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4

## 5 **Social perceptions of coastal hazards in the Anlo Beach Community in the** 6 **Western Region of Ghana**

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12

### 13 **Abstract**

14 Due to climate change, coastal areas are becoming increasingly susceptible to more frequent and  
15 severe environmental catastrophes that endanger the health, safety, and way of life of coastal  
16 dwellers. Understanding the social perceptions of risk and hazard-related concerns can help in the  
17 development of adaptive capacity and associated management strategy preferences. This study  
18 employed structured questionnaires to obtain basic information on how the households of the Anlo  
19 Beach fishing community in the Western region of Ghana perceived and responded to coastal  
20 hazards. The respondents ranked coastal erosion and salinization first and second, ahead of  
21 seawater flooding and other hazards in terms of important risks in the study area. Responses  
22 illustrated high levels of knowledge and awareness about coastal hazards but low levels of trust in  
23 government and commitments in terms of taking personal mitigation measures. To varying degrees,  
24 respondent characteristics such as length of residency and occupancy status are positively and  
25 significantly associated with coastal hazard perception whereas the level of education was negative.  
26 Generally, the findings illustrated the need for better education and awareness campaigns about  
27 self-mitigation actions such as discontinuing beach sand utilization and exploiting mangroves  
28 as firewood and embracing the restoration of mangrove ecosystems. More importantly, the  
29 government should reconsider her earlier shelved plan of relocating the entire community to a safer  
30 location.

31 **Keywords:** *Social perception; coastal hazards; coastal erosion; salinization; Anlo Beach; Ghana*  
32 *coast*

### 33 **Introduction**

34 Globally, coastal areas are becoming more vulnerable to the impacts of increased extreme weather  
35 events, storm surges, and sea-level rise due to climate change (Barnard *et al.*, 2019; Cazenave and  
36 Le Cozannet, 2014; Mölter *et al.*, 2016; Neumann *et al.*, 2015) that pose threats to health, safety,  
37 and livelihoods of the coastal dwellers (Elrick-Barr *et al.*, 2015; Nicholls *et al.*, 2011; Burkett and  
38 Davidson, 2012). Aside from pressure resulting from the growing coastal population, most coastal  
39 areas are increasingly affected by climate change-induced coastal erosion and/or flooding (Barnard  
40 *et al.*, 2019) resulting from sea-level rise (Cazenave and Le Cozannet, 2014) and possible changes  
41 in wind/wave conditions and storm regimes (Ruz *et al.*, 2020; Mölter *et al.*, 2016). Climate change  
42 will therefore increase the vulnerability of the coastal areas to hazards.

43 Understanding public perceptions and the relative priorities given to coastal risk can help  
44 in the development of adaptive capacity and associated adaptation strategies (Button, 2013; Carlton  
45 and Jacobson, 2013), as perceptions tend to shape individual behaviour (Slovic, 1987; Lindell and  
46 Hwang, 2008) and management strategy preferences (Slovic, 1987; Steg and Sievers, 2000;  
47 Peacock *et al.*, 2005; Button, 2013). Also, Social perception of risks can constrain and influence  
48 political, social, and economic activities (Leiserowitz, 2006). The household has been identified as  
49 a valuable unit of analysis for perceptions of risk because it is a unit of action that exists between  
50 individuals and society, where personal values, societal norms, and institutional demands converge  
51 (Elrick-Barr *et al.*, 2015; Collins, 2015).

52 This paper assesses the risk perceptions and preferred strategies for facing future coastal  
53 hazards at the household scale of the Anlo coastal community of the Western region of Ghana. The  
54 study area was chosen because it is characterized by the problem of coastal erosion and marine  
55 flooding that may likely increase in the future due to rising sea levels and a higher frequency of  
56 extreme events associated with climate change (IPCC, 2012; 2021). We begin the paper by  
57 outlining the methods adopted to evaluate household risk perceptions in Anlo coastal community.  
58 Finally, results are discussed, highlighting variation in risk perceptions within and between the  
59 communities, before outlining key considerations for policy and research.

60

61

62

### 63 **Study site**

64 The Anlo Beach community (Figure 1) was purposefully selected as the study site because coastal  
65 flooding and shoreline erosion are increasingly impacting people, property, and ecosystems in this  
66 section of the Ghana coast (CRC, 2013; Mutimukuru-Maravanyika et al., 2017). Thus, it is believed  
67 that people in this area will recognize their vulnerability and have higher perceptions of risk (Brody  
68 et al., 2008).

69 The Anlo Beach coastal community, comprising 740 households (population ca. 4500), is located  
70 in the Shama District, Western Region of Ghana (Fig. 1). It is bordered to the north by mangroves  
71 and wetlands associated with the Pra River Delta that extends from the north-eastern to the western  
72 side of the community and on the south by the open Atlantic Ocean. The community, built on a  
73 dune and sandwiched between the wetlands and the ocean, is highly vulnerable to floods and  
74 erosion (Mutimukuru-Maravanyika et al., 2017). Although the Pra River and its associated  
75 mangroves and wetland areas are highly important for livelihoods, pollution of the river by illegal  
76 gold mining and indiscriminate cutting of mangroves is increasing (Mutimukuru-Maravanyika et  
77 al., 2017). The dominant livelihoods in the Anlo Beach community are fishing, petty trading, fish  
78 selling, and processing. Other popular occupations included: tailoring, hairdressing, catering, and  
79 fabric dyeing.

80

### 81 **The intensity of the use of natural resources in Anlo Beach**

82 Anlo Beach has a vast array of livelihood assets and potentials and a few services. Natural capital  
83 includes the sea and fisheries resources, beaches, sand, River Pra Estuary, wetlands including  
84 swamps and salt marshes, mangrove swamp, mangrove forests, dry land, and farmlands. The  
85 surrounding area possesses ecological features that are interesting to eco-tourism. The Pra River  
86 estuary provides suitable roosting and nesting grounds for birds and marine turtles. Mangroves of  
87 the genera *Avicennia*, *Rhizophora*, and *Laguncularia* are found along the entire perimeter of the  
88 Pra River and its estuary and extend over three kilometres on both sides of the estuary (Okyere,  
89 2015; Coastal Resources Center / Friends of the Nation, 2010). These mangroves are highly  
90 exploited as the main source of firewood for cooking and smoking fish and for construction  
91 purposes in the community thereby resulting in the degradation of the mangrove forest and  
92 reduction in the size of this critical habitat for fish breeding activities. Degraded mangrove areas

93 are used as refuse disposal sites. In addition, sand is wined from the beach for construction purposes  
 94 in the study community. This activity tends to increase coastal erosion and flooding (Kutir et al.,  
 95 2022). Further north of the community has located the farmlands. Fishers in this community are  
 96 actively involved in artisanal marine fishing as well as estuary fishing. Fishing and fish mongering  
 97 are the major livelihood activities running from mid-July to late April while subsistence farming  
 98 becomes the predominant occupation after April, lasting for about three months in the off-fishing  
 99 season after which the community switches back to fishing in mid-July or early August for the  
 100 main fishing season. Not all fishermen practice farming during the off-fishing months, and only a  
 101 few members of the community are small-scale farmers who only fish for subsistence. Cassava and  
 102 maize are the major crops produced although a few farmers cultivate cash crops such as oil palm  
 103 and coconut (Okyere, 2015; Coastal Resources Center / Friends of the Nation, 2010).

104



105  
 106 Fig. 1. a) Map Anlo Beach coastal fishing community. Inset: map of Ghana (sources: Mutimukuru-Maravanyika et al.,  
 107 2017).

108



109

110 Figure 2. The environmental situation in the Anlo Beach community: a) erosion; b) loss of mangroves due to erosion;  
111 and c) impact of salinization.

112

## 113 2 Materials and Methods

114 A household survey was conducted in the Anlo Beach community in the Western Region of Ghana  
115 to obtain information on household risk perceptions. The survey, in which 156 respondents  
116 participated, was conducted as part of the West Africa Coastal Area – mapping Vulnerability,  
117 Adaptability and Resilience in changing climate (WACA-VAR) project, between July and August  
118 2021 by a team of researchers from the Centre for Coastal Management-African Centre of  
119 Excellence in Coastal Resilience (CCM-ACECoR), University of Cape Coast, Ghana, and the  
120 Institut de Recherche pour de Developpement (IRD), Toulouse, France. The interviews were  
121 conducted face-to-face with a systematic selection of every 5th household to ensure that the results  
122 that will be obtained from our survey will approximate what would have been obtained if the entire  
123 population had been surveyed.

124 The survey, with 156 questions, consists of several parts, out of which three are common  
125 to all respondents. First, an identification of the survey site with its GPS coordinates and locality  
126 (section A). Then section B is based on the characteristics of the respondents, focusing on the  
127 respondents' place of residence, age, sex, professional activity, level of academic education, and  
128 attachment to the place. Section C is composed of two questions, dealing with the risks linked to  
129 the hazards and potentially dangerous phenomena observed and identifying the two phenomena  
130 that most affected the respondents. The respondents were allowed to rank the hazards that largely  
131 impact their lives, whether salinization, coastal erosion, coastal flooding, plastic pollution, or oil  
132 pollution.

133 Section D corresponds to a series of detailed questions based on the most impacted hazard  
134 noticed in section C. Questions were broadly structured around the manifestation of the hazard  
135 observed by the respondent, its evolution in recent years, the impact of the hazard on the individual,  
136 and possible measures that are taken or could be put in place in the management of these potential  
137 or actual hazards (Louarn, 2020; Morand, 2021). Kobo connect software, installed on mobile  
138 phones, was used to conduct the interview. In most cases, responses provided to the questionnaire  
139 were used directly as binary or multi-modal variables.

140

### 141 *2.1 Descriptive statistics analysis*

142 A descriptive statistics analysis was performed to describe the personal characteristics of the  
143 respondents, thus providing the structure of the sample.

144

### 145 *2.2 Construction of composite indices for Linear Regression analysis*

146 To consolidate and make more synthetic information in the evaluation of global perceptions, we  
147 created composite indices from binary/multi-modal answers to basic inquiries. To do it, we  
148 employed different subsets of questionnaire answers for this construction, which were sometimes  
149 binary choice answers and sometimes responses on ordered qualitative scales. Each composite  
150 index was calculated by adding values of 1 or 0 applied to the response categories obtained, thereby  
151 creating two synthetic indices: indices of (i) perceived impact and (ii) adaptive measures. The two  
152 indices were presented in the form of quantitative scores which will play, in turn, the role of the  
153 dependent variable for the analyses carried out using the linear model. Each of the two synthetic  
154 indices was then analyzed using a linear model. For the two indices, seven variables were used. No

155 variable taken into account in the construction of a composite index is reused as an explanatory  
 156 factor for the same index, which prevents any risk of circularity in the interpretation of the results.  
 157 The coefficients of the model were estimated using the Linear Regression analysis in the SPSS  
 158 software. Only significant effects up to the 10% ( $p < 0.1$ ) threshold were retained and discussed.  
 159 The value of the coefficient was used to identify the direction of the effect (positive or negative)  
 160 on the evolution of the index.

161

### 162 **3. Results**

#### 163 **3.1 Descriptive analysis**

##### 164 **3.1.1 Basic characteristics of the respondents**

165 Ninety-nine percent of the survey respondents lived at the study site. About 53% of them were  
 166 permanent homeowners while 46.5% were non-permanent owners. Only 10% of the respondents  
 167 had lived less than 10 years in the study site, indicating the majority (90 %) of them had lived in  
 168 the area for more than 10 years. Of the survey respondents, 61% were females while 39% were  
 169 males. Out of the entire respondents, 57.1% were between the ages of 18 and 50 years. About  
 170 11.5% of the respondents had a higher tertiary education while 26.3% never went to school (Table  
 171 1).

172

173 **Table 1. Descriptive statistics of the respondents**

<b>Variable</b>	<b>Response</b>	<b>Percentage</b>
<b>Gender</b>		
Female	95	60.9
Male	61	39.1
<b>Age</b>		
17-25	17	10.9
26-50	75	48.1
>50	64	41
<b>Education</b>		
Illiterate	41	26.3
Primary	59	37.8
Secondary	38	24.4
Tertiary	18	11.5



***Length of residence***

Permanent	83	53.2
>10 years	57	36.5
5-10 years	7	4.5
<5 years	9	5.8

***Occupancy status***

Permanent owners	83	53.5
Non-permanent owners	72	46.5

174  
 175 **3.1.2. Intensity in the usage of natural resources**  
 176 As shown in Table 2, freshwater, mangrove wood, and beach sand were identified by the  
 177 respondents to be of high use in the study area. About 75.7% of the respondents indicated high  
 178 usage of freshwater while 9.6 and 14.7% of the respondents, respectively, indicated low and  
 179 moderate utilization of freshwater. About 58.8% of the respondents indicated high use of mangrove  
 180 wood for domestic and professional activities, while 32.7 and 8.5% indicated low and moderate  
 181 usage. While beach sand was highly used by 62.8% of the respondents, river sand had low  
 182 utilization (by 76.7% of the respondents).

183 **Table 2. Usage of coastal natural resources in Anlo Beach based on the respondents' perception**

***Freshwater usage***

Low	15	9.6
Moderate	23	14.7
High	118	75.7

***Mangrove wood usage***

Low	50	32.7
Moderate	13	8.5
High	90	58.8

***River sand usage***

Low	115	76.7
Moderate	8	5.3
High	27	18

***Beach sand usage***

Low	43	27.6
Moderate	15	9.6
High	98	62.8

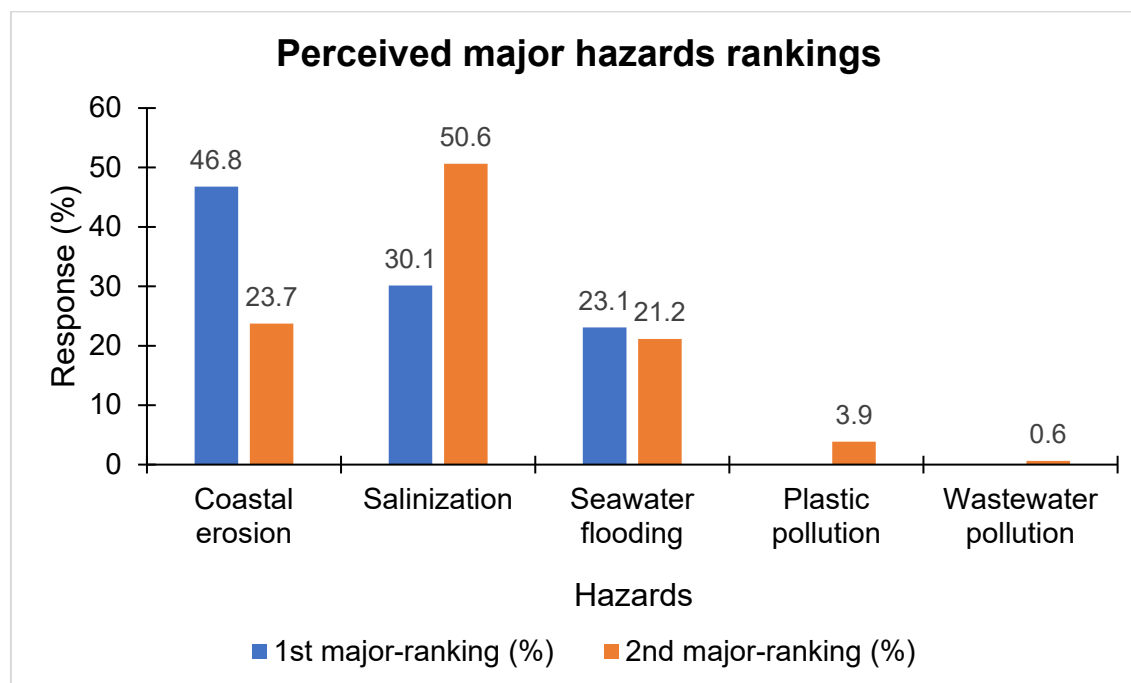
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185

### 186 3.1.3 Perceived coastal hazards assessment

187 To explore the level of perception of coastal hazards in the study area, first, the respondents were  
 188 asked to select three hazards they perceived to have the greatest impacts on their lives and  
 189 properties (Fig. 2).

190 As shown in Figure 2, coastal erosion (46.8 %) was on top of the list of the first major ranking  
 191 coastal hazards perceived by the respondents in the study area, followed by salinization (30.1 %)  
 192 and seawater flooding (23.1 %). Salinization (50.6 %) overwhelmingly topped the list under the  
 193 second major ranking of coastal hazards perceived by the respondents, followed by coastal erosion  
 194 (23.7 %) and seawater flooding (21.2 %). Plastic and wastewater pollution were not cited under  
 195 the first major ranking of coastal hazards perceived by the respondents in the study area but only  
 196 slightly mentioned under the second major ranking of coastal hazards perceived by the respondents  
 197 (Fig. 2) whereas oil pollution and sewage pollution were never mentioned at all. Thus, coastal  
 198 erosion and salinization being the first 2 major coastal hazards perceived by the respondents in the  
 199 study area were considered in the present study.



200

201 Fig. 2. Major ranking of coastal hazards as perceived by the respondents

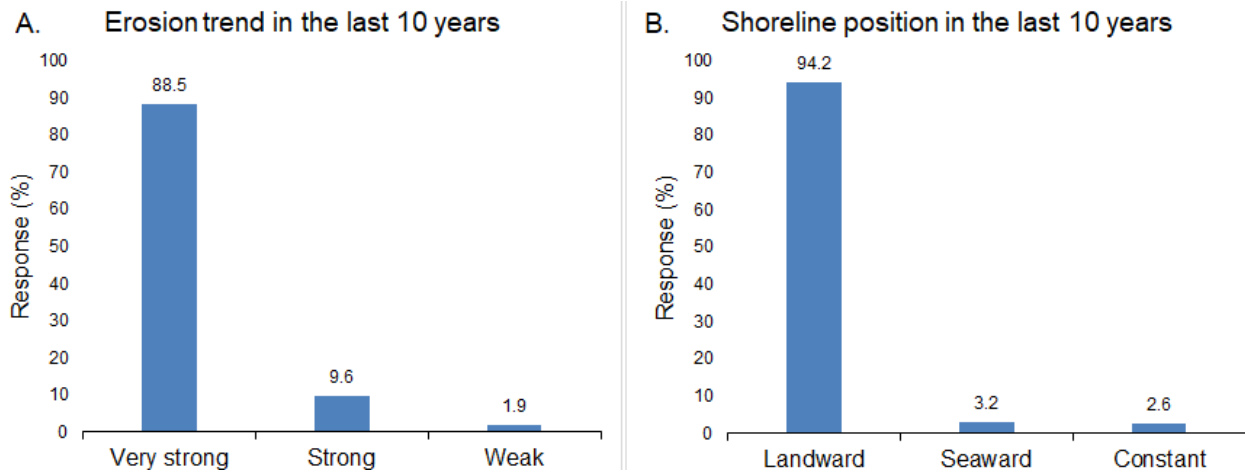
202

203 **3.1.4. Knowledge, causes, potential impacts, and approaches to reducing coastal hazards risks**

204 This section explores respondents' perceptions of the causes and potential impacts and their  
205 approach to mitigating the major coastal hazard risks.

206 *Perceived knowledge and awareness about coastal erosion*

207 The majority of the respondents (88.5%) stated that there has been strong coastal erosion in the last  
208 10 years while only a few (1.9%) believed that it was little (Fig. 3a). About 94.2% of respondents  
209 believed that the shoreline had moved landward more than it was 10 years ago, and 2.6% argued  
210 that it was constant (Fig. 3b). While most respondents (70%) pointed out that the erosion was  
211 highest near the Pra Estuary inlet, others (30%) believed that it was everywhere along the coast.  
212

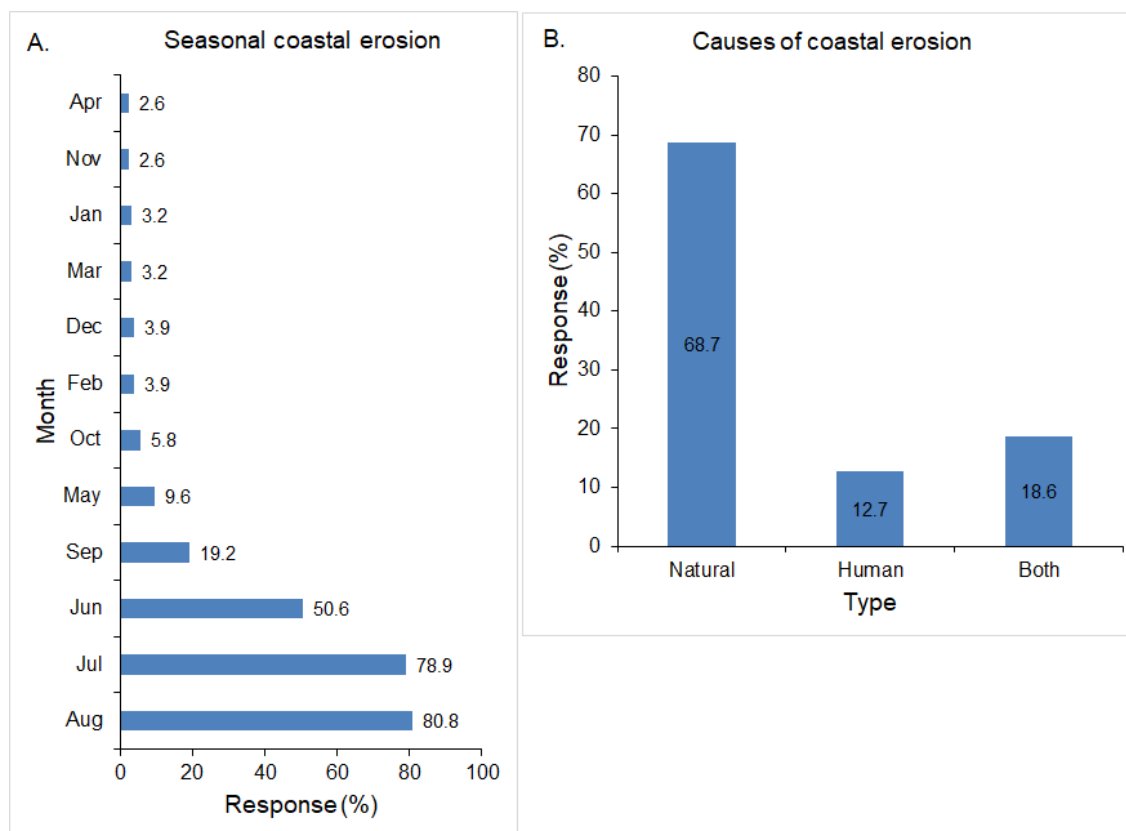


213  
214 **Fig. 3** a) Erosion trends in the last 10 years; b) Shoreline positions in the last 10 years as perceived by the respondents  
215

216 *Seasonality and major causes of erosion*

217 As shown in Fig. 4a, the respondents considered coastal erosion (or a landward advance of the sea)  
218 to be higher between May and September and least between October and April. However, about  
219 58% of respondents maintained that the beach never returned to where it was previously, indicating  
220 a high level of vulnerability in the area. When asked about the major causes of the erosion  
221 phenomenon in the study area, the majority of the respondents (68.7%) linked it to the combined  
222 effects of natural factors (Fig. 4b) such as wave actions, sea-level rise, tidal waves, river flooding,  
223 and seasonal cycles. While about 12.7% of the respondents linked erosion in the study area to  
224 human activities (Fig. 4b) like beach sand mining, harbour construction at Sekondi and Takoradi,  
225 nearby sea defense at Aboadze, the opening of the Pra River estuary inlet, and building houses near

226 the coast; 18.6% of them believed it was both natural and human-induced (Fig. 4b). The majority  
 227 of respondents (75%) believed that erosion became aggravated during some events or years. For  
 228 example, the combined effects of river and sea flooding events during the 2005/2006, 2014/2015,  
 229 and 2017/2018 periods were considered to have aggravated coastal erosion in the study area,  
 230 indicating a high level of awareness about the vulnerability of the area.



231  
 232 **Fig. 4.** a) Monthly/ Seasonal coastal erosion trends; b) Causes of coastal erosion as perceived by the respondents.  
 233

#### 234 *Perceived impacts, efforts at mitigating coastal erosion, and suggested solutions*

235 As presented in Table 3a, 91.7 and 92% of the respondents, respectively, stated that coastal erosion  
 236 had a high to extremely high impact on their domestic activities and general living conditions  
 237 whereas 8.3 and 8% of the respondents said it had a moderate to low impact. Most of the  
 238 respondents (84%) stated that they suffered physical or property damages as a result of coastal  
 239 erosion (Table 3b). However, they displayed low preparedness levels for mitigation measures.  
 240 When asked whether they were taken any measures to combat erosion, the majority (83.3%) of the  
 241 respondents said they were not making any efforts (Table 3c). Owing to various impacts of coastal

242 erosion, about 68.4% of them had been forced to relocate to other parts of Anlo Beach while  
 243 ~76.7% are still contemplating moving in the future (Table 3b).

244 When asked what could be done to slow down to reduce coastal erosion hazards in their  
 245 community, about 78.8% opted for the construction of sea defense along the coast as it was done  
 246 in Cape Coast, a nearby city, while 10.9% suggested relocation of the community to a safer place  
 247 by the government (Table 3d).

248

249 **Table 3a. Impacts of coastal erosion on domestic activities, professional activities, and conditions of living**

Variable	Low		Moderate		High		Very High		Extremely High	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
i. Impact on domestic activities	14	3.2	7	4.5	5	9	23	14.7	106	68
ii. Impact on professional activities	23	14.7	10	6.4	11	7.1	46	29.5	66	41.7
iii. Impact on condition of living	11	7.1	1	0.65	7	4.5	26	16.7	109	70.8

250

251 **Table 3b. The severity of coastal erosion on the respondents and responses**

	Yes		No	
	Freq.	%	Freq.	%
i. Have you suffered any physical or property damage	131	84	25	16
ii. Have you moved to a different location because of coastal erosion?	106	68.4	49	31.6
iii. Do you think you will have to move again?	115	76.7	35	23.3
iv. Any built coastal defense e.g., dikes, breakwaters, groins in your community?	1	0.6	154	99.4

252

253 **Table 3c. Efforts at combating coastal erosion**

	None		Personally		Collectively	
	Freq.	%	Freq.	%	Freq.	%
Any effort at combating coastal erosion in your community?	129	83.8	1	0.6	24	15.6

254

255 **Table 3d. Suggested ways of combating coastal erosion**

What could be done to mitigate coastal erosion in your community?	No idea		Sea defense		Relocation	
	Freq.	%	Freq.	%	Freq.	%
	17	10.9	123	78.8	16	10.3

256

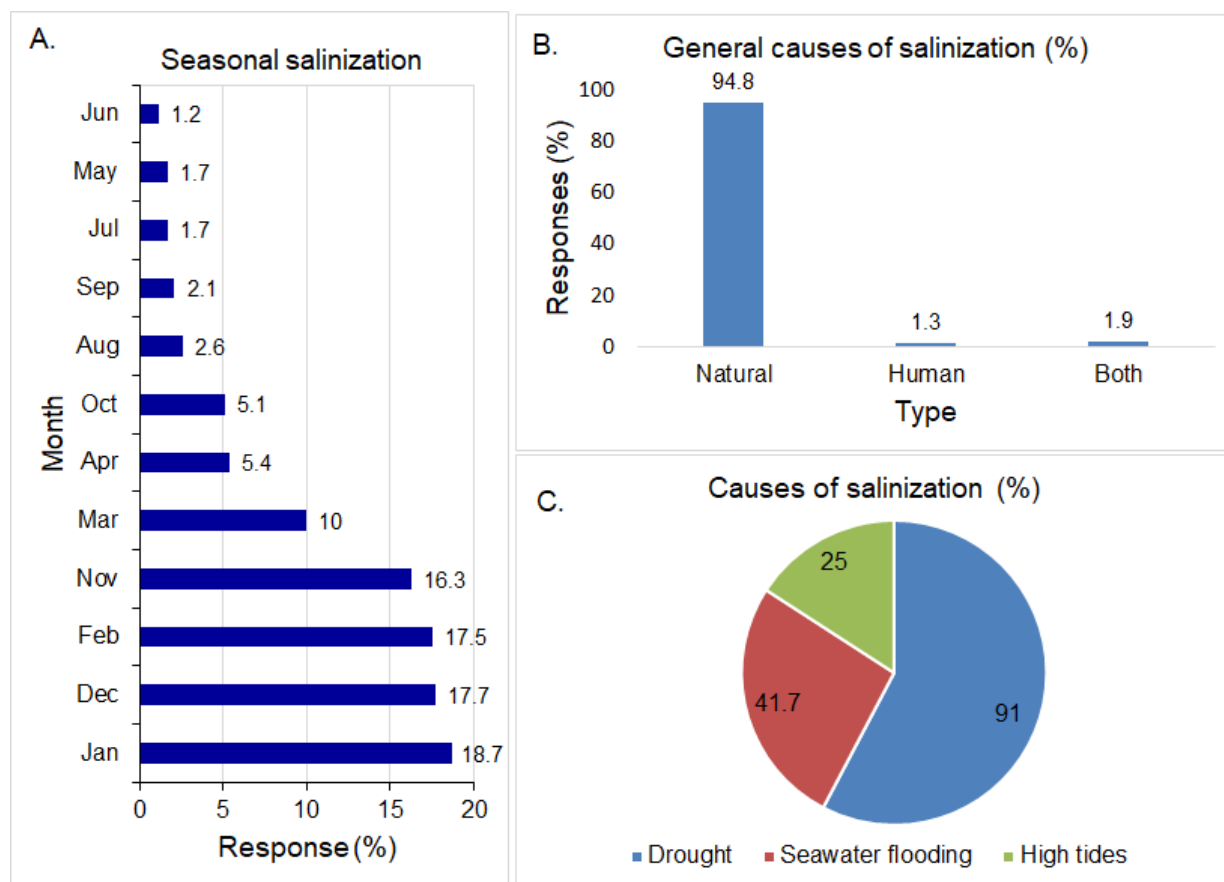
257

258 *Perceived knowledge and awareness about salinization and its major causes*

259 The perception of the respondents about salinization hazards was very high. About 89.1% of the  
260 respondents stated that the situation is well-known to everyone in the community. The majority,  
261 99.4 and 76.3% respectively, of the respondents, reported the presence of salt in the drinking water  
262 from the well and river, in the study area. About 95.5% of the respondents stated that there was an  
263 occurrence of high salinity in the well water during the dry season between November and March  
264 of each year (Fig. 5a). This is consistent with nationally observed weather conditions; the wettest  
265 months in Ghana are May-July and September-October, with the driest period occurring from  
266 December to February and a brief period in August. The majority of the respondents, about 95.5  
267 and 69.9%, described the salt in the well and river as higher than in the past 10 years. The overall  
268 response to the questions was an indication of good knowledge of their local environment.

269 When asked about the causes of salinization in the study area, 94.8% of respondents (Fig.  
270 5b) believed that it was a natural phenomenon due to drought (91%), seawater flooding (41.7%),  
271 high tide (25%) (Fig. 5c). On the other hand, 1.3% of the respondents believed that it was caused  
272 by humans while 1.9% said it was both human and natural (Fig. 5b). Others also believed that the  
273 nearness of the community to the Ocean was a major factor.

274



275  
276 **Fig. 5.** a) Monthly/ Seasonal coastal salinization trends; b) General causes of salinization; and c) Natural causes of  
277 salinization as perceived by the respondents.  
278

279 *Perceived impacts of salinization and mitigation efforts*

280 Ninety-four percent (94%) of the respondents stated salinization has impacted their domestic  
281 activities, 66% of the respondents stated that it has affected their professional activities, while the  
282 general living conditions of 91% of the respondents have been impacted (Table 4a). When asked  
283 if the community had put any measure in place to prevent salt contamination, 85.9% indicated there  
284 was no measure on the ground (Table 4b). When asked what could be done to reduce salinization  
285 in their community, 5.1%, 3.2%, and 41.7% of the respondents suggested relocation, water  
286 treatment, and provision of pipe-borne water, respectively, while 50% of the respondents had no  
287 idea of what to do (Table 4c).

288

289

290

291 **Table 4a. Impacts of salinization on domestic and professional activities and general condition of living**

Variable	Low		Moderate		High		Very High		Extremely High	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Domestic activities	2	1.28	1	0.64	5	3.21	19	12.18	129	82.69
Professional activities	27	17.31	12	7.69	13	8.33	45	28.85	59	37.82
Condition of living	4	2.56	3	1.92	6	3.85	29	18.59	114	73.08

292

293 **Table 4b. The effort to mitigate salinization in your community**

Any effort at mitigating salinization in your community?	None		Personal		Collective	
	Freq.	%	Freq.	%	Freq.	%
	134	85.9	3	1.9	19	12.2

294

295 **Table 4c. How to mitigate salinization in your community**

What could be done to mitigate salinization in your community?	No idea		Pipe-borne water		Water treatment		Relocation	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
	78	50	65	41.7	5	3.2	8	5.1

296

297 3.2 Factors acting on perception: Linear model analysis (LMA)

298 *Perception of impact and adaptive measures regarding erosion hazard*

299 The results of the LMA show that a high level in the perception of the impact of coastal erosion  
 300 (appraised through a composite index) was negatively related to education level ( $p < 0.05$ ; Table  
 301 5a) and positively related to Length of residency ( $p < 0.05$ ; Table 5a). Also, the propensity of  
 302 respondents to take adaptive measures to coastal erosion was only negatively related to age ( $p <$   
 303  $0.01$ ; Table 5a). In other words, respondents who have spent a longer period in the study area are  
 304 more likely to perceive the impact of coastal erosion than those that have resided in the study area  
 305 for a short period. Given the same impact, the higher the education level of the respondents the less  
 306 likely they perceive the impact of coastal erosion. In addition, it was observed that older ( $> 50$   
 307 years) respondents are less likely to take adaptive measures than younger ones ( $< 50$  years).

308

309

310



311 *Perception of impact and adaptive measures regarding salinization hazard*

312 As shown in Table 5b, a high level in the perception of the impact of salinization (appraised through  
 313 a composite index) was negatively related to occupancy status ( $p < 0.05$ ) and positively related to  
 314 education level ( $p < 0.1$ ; Table 5b). Also, the propensity of respondents taking adaptive measures  
 315 (appraised through a composite index) to salinization was negatively related to occupancy status  
 316 ( $p < 0.01$ ) and positively related to education level ( $p < 0.01$ ; Table 5b). In other words, non-owners  
 317 of land in the study area are more likely to perceive the impact of the salinization than the  
 318 landowners. Given the same impact, the higher the education level of the respondents the more  
 319 likely they perceive the salinization impact. In the same vein, non-owners of land are more likely  
 320 to take adaptive measures, and also, the higher the education level of the respondents the more  
 321 likely they take adaptive measures.

322  
 323 **Table 5a. Linear model analysis of social factors affecting the perception of coastal erosion impact and the**  
 324 **propensity to engage in adaptation measures vs erosion**

	Coastal Erosion hazard			
	Indice of perceived impact		Indice of adaptive measures	
	coefficient	p-value	coefficient	p-value
Age	-0.094	0.258	-0.375	<b>0.005</b>
Gender (F vs M)	-0.067	0.482	-0.061	0.277
Level of education	-0.234	<b>0.011</b>	-0.105	0.189
Length of residency	0.170	<b>0.039</b>	0.154	0.175
Occupancy status (owner vs non-owner)	0.124	0.148	-0.007	0.889
Occupation (Farming)	-0.024	0.782	0.017	0.822
Occupation (Fishing)	0.177	<b>0.041</b>	0.033	0.521

325 Note: Bolded values are significant at  $p < 0.05$

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 337 **Table 5b. Linear model analysis of social factors affecting the perception of salinization impact and the**  
 338 **propensity to engage in adaptation measures vs salinization**

	Salinization hazard			
	Indice of perceived impact		Indice of adaptive measures	
	coefficient	p-value	coefficient	p-value
Age	0.132	0.112	- 0.018	0.600
Gender (F vs M)	0.019	0.578	0.015	0.302
Level of education	0.089	<b>0.073</b>	0.085	<b>&lt;0.0001</b>
Length of residency	0.055	0.437	- 0.045	0.113
Occupancy status (owner vs non-owner)	-0.066	<b>0.031</b>	- 0.038	<b>0.002</b>
Occupation (Farming)	-0.047	0.312	0.019	0.301
Occupation (Fishing)	-0.014	0.667	0.013	0.327

339 Note: Bolded values are significant at  $p < 0.05$

340  
 341 **4. Discussion**

342 The results of the present study show that the respondents are more concerned about coastal erosion  
 343 than all other coastal hazard types in the Anlo community of the Western region of Ghana. This is  
 344 in concordance with geomorphological studies that found that this section of the Ghana coast is  
 345 eroding (e.g., [Addo, 2009](#); [Boateng, 2012](#); [Boye et al., 2018](#)). For instance, [Boateng \(2012\)](#)  
 346 observed an erosion rate of  $2.7 \pm 0.4$  m per year between Sekondi port jetty and Pra estuary in the  
 347 long term. [Boye et al. \(2018\)](#) noted that in both the short and long term, the western part of the  
 348 study area is eroding at a faster rate than the eastern section. Findings from the study carried out  
 349 by [Friends of the Nation \(2015\)](#) in the study area revealed that about 146 houses close to the shore  
 350 of the Atlantic Ocean are highly exposed to coastal erosion. Several houses stand threatened once  
 351 the highly exposed ones are eroded. Another report showed that more than 1,000 houses have been  
 352 destroyed by the sea in the last 30 years ([Graphic Online, 2017](#)). According to the same report,  
 353 more than 198 houses were washed away, and more than 800 residents were displaced during the  
 354 2017 tidal wave that hit the area ([Graphic Online, 2017](#)). It is important to note that the Anlo Beach  
 355 community is built on a dune between the wetlands and the Atlantic Ocean, and it is highly  
 356 vulnerable to floods and erosion ([Mutimukuru-Maravanyika et al., 2017](#)).

357 Although seawater flooding is a well-recognized problem in the study area ([Mutimukuru-](#)  
 358 [Maravanyika et al., 2017](#)), it was the third hazard identified by the respondents. Studies have shown  
 359 that laypeople can make a subjective assessment based on sentiments and psychometric factors

360 (Slovic, 1987; Slovic et al., 1984) and/or social values (Wildavsky and Dake, 1990; Dake, 1991)  
361 rather than on data. This may be because seawater flooding was perceived by some respondents as  
362 one of the natural causes of salinization in the study area (Fig. 5), and as it emerged, about 26% of  
363 the respondents saw it as a major cause of salinization (Fig. 5).

364 Looking at it from a different perspective, it could also be due to the systematic failure of  
365 the government (Liddle et al., 2015) to provide piped water services, thereby prompting the  
366 inhabitants to rely on water from wells and boreholes (Grönwall, 2016). About 49% of Ghanaian  
367 coastal dwellers rely heavily on groundwater from shallow aquifer systems for domestic and  
368 professional purposes (Ghana Statistical Service, 2012; Kortatsi, 1994). Salinization of surface  
369 wells and groundwater has been reported as a major problem in many coastal areas of Ghana (e.g.,  
370 Lutterodt et al., 2021; Helstrup et al., 2007; Bannerman, 1994; Gill, 1969). A study indicates that  
371 the salinization of wells in these areas is a result of saltwater intrusion (Helstrup et al., 2007). This  
372 has caused the abandonment of several water wells in the Anlo community (Fig. 2). This may have  
373 caused salinization to be seen as more impactful than seawater flooding. Therefore, there is a need  
374 for control measures to check the further degradation of freshwater through the landward  
375 movement of seawater into these coastal areas.

376 Such a measure could be increased public awareness of the need to lower water abstraction  
377 rates and usage of other water resources that can contribute to an increase in freshwater volume,  
378 which slows the infiltration of saltwater. This is the simplest, most direct, and most economical  
379 solution to problems with saltwater intrusion and groundwater balance in aquifers. However, a  
380 supplemental source of water will be required to substitute for the mandated reduction in the  
381 groundwater pumping plan (Hussain et al., 2019; Abd-Elhamid et al., 2018; Bruington, 1972). As  
382 suggested by the majority of respondents, this additional water source can be the community being  
383 provided with pipe-borne water by the government (Table 4c). It is notable that, while the  
384 respondents' perception of increasing coastal hazards was high, their propensity to take adaptive  
385 measures was very low for both hazards (Table 3). More than 80% of the respondents were not  
386 making any effort to mitigate either coastal erosion or salinization because they viewed them as  
387 natural (Tables 3c and 4b). This is not surprising because previous studies also found no connection  
388 between people's risk perception and their intentions to take mitigation measures (Diakakis et al.,  
389 2018; Baron and Petersen, 2015; Wachinger et al., 2013; Bubeck et al., 2012; Siegrist and Gutscher,  
390 2006; Kreibich et al., 2005; Takao et al., 2004). According to Brilly and Polic (2005), proper

391 actions and countermeasures do not always follow perceived threats. Based on this, Diakakis et al.  
392 (2018) is of opinion that future public sensitization should focus more on the importance of self-  
393 protection measures, rather than emphasizing only the risks.

394 Concerning the variables or factors that influenced the perception of the respondents, our  
395 findings show that respondents' perceptions of increasing coastal erosion hazards were negatively  
396 associated with their level of education and occupancy status, whereas some type of occupation  
397 (fishing) was positively associated with coastal erosion hazard perception. The two factors that  
398 were always statistically significant among all the relevant socio-demographic characteristics were  
399 level of education and occupancy status (owner versus non-owner) (Table 5 a, b). These findings  
400 are consistent with previous studies, which suggest that demographic, attitudinal, and social  
401 contextual characteristics have a significant impact on perceptions of ecological risks (Bord et al.,  
402 1998; Kempton, 1993; Peters and Slovic, 1996).

403 For instance, O'Connor et al. (1999) and Savage (1993) found that people with higher levels  
404 of education and household income have lower levels of ecological risk perception. House  
405 ownership (occupancy status) is also found to be associated with perceived risks. For example,  
406 Burningham et al. (2008) and Grothmann and Reusswig (2006) argued that owning a property  
407 could result in higher levels of perceived risk than renting a residence. A study has also shown that  
408 permanent residence (length of residency) in a risky place may increase risk perception (Kellens et  
409 al., 2011; Burningham et al., 2008; Lindell and Hwang, 2008).

410 Regarding taking adaptive measures to combat coastal hazards, age was negatively  
411 associated with the perception of coastal erosion risks, which is similar to that of Kellens et al.  
412 (2013) but at variance with earlier studies that found older respondents to display a higher  
413 perception than younger people. (e.g., Lindell and Whitney, 2000; Grothmann and Reusswig,  
414 2006; Knocke and Kolivras, 2007; Miceli et al., 2008; Burningham et al., 2008; Bonem et al.,  
415 2015). Taking adaptive measures to salinization was positively influenced by the level of education  
416 and associated with occupancy status. Higher education levels may increase respondents'  
417 promptness to take adaptive measures (Kellens et al., 2011). The varying outcome may be due to  
418 methods of measuring risk perception and different subjects (Kellens et al., 2011). For instance,  
419 while Burningham et al. (2008) measured risk awareness, Grothmann and Reusswig (2006) focused  
420 on the perceived ability to take protective actions against flood risks. Previous studies may not be

421 directly related to coastal erosion and salinization hazards, they shed light on the effects of socio-  
422 demographics on perceptions of coastal hazards.

423 From our findings, there is a belief that the government is solely responsible for the  
424 implementation of protective measures, whereas self-effort by individuals is far less important.  
425 Further, they saw structural coastal protection measures as the key management strategies instead  
426 of taking personal measures. A larger emphasis was placed by residents upon measures to reduce  
427 coastal hazards, rather than concentrating on reducing community activities (such as the  
428 construction of new buildings) in hazard-prone areas. Similarly, Wisner et al. (2004) found that  
429 disadvantaged people (economically or politically) are bound to stop trusting their means of self-  
430 protection and lose self-confidence. This behaviour is intensified by a lack of government attention.  
431 Consequently, the people were blaming the government instead of increasing their resilience  
432 capacity at the local level.

433 We believe that the people also have a role to play. For instance, our findings (see [Table 2](#);  
434 [Fig. 2](#)) revealed that mangrove woods are heavily exploited (58.8%) in the study area, and beach  
435 sand (62.8%) is heavily utilized compared to river sand (18%). However, mangroves are known to  
436 be a natural protector of coastlines and builders of beaches ([Besset et al., 2019](#); [Gracia et al., 2018](#);  
437 [Spalding et al., 2014](#)). While the aerial roots of mangroves encourage sediment deposition and  
438 prevent erosion, the roots, trunks, and canopy dampen the force of oncoming waves and storm  
439 surges and thus reduce seawater flooding. So, there is a need for attitudinal change: to discontinue  
440 beach sand utilization and exploitation of mangroves as firewood for cooking and smoking fish in  
441 the community and embrace the restoration of mangrove ecosystems.

442  
443 **5. Conclusions**  
444 This research examines the societal perceptions of coastal risks in the Anlo Beach Fishing  
445 Community in Ghana's Western Region. We identified and explained numerous critical factors  
446 determining household risk perception using descriptive statistics and multivariate regression  
447 models. Our findings not only reveal how individuals view coastal risks, but also provide crucial  
448 information to policymakers interested in reducing the negative effects of coastal hazards on local  
449 populations. Although this research gives insight into the factors that influence people's perceptions  
450 of coastal risks in the study area, it should only be used as a starting point for further research.  
451 More real actions are required, such as actual legislative responses to coastal dangers. Further,

452 findings from this study call for interventions from the appropriate authorities. These interventions  
 453 should take the form of educating people about the necessity of self-protection measures like  
 454 ceasing to use of beach sand exploitation of mangroves for fuel, as well as embracing mangrove  
 455 ecosystem restoration; and awareness about the need to lower water abstraction rates and usage of  
 456 other water resources such as the provision of pipe borne water to the community to an increase in  
 457 freshwater volume and slows the infiltration of saltwater.

458

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### 471 **References**

- 472 **Abd-Elhamid, H.F., Abd-Elaty, I., Negm, A.M., 2018.** Control of Saltwater Intrusion in Coastal  
 473 Aquifers. In: Negm, A. (eds) Groundwater in the Nile Delta. The Handbook of  
 474 Environmental Chemistry, vol 73. Springer, Cham. [https://doi.org/10.1007/698\\_2017\\_138](https://doi.org/10.1007/698_2017_138)
- 475 **Addo, K.A., 2009.** Detection of coastal erosion hotspots in Accra, Ghana. *Journal of Sustainable*  
 476 *Development in Africa* (Volume 11, 4).
- 477 **Bannerman, R.R., 1994.** Appraisal of the limestone aquifer of the Keta Basin, Ghana. In: Soveri  
 478 J. and Suokko T. (Eds.), *Future Groundwater Resources at Risk*. Publ. 222. International  
 479 Association for Hydrological Sciences, Wallingford, pp. 315–321.
- 480 **Barnard, P.L., Erikson, L. H., Foxgrover, A.C., Finzi Hart, J.A., Limber, P., O'Neill, A. C.,**  
 481 **van Ormondt, M., Vitousek, S., Wood, N., Hayden, M.K. and Jones, J.M., 2019.** Dynamic  
 482 flood modeling essential to assess the coastal impacts of climate change. *Scientific Reports*,  
 483 9: 4309.
- 484 **Baron, N. and Petersen, L.K., 2015.** Climate change or variable weather: rethinking Danish  
 485 homeowners' perceptions of floods and climate, *Reg. Environ. Change* 15, 1145–1155.
- 486 **Besset, M., Gratiot, N., Anthony, E. J., Bouchette, F., Goichot, M. and Marchesiello, P.,**  
 487 **2019.** Mangroves and shoreline erosion in the Mekong River delta, Viet Nam. *Estuarine,*  
 488 *Coastal and Shelf Science*, 226, 106263.
- 489 **Boateng, I., 2012.** An application of GIS and coastal geomorphology for large scale assessment

- 490 of coastal erosion and management: a case study of Ghana. *Journal of Coastal*  
 491 *Conservation*, 16:383–397.
- 492 **Bord, R. J., Fisher, A., and O'Connor, R. E., 1998.** Public perceptions of global warming: United  
 493 States and international perspectives. *Climate Research*, 11, 75-84.
- 494 **Bonem, E.M., Ellsworth, P.C., and Gonzalez, R., 2015.** Age differences in risk: perceptions,  
 495 intentions and domains, *J. Behav. Decis. Mak.* 28, 317–330.
- 496
- 497 **Boye, C. B. Appeaning Addo, K., Wiafe, G. and Dzigbodi-Adjimah, K., 2018.** Spatio-  
 498 temporal analyses of shoreline change in the Western Region of Ghana. *Journal of Coastal*  
 499 *Conservation*. <https://doi.org/10.1007/s11852-018-0607-z>
- 500 **Bradford, R. A., O'Sullivan, J. J., van der Craats, I. M., Krywkow, J., Rotko, P., Aaltonen,**  
 501 **J., Bonaiuto, M., De Dominicis, S., Waylen, K., and Schelfaut, K., 2012.** Risk perception –  
 502 issues for flood management in Europe, *Nat. Hazards Earth Syst. Sci.*, 12, 2299–2309.
- 503 **Brilly, M., and Polic M., 2005.** Public perception of flood risks, flood forecasting and  
 504 mitigation, *Nat. Hazards Earth Syst. Sci.* 5, 345–355.
- 505 **Brody, S.D., Zahran, S., Vedlitz, A. and Grover, H., 2008.** Examining the relationship between  
 506 physical vulnerability and public perceptions of global climate change in the United States.  
 507 *Environment and Behavior* 40(1), 72–95.
- 508 **Bruington, A. E., 1972.** Saltwater intrusion into aquifers 1. *JAWRA Journal of the American*  
 509 *Water Resources Association*, 8(1), 150-160.
- 510 **Bubeck, P., Botzen, W. J. W., Kreibich, H., and Aerts, J. C. J. H., 2013.** Detailed insights into  
 511 the influence of flood-coping appraisals on mitigation behaviour. *Global Environ. Chang.*,  
 512 23, 1327–1338.
- 513 **Bubeck, P., Botzen, W.J., and Aerts, J.C., 2012.** A review of risk perceptions and other factors  
 514 that influence flood mitigation behaviour, *Risk Anal.* 32, 1481–1495.
- 515 **Burkett, V.R. and Davidson, M.A., 2012.** Coastal impacts, adaptation and vulnerability: a  
 516 technical input to the 2012 national climate assessment. cooperative report to the 2013.  
 517 *National Climate Assessment* 150, 1–89.
- 518 **Burningham, K., Fielding, J., and Thrush, D., 2008.** “It’ll never happen to me”: Understanding  
 519 public awareness of local flood risk. *Disasters* 32(2):216–238.
- 520 **Button, C., 2013.** Coastal vulnerability and climate change in Australia: public risk perceptions  
 521 and adaptation to climate change in non-metropolitan coastal communities. PhD Thesis,  
 522 School of Social Sciences, The University of Adelaide, Australia, 361 pp.
- 523 **Carlton, S.J and Jacobson, S.K., 2013.** Climate change and coastal environmental risk  
 524 perceptions in Florida. *Journal of Environmental Management*, 130, 32-39.
- 525 **Cazenave, A. and Le Cozannet, G., 2014.** Sea level rise and its coastal impacts. *Earth's Future*,  
 526 2, 15-34.
- 527 **Coastal Resources Center (CRC, 2013).** Coastal Hazards and Flooding Risk in Ghana's  
 528 Western Region. Issue Brief 7 in series “Hen Mpoano: Our Coast, Our Future”.  
 529 Narragansett, RI: Coastal Resources Center, Graduate School of Oceanography, University  
 530 of Rhode Island. USAID Integrated Coastal and Fisheries Governance Program for the

- 531 Western Region of Ghana. Narragansett, RI: Coastal Resources Center, Graduate School  
 532 of Oceanography, University of Rhode Island. 15 pp.
- 533 **Collins, R., 2015.** Keeping it in the family? Re-focusing household sustainability. *Geoforum* 60,  
 534 22–32.
- 535 **Coastal Resources Center / Friends of the Nation, 2010.** Report on characterization of coastal  
 536 communities and shoreline environments in the Western Region of Ghana. Integrated  
 537 Coastal and Fisheries Governance Initiative for the Western Region of Ghana. Coastal  
 538 Resources Center, University of Rhode Island, 425pp.
- 539 **Dake, K., 1991.** Orienting dispositions in the perception of risk: an analysis of contemporary  
 540 worldviews and cultural biases, *J. Cross Cult. Psychol.* 22, 61–82.
- 541 **Diakakis, M., Priskos, G. and Skordoulis, M., 2018.** Public perception of flood risk in flash  
 542 flood prone areas of Eastern Mediterranean: The case of Attica Region in Greece,  
 543 *International Journal of Disaster Risk Reduction* 28, 404-413.
- 544 **Elrick-Barr, C.E., Smith, T.F., Thomsen, D.C. and Preston, B.L., 2015.** Perceptions of Risk  
 545 among Households in Two Australian Coastal Communities. *Geographical Research* 53  
 546 (2), pp. 145-159
- 547 **Friends of the Nation (2015).** Shama Disaster Management Committee Meeting and Field Work  
 548 to Plan Anlo Beach Resettlement, The USAID/Ghana Sustainable Fisheries Management  
 549 Project (SFMP). Narragansett, RI: Coastal Resources Center, Graduate School of  
 550 Oceanography, University of Rhode Island and Friends of the Nation, Adiembra – Parks  
 551 and Gardens. GH2014\_ACT085\_FON 26 pp.
- 552 **Ghana Statistical Service (GSS), 2012.** Summary report of final results for 2010 population and  
 553 housing census. Ghana Statistical Service. Accra, Ghana.
- 554 **Gill H. E., 1969.** A groundwater reconnaissance of the Republic of Ghana, with a description of  
 555 geohydrologic provinces. US Geological Survey Water-supply Paper 1757-K Washington,  
 556 DC, 37pp.
- 557 **Gracia, A., Rangel-Buitrago, N., Oakley, J. A., and Williams, A. T., 2018.** Use of ecosystems  
 558 in coastal erosion management. *Ocean & coastal management*, 156, 277-289.
- 559 **Graphic Online, 2017.** Anlo Beach to be wiped out in a year. Retrieved 24th of February 2022  
 560 from [https://www.graphic.com.gh/news/general-news/anlo-beach-to-be-wiped-out-in-a-](https://www.graphic.com.gh/news/general-news/anlo-beach-to-be-wiped-out-in-a-year.html)  
 561 [year.html](https://www.graphic.com.gh/news/general-news/anlo-beach-to-be-wiped-out-in-a-year.html)
- 562 **Grönwall, J., 2016.** Self-supply and accountability: to govern or not to govern groundwater for  
 563 the (peri-) urban poor in Accra, Ghana. *Environ. Earth Sci.* 75, p.1163
- 564 **Grothmann, T. and Reusswig F., 2006.** People at risk of flooding: Why some residents take  
 565 precautionary action while others do not. *Natural Hazards* 38(1–2):101–120.
- 566 **Helstrup T., Jorgensen N. O. and Banoeng-Yakubo, B., 2007.** Investigation of hydrochemical  
 567 characteristics of groundwater from the Cretaceous–Eocene limestone in southern and  
 568 southern Togo using hierarchical cluster analysis. *Hydrogeology* 15, p. 977–989.
- 569 **Hussain, M.S., Abd-Elhamid, H.F., Javadi, A.A. and Sherif, M.M., 2019.** Management of  
 570 Seawater Intrusion in Coastal Aquifers: A Review. *Water* 11(12):2467.
- 571 **IPCC, 2012.** Summary for policymakers. In: Field CB, Barros V, Stocker TF, Qin D, Dokken  
 572 DJ, Ebi KL, Mastrandrea MD, Mach KJ, Plattner G-K, Allen, SK, Tignor M, Midgley PM,  
 573 editors. *Managing the risks of extreme events and disasters to advance climate change*



- 574 adaptation. A special report of Working Groups I and II of the Intergovernmental Panel on  
 575 Climate Change. Cambridge University Press, Cambridge, UK, 19 p.
- 576 **IPCC, 2021: Climate Change 2021.** The Physical Science Basis. Contribution of Working Group  
 577 I to the Sixth Assessment Report of the Intergovernmental Panel on Climate  
 578 Change[Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N.  
 579 Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R.  
 580 Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)].  
 581 Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In  
 582 press, doi:10.1017/9781009157896.
- 583 **Kellens, W., Zaalberg, R., Neutens, T., Vanneuville, W. and De Maeyer, P., 2011.** An Analysis  
 584 of the Public Perception of Flood Risk on the Belgian Coast. *Risk Analysis* 31 (7), 1055-  
 585 1068.
- 586 **Kellens, W., Terpstra, T. and De Maeyer, P., 2013.** Perception and communication of flood  
 587 risks: A systematic review of empirical research. *Risk Anal.* 33, 24–49.
- 588 **Kempton, W., 1993.** Will public environmental concern lead to action on global warming?  
 589 *Annual Review of Energy and the Environment* 18, 117-145.
- 590 **Knocke, E.T. and Kolivras, K.N., 2007.** Flash flood awareness in southwest Virginia, *Risk*  
 591 *Anal.* 27, 155–169.
- 592 **Kortatsi B. K., 1994.** Groundwater utilization in Ghana. *Future Groundwater Resources at Risk*  
 593 (Proceedings of the Helsinki Conference). IAHS Publ. no. 222.
- 594 **Kreibich, H., Thielen, A.H., Petrow, T., Müller, M. and Merz, B., 2005.** Flood loss  
 595 reduction of private households due to building precautionary measures - lessons learned  
 596 from the Elbe flood in August 2002, *Nat. Hazards Earth Syst. Sci.* 5, 117–126.
- 597 **Kutir, C., Agblorti, S.K.M., and Benjamin B. Campion, B.B., 2022.** Migration and Estuarine  
 598 Land use/land cover (LULC) change along Ghana's coast. *Regional Studies in Marine*  
 599 *Science* 54, 102488.
- 600 **Leiserowitz, A., 2006.** Climate change risk perception and policy preferences: the role of affect,  
 601 imagery, and values. *Climatic Change*, 77, 45-72.
- 602 **Lindell, M.K. and Hwang, S.N., 2008.** Households' perceived personal risk and responses in a  
 603 multi-hazard environment. *Risk Analysis* 28(2), 539–556.
- 604 **Liddle, E.S., Mager, S.M., and Nel. E.L., 2015.** The suitability of shallow hand-dug wells for  
 605 safe water provision in sub-Saharan Africa: lessons from Ndola Zambia. *Appl. Geography*.  
 606 57, pp.80-90.
- 607 **Louarn, A., 2020.** Vulnerability of coastal socio-ecosystems in West Africa: design of a survey  
 608 to analyse the role(s) of communities in erosion, submersion, salinisation and pollution  
 609 processes, 2020. M2 internship thesis.
- 610 **Lutterodt, G., Miyittah, M.K., Addy, B., Ansa, E.D.O. and Takase, M., 2021.** Groundwater  
 611 pollution assessment in a coastal aquifer in Cape Coast, Ghana. *Heliyon* 7(4), e06751.  
 612 <https://doi.org/10.1016/j.heliyon.2021.e06751>.
- 613 **Miceli, R., Sotgiu, I. and Settanni, M., 2008.** Disaster preparedness and perception of flood risk:  
 614 a study in an alpine valley in Italy, *J. Environ. Psychol.* 28 (2), 164–173.
- 615 **Mölter, T., Schindler, D., Albrecht, A. and Kohnle, U., 2016.** Review on the projections of

- 616 future storminess over the North Atlantic European region. *Atmosphere*, 7(4),  
617 doi.org/10.3390/atmos7040060.
- 618 **Morand, J-A, 2021.** Statistical and geomatic analysis of perceptions of environmental change by  
619 coastal communities in Senegal. M1 internship thesis. University of Savoie Mont-Blanc,  
620 53p.
- 621 **Mutumukuru-Maravanyika, T., Mills, D.J., Asare, C., Asiedu, G.A., 2017.** Enhancing  
622 women's participation in decision-making in artisanal fisheries in the Anlo Beach fishing  
623 community, Ghana, *Water resources and rural development* 10, pp. 58-75.
- 624 **Neumann, B., Vafeidis, A.T., Zimmermann, J. and Nicholls, R.J., 2015.** Future coastal  
625 population growth and exposure to sea-level rise and coastal flooding - A global  
626 assessment. *PLOS ONE* 10(3): e0118571.
- 627 **Nicholls, R.J., Marinova, N., Lowe, J.A., Brown, S., Vellinga, P., de Gusmao, D., Hinkel, J.**  
628 **and Tol, R.S., 2011.** Sea-level rise and its possible impacts given a 'beyond 4°C world' in the  
629 twenty-first century. *Philos Trans A Math Phys Engineering and Science* 369, 161–181.
- 630 **O'Connor, R. E., Bord, R. J., and Fisher, A., 1999.** Risk perceptions, general environmental  
631 beliefs, and willingness to address climate change. *Risk Analysis*, 19, 461-471.
- 632 **Okyere, I., 2015.** Assessment of aquatic ecosystems, the fishery and socio-economics of a coastal  
633 area in the Shama District, Ghana (Doctoral dissertation, University of Cape Coast).
- 634 **Peacock, W.G., Brody, S.D. and Highfield, W., 2005.** Hurricane risk perceptions among  
635 Florida's single family homeowners. *Landscape Urban Plan.* 73, 120-135.
- 636 **Peters, E., and Slovic, P., 1996.** The role of affect and worldviews as orienting dispositions  
637 in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology*,  
638 26(16), 1427-1453.
- 639 **Ruz, M.-H., Rufin-Soler, C., Héquette, A., Révillon, R., Hellequin, A.-P., Deboudt, P.,**  
640 **Herbert, V., Cohen, O., Lebreton, F., Le Goff, L., Schmitt, F.G., Marin, D., 2020.** Climate  
641 change and risk perceptions in two French coastal communities. In: Malvárez, G. and  
642 Navas, F. (eds.), *Proceedings from the International Coastal Symposium (ICS) 2020*  
643 (Seville, Spain). *Journal of Coastal Research*, Special Issue No. 95, pp. 875-879.
- 644 **Savage, I. (1993).** Demographic influences on risk perceptions. *Risk Analysis*, 13(4), 313-420.
- 645 **Siegrist, M. and Gutscher, H., 2006.** Flooding risks: a comparison of lay people's perceptions  
646 and expert's assessments in Switzerland, *Risk Anal.* 26, 971–979.
- 647 **Slovic, P., 1987.** Perception of risk, *Sci. New Ser.* 236 (1987) 280–285.
- 648 **Slovic, P., Fischhoff, B. and Lichtenstein, S., 1984.** Behavioral decision theory perspectives on  
649 risk and safety, *Acta Psychol.* 56, 183–203.
- 650 **Spalding, M., Mcivor, A., Tonneijck, F., Tol, S., and Eijk, P. V., 2014.** Mangroves for coastal  
651 defence. Guidelines for coastal managers & policymakers. Published by Wetlands  
652 International and The Nature Conservancy. 42 p
- 653 **Steg, L. and Sievers, I., 2000.** Cultural theory and individual perceptions of environmental risks.  
654 *Environment and Behavior* 32, 250–269.
- 655 **Takao, K., Motoyoshi, K, T., Sato, T. and Fukuzono, T., 2004.** Factors determining residents'  
656 preparedness for floods in modern megalopolises: the case of the Tokai flood disaster in  
657 Japan, *J. Risk Res.* 7 (2004) 775–787.
- 658 **Wildavsky, A. and Dake, K., 1990.** Theories of risk perception: who fears what and why? *J.*

659 Am. Acad. Arts Sci. 119, 41–60.

660 **Wachinger, G., Renn, O., Begg, C. and Kuhlicke, C., 2013.** The risk perception paradox –  
661 implications for governance and communication of natural hazards, *Risk Anal.* 33, 1049–  
662 1065.

663 **Wisner, B., Blaikie, P., Cannon, T., and Davis, I., 2004.** At-risk. Natural hazards, people's  
664 vulnerability and disasters, Routledge, London, 471 pp.

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