

1 "Blueing" the economy:
2
3 **Industrialisation and coastal fishing livelihoods in Ghana**
4

5
6 **Abstract**

7
8 The growing focus on the blue economy is accelerating industrial fishing in many parts of the world. This
9 intensification is affecting the livelihoods of small-scale fishers, processors, and traders by depleting local fishery
10 resources, damaging fishing gears, putting fishers' lives at risk, and compromising market systems and value chain
11 positions. In this article, we outline the experiences, perspectives, and narratives of the small-scale fishing actors in
12 Ghana. Drawing on qualitative interview data, we examine the relationship between small-scale and industrial
13 fisheries in Ghana using political ecology and sustainable livelihood approaches. **We demonstrate how**
14 **industrialised, capital-intensive fishing has disrupted the economic and social organisation of local fishing**
15 **communities, affecting incomes, causing conflicts, social exclusion and disconnection, and compromising the social**
16 **identity of women.** These cumulative impacts and disruptions in Ghana's coastal communities have threatened the
17 viability of small-scale fisheries, yet coastal fishing actors have few capabilities to adapt. We conclude by
18 supporting recommendations to reduce the number and capacity of industrial vessels, strictly enforce spatial
19 regulations, and ensure "blue justice" against marginalisation.

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21
22 **Keywords:** Artisanal fishing; Industrial fishing; blue justice; harmful fisheries subsidies; **Illegal Unregulated**
23 **Unreported Fishing;** West Africa

24
25 **Introduction**

26
27 Small-scale fisheries account for around 40% of global fish catch and support over 113 million fishery workers
28 along the value chain globally, with at least 45 million women involved (IHH, 2021; Teh and Sumaila, 2013). In
29 developing countries, small-scale fisheries are also critical components of the domestic fishery chains and
30 economies of coastal communities, supporting livelihoods, nutrition needs, and social well-being (Schorr, 2005).
31 Moreover, small-scale fisheries' contributions transcend their economic values to encompass social, relational, and
32 historical networks (IHH, 2021; O'Neill and Crona, 2017).

33
34 Globally, the expansion of large-scale ocean fisheries has significantly impacted small-scale fisheries by achieving
35 unprecedented levels of overfishing and overproduction (Longo et al., 2011; Mansfield, 2010). Despite initiatives
36 to reduce overfishing, over the last few decades in many locations, governments, international organisations, and
37 multilateral institutions have promoted the industrialisation of the fisheries sector in the pursuit of economic
38 progress and modernisation (Mansfield, 2010; Overå, 2011). Scholars have documented the unequal relations
39 between developed and developing countries in terms of technological advancement and investment in industrial
40 fishing because of the global south's limited resources (Belhabib et al., 2015; Okafor-Yarwood and Belhabib,
41 2020). They have also highlighted the imbalance in subsidy allocation between large- and small-scale fisheries,
42 with most of the harmful subsidies going to industrial fishing businesses (Schuhbauer et al., 2020; Sumaila et al.,
43 2019; Sumaila et al., 2016).

45 Recent studies have underscored the contribution of the global fisheries industry to climate change through large
46 fuel consumption and have emphasised the substantial effects of ocean acidification on marine ecosystems (Sala et
47 al., 2022; Wang & Wang, 2022; Sumaila et al., 2011; Ficke et al., 2007). Recent estimates indicate that worldwide
48 fishing industry emissions increased by 28% in total between 1990 and 2011 and that fisheries produced 179
49 million tonnes of CO₂-equivalent Greenhouse gases (4% of global food production) (Parker et al., 2018). The
50 growth in global fisheries emissions is mostly attributable to increased harvests by fuel-intensive industrial fisheries
51 activities, which depend heavily on fossil fuels for fishing, searching for fish (trawling), and handling, including
52 refrigeration and industrial processing (Sala et al., 2022; Parker et al., 2018). Small-scale fisheries also contribute
53 to the global fisheries' fossil fuel consumption, which comprises mostly of travel to and from fishing grounds.
54 However, most of their passive fishing gear is set and hauled manually or with small motor power, making them
55 one of the world's most efficient forms of animal protein production (Parker and Tyedmers, 2014). In addition, the
56 expansion of industrial bottom trawling activities by industrial fishing vessels has considerably contributed to the
57 loss of ocean biodiversity (Kuczenski et al., 2022; McConnaughey et al., 2020). A recent assessment by the
58 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2022), for example,
59 highlights that in marine systems, industrial fishing has had the most impact on biodiversity in the past 50 years
60 through overexploitation. Industrial fishing corporations cover at least 55 percent of the oceans, concentrated in the
61 north-east Atlantic, north-west Pacific, and upwelling zones off the coasts of South America and West Africa
62 (IPBES, 2022). In many developing countries, these trends in global fisheries have created significant social and
63 economic legacies for small-scale fisheries, marine ecosystems, and food security (Kolding and van Zwieten, 2011;
64 Pauly et al., 2005).

65
66 The literature on the "tragedy of the commons" (Hardin, 1998) has frequently been referenced to explain over-
67 exploitation of fisheries, with less emphasis on the influence of industrialisation (Feeny et al., 1996; McWhinnie,
68 2009). Yet technical advancements in the fisheries sector have accelerated resource depletion, particularly since the
69 second half of the twentieth century (Campling and Colás, 2021). Some researchers contend that fisheries resource
70 exploitation has been intensified by the global industrial revolution facilitated by capital-intensive fishing and
71 private capital accumulation (Berkes et al., 2006; Longo and Clausen, 2011; Mansfield, 2010). These global
72 patterns of marine resource exploitation have been described as "contagious resource exploitation" (Eriksson et al.,
73 2015, p.435), a "tragedy of the commodity" (Longo and Clausen, 2011, p.316) and profit-driven "roving banditry"
74 (Berkes et al., 2006, p.1557). We build on this critical lens to demonstrate how the industrial fishing transitions in
75 Ghana have negatively affected small-scale coastal fishing livelihoods.

76
77 Recent global and regional initiatives to define Africa's oceans and coastal frontiers as a "blue economy" have
78 intensified (African Union, 2019; Economic Commission for Africa, 2016; European Investment Bank, 2021).
79 While stakeholders use the term blue economy in very different ways (Silver et al., 2015; Smith-Godfrey, 2016)
80 and the types of implementation vary, the concept aligns closely with green economy paradigms that aim to
81 stimulate economic growth through the maritime economy while safeguarding ecological sustainability and
82 fostering social inclusion (Bennett et al., 2019; Smith-Godfrey, 2016). Numerous African nations, including
83 Seychelles, Comoros, Madagascar, Mauritius, Mozambique, and South Africa, are exploring blue economy
84 initiatives (Bolaky, 2020). Expanding industrial fishing is a major component of Ghana's blue economy. In

85 particular, the National Policy for the Management of Marine Fisheries Sector 2015–2019 is framed to create
86 employment, contribute to **Gross Domestic Product (GDP)**, and generate foreign exchange revenue through
87 fisheries (Ministry of Fisheries and Aquaculture Development (MoFAD, 2015, p.1). We draw on this framing to
88 argue that industrial fishing seems likely to intensify and expand in Ghana. Recent developments, such as offshore
89 petroleum exploration and temporary closed-season fishing restrictions, have put coastal fisheries in Ghana under
90 some threat (Adjei and Overå, 2019; Owusu and Andriessse, 2020). In addition, unlike other sectors of the blue
91 economy in Ghana, industrial fishing directly competes with small-scale fishing for coastal fisheries resources,
92 degrading fisher communities' sustainable livelihoods and resilience systems (Nolan, 2019; Seto, 2017). While
93 acknowledging small-scale fishers' human agency and capacity for adaptation, such measures are limited to coping
94 actions (Freduah et al., 2018) and do not address the fundamental impact of industrial fishing in Ghana.

95
96 In most developing countries, fishery problems have deep historical, cultural, and political roots (Bavinck, 2005;
97 Okeke-Ogbuafor et al., 2020). In this study of fisheries livelihoods, we used a qualitative approach to draw on the
98 experiences, views, and narratives of small-scale actors who are usually excluded from fisheries management
99 (Martins et al., 2018). We discuss the impacts of industrial fishing on small-scale livelihoods, emphasising the need
100 for inclusion and protection of small-scale fishing in Ghana's aspirations for the blue economy. Our paper broadly
101 contributes to the growing blue justice literature aimed at safeguarding small-scale fisheries globally.

102

103 **Methods and materials**

104

105 Ghana's industrial fishing transformation

106

107 After beginning in the 1950s as part of a state-led development reform strategy to maximise catch of Ghana's then
108 enormous fish stocks and as an economic strategy to modernise and diversify the economy, the industrialisation of
109 the country's fisheries expanded by the early 2000s to incorporate joint ventures and lease finance agreements
110 (Akpalu and Eggert, 2021; Bank of Ghana, 2008; Nunoo et al., 2014). According to reconstructed data from the Sea
111 Around Us Initiative, Ghanaian fisheries had much higher catches per unit of effort in the 1950s compared to more
112 recent decades, despite low productivity (see Pauly and Zeller, 2015 for full methods and data description). In 1952,
113 the Colonial Fisheries Department imported two 30-foot motorised boats from the United Kingdom for testing
114 purposes, which proved effective and led to the establishment of a local boatyard production corporation (Acquay,
115 1992; Akyeampong, 2007). In the 1960s, Ghana's first president, Osagyefo Kwame Nkrumah, established the State
116 Fishing Corporation (SFC), acquired state trawler fishing vessels, and constructed cold storage facilities, including
117 the expansion of the Tema Harbour (Bennett and Bannerman, 2002; Overå, 2011). By the 1970s, the SFC fleet had
118 grown to 34 vessels operating in Ghana and neighbouring nations. However, with ratification of the United Nations
119 Convention on the Law of the Sea in 1982, these vessels were repatriated to Ghana's limited continental shelf,
120 increasing strain on its maritime waters (Akpalu and Eggert, 2021; Atta-Mills et al., 2004). The SFC subsequently
121 collapsed due to Ghana's economic challenges, political instability, and technical and managerial difficulties (Bank
122 of Ghana, 2008; Nunoo et al., 2014).

123

124 A fisheries law (Fisheries Decree, 1979) established the framework for joint ventures (JVs), allowing Ghanaians to
125 control at least 50% of JV firms. This policy reform has been described as the first significant step towards
126 expanding foreign private sector participation in industrial trawler fishing in the country (Acquay, 1992). In the
127 1980s, in response to Ghana's economic decline, the government implemented a structural adjustment program

128 (SAP) with the support of the World Bank (Acquay, 1992; Bennett, 2002). As part of the SAP, Ghana's currency
129 was devalued, trade barriers were removed, inefficient state-owned enterprises were privatised, and the civil service
130 was restructured. Acquay (1992) observed that the SAP had three broad implications for Ghana's maritime fisheries.
131 First, the devaluation was an incentive for JV firms to expand and intensify their harvests and exports. In contrast,
132 locally owned fishing firms, including the SFC, were forced to liquidate due to high overhead costs from imported
133 fishing inputs and gear. Second, foreign direct investment increased, leading to the significant growth of JV
134 industrial trawlers from Europe and Asia. Third, the Fishery Department's staff numbers were reduced and
135 employment was restricted, affecting its capacity to research, manage, and enforce the reduction in excess fishing in
136 Ghana.

137
138 A subsequent fisheries law (Fisheries Act 625, 2002) limited foreign capital in industrial fishing to tuna (Akpalu and
139 Eggert, 2021). The law also restricted industrial trawling to Ghanaians, the government, or a company or partnership
140 wholly owned by Ghanaians, and it prohibited foreign beneficiary ownership. It also permitted lease-type financing
141 agreements with foreign firms, such as hire-purchase, chartering, and rental of vessels and fishing gear. While these
142 reforms sought to maximise local gains from Ghana's industrialisation and increase domestic economic growth
143 through fisheries resources (Bennett, 2002), local entrepreneurs resorted to leasing from Chinese companies due to
144 the difficulty of raising domestic financing to run capital-intensive industrial trawlers. However, these lease-type
145 commercial arrangements evolved into what has been labelled as an illegal strategy (EJF, 2018) used by distant-
146 water fishing companies to control industrial trawler fishing (Belhabib et al., 2020; Belhabib et al., 2015), and by
147 2021, they were the only agreements permissible for trawler fishing in Ghana. For instance, Ghanaian entrepreneurs
148 might obtain the licences while their Chinese partners provide finance and retain significant portions of the profit. In
149 most instances, trawler captains and fishing company managers are Chinese, while Ghanaians serve as casual crew.

150
151 The proliferation of Chinese trawlers, which target most of the local catch, has resulted in these stocks' dramatic
152 decline (EJF, 2018; Failler and Binet, 2011). A recent stock assessment by the Ghana Fisheries Commission shows
153 increased fishing effort over the last decade, yet the fleet's catch per unit of effort has decreased except for the tuna
154 fleet (MoFAD, 2015). Local fishers began purchasing rejected fish from commercial trawlers in reaction to the
155 reduction in catch rates (Nunoo et al., 2009). This increased demand for "trash fish" (locally called *saiko*) and
156 bycatch resulted in a massive domestic market boom and encouraged transshipment involving local community
157 entrepreneurs. Thus, the depletion of coastal fisheries in Ghana has primarily been due to licenced trawlers either
158 operating in the artisanal fishing zone or employing illicit fishing gear and conducting illegal transshipments (Nunoo
159 et al., 2014). Although the steady growth in the number of small-scale fishing canoes has also compounded the
160 decline of coastal fisheries, this study examines the impacts of industrial fisheries on small-scale fishing chains.

161
162 The geographical range of operations for different fisheries types is divided into the Inshore Exclusive Zone and the
163 Exclusive Economic Zone. In principle, Ghana's Inshore Exclusion Zone is reserved for small-scale fishing
164 (Fisheries Act 625, 2002), but this is rarely the case in practice. Local Non-Governmental Organisation (NGO) data
165 indicates that all industrial trawler arrests in Ghana between 2007 and 2015 related to territorial violations (Friends
166 of the Nation, 2015). The small-scale fishing sector in Ghana consists of motorised and non-motorised canoes
167 ranging in length from 3 to nearly 20 metres (MoFAD, 2015). Ghana has an open-access policy for small-scale
168 fisheries, although the Fisheries Law (Act 625) stipulates that in order to fish, small-scale fishers must first register
169 with their local district assembly. Approximately 200,000 fishers operate around 12,000 small-scale fisheries canoes
170 in 334 fishing community landing centres in Ghana (Adjei and Overå, 2019). Small-scale fishers frequently employ
171 beach seines, line, set nets, gillnets (locally called *ali*), and drift gill nets (Lazar, 2018). Most of the small-scale catch

172 is processed and marketed in domestic markets in the local and bigger cities, with a considerable amount also
173 exported to neighbouring Togo, Benin, Cote d'Ivoire, and Nigeria (Ayilu, 2016). However, the total catch volume of
174 small pelagic catch targeted by the local small-scale fisheries has steadily declined over the years, putting local
175 livelihoods under threat (Figure 1). Fishers have adapted their livelihoods through both legal and illegal measures,
176 such as internal and external migration (Bortei-Doku, 1991; Overå, 2005), as well as fishing with explosives,
177 poisons, aggregating devices, and monofilament nets (Freduah et al., 2018). Small-scale processors leverage
178 smokeless ovens (Ahotor and FAO-Thiaroye Technique) to minimise processing losses resulting from burns to the
179 fish and to improve fish quality for premium prices (Mindjimba et al., 2019; Seyram, 2020).

180

181 **[Insert Figure 1]**

182

183 **Fig. 1** Graph showing the average landings of small pelagic stocks (red line) and fishing effort (number of canoes)
184 (blue bars) from 1990 to 2016

185 **Source:** Lazar et al. (2018), reproduced with permission

186

187 Study areas

188

189 The study was conducted in two of Ghana's coastal regions, the Western Region and the Greater Accra Region (Fig.
190 2). These regions are the country's industrial and commercial centres, with considerable infrastructure, including
191 Ghana's only two commercial ports and its two largest industrial fishing ports, Sekondi-Takoradi and Tema. Ghana's
192 industrial vessel fleets are classified into three categories: the semi-industrial sector, the industrial sector (mostly
193 comprised of trawlers), and industrial foreign tuna vessels. Together, these two regions have 15 of Ghana's 26
194 coastal administrative districts, with the total small-scale fisher population estimated at about 26,000 in the Greater
195 Accra Region and 34,000 in the Western Region (Dovlo et al., 2016).

196

197 This study focuses on eight fishing communities that are important fishing towns for small pelagic catches in the
198 two regions, with fish processing and trading being the primary occupations of most of the women residents.

199 The key features of the study locations and districts are summarised in Table 1, and their locations in Figure 2.

200 **Table 1 shows the number of small-scale fishing fleets and people who engage in fishing in the various localities, as
201 well as the average catch quantities, underscoring the importance of small-scale fishing to the local economies.**

202 These communities were drawn from seven of the coastal administrative districts where small-scale fishing
203 constitutes a significant economic activity, and they were purposively selected (Marshall and Rossman, 2014) for
204 one or all of the following reasons: 1) their proximity to the commercial fishing port where the industrial fishing
205 vessels land and begin their fishing; 2) their contribution to small-scale fisheries catch; and 3) their listing as a
206 community in Ghana's Fisheries Scientific Division's Marine Canoe Survey Framework of the Ministry of Fisheries
207 and Aquaculture Development (Dovlo et al., 2016). Ghana's Fisheries Scientific Division's Marine Canoe Survey
208 indicate that the catch quantities in the communities vary based on a number of reasons, including the number of
209 fishers, the variation in fishing capability in terms of fishing gears, and the seasonal fluctuations in the fishery
210 across the coastal villages.

211

212

[Insert Figure 2]

213 **Fig. 2** Map of the Western Region and Greater Accra Region of Ghana, with the studied communities indicated with
 214 dots.

215 **Table 1:** Characteristics of the study communities and districts
 216

Study communities	Tema New Town	James Town	Teshie	Ningo-Prampram	Sekondi and New Takoradi	Axim	Half Assini
Administrative Area	Tema Metropolitan Assembly	Accra Metropolitan Assembly	Ledzokuku-Krowor Municipal	Ningo-Prampram Municipal	Sekondi/Takoradi Metropolitan	Nzema East Municipal	Jomoro Municipal
Population	212,926	555,767	128,675	89,387	435,009	80,933	129,163
Land Area (Km ²)	88	140	48	622	192	1,084.0	1,495
Numbers of Small-scale fishing fleets	574	470	130	555	664	657	405
Number of Small-scale fishers	5,340	2,981	1,573	5,439	4,542	5,405	6,614
Major fishing gear	Purse net Line Set net	Purse net Line Set net Drift net	Purse net Set net	Purse net Line Set net	Purse net Line Set net Ali net	Purse net Line Set net Ali net Drift net	Purse net Beach seine Set net Ali net
Five years Average Catch (MT)	4,000	52,902	2,500	1,000	5,000	6,200	825

217 **Source** Ghana Statistical Service (2010); Ghana Canoe Survey Framework (Dolvo et al., 2016)
 218

219 Data collection
 220

221 Our data triangulation approach in this study included in-depth individual interviews and focus group discussions
 222 (FGDs) (Jonsen and Jehn, 2009). Field data were collected between January 2021 and June 2021, coinciding with
 223 the COVID-19 pandemic. The lead author participated in most field interviews using video conferencing software
 224 (Zoom.us)¹. During the data collection period, domestic restrictions were eased, and fishing recommenced in the
 225 local coastal communities. The interviews were conducted using a COVID-19 safe-research protocol checklist
 226 (McDougall et al., 2020) and Ghana Health Service (2021) COVID-19 health advice protocols.
 227

228
 229
 230 In Ghanaian coastal communities, the chief fisherman and chief fish processor are the traditional custodians of
 231 fisheries and relate with external stakeholders on behalf of fishing actors (Ameyaw et al., 2021; Bennett and
 232 Bannerman, 2002). These community leaders constituted the key informants for the in-depth interviews (n =16) (i.e.
 233 two key informant interviews in each community). The FGDs (n = 2) in each community included one (n = 1) with
 234 five small-scale fishers and another one (n = 1) with five fish processors/traders. The participants who formed the

¹ The lead author could not travel to Ghana for the interviews, therefore he worked with the fourth co-author, who was in Ghana.

235 FGDs (n = 16) were part of the governing council of the chief fisherman and the chief fish processor, and they were
236 drawn from different landing beaches within the community. In total, we conducted 16 interviews and 16 FGDs
237 were conducted, comprising 96 participants across the communities: Western Region (24 men, 24 women) and
238 Greater Accra Region (24 men, 24 women). These participants had been involved in the local fisheries of the
239 community for at least a decade and had extensive experience and history regarding local fisheries livelihoods. In
240 Ghana, both men and women are actively involved in small-scale fisheries. However, the division of labour is sex-
241 segregated; with few exceptions, males work as fishers and women work as processors/traders (Walker, 2001). We
242 purposively recruited both fishers (men) and processors/traders (women) to reflect this gendered division of labour
243 in Ghana's small-scale fisheries value chain.

244 All informants verbally consented to participate in the study. The topics covered during the focus group discussions
245 (FGDs) and individual key informant interviews (KEIs) included the effects of declining coastal fisheries on social
246 cohesion and inclusion, community conflicts and disconnections, fish trading and processing, income level and the
247 day-to-day livelihoods of fishing actors, as well as coastal cultural institutions, including traditions, norms and
248 identity. The interviews lasted 30 to 60 minutes on average. Field interviews were conducted in Ga and Fante, two
249 of the native languages spoken in the study communities. The fourth co-author is fluent in the Fante language and
250 conducted those interviews. The Ga interviews were conducted with the assistance of an interpreter.

252 253 Data analysis

254
255 The interviews were recorded with permission, translated, and transcribed. The Fante interviews were translated
256 verbatim into English by the fourth co-author and the Ga interviews were translated into English using an
257 interpreter; both sets of interviews were then transcribed. We used thematic content analysis, which involved the
258 reading, scrutinising, identifying themes, and threading up of themes from the transcripts. First, the transcribed
259 interviews notes were read manually to identify key emerging trends. Second, the interview notes were imported
260 into NVIVO 12 for coding and theme comparison for validity. The lead author initially coded the data, which was
261 subsequently validated by the second co-author. We generated seven themes in total from the coding, which were
262 then integrated and qualitatively analysed using the assets conceptualisation of the sustainable livelihoods
263 framework (Allison and Ellis, 2001; Scoones, 2015). Additionally, direct quotations from selected participants are
264 used where appropriate to provide a complete argument.

265
266 The theoretical framing for the data analysis draws from the sustainable livelihood framework and political
267 ecology. Building on Sen's (1981) concepts of entitlements and capabilities, the sustainable livelihood framework
268 focuses on various aspects of livelihoods, including the vulnerability context, asset portfolios, livelihood strategies,
269 and institutions that mediate the ability to attain (or fail to attain) such outcomes (Chambers and Conway, 1992;
270 DfID, 1999; Sen, 1981). The framework outlines the assets and activities required by people and households to
271 meet their livelihood needs and deal with pressures, disruptions, and perturbations (Scoones, 2015). In particular,
272 the sustainable livelihood framework examines the interrelationships of people's assets (human, financial, physical,
273 natural, and social) and the pursuit of their livelihoods at the individual, household, or community level (Scoones,
274 1998). This analytical approach has been extensively used to study various aspects of livelihoods, including
275 vulnerability, impacts of shocks, and adaptive responses (Allison and Ellis, 2001; Ferrol-Schulte et al., 2013).

276 Livelihoods become vulnerable when the assets required for their social, economic, and ecological systems to
277 adapt, adjust, and respond are weakened or eroded (Adger, 2006).
278
279 In West Africa, fisheries development and management projects first adopted the sustainable livelihood framework
280 to assess small-scale fisheries in the 1990s (Allison and Horemans, 2006; DfID, 1999). In the current study, we used
281 the sustainable livelihood framework specifically to explain the impacts of marine industrial fishing on the
282 livelihood assets of small-scale fishers (Bennett and Dearden, 2014; Owusu and Andriessse, 2020). As a result, the
283 sustainable livelihood framework's existing five capital assets – human, financial, physical, natural, and social –
284 have been reorganised as economic (including financial and physical), social, and natural assets. This reorganisation
285 revealed how specific livelihood assets are related, which is particularly useful for assessing fishers' livelihood
286 prospects and limitations.

287
288 The interview data reflects the interactions between small-scale and industrial fishers in Ghanaian fishing
289 communities, with a focus on the livelihood assets most impacted by these interactions. By fishing with nets,
290 canoes, and other fishing gear, as well as by fish processing and trading, these communities derive incomes
291 principally from economic assets, both financial and physical. Their social assets include their culture, history, and
292 social networks, which all revolve around everyday fishing. The ocean is a natural asset that which includes the
293 fishers' knowledge of its ecology along with the value-chain players' competence and capabilities.

294
295 Despite the usefulness of the sustainable livelihood framework, it has been criticised for insufficiently
296 incorporating the dynamics of power and historical patterns of change in mediating access to environmental
297 resources (De Haan and Zoomers, 2005). In our analysis, in addition to emphasising the importance of livelihood
298 assets, we also use a political ecology approach that emphasises the importance of "scale, history, conflict and
299 power relations" (Nolan, 2019, p. 12), which influence resource access and the politics around fishers' livelihoods
300 (Robbins, 2011; Bryant, 1992). Ghanaian industrial fishing emerged as a historical outcome, hence its growth into
301 coastal areas represents a capitalist expansion and the failure of fisheries management underscores power
302 imbalances (Nolan, 2019; Mansfield, 2010). In summary, we used the intersecting theoretical underpinnings of
303 SLA and political ecology to explore how the expansion of industrial fishing in Ghana has interrupted and damaged
304 not only the sustainable livelihood assets of coastal fisheries actors, but also their ability to respond effectively.

305
306 Limitations

307
308 The research focused on understanding the concerns of small-scale fisheries. However, the inability to interview
309 industrial fishers due to the COVID-19 pandemic and the difficulty with access constitute a limitation. To address
310 this gap, we reviewed existing literature and drew on the authors' experiences as fisheries scientists in developing
311 countries, particularly the first author's Ghanaian experiences. While this research addresses issues raised in the
312 literature and allegations made by the small-scale fishers and processors we interviewed, it does not seek to provide
313 factual evidence of specific instances of wrongdoing.

314
315 **Results and discussion**

316

317 This section provides a qualitative explanation of the disruption to local fisheries actors' economic, social, cultural,
318 natural, and human assets, as well as the reduction in their livelihoods and well-being caused by industrial-scale
319 fishing activities. Industrialisation and technology have accelerated the expansion and exploitation of marine
320 fisheries in many developing countries beyond their management capability (Berkes et al., 2006; Eriksson et al.,
321 2015). In addition, the role of fisheries subsidies in the success of Chinese distant trawler fleets in developing
322 countries in Africa and Asia is a global concern for fisheries management (Belhabib et al., 2015; Mallory, 2013).
323 According to Mallory (2016), China spent over \$6.5 billion on fisheries subsidies in 2013, 95 percent of which were
324 harmful to sustainability. These subsidies, of which 94% are fuel subsidies, are linked to unsustainable fishing
325 practices in developing countries, including overfishing, overcapacity, and illegal, unreported, and unregulated
326 (IUU) fishing. While the role of Ghanaian front persons cannot be discounted as a form of social power, the
327 economic success of the industrial fishing fleet can likely be attributed to Chinese subsidies on distant trawlers (EJF,
328 2018). The results in this section constitute common themes based on the responses, comments, and experiences of
329 the actors interviewed regarding the impacts of the industrial fishing.

330

331 Economic (financial and physical) assets
332

333

334 *Income and livelihood*

335

336 In Ghana, access to sufficient fish, in terms of both quality and quantity, is no longer a privilege reserved for local
337 communities; it is now available to technologically advanced foreign commercial trawlers (Nolan, 2019; Nunoo et
338 al., 2014). The expansion of industrial trawlers' activities into local fishing grounds, mostly at night, has caused
339 small-scale fishers to withdraw, allowing industrial trawlers to exploit and overfish the pelagic species. The
340 industrial vessels use adapted fishing gear (for example, illegal small-mesh nets) to target these species in coastal
341 protected areas. The number of industrial fishing vessels has increased in Ghana through massive Chinese
342 investment (Akpalu & Eggert, 2021; EJF, 2018), a situation that has affected how, where, what, and for how long
343 local fishers can actually catch. For instance, in Ghana's inshore exclusive zone, fishers participating in this study
344 reported conflict with industrial and/or semi-industrial trawler vessels that led to the destruction of physical assets
345 (canoes and fishing nets) and injuries to crew members. The local fishermen explained that losing fishing gear
346 hampers their primary economic activity and source of income. In the coastal communities, the construction of a
347 wooden canoe and the acquisition of an outboard motor and fishing nets represents a lifetime investment for local
348 fishers. They acquire such equipment and gear primarily through the sale of personal property or by taking out
349 small loans. They explained that when such investments are damaged, the consequence on family livelihoods
350 becomes "hard". Moreover, the way fishers conduct their fishing trips in Ghana has also changed due to the
351 increased activities of industrial vessels. The duration of fishing, the distances travelled, and the frequency of
352 fishing trips have all been disrupted. A local fisherman claimed:

353

354 We are no longer able to leave our net out at sea during the night or [to] fish, which is a common practice
355 in Ghana. That's what we all do in our communities; it's the best technique for us, but we can't do it
356 anymore because of these large vessels in our fishing zones (Fisherman, May 21, 2021)

357
358 The loss of access to and control over fisheries resources in Ghana has affected the incomes and livelihoods of these
359 local fishers. Small-scale fisheries households that were economically secure are now poorer compared to the
360 average household in Ghana's coastal regions (Ofori-Danson et al., 2013). Local fishers use their physical assets
361 (fishing gear) to acquire economic assets (harvest fish); therefore, these dimensions are intertwined in terms of
362 achieving or not achieving their livelihood goals. However, by disrupting their physical assets, the increase in
363 industrial fishing exploitation has negatively affected these fishers' economic participation. The research
364 participants also accused industrial fishing vessels of direct rivalry in fish marketing by using freezing technologies
365 to preserve the freshness of small pelagic catch. One local processor told us:

366
367 They [small-scale fishers] waste so much fuel because they have to travel so far, and by the time they
368 land, the little fish they harvested would have also gone bad, and we can't afford to pay a high price for
369 bad fish (Fish processor/trader, July 29, 2021)

370
371 *Fish trading and processing*

372
373 Coastal women involved in the processing and selling of fish claimed they are in a precarious position due to
374 declining coastal fisheries, and that obtaining the required quantity of fish from local communities has become
375 difficult and sometimes impossible. They now need to travel long distances to different community landing
376 beaches to buy fish in small quantities. A processor said:

377
378 When we are unable to get fish from this beach, we must travel to other communities such as Edina and
379 Fetteh to purchase fresh fish. As a result, the fish becomes more expensive, and selling it becomes a
380 difficulty (Fish processor/traders, March 10, 2021)

381
382 Additional operational costs include transportation and ice. Unable to meet their increased operational costs
383 associated with the declining fisheries, local fishers have increased catch prices disproportionately, which affects
384 the profits of the processors/traders. The local women explained that apart from the difficulty in obtaining fresh
385 fish, the marketing of processed fish has also become challenging because it has become more expensive for
386 consumers due to the associated operational expenses and shortages.

387
388 Additionally, most of the fish traders explained that they can no longer store fish and thus maintain competitive
389 prices due to the fishers' insistence on prompt payment. They mostly stockpile the smoked fish for better prices –
390 sometimes up to a month – but due to the fisheries' decline, they are unable to store smoked fish for a lengthy period
391 due to fishers' demands. As a result, processed fish are occasionally sold at lower prices. One fish trader said:

392
393 The fishermen bother us to get their money back within one or two days after giving you the fish. So, we
394 are unable to keep the fish on the shelf for long. We have no choice but to sell it at whatever price is
395 offered to us. When this happens, we are always at a loss (Fish processor/trader, May 26, 2021)

396
397 Furthermore, the local processors claimed the control of small-scale fishery markets has shifted away from them to
398 a small group of financially well-resourced businesswomen who are mostly from the communities but do not

399 belong to the small-scale fisheries local networks and who obtain illegally transhipped small pelagic fish species
400 (*saiko*) from industrial trawlers. These individuals also enjoy a consistent supply with little operational cost and
401 frequently supply fish to markets at a discounted retail price. By maintaining the market monopoly over customers
402 and distorting the prices of locally processed fish, such actors disadvantage the local processors, who are mostly
403 local women facing large operating costs and a limited supply. A chief fish processor explained:

404
405 Businesswomen from the city with money have taken over our job because they call the shots at the
406 shores and at the markets. When you go to the market, there is fish alright, but about 95% of the fish in
407 the market comes from the industrial trawler fishers (Chief fish processor/trader, February 15, 2021)

408
409 Social assets

410
411 *Social exclusion and disconnection*

412
413 The small-scale fisheries decline has impacted the organisation and interactions of Ghana's coastal fishing
414 communities, both at the state level and within the local communities. Small-scale fisheries actors are being
415 excluded from local fishing organisations at the community level due to livelihood disruption caused by the decline
416 of local fisheries. Historically, the communities along the coast have been linked and organised through kinship and
417 occupation (Bortei-Doku, 1995; Kronenfeld, 1980). Thus, local fishing community members demonstrate solidarity
418 through these kinship networks and established social and economic groups. Fishing for small-scale commercial
419 purposes and fish processing is one of the most socially organised economic activities in the coastal communities,
420 with fishers and processors/traders supporting each other both financially and non-financially during celebratory
421 social occasions. Boat owners and crew members share a close bond, living and working together as a family and
422 finding personal fulfilment via fishing, while fishers gathering daily at the local landing beach strengthens the
423 community cohesion. Women participants reported that when they gather on the shore to buy fish, they discuss their
424 sexual and family lives. A female local processor recalled:

425
426 This area [the landing beach] serves as a gathering place for women; we came here to wait for the canoes
427 and, while waiting, we discussed our families and women's issues (Chief fish processor/trader, January 30,
428 2021).

429
430 Another woman said:

431
432 That joyful period of our lives has passed; we no longer see one another daily (Fish
433 processor/trader, April 23, 2021)

434
435 The participating local actors explained that these support structures have been affected by the declining incomes
436 and other disruptions in fishing activities. They claimed small-scale fishermen are disengaging from coastal
437 communities' shared goals and identities. A fisherman explained:

438
439 We fishermen were born into a loving and supportive community, but the current situation caused by the
440 industrial trawlers has shifted that sense of community. We want and desire to assist each other, but the

441 resources to provide that level of assistance are simply not available. The community thinks fishers have no
442 place and reputation anymore (Fisherman, April 19, 2021)

443
444 These subjective social, well-being, and economic interactions considerations have been significantly disrupted
445 in the Ghanaian coastal fisheries. Fishermen told us of emotional encounters with crew members who had to
446 relocate to different towns due to low catches. Moreover, fishing community connections at local landing
447 beaches, processing sites, or markets have all been weakened. A chief fisherman said:

448
449 We support one another, mend and drag each other's fishing nets while singing Indigenous rhythms;
450 this served as a customary way of invoking the ancestral spirits of the sea and our fathers who lived
451 and worked as fishers in this community (Chief fisherman, July 1, 2021)

452
453 Local fishermen told us that the state has failed to protect and prioritise their livelihoods at the broader state level,
454 so they feel disconnected from the successive administrations. The relationship between government institutions
455 (national and local) and Indigenous fishers over fisheries management, citizenship responsibilities, and
456 governance has remained antagonistic because of the *saiko* activities of the industrial fishers. Local fishers and
457 local NGOs attribute the decline in small-scale fisheries to political decisions that have allowed industrial vessels
458 into maritime space and to subsequent failures to manage illegal activities (EJF, 2018). During a focus group
459 discussion with local fishermen, one participant summarised this concern:

460
461 As a community, we are united in our belief that the government has failed us. They have let us down.
462 Governments' unpopular decisions over the years to expand industrial fishing have ruined our livelihoods.
463 We do not appear to matter to the government; if we did, more would have been done to alleviate our
464 plight. From artisanal fishermen to women processors, nothing about us is significant to the government
465 (Fisherman, June 1, 2021)

466
467 *Conflict and social cohesion.*

468
469 Emerging evidence reveals a decline in social cohesion because of increased fisheries conflicts between small-scale
470 fishers, between small-scale fishers and fishmongers, and between processors, traders and customers (Ameyaw et
471 al., 2021; Alexander et al., 2018). In coastal Ghana, conventional norms that assign rights to cast nets and harvest
472 fish based on first sighting are now flouted, and fishermen frequently disagree over who spotted the fish first. A
473 fisher explained:

474
475 What happens is that when we notice a canoe throwing its net in a particular area of the sea, it indicates
476 that they have spotted fish, so we also get close to cast our net ... in such situations, our nets overlap on
477 each other and that can result in a heated argument and fight at sea (Fisherman, April 2, 2021)

478
479 Furthermore, as observed by Overå (2003), the prerequisite for the success of female entrepreneurs in Ghanaian
480 coastal fisheries is a loyal and trustworthy male (fisherman) partner. However, the decline in small-scale fisheries
481 has affected women's cooperation with local fishers. Women processors provide fuel for the fishing trip and, in
482 some cases, help fishers repair their fishing gear. They also often become responsible for crewmembers' food,

483 mainly using the profit from the sale of processed fish. In exchange, the fishers deliver the catch to these
484 processors/traders. The processors explained that the decline in profits due to the limited supply and the associated
485 operational cost has affected their ability to meet the expected expenditures for the fishing trips. As a result, most
486 fishers have become disloyal and sell their catch to the highest bidder. Many fish processors do not have immediate
487 cash reserves for payment and rely on the conventional fisher-processor arrangement, which is now dysfunctional.
488 Besides, the catch price in the coastal communities is commonly determined by a committee of local fish processors
489 (or chief fish processors), but fishers now disregard this convention as they look for the highest bidder. Moreover,
490 the lack of catch frequently results in misunderstandings between fishers and the fish processors/traders who
491 sponsor the fishing trips.

492
493 *Heritage, traditions, and norms*
494

495 Fishing communities in Ghana are inextricably linked to broader socio-cultural beliefs, traditions, and taboos as a
496 source of identity and social well-being (Bennett, 2002; Dosu, 2017). The declining economic status of fishing
497 discourages young adults from pursuing it as an occupation. Local fishers and processors/traders explained that
498 their responsibility is to bequeath the fishing tradition by initiating young family members into adulthood with
499 fishing gear and equipment to begin their working lives. For chief fishermen's families, this is particularly
500 important as the elder male son must inherit the father's fishing occupation to retain the "chief fisher" title in that
501 family. A Chief fisherman reported:

502
503 When I ask my son to help me mend my fishing net, he refuses. He's not interested in learning about my
504 work, let alone applying it ... it means he disapproves of my occupation. That's how badly we are losing
505 our family heritage (Chief Fisherman, February 25, 2021)

506
507 Additionally, industrial fishers disregard local community norms by, for example, violating restrictions
508 prohibiting fishing on designated non-fishing days (most commonly Tuesday) and during coastal festivities.
509 Local festivals are celebrated at the end of the fishing season at the community level. During abundant catches, a
510 portion of each daily catch is set aside for these seasonal and calendar celebrations. The fishermen explained that
511 the decline in coastal fisheries and fishing livelihood has significantly impacted the local social activities that
512 define their identity as fishers. One of them summarised the situation:

513
514 At the end of the fishing year, we saved money for drinks, food, clothes, and gifts for each crew member.
515 We did so because we had a good catch and wanted to keep celebrating our fishing heritage. We felt a
516 strong sense of community and joy, but all these memorable days are gone because of the China *saiko*
517 fishers (Chief fisherman, May 19, 2021)

518
519 *Women's identity and prestige – "a good wife"*
520

521 Gender concerns have not been adequately addressed in most studies of fishing livelihoods (Harper et al., 2017;
522 Harper et al., 2013; Torell et al., 2019). In Ghana, the economic position, identity, and social prestige of coastal
523 women are linked to small-scale fisheries, which are important sources of income for them (Coastal Resources
524 Center, 2018). Women exclusively control and make decisions regarding post-harvest management activities; they

525 purchase the local catch, process it, and then market it (Ameyaw et al., 2020; Torell et al., 2019). Generally, women
526 in small-scale fisheries use their income to maintain their homes, and a portion of the fish is consumed by the
527 household (Harper et al., 2013; Weeratunge et al., 2010).

528
529 According to the local women we spoke to, the processing and trading in small-scale fisheries have traditionally
530 been female occupations, proudly passed down from generation to generation. However, the women claimed that in
531 most communities, fishers now bypass them to sell the catch to former fishermen. Members of fishing crews who
532 have lost their livelihoods because of declining fisheries have assumed the role of intermediaries between fishermen
533 and women traders and processors. The women revealed that former crewmembers exploit both their relational
534 advantage with the fishers and their ability to travel out to sea to obtain the fish. The women, who are primarily
535 involved in either processing or marketing, are unable to meet fishers offshore to collect the catch. The leader of the
536 processors explained:

537
538 One major concern for us here is that the fish selling and processing business was traditionally the preserve
539 of women. But now the men have taken up this occupation ... the fishermen will sell the fish to men traders
540 offshore, who will, in turn, sell it to buyers [women] on shore. The China people have caused all these
541 problems, because the men would have gone fishing and we the women control the processing and trading
542 (Chief fish processor/trader, January 28, 2021)

543
544 In this context, the women frequently blamed the Chinese investors in industrial fishing and their Ghanaian allies
545 (politicians, fisheries managers, and businesspeople) for their livelihood predicaments.

546
547 The decline in small-scale fisheries has added to the burdens of coastal women. Processors and traders claimed that
548 their social standing as "good wives" has deteriorated due to their inability to access food from the fish business.
549 Local fish traders/processors are culturally responsible for maintaining their homes and the crew members with the
550 proceeds from their fish businesses. Based on their traditional role as fishers' wives, the women said they have lost
551 their social status, as well as becoming impoverished. Bartering fish for other food supplies to meet the family's
552 nutrition needs is no more common. One processor said:

553
554 Food was not bought with money; the women who brought foodstuffs from other communities to our
555 market gave it out to us and in return, took fish ... things have gotten out of hand and I feel like am not a
556 woman (Fish processor/trader, June 8, 2021)

557
558 Natural assets

559
560 *Ecological damage and fishing capacity*

561
562 Local knowledge helps small-scale fishers determine where to fish, how to fish, and what species to target. It
563 constitutes their human capital. Local fishers reported that industrial fishing vessels either use technology to crush
564 rocks or trawl the seabed to catch crustaceans, destroying specific ocean features and fauna and severely altering
565 the marine ecosystem and landscape. This affects their ability to forecast changes in the fishing seasons and to
566 predict coastal fishery behaviour – a traditional practice. A chief fisherman explained:

567
568 These vessel operators have machines that have broken all the rocks into pieces in order to catch octopus,
569 shrimps and crabs. They have wiped out the sea's features which we use as signals to trace the fish or
570 target the fish with the appropriate gear (Chief fisherman July 24, 2021)

571
572 Fishing around areas where dolphins and whales are observed, particularly on the western side of Axim and Half-
573 Assini, is usually productive (Banful, 2021). However, such mammals are more difficult to find due to industrial
574 trawlers' intensive harvesting of them (Van Waerebeek and Perrin, 2007). For example, the International Whaling
575 Commission (IWC 2021) and the International Union for Conservation of Nature (IUCN 2010) classified Atlantic
576 humpback dolphins and the West African manatees as vulnerable or critically endangered, due largely to their
577 deaths as bycatch, targeted capture, habitat degradation, and prey depletion due to overfishing. Additionally, fishers
578 participating in this study said that seasonal variations have become unpredictable due to industrial trawlers'
579 destructive activities, which affect trip planning. One fisher explained:

580 Every fish has its seasonal time they come down. Herrings and salmon are in July, August, and September.
581 Anchovies come every three months. Lobsters and octopus stay at one place in the sea ... all this has
582 changed because of the trawler people (Fisherman April 5, 2021)
583

584
585 While small-scale fishers emphasise the role of industrial trawling, other anthropogenic factors such as climate
586 change are also likely to exacerbate fishing decline and contribute to the livelihood vulnerability of communities
587 in Ghana (Freduah et al., 2017; Pabi et al., 2015).

588
589 **Conclusion**

590
591 This study demonstrates that the modernisation of Ghana's historical fisheries (Overå, 2011) and the current blue
592 economy aspirations of industrial fishing have considerably impacted coastal fishing livelihoods in that country.
593 As innovation and globalisation accelerate marine transformation, research into coastal fishing livelihoods is
594 becoming crucial to understanding their social, economic, and ecological effects. Blue economy initiatives, which
595 have been compared to earlier maritime transitions are putting pressure on poorer coastal communities,
596 particularly small-scale fisheries. In the context of Ghana, industrial fishing seems likely to intensify and
597 overwhelm small-scale fishing in pursuit of the blue economy, with considerable economic and social
598 consequences for coastal livelihoods. We found in Ghana that industrial fishing has already harmed fisheries
599 resources, caused damage to gear, weakened the local market systems, and diminished the positions of coastal
600 fishing actors (i.e., small-scale fishers and traders), thereby jeopardising the economic, social, and cultural
601 formations associated with the country's coastal fishing value chains. With the multiple dimensions of coastal
602 fisheries' livelihoods now eroding, the sustainability of the value chains is also at risk of collapse. The small-scale
603 fisheries and the coastal communities in Ghana may be approaching a "tipping point" (Serrao-Neumann et al.,
604 2016) beyond which they cannot operate as they have in the past.

605
606 Fisheries scientists and environmental non-governmental organisations are optimistic that recent progress by the
607 World Trade Organisation (WTO) at its 12th Ministerial Conference to address the issue of 'harmful' fisheries
608 subsidies on a global scale will help to reduce the phenomena (WTO, 2022). While these international actions are

609 underway to address the effects of fisheries subsidies, their success may eventually have beneficial spillover effects
610 at the local level for small-scale fisheries. In the case of Ghana at the moment, we recommend that the government
611 of Ghana take immediate steps to reduce the number and capacity of industrial fishing vessels to enable local small-
612 scale fisheries to rebuild. The Ghana Fisheries Management Plan (2015–2019) made a similar proposal to cut all
613 fleet sizes to reduce overcapacity in the country's coastal waters (MoFAD, 2015). However, the management plan
614 expired in 2019 without any tangible actions and the political will to implement the proposal. Establishing a closed
615 fishing season for both the industrial fishing fleet and small-scale fishing in Ghana during the past few years is a big
616 step towards allowing adult fish to spawn and increasing their production. Nonetheless, this management decision
617 has severely impacted coastal fishing actors who have no other source of income or investments to rely on during
618 the restricted fishing season. Additionally, we recommend that the recently established Fishery Enforcement Unit
619 (FEU) strictly enforce the country's law on fisheries' spatial limits. Moreover, donor-funded initiatives to implement
620 participatory and co-management in Ghana's fisheries and to build marine protected areas (Kassah and Asare, 2022)
621 must provide an equitable and inclusive space for small-scale fishing as a matter of social and economic rights
622 (Jentoft et al., 2022; Bennett et al. 2019). As a form of adaptation, future research may examine the social and
623 political agency available to small-scale operators in Ghana.

624

625 **Ethics Declarations**

626 The Human Research Ethics Committee of [Lead Authors Affiliated] gave ethical approval for this study.
627 Fieldwork procedures followed the required ethical guidelines, and all participants provided informed consent.

628

629 **CRediT**

630 The first author conceptualised the research, obtained ethical approval, and wrote the first draft. The second and
631 third authors supervised the research and contributed to analysis. The first and fourth authors conducted the
632 fieldwork and managed data.

633

634 **Competing Interest**

635 The authors declare no competing interests.

636

637 **Data Availability Statement**

638 Due to the research participants' confidentiality and privacy concerns, the datasets collected for this research may
639 not be made publicly available except in limited circumstances.

640

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