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1 Governance and stakeholder perspectives of managed re-alignment: 2 Adapting to sea level rise in the Inner Forth estuary, Scotland

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11 **Abstract**

12 With climate change, coastal areas are faced with unprecedented sea level rise and flooding, raising questions as
13 to how societies will choose to adapt. One option is to strengthen existing sea walls to maintain current land uses;
14 however, scientists, policy-makers and conservationists increasingly see the benefits of managed realignment,
15 which is a nature-based coastal adaptation that involves the conversion of reclaimed farmland back to wetlands,
16 allowing periodic local flooding in designated areas to reduce the risk of flooding downstream. We interviewed
17 sixteen local organisations, landowners and farmers, and held workshops with 109 citizens living the Inner Forth
18 estuary in eastern Scotland, to examine how managed realignment is supported by stakeholder attitudes and their
19 engagement.

20 Most of the farmers we interviewed prefer strengthened sea walls, to maintain their livelihoods and agricultural
21 heritage. Citizens and local organisations were mainly supportive of managed realignment, because it provided
22 wildlife and flood regulation benefits. However, we identified several barriers that could present obstacles to
23 implementing managed realignment, for example, uncertainty whether it would support their principles of
24 economic and rational decision-making. Our findings suggest that the local capacity to cope with rising sea levels
25 is limited by lack of engagement with all relevant stakeholder groups, the limited scope of existing stakeholder
26 partnerships, and poor short-term funding prospects of landscape partnerships that would facilitate collaboration
27 and discussion. We suggest that including citizens, landowners, farmers and industries would strengthen existing
28 stakeholder deliberation and collaboration, and support the Inner Forth's transition towards a more sustainable
29 future shoreline.

30 1. Introduction

31 People have an innate preference to live close to the sea, and the majority of the world's population lives in low-
32 lying areas in coastal settlements that depend on the sea for trade and livelihoods (Small and Nicholls 2003). For
33 centuries, humans have actively transformed coastlines and estuaries by enclosing tidal land for settlements and
34 agricultural purposes (Doody 2004, Agardy and Alder 2005). In modern times, construction of industrial ports
35 and the extension of urban areas into the sea have continued this process (Rogers et al. 1998, McGranahan et al.
36 2007). These land claims have led to a significant loss of wetlands, such as salt marshes and mudflats (Mitsch and
37 Gosselin 2007), affecting marine biodiversity and important ecosystem functions that characterize these intertidal
38 habitats, such as carbon sequestration (Chmura et al. 2003), sediment trapping and retention (Adam 2002), and
39 protection from waves during storms (Möller et al. 2014).

40 In addition to these longstanding land use changes, anthropogenic climate change is an emerging threat to
41 estuarine ecosystems, most notably due to coastal squeeze (Scavia et al. 2002, Roebeling et al. 2013). Coastal
42 squeeze is a common phenomena due to sea level rise in areas with developed shorelines, where infrastructure,
43 such as sea walls, stop the intertidal zone from its natural process of moving landwards (Doody, 2004). Combined
44 with population growth and urban expansion in coastal cities, pressures exerted on estuarine ecosystems are
45 increasing (McGranahan et al. 2007). As a result, people are increasingly exposed to coastal flooding (Small and
46 Nicholls 2003). This is a global trend, and is particularly pressing in Scotland, where more than 95% of the
47 population live within 50 km of the coast (European Commission 2013) and where coastal flooding and erosion
48 are concerns that require immediate action (UK Committee on Climate Change 2016). Flood damages are
49 expected to cost £200-250 million in Scotland annually in 2016-2021 (ClimateXChange 2016; Pirie 2017), which
50 is 7-8 % of Scotland's education budget in 2016 (Scottish Government 2016a). Coastal flooding is estimated to
51 contribute 21% of the monetary cost of flood damages.

52 There are two main climate change adaptation options for coastal flooding: static and nature-based. The first,
53 more traditional engineering option is the static approach to shoreline defences, where constructed barriers, such
54 as sea walls and piers, protect urban, industrial or otherwise human-used areas from flooding (Zhu et al. 2010).
55 The second option is to restore the wetlands that characterize many estuarine areas for nature-based coastal
56 adaptation (King and Lester 1995). Wetland protection and restoration can play an essential role in decreasing the
57 risk for coastal flooding in those areas that are most vulnerable to sea level rise (Spalding et al. 2014). The
58 deliberate moving inland of coastal defences such as levees to give more space to the sea, an approach known as
59 managed realignment, has been suggested to be the only viable option in the long term for some coastal areas
60 (Morris 2013). Moving vulnerable settlements and infrastructure from harm's way would improve coastal
61 adaptation in the long-term (Esteves 2014) and create habitat benefiting a variety of species (Colclough et al.
62 2005).

63 The planning and implementation of coastal adaptation can be hindered by a multitude of factors related to
64 governance, policy goals, and people's perceptions (Ledoux et al. 2005, Morris 2013), as well as economics
65 (Turner et al. 2007), hydrology, and ecology (Spencer and Harvey 2012, Doody 2013). Many of these factors can

66 prevent the implementation of managed realignment schemes, although examples of successful managed
67 realignment pilot projects exist in the UK (Midgley and McGlashan 2004). Moreover, managed realignment is
68 increasingly used for coastal habitat compensation in the UK, although it is unclear whether this actually leads to
69 net benefits for biodiversity (Brady and Boda 2017).

70 Studies by Ledoux et al. (2005), and Wiering and Arts (2006) reveal that the public perceives managed
71 realignment as admitting defeat against the sea and a threat for productive land, particularly in times of climate
72 change and sea level rise when agricultural land is already becoming increasingly scarce. If avoiding admitting
73 defeat against the sea is a strong cultural norm, defined as “typical or expected standard or behaviour” (Oxford
74 Dictionary 2017a), we argue that it represents a powerful informal institution (Hansen et al. 2014) that influences
75 coastal adaptation efforts and the discussion with various stakeholder groups. This requires an understanding of
76 formal and informal institutions, understood as the structures or mechanisms that influence our behavior in
77 society, or in other words “the rules of the game” (North 1990). According to Williamson (2000), formal
78 institutions are for instance governance structures, policies and laws set by authorities at the national or regional
79 level. By contrast, informal institutions are for example traditions, values, customs or practice “in the political or
80 social life of a people” (Oxford Dictionary 2017b). Recognising these informal elements of governance, including
81 norms, can shed light on why there is reluctance amongst local communities to retreat sea defenses landward,
82 which may in turn impede the implementation of managed realignment (Ambros 2016; Foster et al. 2013; Luisetti
83 et al. 2011).

84 Managed realignment is currently under increasing local interest and debate in the case of the estuarine area in
85 the Inner Firth of Forth (hereafter referred to as the Inner Forth), Scotland (Fig. 1 in Liski et al. 2019, this issue).
86 Over 50 percent of the former wetlands in the intertidal area in the Inner Forth has been reclaimed (via land
87 draining and building sea walls) in the last 400 years for farming and industrial uses (SNH 2011). Most of the
88 areas that were claimed from the sea were wetlands that are now owned and used by individual farmers and the
89 local authorities. Due to its low elevation, closeness to the sea, climate change and sea level rise, these lands are
90 increasingly vulnerable to coastal flooding. Yet, given coastal development, there is less space to absorb excess
91 water and the damage to property and built infrastructure elsewhere is higher. Locally observed trends in sea level
92 rise in recent decades are already in line with the high emissions scenario (Rennie and Hansom 2011) that projects
93 sea level rise for the Inner Forth region of about 30 to 54 cm by 2080 (central to high-end estimates, Lowe et al.
94 2009), requiring the Inner Forth, like many other coastal communities, to choose its adaptation pathway: will they
95 continue to rely on the current sea walls or give space back to the sea?

96 *1.1. The governance context*

97 A variety of different actors, representing civil society, the government and industry interest groups, are key in
98 the governance in the Inner Forth area and coastal management. At the local level, a prominent example is the
99 Inner Forth Landscape Initiative, a partnership that brings together many organisations to encourage both
100 ecological and economic regeneration of the area (Inner Forth Landscape Initiative 2017). It involves four local
101 authorities (Falkirk, Stirling, Clackmannanshire and Fife), the Central Scotland Green Network Trust, the Scottish

102 Environmental Protection Agency (SEPA), Scottish Natural Heritage (SNH), Historic Scotland and Sustrans, and
103 strongly emphasizes the involvement of stakeholders and local people (Kenter 2014).

104 Nationally in Scotland, the two government agencies, SEPA and SNH, are responsible for flood protection and
105 nature conservation respectively, and providing legal advice to existing or new legislation. In addition, both
106 organizations also have an advisory role to other public stakeholders, such as local authorities. The local
107 authorities are in turn obliged to comply with national legislation and European Union directives, for example the
108 Flood Risk Management (Scotland) Act (2009), Climate Change (Scotland) Act (2009) and the EU Water
109 Framework Directive (2000/60/EC). The implementation of these legislations should, in principle, be reflected in
110 the local authorities' management plans. However, due to the differences in geography, development, interests
111 and political leadership, the local authorities comply with legislation in separate ways.

112 The statutory process of coastal adaptation has been set by The Flood Risk Management (Scotland) Act 2009.
113 The act includes several measures for flood risk management in Scotland, for instance, the preparation of local
114 flood risk management plans to fulfil the requirements on a local level (Scottish Government 2016b). The plans
115 for the Inner Forth were recently published as part of a plan for the entire Forth Estuary (City of Edinburgh Council
116 2016). The plan does not include managed realignment or other nature-based approaches to flood management in
117 the Inner Forth, despite numerous sites being recognized as potentially vulnerable to coastal flooding, and the
118 presence of several sites that would be suitable for managed realignment. However, the document does indicate
119 plans to assess opportunities for natural flood management measures in the future.

120 Many other national policies also directly impact coastal management. In Scotland, landowners have the primary
121 responsibility to protect their land and property, and there are no incentives for land use or management that would
122 improve flood safety in vulnerable areas (Scottish Government 2014). The current coastal management strategy
123 is almost solely based on static flood defences in the form of sea walls that were introduced between 400 - 40
124 years ago as wetlands were drained and converted for agricultural and industrial uses (Smout and Stewart 2012).
125 For privately owned land, such as agricultural land adjacent to the sea, the responsibility for flood protection lies
126 with the landowners, mainly via maintaining existing sea walls. Under the Coast Protection (UK) Act (1949),
127 landowners have been given the right and duty to maintain these sea walls and keep a static defence towards the
128 sea.

129 On the European level, the existing institutional arrangements, such as rights and responsibilities of different
130 institutions involved in marine and coastal management are often complex and unclear (Boyes and Elliot 2014;
131 2015). How the UK's decision to leave the EU will affect policies that have been designed at the EU level is an
132 important yet open question for coastal management. For example, it is not yet clear whether and how policies
133 are transposed to a national level, and whether the downscaling of policies will convolute responsibilities in
134 coastal planning and policy.

135

136 *1.2. Aims and objectives*

137 In this paper we investigate how current governance arrangements are aligned to support societal responses to the
138 increased risk of coastal flooding in the Inner Forth. The following three research questions guide the research on
139 how citizens' and other stakeholders' attitudes, and current stakeholder engagement, support coastal adaptation
140 to climate change in the Inner Forth.

141 RQ1 How do local stakeholders perceive the two alternative coastal adaptation options (reliance on the
142 existing sea walls and nature-based coastal adaptation)?

143 RQ2 Which institutions govern the Inner Forth shoreline from a citizen perspective?

144 RQ3 How does existing stakeholder engagement support climate change adaptation on the Inner Forth
145 shoreline?

146 **2. Methods**

147 To collect data to address the above three research questions, we employed a suite of methods, presented as four
148 steps in Table 1. Step 1 involved 'stakeholder mapping' through 16 semi-structured interviews with local
149 landowners, farmers and locally active organisations (two conservation charities, a private agricultural estate and
150 two government agencies) who are involved in coastal adaptation in the Inner Forth. Semi-structured interviews
151 (Babbie 2013) of approximately 60 min were conducted with relevant stakeholders (Step 2, Table 1) in February-
152 March 2016 and October 2016. Furthermore, we recruited and engaged with a total of 109 citizens living in the
153 Inner Forth through five workshops (steps 3 and 4, see Table 1).

154 << insert Table 1 >>

155 We interviewed sixteen stakeholders representing seven different organisational types and roles, including: i)
156 seven farmers, owning land potentially subjected to managed realignment, ii) representatives from three (out of
157 four) local authorities, iii) two government agencies (Scottish Environment Protection Agency and Scottish
158 Natural Heritage), iv) an estuary partnership organisation (Forth Estuary Forum), v) the locally active
159 conservation charity Royal Society for the Protection of Birds (RSPB), vi) the Scottish Wildlife Trust, and vii)
160 one private agricultural estate. Although we identified sixteen farmers as potential stakeholders, nine farmers
161 could not or did not want to be interviewed. The fourth local authority, Stirling, was not interviewed because they
162 do not own or manage any coastal land holdings.

163 We organised five workshops with a total of 109 citizens in October 2015 - February 2016 in Alloa, a town on
164 the shore of the Inner Forth. Participant recruitment and workshop programme are summarised in Steps 3 and 4

165 in Table 1. The full details of citizen engagement are described by a parallel paper Liski et al. (2019; this issue),
166 which examines how deliberation shapes citizens' attitudes towards managed realignment. This paper compares
167 and contrasts the attitudes of citizens with the perceptions of other stakeholders to achieve a more rounded view
168 of local-scale adaptation dilemmas in the Inner Forth. In total, we have collected data from twenty break-out
169 groups (four groups in each workshop) to analyse the main points that were raised during the discussions.

170 Both the stakeholder interviews and the citizen workshop discussions were recorded and transcribed. The process
171 of content analysis differed for each research question, as described next.

172 *2.1. How do stakeholders perceive the two alternative coastal adaptation options?*
173 *(RQ1)*

174 From the interview transcripts, comments relating to either static defences (seawall) or nature-based coastal
175 adaptation were identified and assigned to one of the two coastal management approaches. We also identified all
176 motivations for their positions on static and nature-based coastal adaptation, to identify common reasons or norms
177 supporting or hindering coastal adaptation. Quotations are included to illustrate findings, but these are not
178 attributed to stakeholders to avoid revealing their identities.

179 For the citizen workshops, content analysis of transcripts was carried out for the first part of the discussion (Step
180 3 in Table 1). We identified comments about either the potential sites for managed realignment, or participants'
181 motivations for supporting or opposing wetland restoration. If appropriate, these were coded according to the
182 extent of support for nature-based coastal adaptation.

183 *2.2. Which institutions govern the Inner Forth shoreline from a citizen perspective?*
184 *(RQ2)*

185 To understand citizen's perceptions of shoreline governance, content analysis was carried out for transcripts from
186 the second discussion-based exercise (Step 4, Table 1): we identified and coded institutions that participants
187 perceived to govern the shoreline areas, and counted the frequency of mentions from the mindmaps. The
188 discussion in most groups, however, broadened in scope to cover issues beyond immediate shoreline areas. To
189 maintain focus on coastal adaptation, we excluded institutions that only relate to issues beyond the shoreline.

190 *2.3. How does stakeholder engagement support shoreline adaptation in the Inner*
191 *Forth? (RQ3)*

192 For stakeholder interviews, mentions of collaborations and interactions with other stakeholders regarding coastal
193 management were identified to understand how stakeholder engagement currently supports coastal adaptation.
194 These were coded according to spatial scale of governance. We also identified and coded any mentions of factors
195 that limit the extent to which these collaborations drive adaptation.

196 For citizen workshops, we identified examples of how citizens felt they were informed and included in local
197 planning and policy. Here too, quotations are included to illustrate findings, but these are not attributed to
198 individuals to avoid revealing their identities.

199 3. Results

200 3.1. How do stakeholders perceive static and nature-based coastal adaptation?

201 Based on their land ownership and existing property rights and responsibilities, the private landowners, farmers and
202 the private estate had the highest stake in decisions regarding shoreline management, whereas the RSPB and the
203 estuary partnership had the lowest stake (Fig. 1). The RSPB and Clackmannanshire residents were the most
204 supportive of nature-based coastal adaptation, whereas the private landowners, farmers and the private agricultural
205 estate were the only stakeholder groups that did not support nature-based coastal adaptation (Fig. 1). The
206 stakeholder motivations and stakes in shoreline management are described in more detail below.

207 << Insert Fig. 1 here >>

208 3.1.1. Farmers and locally active organisations (RQ1)

209 The seven farmers we interviewed (Fig. 2a), who manage most of the land suitable for creating nature-based
210 coastal adaptation, prefer static defences, whereas the private estate (largest landowner in the area) is supportive
211 of nature-based coastal adaptation. Farmers attributed their reluctance to managed realignment to three main
212 reasons: the effects on their land and resulting economic losses, the desire to maintain their agricultural heritage,
213 and their awareness of unsuccessful nature-based flood risk management schemes in the area.

214 << Insert Figs. 2a-2b here >>

215 Sustaining livelihoods was the main reason why the farmers preferred static defences, as managed realignment
216 would result in the loss of land area where they could grow crops, and consequently loss of crop yields.
217 Agriculture generated 25-100% of the income (67% average) for the seven farmers we interviewed. For the
218 private estate, the “main aim is trying to preserve income from the land: if it is under water, it would probably
219 not be very much land”. This motivation was also linked to family heritage, for example, one of the farmers
220 mentioned how it was important to “make a living and leave something for the boys to carry on with, I have
221 two sons”. Another farmer we interviewed was motivated to farm “to progress so the next generation can carry
222 on”. Concerns over past experiences, for example in the Skinflats nature-based flood management scheme,
223 where an engineering fault resulted in erosional impacts on adjacent farmland, were also reflected in their
224 reactions to managed realignment: “No, don’t think it would do any good for anybody, we have seen how bad
225 it can get”.

226 Representatives from the three local authorities (Clackmannanshire, Falkirk, and Fife), government agencies
227 (SNH and SEPA) and the RSPB are mainly supportive of managed realignment (Fig. 1). Although none of the
228 three local authorities we interviewed were opposed to managed realignment, they all prescribe a static shoreline
229 defence approach in their coastal management plans. Furthermore, two local authority representatives noted
230 concerns about the trade-offs arising from managed realignment as a nature-based coastal adaptation and had
231 rejected proposals in the past, whereas the third local authority was not implementing any managed realignment
232 schemes in the Inner Forth area. The government agencies were supportive of managed realignment: the first
233 representative, however, noted that their support depended on careful planning, alignment with other coastal
234 development goals and flood protection, whereas the second representative appreciated its potential for nature
235 conservation.

236 The locally active organisations we interviewed describe three types of norms that contradict managed
237 realignment in the Inner Forth. These norms relate to decision-making, their relationships with the private
238 landowners, and preferences for land management approaches (Table 2). The first type of norm relates to their
239 principles of evidence-based and economically rational decision-making, which are demanded by the broader
240 economic and political systems in order to justify decisions. These norms were exemplified by concerns over the
241 maintenance costs of nature-based coastal adaptation, and a notion that other social priorities (e.g. need for
242 housing) are more important. The second type of norm, as described by one local authority representative, related
243 to concerns that creating nature-based coastal adaptation would compromise their relations with the local farmers.
244 The third type of norm was directly linked to attitudes towards nature-based land management, some of which
245 were justified by the erosional issues in the Skinflats scheme mentioned earlier.

246 << Insert Table 2 here >>

247 3.1.2. *Deliberative citizen workshops (RQ1)*

248 At the citizen workshops (Fig. 2b), we formed twenty groups of 3-7 people for discussion. The workshops revealed
249 that their knowledge of the shoreline areas was limited, and most were unfamiliar with a majority of the sites
250 where managed realignment is proposed. Only two out of the twenty groups explicitly mentioned the agricultural
251 production currently occurring on potential sites for managed realignment. Some participants responded to the
252 information provided in the workshops by noting that the Inner Forth might flood more frequently in the future,
253 but only two out of 109 participants indicated that they had been aware of the flood risks before the workshops.

254 Despite the limited knowledge of the local shoreline, citizens in the workshops discussed several reasons why
255 they support wetland restoration (Fig. 1). They noted how keeping “more nature in the area, [so] it would help
256 with many of these other things. When it rains, there is somewhere for it [the water] to go”. Many participants
257 said that they “didn’t know wetlands slow down flood water, or that it would remove pollutants, that is quite
258 surprising to me, but blatantly obvious”, and that their appreciation for wetlands had increased during the
259 workshop as they gained more knowledge:

260 *The wetlands, from what I have learned, are the most important feature on the banks of the river, and*
261 *they should be increased, or at least, maintained, as well as possible. Just to broaden up the benefits of*
262 *them, and the effects that not having them, or having less of them, could have on the community.*

263 It was also recognised how nature brings emotional and physical wellbeing, such as the “sounds and the smells,
264 [which] are all important, for providing the natural experience. When you are standing by the water, the smell of
265 the flora, it is part of the experience of being part of these areas”. One participant described the importance of
266 spending time outdoors for her wellbeing:

267 *I love walking by myself, you and your thoughts, it clears your mind. If I have got a lot on my mind, I'll*
268 *just put my jacket on, and go for a long walk. Every time I come home, I'm so chilled, my mind is empty.*
269 *It makes you feel good.*

270 Managed realignment schemes were also perceived as intentional human interventions, which raised concerns,
271 for example, one participant felt that it would be better to “... leave it alone, there is nothing wrong with [the
272 potential sites for managed realignment]”. One participant noted that the “instinct is to think that where it is good
273 for nature and wildlife, it is basically stuff that has been left on its own for a while, and then [where there are]
274 people, there is always going to be a conflict” and that it was “important to have places . . . where we can't actually
275 go”.

276 One of the groups that was aware of the farmland and flood risk also foresaw it to be difficult for the local
277 landowners to accept managed realignment, saying: “I cannot see the farmers giving up their ground, to be quite
278 truthful”; and noted the potential need for financial compensation: “I suppose there are ways of easing the pain
279 for these things, like government subsidies”. One of the groups who was concerned about coastal flooding
280 discussed the responsibilities of the landowners to use their land with the effect on the broader community in
281 mind, stating:

282 *[The landowners] need to realise, although they own it, on a piece of paper that says it is theirs, if it is*
283 *going to have an effect on everybody, the whole community, and potentially the wildlife, they need to kind*
284 *of realise that their ownership is not there.*

285

286 3.2. *Which institutions govern the Inner Forth shoreline from a citizen perspective?*
287 *(RQ2)*

288 During the group discussions in the citizen workshops, participants identified the following institutions as directly
289 or indirectly involved in the governance of the Inner Forth shoreline areas: industries; government; schools and
290 education; citizens; and social media and technology (Fig. 3). Industries (21 times) and government (20 times)
291 were listed most frequently as drivers of change on the Inner Forth shoreline. Fracking, driven by industries and
292 potentially supported by the government, was discussed in all twenty groups, in terms of its impacts on the
293 shoreline and how the industry was looking to increase local support, by offering financial compensation and
294 organising events (Fig. 3). Illustrative quotes of citizens' knowledge and views regarding the shoreline
295 governance are included in Fig. 3.

296 << Insert Fig. 3 here >>

297 Social media, education and government were all seen to play a role in raising public awareness of the shoreline,
298 which was highlighted as an important way of “increasing environmental awareness and attitudes . . . [and] train
299 up the next generation to follow on what’s been done at the moment . . . because a lot of people don’t have an
300 idea why wetlands are wetlands”. It was also noted how Inner Forth residents are increasingly interested in local
301 planning and policy, particularly young people, because more information is available to them. One group stated
302 how important it was to:

303 *Try to reconnect people with the natural. Because if there is nobody connected to it, then there is no way*
304 *to care and put in the work, when the physical work needs done, who is going to sign up for it.*

305 3.3. *How does stakeholder engagement support shoreline adaptation in the Inner Forth*
306 *(RQ3)?*

307 Our interviews suggest that stakeholders in the Inner Forth discuss and collaborate on coastal management on
308 both local and regional levels. At a local level, stakeholders collaborate through the charity-led Inner Forth
309 Landscape Initiative, whereas at the regional level, they collaborate through the government agency-led Forth
310 Area Advisory Group, and the Forth Estuary Forum.

311 Although these institutions succeed in bringing stakeholders together, we identified three ways in which these
312 institutions (on both local and regional levels) are limited in their capacity to support coastal adaptation: financial
313 resources, types of stakeholders involved, and scope.

314 At the local level, financial resources are a limiting factor in stakeholder collaborations to support coastal
315 adaptation. The Inner Forth Landscape Initiative works with short-term funding (2014-2018) from the Heritage
316 Lottery. Furthermore, the scope of the landscape initiative is a limiting factor, as it works towards broader social

317 and environmental goals, rather than the explicitly addressing coastal adaptation. Up to now, no organisation
318 focuses on coastal adaptation and only the RSPB has taken up the managed realignment as a central objective in
319 their habitat restoration agenda.

320 At both local and regional levels, the types of stakeholders involved is a limiting factor: the farmers we
321 interviewed said they were neither involved in collaborations or discussions on coastal adaptation, nor do they
322 feel included in decision-making. Half of the farmers we interviewed expressed interest in being included in
323 decision-making, and felt that “there should be, at least the local farmers and landowners, but [also] people who
324 just stay in the country, should all be involved in deciding in what’s going to happen”. Some farmers, however,
325 were reluctant to take part and did not trust local policy-makers, as expressed by one of the farmers: “they would
326 listen to you and that is how far they would go. My husband [a farmer] has a pretty poor opinion on how
327 bureaucracy works”.

328 For citizens, many workshop participants stated that they currently feel overlooked and uninformed by local
329 authorities with regards to coastal management and climate change adaptation plans. Many participants realized
330 “it is hugely important to actually ask people in the area what they think of all of this”, and that “when it comes
331 to meetings like this, we are overlooked”, and that “we could improve awareness by getting you guys to do this
332 every week”.

333 **4. Discussion**

334 *4.1. Static defences or nature-based coastal adaptation?*

335 Overall, citizens and locally active organisations who do not privately manage land were positive or open to
336 managed realignment in the Inner Forth, whereas the farmers were mostly critical. There is a body of literature
337 that compare and contrast stakeholders’ attitudes towards coastal adaption (Luisetti et al. 2011; Roca and Villares
338 2012; Myatt et al. 2003). Yet, these papers predominantly use quantitative and monetary valuation to show citizens
339 to be in favour of nature-based coastal adaptation for reasons of economic rationality. Our qualitative approach
340 brings to light other dimensions and motivations, thereby supporting the findings of Martín-López et al. (2014)
341 who suggest using diverse methods to articulate different value domains, which include but are not limited to
342 biophysical, socio-cultural, monetary valuation. Based on the interviews with landowners, farmers and local
343 organisations (3.1.1), and the workshops with citizens (3.1.2), we are able to articulate how static defences and
344 nature-based coastal adaptation differ across three governance scales: individual, local community, and broader
345 society.

346 On an individual level, static shoreline defences represent benefits by maintaining the reclaimed land for farming.
347 This additional farmland provides livelihoods for several farmers in the Inner Forth area, and it represents
348 agricultural land, associated with food provision, cultural values and traditions that are translated into a norm or
349 preference to not return land back to the sea. However, these individual benefits carry a societal cost in the form

350 of flood risks and associated damages without a natural coastal margin as a buffer. In addition, current legislation
351 mandates that landowners are responsible to protect land from flooding, which directly translates into the
352 continuous upkeep and maintenance of existing sea walls for farmers.

353 On a community level, managed realignment has potentially more benefits, because it can support restoration of
354 up to 387 ha of wetlands (MacDonald et al. 2017) that could deliver multiple benefits, e.g. a decrease in flood risk
355 and an increase in wildlife habitat (Myatt et al. 2003; Jones and Clark 2014; Roca and Villares 2012; Myatt-Bell
356 et al. 2002; Ledoux et al. 2005). Therefore, managed realignment can enable more outdoor activities in nature,
357 which residents described to contribute to their wellbeing. Discussions with the citizens, however, revealed that
358 their support for managed realignment schemes was mainly based on their nature-regarding, or biocentric values
359 (Davidson 2015; Morelli 2016; Weesie and van Andel 2008), rather than the cultural and regulating ecosystem
360 services. For instance, people often rejected the idea to make the newly created wetlands accessible through paths,
361 but preferred if these were to remain off-limits. This finding contradicts the common belief that motivations for
362 wildlife restoration schemes cannot be solely based on biocentric arguments (Clewell and Aronson 2005; Aronson
363 et al. 2006), and the trend for restoration to be mainly motivated by expected recreational possibilities (Adadottir
364 et al. 2013).

365 On a broader societal level, the main argument for static defences is flood protection, and in the case of reclaimed
366 lands, the additional agricultural land that can be used. MacDonald et al. (2017) calculate that if all potential sites
367 in the Inner Forth were realigned and converted back to wetlands, the annual income lost from all agricultural
368 land to be worth just £33,732 (excluding subsidies). The potential economic value of nature-based flood
369 management in the Inner Forth, in terms of increasing carbon storage (£316 700 per year, MacDonald et al. 2017),
370 wetland bird populations (£111 247, Kenter 2014), and water purifying ecosystem services (£489 234, Kenter
371 2014), provide greater benefits to society overall, than limited financial gains to farmers, which are subsidized by
372 society who bears the cost of potential flooding.

373 *4.2. Shifting governance in the context sea level rise*

374 A transition to inclusive, deliberative and adaptive governance in estuarine and coastal areas is important in order
375 to adapt to climate change impacts, minimize the risks of severe flooding events and the resulting property damage
376 and risk to human lives, and enhance biodiversity benefits (Turner et al. 2016). One of the main challenges is to
377 change the incentive structure that typically accrued benefits from land use changes such as wetland conversion
378 to individuals, while the costs are borne by society at large. The example from the Inner Forth underlines this
379 dilemma and the trade-offs involved. Furthermore, the private benefits of wetland conversion are often
380 exaggerated by subsidies such as those that encourage the drainage of wetlands for agriculture or the large-scale
381 replacement of coastal wetlands by infrastructure, such as urban and industrial development (MEA 2005).

382 Coastal adaptation to climate change is supported by institutions (e.g. the Inner Forth Landscape Partnership) that
383 facilitate collaboration between local stakeholders. However, they are limited in their capacity to deal with coastal
384 adaptation in terms of scope, finances and stakeholders involved. These deliberative institutions could address the

385 existing norms, which currently hinder more sustainable coastal adaptation efforts in the Inner Forth (Anguelovski
386 and Carmin 2011).

387 Based on our findings and the literature, we propose three principles for stronger inclusion of important
388 stakeholder groups that should be considered in such institutions in the Inner Forth.

389 i. Include farmers, because they own most of the land where managed realignment could take place (3.1.1),
390 hold identities that contradict giving in to the sea (3.1.1), and are currently not included in coastal planning
391 (3.3).

392 ii. Include citizens (Few et al. 2007; Anguelovski and Carmin 2011; Dodman and Mitlin 2011; Wamsler and
393 Brink 2014) and particularly vulnerable groups (Lesnikowski et al. 2015), because many of them hold strong
394 intrinsic and biocentric values for wildlife conservation (3.1.2) and currently do not feel sufficiently included
395 in planning and decision-making (3.3).

396 iii. Involve industries (Aylett et al. 2010; Abel et al. 2011) that citizens identified to play a role in the governance
397 of the Inner Forth shoreline (3.2). Including industry actors would potentially reduce the friction between
398 interests (Granderson 2014) as well as legitimizing the process towards a sustainable coastal development.

399 These principles imply the need for an inclusive and participatory and deliberative planning approach, which has
400 proved successful in planning stage of partnerships to restore rivers and deliver Water Framework Directive goals
401 (Tippett 2005; Petts 2007; Koontz 2014) and in developing climate change adaptation plans in a range of contexts
402 e.g. urban planning in Australia (Akompab et al. 2013), Sweden and Germany (Wamsler 2017) and wetland
403 planning in the UK (Turner et al. 2016).

404 *4.3. Conclusion*

405 The Inner Forth is a place where the complex challenges of adaptation to climate change, the governance of
406 estuarine and coastal ecosystems, and the socio-economic barriers to change all combine to reveal the underlying
407 contradictions of the current political economy. Yet, the main industrial activity in the Inner Forth is associated
408 with one of Europe's largest oil refineries. In some way, the image of the oil refinery with its smokestacks amidst
409 the restored wetlands is a symbol of the contradictory logic that continues to mark many societies. On the positive
410 side for climate mitigation, the Longannet coal-fired power plant, the single largest contributor to Scotland's
411 greenhouse gas emissions, was recently shut down (Macalister 2016). Although this was not a direct outcome of
412 ambitions to transition towards a more sustainable Firth of Forth, it nevertheless represents an opportunity towards
413 a more natural state of the coastline for biodiversity habitat, flood protection and reconnecting local communities
414 with the Forth estuary.

415 Rising tides mean local stakeholders need to work together more closely on shorelines, like the Inner Forth in
416 Scotland. In some low-lying areas, shorelines may need to be intentionally realigned landwards to reduce flood

417 risk, however, existing governance arrangements may not support such changes. This paper has shown how
418 citizens appreciate the socio-cultural and wildlife benefits provided by nature-based coastal adaptation, but that
419 this change implies trade-offs for landowners' livelihoods and agricultural heritage, who perceive nature-based
420 coastal adaptation negatively. Existing institutions for collaboration and deliberation – such as landscape
421 partnerships and advisory groups – need to be strengthened in terms of funding, stakeholder involvement and
422 scope, to support knowledge sharing on the local impacts of sea level rise and legitimize decision-making. These
423 improvements in governance would also help to overcome existing norms amongst farmers and locally active
424 organisations, which currently work against nature-based coastal adaptation.

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432 **Compliance with Ethical Standards**

433 Conflict of Interest: The authors declare that they have no conflict of interest.

434 We obtained informed consent from all research participants, and adequately handled their confidentiality, in line
435 with the School of Geosciences (University of Edinburgh) Research Ethics Procedure. For the citizen workshops,
436 the research plan was reviewed and approved by the School of Geosciences Ethics Committee and permission
437 was obtained for photography and filming. Prior to the stakeholder interviews, participants provided consent to
438 how the data would be used.

439 **List of figure captions**

440 **Fig. 1** Stakeholder attitudes towards and stakes in managed realignment, drawn from the content analysis of the
441 sixteen interviews conducted, and the citizen workshops in Alloa Town Hall. Whereas the position along the
442 vertical axis reflects the direction and strength of the attitude, position along the horizontal axis reflects
443 responsibility and/or vulnerability to flood risk in relative terms

444 **Figs. 2a and 2b** We interviewed seven farmers and eleven other stakeholders (2a) across the Inner Forth area,
445 and held workshops with 109 citizens in the Alloa Town Hall (2b). Photography permissions granted by
446 participants

447 **Fig. 3** Institutions with an impact on the Inner Forth shoreline, as identified by the workshop participants. The
448 frequency of mentions corresponds to the number of times each institution was to listed as a driver of change on
449 the mind maps in the twenty breakout groups. The shade of blue indicates how many institutions are involved in
450 driving the impact (dark = 1, medium = 2, light = 3). The relative importance of each institution is indicated by
451 the the height of each institution, and the thickness of the line on the left

452 **List of table captions**

453 **Table 1** Overview of the methodology for the stakeholder interviews and citizen workshops in the Inner Forth,
454 Scotland. The corresponding research questions for each activity are indicated in brackets (RQ)

455 **Table 2** Three main sets of norms identified from interviews with seven locally active organisations that influence
456 their position towards nature-based shoreline adaptation schemes in the Inner Forth, and examples emerging from
457 the interviews

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