dominated decision making in respect of the governance domain, and costs/benefits was the most prominent concern under economic drivers. Short-term decisions were found to be mainly influenced by weather conditions as part of the environmental domain, while longer-term changes, which might relate to adaptation or transformation, were driven by governance aspects such as stricter regulations and new policies. Decisions about fishing location and target species were often driven by economic factors, such as fuel cost and market dynamics. Their interviews with fishers also brought to light important influencing factors such as lack of crew and poor mental health, both of which have been identified elsewhere (King et al., 2021; White, 2015a). Overall, their study concluded that social drivers had the greatest influence on fishers' choices, with knowledge and community identified as the most prominent sub-drivers. As an example of knowledge and community socio-cultural factors, Salgueiro-Otero et al., (2022) argue that communication structures play a pivotal role in adaptation decision making. They argue that bonding network structures, that facilitate mutual learning and provide social support within the sector, are linked to adaptation. In contrast, bridging network structures, i.e. communication with other industries and gaining access to new resources and ideas, are more likely to lead to transformation or exit. In another study, Brown and Westaway (2011) highlight the critical role of social and economic capitals, distributional governance, and technological and social connectedness for building adaptation capacity and community resilience.

Proponents of considering a wider range of influencing factors reject attempts to define fishers as a homogenous group that makes rational decisions based on profit maximisation but argue a multi-dimensional perspective, taking into consideration strategic and non-strategic decision-making processes, yield a better understanding of fishers' decision-making processes (Andrews et al., 2021c). Boonstra and Hentati-Sundberg (2016), for instance, found that the attitudes, characters, and mentality differ considerably between archipelago fishers, coastal fishers and offshore trawling, and that ecological and social conditions influence them in different ways. They argue that non-strategic factors, such as fishing heritage, life history, identity, habits, values, and norms influence fishers' diverse responses and adaptation behaviour to change.

In a similar vein, Schadeberg et al., (2021) found that while Dutch fishers might be operating in the same metier, their behaviour differs depending on business structure, weekly working patterns, and level of specialism. The researchers compared the decision-making powers and strategies between businesses where the skipper is, or was, the vessel owner or ownership stakes are distributed amongst family members (i.e. skipper-owners), and skippers as employees in larger multi-vessel operations. They identified that in larger companies and multi-vessel

operations, decisions about long-term strategies on what, when, how and where to fish are usually outside the skipper's responsibility and control, instead being made by fleet management (which might not be directly involved in the fishing practice) and driven by commercial rationale (Schadeberg et al., 2021). Without involvement in business strategy, employed skippers focus on tactical decisions at sea. In contrast, owner-operated businesses' adaptation decisions and behaviour are more influenced by personal relationships and family ties, and grounded in fishing identities and heritage, rather than based on economic rationale. In those contexts where family members are actively involved in the fishing business and ownership, stakes are distributed amongst family members, and decisions about tactical and strategic decisions are usually negotiated amongst family members rather than taken by individuals. The study however does not detail how decisions are negotiated at household level. In terms of target species (polyvalence), the study found that specialised fishers might flourish under management regimes that advocate single quota. These fishers might heavily invest in specialised gear, act more habitually and are usually more risk-averse, but this also makes them less resilient to changes in quota allocation or area closures. In contrast, 'switchers', i.e. those fishers who hold a diverse licence and gear portfolio are able to fish throughout the year and are more resilient to change. In consequence, this social heterogeneity means that fishing policies might unintentionally advantage or disadvantage one group of fishers over another, and that these social factors should be considered in management decision making.

While all six factors shown in Table 2 drive fishers' behaviour and co-occur (Figure 2), the reviewed literature indicates that psychosocial factors, such as wellbeing, emotions and values, are particularly relevant in fishers' adaptation decision making (Nightingale, 2013; Song et al., 2013). It is argued that attention to psychosocial dimensions has the potential to improve marine governance, and therefore should take centre stage in policy and governance (Andrews et al., 2021a; Nightingale, 2013). For example, Andrews et al., (2021a) evidenced that emotions play a major role in adaptation decision making of inshore fishers. Their study of Newfoundland inshore fishers found that positive emotions such as enjoyment and relief drove adaptation behaviours. In contrast, negative emotions such as frustration or anger about fishing decline inhibited adaptation such as capital investment or encouraging future generations to join the industry. Feelings of uncertainty about future quota allocations resulted in fishers holding out hope for improved future earnings and wellbeing, and hope was also found to underpin decisions to re-enter or invest in the fishery, thereby practising adaptive strategies. The research further indicated that people remained in the industry and tried to cope largely out of fear and uncertainty about leaving the area. They concluded that fishers' wellbeing priorities can be explained by emotions and perceptions, which combined, determine behavioural change.

Finally, research highlights the importance of considering the interaction and dependencies between and amongst diverse human and non-human actors and social-ecological systems through *systems-thinking* that should inform and support adaptation decision making (Chuenpagdee and Song, 2012; Kittinger et al., 2013).

Stead (2005), for instance, conducted a SWOT analysis of adaptation and diversification strategies of Scottish fishing communities. They considered initiatives that sustain existing fishing practices, such as capture, fish processing and selling, as well as intra- and inter-sectoral diversification, including supply chain diversification, aquaculture, oil and gas industries, and leisure and tourism sectors. Their study highlights the importance of moving beyond relying solely on quantitative measures of adaptation and diversification, but instead developing an understanding of stakeholders' priorities, perceptions, attitudes, and to inform strategic planning and decision making. Their findings show that a systems approach to diversification is required, considering social and ecological aspects combined, rather than in isolation.

4.5.2 Strategies of fishing households to maintain and protect fishing livelihoods

This section expands the discussion on adaptation strategies and the factors influencing decision making, with a focus on household level strategies, as family members are often formally or informally involved in fishing and play an integral part in how fishing livelihoods unfold.

The literature increasingly recognises the important role women play in the social resilience of fishing economies (Szaboova et al., 2022). Their activities within or outside fisheries form an integral part of a diverse livelihood portfolio that enhances the household's abilities to respond to change through adaptation (Ross, 2015). Women's fisheries related work might involve shore-based activities such doing the accounts for the fishing business, fish deliveries, or running errands (Schadeberg et al., 2021; Szaboova et al., 2022). While such unpaid work is often deemed 'invisible' (Zhao et al., 2013), the authors highlight how these activities reduce business costs and support fishing's longer-term sustainability. In addition to their varied economic contributions, women also safeguard the physical and psychological wellbeing of their partners and children. This involves taking on most of the caring responsibilities while their partners are at sea, emotionally supporting their children and partners in relation to the frequent absences and dangers inherent in the fishing occupation, and ensuring their partners are cared for in terms of medical needs (Szaboova et al., 2022). Gustavsson makes an important contribution by highlighting the significance of female entrepreneurship within fisheries (Gustavsson, 2021). The study shows how women negotiate their activities between gendered roles such as motherhood and being fishing entrepreneurs in their own right, and therefore should be considered individually rather than only in addition to or within a household context. Women also increasingly support fishing businesses' financial viability through work outside the fishing sector, by providing regular household income from, for example, work in retail or tourism (Szaboova et al., 2022). Such activities buffer against fluctuating income patterns of their fishing partners and enable the continuation of fishing activities (Szaboova et al., 2022). Existing research, however, found several challenges in regards to the role of women in supporting and sustaining fishing livelihoods. For example, studies identified that women often sacrifice their own wellbeing in favour of protecting the social and economic resilience of their families

and the fishing industry (Britton, 2012; Coulthard, 2012; Szaboova et al., 2022). Further, spouses taking on work outside fishing involves renegotiating gender roles and power dynamics, which can lead to family conflict (Szymkowiak, 2020). In a more positive vein, such a shift in responsibility can help balance gender roles (Szymkowiak, 2020).

Strategies to maintain fishing within households also include inter-generational continuity. For example, Schadeberg et al., (2021) explain that fishers' children might be expected to take over the family business, thereby protecting the family's fishing heritage and identity, and contributing to the pension income of retired skipper-owners, and shared vessel ownership or renumeration arrangements across extended families. Such situations, however, can put pressure on younger generations, who might feel that they have no choice about their decisions, as giving up the business in favour of another occupation is a sentimental matter rooted in family tradition, and might be perceived as failure (Schadeberg et al., 2021).On the other hand, there is evidence that even in families with a long fishing heritage, fishers pro-actively discourage or prevent their children from working in the fishing industry (Winchenbach, 2022).

This section outlined various strategies fishing families engage in to maintain and protect fishing livelihoods. Where possible, we also showed how these strategies are negotiated, yet evidence of intra-household negotiations is limited within the scope of the literature reviewed and requires further research.

4.5.3 Barriers and enablers to livelihood adaptation and resilience

There are many factors that prevent or support fishers to take adaptive actions. Based on the literature review, barriers and enablers play an important role in how decisions are made, the agency people have to make decisions, and how decisions can be turned into actions. These can be categorised into Intrinsic, Demographic, Knowledge, Technical, Environmental, Social, Financial, Business, and Political barriers and enablers (see Table 3). It is important to note that while Table 3 provides an overview about the most relevant barriers and enablers discussed in the literature, there can be many relationships between and across barriers and enablers. Some aspects can act as both, a barrier or enabler, and certain enablers may overcome several of the barriers.

Intrinsic barriers and enablers are embedded in personal characteristics and are a sub-section of the psycho-social factors described in Table 2. They include personal values, motivations, attitudes, and preferences, and the feeling of having a choice (agency, see Section 4.5.1) (Christy et al., 2021). Steins et al., (2023), for instance, found that fishers' willingness to adapt, rather than only their ability to do so, plays an important role in enabling or preventing uptake of new gear. Their research shows that willingness to adapt is driven by intrinsic beliefs about regulations and policy measures being fair and legitimate, and the level of trust in regulatory enforcement and compliance.

Demographic enablers and barriers relate to age, gender, marital status and health condition as shown in Table 3. For example, Arias Schreiber and Gillette (2021) found that fishers who are older, have low education (Knowledge domain) and live alone are less likely to exit fishing, which means that these factors can be considered barriers to adaptation. Regarding gender, several studies show that women play a critical role in fisheries adaptation and diversification, including within and outside the industry, to buffer against economic downturns in fishing (Gustavsson and Riley, 2018b; Neilson et al., 2019). However, gender discrimination remains. For example, in her research on women's role in fishing entrepreneurship, Gustavsson (2021) highlights how current regulations and funding supporting fishing diversification and entrepreneurship, and the language used, implicitly disadvantage women. She argues that most value adding opportunities are tied to male-dominated fishing activities, thereby not accounting for the (gendered) realities in which value addition takes place, where women are fisheries workers in their own right, rather than merely supporting fishing activities.

Knowledge includes the skills and qualifications, but also awareness of, and support for, adaptation options. Prosperi et al., (2019), for instance, found that knowledge about different species and markets enables access to intra-and inter-sectoral diversification opportunities, for example through fish processing and culinary experiences. Another study in a Dutch context found that knowledge exchange encourages collaboration amongst fishers, acting as an enabler for taking up proven fishing gear and gear development (Steins et al., 2023).

Technical barriers and enablers include access to new technologies, products and specialist gear. An example includes research by Jentoft et al., (2019), who argue that a lack of innovation and product development constrain adaptive opportunities. Technical and financial barriers are often intertwined, as access to new technologies require larger investments. Theoretically, fishers can decide to alter and adapt fishing strategies, yet some argue, in reality, this is rarely the case as specialisation requires specific technologies and licensing systems might legally prevent, or at least make such adaptation harder (Yletyinen et al., 2018). Therefore, while larger vessels might be able to geographically move to more abundant fishing grounds more easily, inshore fishers face more technical, financial, and licensing barriers, and mainly adapt by changing target species (Yletyinen et al., 2018).

Natural and built environment barriers and enablers are similar to environmental factors in Table 2, but also consider human-made structures and infrastructure. Bad weather, for example, can be considered as barrier for small-scale fishers to go to sea (Andersen et al., 2012; Prosperi et al., 2019), with more frequent bad weather events being a barrier to continue fishing despite adaptive activities. Additionally, decreasing marine stocks are a main barrier to continue fishing and sustain livelihoods, particularly for small scale fishers (Boonstra and Hentati-Sundberg, 2016). Diversification activities such as value-added activities are enabled through sufficient infrastructure, such as processing, cooling and storage space within ports and harbours.

Social barriers and enablers refer to the socio-cultural factors identified in Table 2, such as societal traditions and norms, social capital, and relationships. Salgueiro-Otero et al., (2022), for instance, found that communication structures and bonding

network structures facilitate mutual learning and provide social support within the sector, which in turn enables adaptation. Negative perceptions about diversification and innovation by other fishers or community members are examples of where community norms prevent adaptation activities (Steins et al., 2023).

Financial barriers such as rising operating and household costs and lack of access to funds to upgrade existing or invest in new gear and technologies, or to engage in entrepreneurial and innovative activities, are commonly cited constraints to fishing adaptation, particularly for smaller operations (Morgan, 2017; Steins et al., 2023). For instance, Steins et al., (2023) found that Dutch fishers consider investment costs for new gear as too large, which limits their ability to adapt. Therefore, structures and systems that support fishers' ability to access funds are required to support adaptation, for example, through government grants and loans (Jeffery et al., 2021; Steins et al., 2023). On the other side, fishers who have savings and financial security are enabled to acquire new licenses or upgrade their fleet (Andrews et al., 2021a)

Limited intra- and inter-sectoral collaboration are frequently cited barriers to decision making and fishing adaptation (Galappaththi et al., 2019; Korda et al., 2021). For example, Di Cintio et al., (2023) in their study of Tuscan artisanal fisheries found that while most fishers practice multi-gear and multi-species fishing strategies throughout the year, very few value-added activities are implemented due to the relatively low bargaining power of SSF and a lack of intra- and inter-sectoral collaboration (Di Cintio et al., 2023). Volatile and highly competitive markets on one hand can be a barrier to diversification, but can also be an incentive to form cooperatives, purchasing groups or direct selling schemes, which are considered transformational activities (FAO, 2012; Jentoft et al., 2019; Prosperi et al., 2019).

Political enablers and barriers include fishing regulations, governance structures and distribution of power. As an example, fishers might perceive the uneven quota distribution between inshore and offshore fishers as a barrier to continue their previous fishing practices, which in turn drives adaptation by targeting non quota and higher value catches (Prosperi et al., 2019). Pascual-Fernandez (2018) found that when fishing communities needs and concerns are considered in marine protected area management, new synergies and intra-and inter-sectoral diversification activities and collaborations can develop. Further, research studies identify improved inter-sectoral governance as an important enabler to support decision making and livelihood adaptation (Haapasaari et al., 2021; Song et al., 2018). For example, Haapasaari et al., (2021) found that societal, political, institutional, operational, and technical factors, and a willingness of policy makers to enhance their cross-sectoral knowledge affect the successful implementation of inter-sectoral governance. To overcome potential challenges, they advise against creating new advisory or strategy bodies, or a complete integration of assessment and management. Instead, a softer approach with an emphasis on understanding cross-sectoral issues and knowledge exchange to strengthen inter-sectoral governance in fisheries might be a way forward.

The various barriers and enablers can overlap and occur simultaneously. For example, a study based on a survey of English Channel inshore fisheries and non-fisheries respondents (Morgan, 2017) concluded that the most prevalent constraints

influencing diversification into other sectors (inter-sectoral diversification) include intrinsic (attitudes), knowledge (formal qualifications and knowledge and skills), political and administrative (regional and national regulations and legislation, and bureaucracy constraints, lack of business opportunities, and financial factors (lack of access to capital and profitability, and financial risk).

Table 3. Enablers and barriers to fishers' adaptation and decision making

Theme	Barriers	Enablers	Example references
Intrinsic	Agency - not feeling able to make own decisions about adaptation Negative attitudes to adaptation Risk aversity Lack of intrinsic motivation Other industries / occupations perceived as boring Lack of trust in governance/ science	Agency – positive perceptions about having a choice Capacity to anticipate changes and ability to plan Similar job motivations (e.g. aquaculture) Flexibility Moral obligation (to environment, future generations, not to break laws) Ability and willingness for translating enablers into adaptive action	Morgan, 2017; Cinner and Barnes, 2019.
Demographic	Health problems might prevent continuation of fishing livelihood Fishers close to retirement might be less inclined to adaptation / diversification (but in some cases engage in inter-sectoral diversification, e.g. tourism) Younger fishers are not earning sufficient fishing income to support a family Gender discrimination (e.g. entrepreneurship, recognition of women contribution) Lack of new entrants	Support for fishers' health and wellbeing Younger fishers are more flexible Gender equality	Arias Schreiber and Gillette, 2021; Gustavsson, 2021; King et al., 2021; Winchenbach et al, 2022
Learning and Knowledge	Lack of formal qualifications, and lack of knowledge and skills constrain intra- and inter-sectoral diversification Lack of examples of good practice	Access to information and technical advice, new skills and knowledge (e.g. fishing techniques, marketing, product development)	Cinner, and Barnes, 2019; Prosperi et al., 2019; Morgan, 2017.

		Knowledge about diversification opportunities and the processes to follow these through Cross-sectoral partnerships to facilitate knowledge sharing	
Technical	Specialisation requires investment in and knowledge of specific technologies Limited geographical mobility (e.g. inshore fleet less able to move to other fishing grounds) Outdated gear	Access to funds and knowledge for adapting new technologies Innovation Technical ability to relocate fishing grounds Support for updating gear	Jentoft et al., 2019; Yletyinen et al., 2018.
Natural and built environment/ infrastructure	Physical barriers/ Limitations at landing sites Insufficient commercial infrastructure (e.g. storage, refrigerators) Geographical access limitations (vessel size, launching) Lack of other species Spatial squeeze in form of encroachment from other marine users (e.g. tourism, offshore wind farms) SSF highly dependent on local and regional ecosystem resources due to small size and reduced mobility	Physical and technical infrastructure improvements and investment Place-based and cross-sectoral spatial planning (considering wider stakeholders using the same space)	Khan et al., 2018; Andersen et al, 2012; Prosperi et al, 2019.
Social	Social norms and values discouraging adaptation Low level of community morale Outward migration (lack of innovators)	Social norms and values encouraging adaptation Diversified household income Family/ community support	Cinner, and Barnes, 2019; Schadeberg et al., 2021.

	Heritage/obligation to continue family business Place attachment Weak social capital	Strong social capital and support networks	
Finance	High cost of gear/insurances Lack of access to finance (e.g. to buy new gear, upgrade vessel/s or support diversification activities), particularly for SSF Limited financial security (e.g. limited savings, boat value decreased) Gender discrimination (e.g. limited access to funds for diversification and entrepreneurship)	Structures and systems that support fair and equal access to funds, for example loans, grants, or direct financial support Financial security (e.g. savings, property ownership)	Jeffery et al., 2021; Morgan, 2017; Gustavsson, 2021.
Business environment	Lack of access to markets Market volatility and fluctuations Lack of business opportunities Limited value-added activities due to low economic bargaining power (especially SSF) Lack of innovation and product development (Jentoft et al., 2019) Competition amongst fishers and from larger vessels	Availability of alternative industries/ livelihoods Strong bargaining power through trade associations and networks Cross-sectoral partnerships to facilitate collaboration Local initiatives (e.g. FAs setting up direct selling schemes) Local hospitality demand (e.g. fish restaurants, culinary tourism) Ethical consumption trend	Di Cintio et al., 2023; Prosperi et al., 2019; Jentoft et al., 2019.
Political	Lack of participation in decision making (e.g. format/timing/location of consultations) Bureaucracy	Participation in decision-making/citizen voice Knowledge exchange to strengthen inter-sectoral governance	Galappaththi et al., 2019 Korda et al., 2021; Haapasaari et al., 2021; Song et al., 2018; Prosperi et al., 2019; Pascual-

	Lack of intra- and inter-sectoral governance and collaboration Perceived unequal treatment of marine users (e.g. fisheries and tourism) Licensing systems might legally prevent adaptation Gender discrimination (e.g. regulations for diversification and entrepreneurship)	Active engagement in planning and community decision making Co-management of resources	Fernandez, 2018; Gustavsson, 2021.

5. Towards a conceptual framework on drivers for fishers' decision making

This section seeks to bring together the literature review into a workable framework (Figure 3) to help inform fisheries management and guide further research into fishers' adaptation decision-making processes and adaptation strategies, to ultimately support social resilience.

Fishers, fishing households and communities are experiencing multiple pressures that affect their livelihoods (Section 3.1). Fishers' responses to these pressures are influenced by distinct, yet interrelated factors that vary across demographic, psycho-social, environmental, economic, socio-cultural and governance domains which, when combined, are the underlaying drivers for fishers' decision making (Section 4.5, Table 2). Fishers' perception of agency (Section 4.5.1), the extent to which they feel they have a choice, plays an important role in what decisions they are actually able to make. This, together with a combination of multiple barriers and enablers to livelihood adaption and social resilience across intrinsic, demographic, knowledge, technical, environmental, social, financial, business and political domains (Table 3) then determine fishers' livelihood decisions and activities to cope, adapt, or transform (Section 4.1 – 4.3). These processes affect social resilience as the ultimate outcome (Section 3.2).

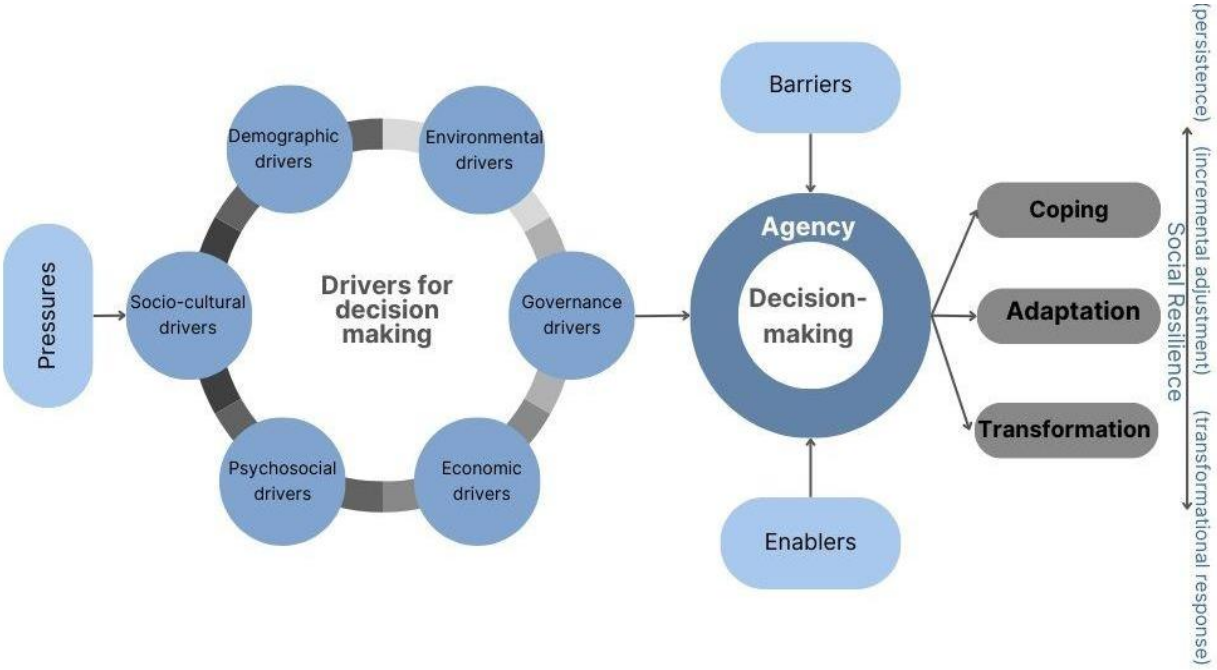

Figure 3. Framework for understanding adaptation decision-making processes, behaviours and social resilience of fishers (inspired by Black et al., 2011)

Several authors argue that for any adaptation intervention to be successful in the long term, consideration of local contexts (Alban and Boncoeur, 2004; Frawley et al., 2019; Gustavsson and Riley, 2018a) and co-designing solutions with important stakeholders (Guimarães et al., 2023; Urquhart et al., 2023) are essential, rather than making a priori assumptions about the best adaptation strategies. Brown and Westaway (2011) and others (Meuwissen et al., 2019) raise important questions about who and what should be changed and adapted to, who holds the capabilities and responsibility for change, how much people under pressure can and should endure, and whose responsibility it is to provide support. Therefore, it is important to identify priority objectives and potential trade-offs as part of fisheries adaptation and to co-create solutions.

5.1 Field-testing the framework

The data from the two case studies (Northumbria and Hastings) was analysed using the framework (Figure 3) to test whether it can be operationalised in real-world settings. Clearly further work will need to be undertaken to fully test and refine the framework, but generally it appears to work well and reflect the reality of fishers in the day-to-day decision-making and contexts. A summary is provided here with further detail from each contained in Appendix 1.

5.1.1 Inshore lobster potting in Northumbria

Drivers: 'Environmental drivers' such as stock availability were historically the main drivers for adaptation, with declines in lobster stocks in the 1990s and the introduction of a minimum landing size. 'Governance drivers' are more prominent now and relate to increasing restrictions, health and safety, marine conversation designations and management. 'Demographic drivers' such as ill health also influence fishing activity.

Social resilience: Adaptive capacities change over time depending on available options, especially stock abundance. A number of examples of adaptation were identified including (i) switching from under 10m boat potting for lobster to crewing on large prawn trawler; (ii) switching from trawling to potting due to ill health; (iii) changes in fishing duration from seasonal to all year round; and (iv) changes in fishing intensity by having more pots on the ground.

Enablers/barriers: Increasing 'governance drivers' restrict the opportunity to adapt. The biggest factor shaping decision-making and capacity to adapt is dependency on the resource, and the risk of targeting a single species.

5.1.2 Shore-launched mixed fishery in Hastings

Drivers: Main drivers are 'governance drivers' related to uncertainty about quota allocations and 'environmental drivers' related to the reduction in the presence of target species in inshore waters (attributed to climate change and pressure on stocks from over-exploitation by larger, including foreign, vessels). 'Economic drivers' are

related to increasing costs associated with licensing, training, health and safety requirements, and mortgage payments for the boat.

Social resilience: A number of examples of adaptation were identified including (i) diversification by having a wide range of gear in order to be able to target species when quota is available or target non-quota species, (ii) selling catch directly to Brixham Trawler Agents rather than local merchants as this brings a better price and a more streamlined approach to selling, (iii) inter-sectoral diversification by only fishing part-time and working outside the sector. Coping mechanisms identified included partners of fishermen working in order to supplement household income. Transformation is frequent in the Hastings fishery, most likely in the form of exit from fishing. This is an increasing strategy, particularly for younger fishermen.

Enablers/barriers: A barrier to diversification into targeting other species is the large financial investment needed to have multiple gears, particularly when there is little quota available, and gear is rarely used. A barrier to fishermen, particularly young fishermen, staying in the industry is the unpredictability of income and uncertainty about the future viability of the industry. The historic fishing rights to launch from the beach enjoyed by the Hastings fishing fleet is an enabling factor and provides a buffer and some resilience to the fleet, as fishermen do not incur large mooring fees and so can exit fishing temporarily if needed. The main barrier identified was a lack of agency in decision-making with fishermen feeling that they had little choice in what they could do to adapt and persist in the fishery.

6. Conclusion and recommendations

The degree of agency that an individual has in their decision-making will determine the extent to which they have capacity to cope, adapt or transform, with the ultimate desired outcome of social resilience. This literature review summarises current evidence about the different types of livelihood adaptation strategies that are employed in commercial fishing livelihoods and, where available, the type of factors that have been found to influence fishers' decision-making regarding adaptation, as well as the barriers and enablers to adaptation. The resulting conceptual framework (Figure 3) provides a useful rule of thumb for understanding adaptation decision-making processes, behaviours and social resilience by recognising that fishers, fishing households and communities are subject to a range of pressures (shocks and stresses) on their activities. These manifest as individual or cumulative drivers (demographic, environmental, governance, economic, psycho-social, socio-cultural) that influence decision-making, alongside barriers and enablers to adaptation.

The following recommendations are made to suggest considerations for fisheries managers to better support the adaptive capacities of fishers, fishing households and communities. Further recommendations to fill gaps in evidence and research are also provided.

6.1 Recommendations for fisheries management

Fisheries management should seek to better understand and recognise the diversity of the fishing sector in terms of the differentiation of impacts across different parts of the fleet and should facilitate and support equal access (to fisheries resources, markets, financial support, training) and the potential for agency and self-organisation within the sector, in order to enhance and sustain the social resilience of fishers, fishing households and communities.

Recognising Diversity:

- Through a co-design process with fisheries stakeholders, test the social resilience framework (Figure 3) by applying it to a real-world context to better understand: the multiple pressures and vulnerabilities on fishers; impacts of management measures; the biggest drivers of adaptation; likely responses across different parts of the fishing industry; and factors underpinning adaptive capacity.

- Consider context-specific policies that facilitate the inclusion of psychological and other social evidence into management and policy making.

Supporting Equitable Access:

- Facilitate the inclusion of engagement from all sectors of the fishing industry (e.g. under/over 10m, different fisheries, location) in management decisions (e.g. FMPs) by ensuring engagement formats are suitable for all sectors and all voices have an equal opportunity to be heard.

- Improve understanding of the impacts of different forms of licensing on different parts of the sector, adjusting to ensure fair and equal access to fisheries resources, recognising the adaptation limitations for certain parts of the industry.

Improving Agency:

- Adaptation support decisions and tools need to be dialogue-based and co-designed with fishers.

- Bursaries and other forms of financial support for young fishers to undertake training and the necessary qualifications for working on a fishing vessel and/or in the supply chain.

- Funding to support intra-sectoral diversification at both the fishing business level (e.g. seed funding for adding value to catch, grants, loans) or fishing community level (e.g. port infrastructure investment). The European Commission funded Fisheries Local Action Groups (FLAGs) are a good example of partnerships between fisheries actors and other local stakeholders (private and public) to provide funding for local projects to contribute to development in the local area.

- Facilitate/explore the potential for fishing cooperatives or trade associations to support investment in shared infrastructure (e.g. ice or processing facilities), improve price-negotiating power, make cost-savings on bulk purchase of gear, equipment, fuel and to facilitate microcredit schemes for fishers.

6.2 Further research

- Empirically testing the conceptual framework in real-world fisheries contexts, across a range of geographical and fisheries sectors so that it can be operationalised for fisheries management. This would seek to (i) validate the framework; (ii) improve understanding of the main drivers, barriers and enablers to social resilience; (iii) identify fishers' intentions/preferences for adaptation (e.g. inter- and intra-sectoral diversification) across different sectors of the fleet; and (iv) identify fisher-informed support mechanisms for improving social resilience.

- The scoping review of the literature within the geographical scope and context of this report provide limited evidence on *how* intra-household strategies are negotiated within fisheries. Understanding intra-household strategies in other sectors (e.g. farming) could provide insights that are relevant and useful in the fisheries context and would provide the MMO with a better understanding of how management measures may impact fishing households.

- Investigate the difference between aspirations (what people would like to do) versus people's ability to respond to challenges (what they feel able to do). This would provide the MMO with a better understanding of the agency of fishers to adapt to changes in fisheries management.

- Identify the vulnerability of different fishing sectors, geographies and household compositions to exposure and sensitivity to climatic and non-climatic challenges and the drivers of vulnerability in order to better understand likely impact of changes in fisheries management.

- Currently there is limited knowledge about experiences/ life trajectories and social outcomes for fishers who diversified or exit industry. Thus, there is a need for longitudinal studies and research that investigates the livelihood outcomes of those who exit fishing.

- An improved understanding is needed on how psycho-social factors (e.g. identity, attitudes, values, beliefs, preferences, loneliness, relationship status, bereavement, job control, mental health) and socio-cultural factors (e.g. social support, social status, social capital, power, collaboration and conflict within or between communities and sectors) can explain behavioural responses to policy and management changes. This will better inform the MMO about likely fisher responses to management and compliance behaviours.

- Developing a systems approach to consider the interactions and dependencies between and amongst diverse human and non-human actors and social-ecological systems (e.g. catch sector, fish processing and selling, intra- and inter-sectoral diversification, aquaculture, oil and gas industries, leisure and tourism) in order to better understand the wider impacts of management measures.

6.3 Questions to potentially add to Defra's national pilot of the new fisher social survey

In response to the findings in the literature review, three question sets framed around adaptation, agency and outcomes are proposed for inclusion in Defra's fisher social survey. These questions will allow data to be collected to identify and monitor these elements over time and could be used as a set of social resilience indicators. These questions/indicators will need to be reviewed and refined by the Defra social survey team to integrate them into the survey appropriately. We recommend that they (or an adapted form) be included in the national pilot of the social survey in autumn 2024 to test their utility as a tool for understanding social resilience and potentially to develop a typology of fisher livelihood strategies.

[Adaptation Question] Over the last 10 years, have you significantly changed the way you fish, if so, please indicate how:

- No, I have not significantly changed the way I fish
- I have changed the main species I target
- I have added new target species to my fishing
- I have changed the location where I fish
- I have changed the duration of my fishing trips at sea (longer/ shorter)
- I have changed the number of crew I use (reduction/ increase of crew members)
- I have changed my boat (downsized/ upsized)

- I have moved from full time to part time fishing
- I have taken on additional work outside of fishing to bring in income
- Someone in my household has taken on additional work to bring in further income (please state who)
- I have changed the way I sell my catch (please indicate how)

If YES, please indicate what pressures resulted in you changing the way you fish?

- climate change
- changes in stock
- fisheries rules/management measures
- my health
- business/income
- Other (please specify)

[Agency Question] To what extent do you feel in control over decisions about the future of your fishing business? (Likert scale 1-5, completely, mostly, partially, not at all, not sure)

If answered ‘partially’ or ‘not at all’: Why don’t you feel that you have control over decisions about the future of your fishing business? (Open question)

Only answer the following if the way you fish has changed /adapted (Likert scale 1-3, agree, not sure, disagree):

- I feel I had no choice but to change my fishing behaviour
- I was influenced by other fishers in my community
- I was influenced by my family members
- I adapted my fishing to take advantage of a new opportunity to earn money from the fishery

[Outcomes Question] Since I changed my fishing activity, I feel that: (please score using a Likert scale 1-3, agree, not sure, disagree)

- I am economically better off
- Relationships in my household are improved
- My stress levels have reduced
- The fishery is more sustainable
- I have more pride in my job
- I will be able to cope with changes in the future

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Appendix 1: Summary of semi-structured interviews

Vignette 1: Livelihood adaptation in a Northumbrian fishery

Questions asked: Think about when you first started fishing and how you fished back then:

What have been the main changes you've made in your fishing livelihood over time (coping and adaptation), and what caused you to make those changes (drivers of adaptation)?

The findings from the interview are summarised in Figure A1, which shows the timeline adaptation strategies over a 30-year period.

Overall reflections from the North East Vignette:

1. Historically adaptation has been opportunity driven, tailored the job to where profits were to be made, based on stock availability. These days it is restriction driven, "it's not what you can do that drives a decision, it's what you can't do". This growing 'tightening' of restrictions, health and safety, marine conservation designations, management – narrows opportunities to adapt.
2. The biggest factor that shapes decision-making and capacity to adapt, is **dependency** on the resource. "If you're 99% dependent on prawns, you really can't fish for anything else".
3. Adaptation isn't linear, it's cyclable – cycles of what people go into and what they leave, it oscillates over time and sometimes repeats itself depending on available options, especially stock abundance.

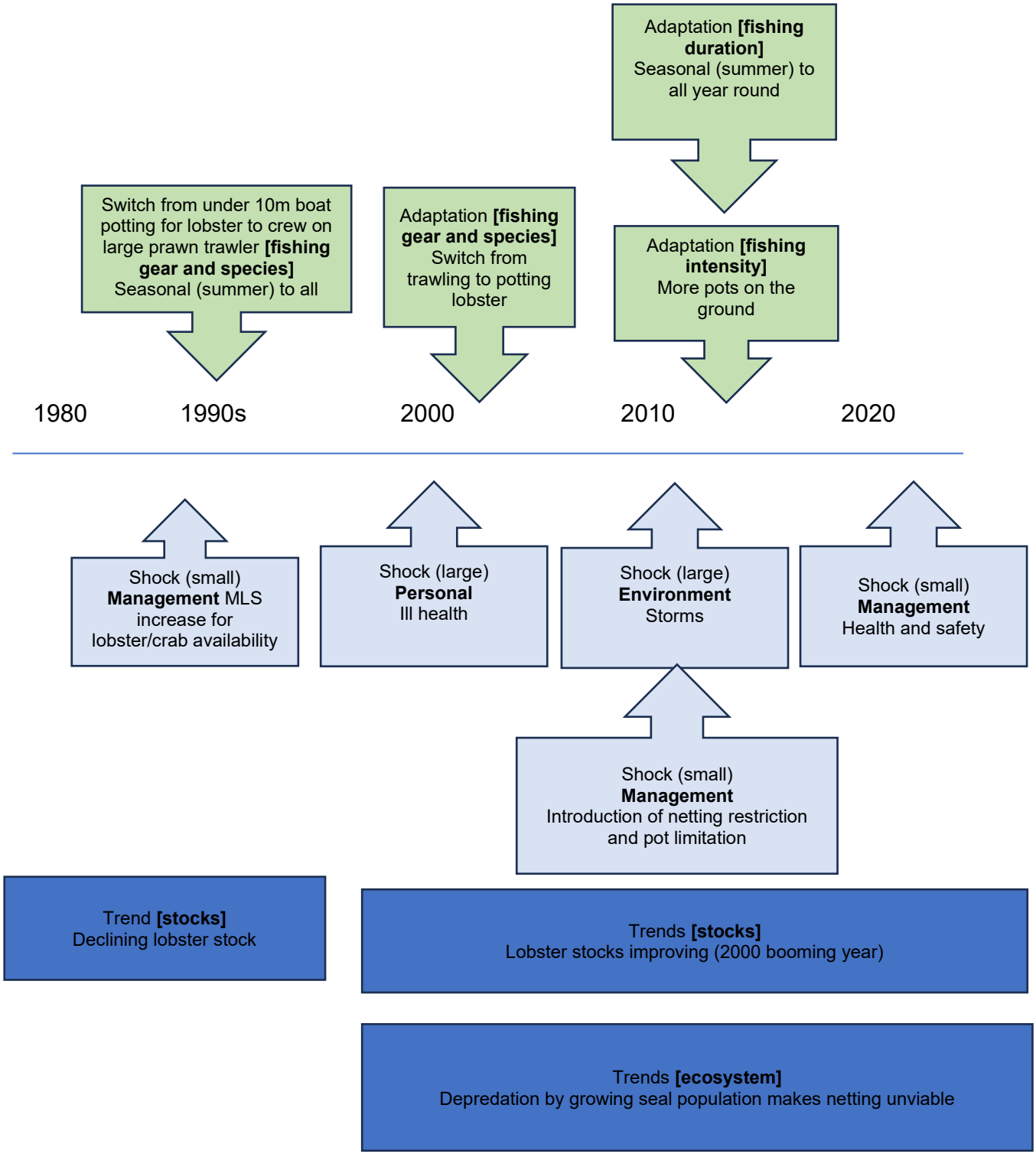

Figure A1. Livelihood adaptation [A] from a Northumbrian inshore lobster potter, under 10m boat

Vignette 2: Livelihood adaptation in a Hastings fishery

Hastings is a coastal town on the coast of East Sussex with boats working from the shingle beach in the Old Town. It has traditionally been a mixed fishery, with the under 10 metre vessels targeting both white fish and shellfish on a seasonal basis within the 6 NM zone. Currently there are about 15 active vessels, reduced by half over the last ten years. Two fishermen discussed the livelihood strategies that the Hastings fishermen have adopted in order to continue (or exit) fishing.

The main drivers of (stresses that cause) adaptation are the uncertainty in quota allocations and the reduction in the presence of target species in inshore waters. Quota for the under 10m pool are set on a monthly basis, with fishermen reporting a reduction in quota and sometimes no quota available making it very difficult to work full-time as a fisherman. This makes it challenging to anticipate future fishing opportunities regarding quota stock. In addition, fishermen reported a significant reduction in stock availability within the 6 NM zone, where they fish. They attributed this to warmer inshore waters preventing stocks from moving to shallower grounds, and over-exploitation by larger (including foreign) vessels up to the 6 NM limit. An additional stressor is the increasing costs associated with more licensing, training, health and safety requirements, and mortgage payments for the boat which places an additional financial burden on fishing businesses. Boat values have also decreased so exiting fishing and recouping some costs (for a pension, for instance) is also challenging financially.

Adaptation strategies include diversification by having a wide range of gear that can be deployed across different target species, so that they can be flexible to target species when quota is available or target non-quota species such as cuttlefish or whelk. However, increasing quota restrictions means increasing pressure on other species, such as bass, which can become over-exploited in the Channel. It is also a big investment (financial capital) to have multiple gears, particularly when there is little quota available and gear can remain unused for long periods, which restricts the ability to diversify.

Another coping strategy was that most of the catch is now sold directly to Brixham Trawler Agents rather than local merchants, as they get a better price for their catch, and it is a more streamlined approach. This emerged after two Hastings fishermen relocated their boats to Brixham in order to land in Brixham and reported back to the Hastings fleet that they could improve the price they receive for their catch.

An important coping strategy amongst fishers in Hastings is to only fish part-time and engage in other employment (inter-sectoral diversification) (e.g., carpentry, engineering, building, window fitting etc.). Most partners of fishermen also work in order to provide a stable income into the household. This is difficult for younger families with childcare responsibilities. Another response is to leave fishing altogether, which is an increasing strategy, particularly for younger fishermen as fishing is unpredictable and does not pay enough to sustain a family. Currently there are very few younger fishermen (three) in the fleet and older fishermen are not encouraging their children to go into the industry due to the uncertainty about whether there will be a viable industry into the future. Ultimately these decisions are

made individually and are based on people's circumstances and various capitals (e.g. partner working, age, savings).
The Hastings fishery is unique in the sense that it has historic rights to fish from the beach and so fishermen are not subject to high mooring fees. They pay £5 per week to keep their boats on the beach, which means that they can exit fishing temporarily if needed and return when fishing is viable again, providing a buffer and some resilience to the fleet. For instance, one fisherman indicated that his boat had not been to sea for 3 months due to him having an operation and being off sick. There is also a fishermen's cooperative in Hastings, providing access to reduced prices on gear and kit.

Agency in decision making was limited, with fishermen indicating they felt they had little choice in what they could do to adapt and persist in the fishery. They felt their choices were confined by quota, access to the resource and availability of fish stocks. Thus, much of the influence on Hastings' fishermen is related to UK government management of the fishery. Within this, fishermen do influence the actions of each other in terms of what species to target. They mentioned that when they see fellow fishers coming back almost empty from trawling, they decided against this strategy, but then end up all targeting the same species which increases competition and risk of overfishing that species. The perceived lack of agency impacts on fishermen's wellbeing and quality of life, resulting in a pessimistic view of the future of the fishery and their ability to maintain control over their livelihood.