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3 Bringing social and cultural considerations into environmental management for vulnerable coastal
4 communities: responses to environmental change in Xuan Thuy National Park, Nam Dinh Province, Vietnam

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13

14 Abstract:

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16 This paper elaborates the importance of considering social and cultural factors within management
17 responses to environmental change in coastal areas. The case study taken is Xuan Thuy National Park in Nam
18 Dinh Province, Vietnam. This is a marginalised coastal area where rising sea levels, increasing storm surges
19 and saltwater intrusion place pressure on coastal ecosystems, yet where communities continue to rely on
20 these same ecosystems for agriculture- and aquaculture-related livelihoods. We interview stakeholders in
21 Xuan Thuy National Park, connecting these with a narrative review of existing research into social and
22 environmental change in the park to understand research gaps and challenges for vulnerable coastal areas
23 like the Nam Dinh coast. Based on our findings, we suggest that whilst the effects of a changing environment
24 on physical health and economic activity are increasingly well understood, effects on wellbeing and social
25 relations can be even more immediate and profound in daily living. In turn, we argue environmental
26 management has a crucial role to play not only for ecosystem-based adaptation, but also in sustaining
27 wellbeing and allowing culturally meaningful practices to continue – especially in coastal regions where
28 changes can be even more intense and immediate. However, we caution that whilst techno-scientific
29 solutions grounded in environmental management do have significant potential in reducing impacts of
30 extreme events and slower-onset environmental changes, they must not divert attention away from
31 structural issues that can make some people or areas more vulnerable in the first instance.

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33 Keywords: climate change adaptation; ecosystem-based adaptation; vulnerability assessment; wellbeing;
34 Xuan Thuy National Park.

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37 Research highlights:

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- 39 • Xuan Thuy National Park is a vulnerable coastal area affected by environmental change;
- 40 • Ecosystem health crucial to both climate adaptation and livelihood continuation;
- 41 • Environmental change affects wellbeing and social relations as well as health and income;
- 42 • Coastal management for climate adaptation requires significant technical competence;
- 43 • Findings show need for social policy and structural responses alongside techno-scientific.

44

1 1. Introduction

2

3 1.1. Overview

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5 This paper considers how the social and cultural implications of environmental change may connect with
6 techno-scientific responses to climate change adaptation and environmental protection, through the case of
7 Xuan Thuy National Park in Vietnam. Human development relies on services such as water circulation, climate
8 regulation and disease control provided by nature (Millennium Ecosystem Assessment, 2005). If these
9 services are damaged or managed incorrectly, there can be consequences for development and wellbeing
10 (Su et al, 2010). The ‘health’ of an ecosystem – which Costanza (1992) defines as the ability of an ecosystem
11 to sustain itself as a result of its productivity, structure and diversity, and resilience to outside stresses – is
12 one way to understand the ability of an ecosystem to support people. Such ecosystem health takes on
13 additional significance in low-to-middle income country (LMIC) contexts, where direct reliance on ecosystems
14 for sustenance or livelihood may be greater (Roberts et al, 2012). Moreover, the role of ecosystems in
15 reducing impacts of extreme events and slower-onset changes through ecosystem-based adaptation - for
16 instance, stormwater retention, heat reduction and carbon sequestration (Munang et al, 2013; UNEP, 2017)
17 – further reinforces the importance of environmental protection to a sustainable society. In coastal and
18 marine areas, Leslie and McLeod (2007) indicate that greater biodiversity may be linked to greater ecosystem
19 functioning, hence increasing potential for ecosystem-based adaptation. Mangroves, salt marshes, coral
20 reefs, beaches, dunes and seagrass habitats have all been argued to have a role in reducing wave energy,
21 increasing sedimentation and reducing erosion and movement (e.g. Jones et al, 2012; Spalding et al, 2014,
22 UNEP, 2017). Spalding et al (2014) list formation of marine protected areas, habitat restoration, managed
23 realignment of coastal ecosystems, and hybrid natural and ‘hard’ engineering as management strategies that
24 may facilitate coastal ecosystem-based adaptation.

25

26 Yet in LMIC contexts, additional imperatives need to be balanced while working towards the adaptation gains
27 that come from preserving healthy ecosystems. A drive for environmental protection or biodiversity
28 conservation must be set against more immediate needs relating to poverty, sanitation, drinking water,
29 infrastructure supply and livelihood (Seto et al, 2012). This is even tougher in coastal settings, where risks
30 from rising sea levels and exposure to storms are intensified (McGranahan et al, 2007; Saleem Khan et al,
31 2012) and ecosystems may be a crucial ‘first line of defence’ in physically mitigating extreme events deriving
32 from the sea, yet access to coastal resources and ecosystems is vital for communities’ livelihoods and survival
33 (Aguilera et al, 2015).

34

35 Environmental managers thus have to manage coastal ecosystems in a way that maximises adaptation
36 potential through specific actions, whilst also allowing the most marginalised members of society access to

37 these same natural resources to sustain livelihood and development. For those setting policy at the national
38 or regional level, this means finding ways to link adaptation policy and implementation with poverty
39 reduction and vulnerability reduction measures in different social and economic sectors (e.g. Klein, 2010;
40 Roberts, 2010).

41

42 1.2. Theoretical context: vulnerability as a social process

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44 This challenge of linking adaptation actions with development imperatives is further complicated by socio-
45 political processes, which arguably contribute to the differences in vulnerability and uneven development
46 that exist within society. We understand vulnerability as the exposure of groups or individuals to stress as a
47 result of extreme events and environmental changes (Adger, 1999a), depending on their social, economic
48 and political characteristics (Oulahen et al, 2015). As Smith (2006: np) argues, “there is no such thing as a
49 natural disaster. In every phase and aspect of a disaster [...] the contours of disaster and the difference
50 between who lives and who dies is to a greater or lesser extent a social calculus.” Factors such as access to
51 finances, education levels, and social capital have all been argued to affect vulnerability to environmental
52 changes (e.g. Cutter et al, 2003; Adger et al, 2004; Oulahen et al, 2015). It has also been demonstrated that
53 groups marginalised through income, ethnicity or gender are less likely to have access to these resources
54 that can reduce vulnerability, and hence bear a disproportionate burden of the negative effects of climate-
55 related hazards (e.g. Klinenberg (2002) and Byrne et al (2016) on heat; Laska and Morrow (2006) on
56 hurricanes). These studies indicate this disparity is relevant not only at the national level, where it is
57 understood that less affluent nations who have done the least to contribute to climate change will be affected
58 hardest and earliest (Stern, 2007), but also within regions and municipalities. There is hence a concern with
59 spatial justice (Soja, 2010) in terms of fairness in allocation of resources, services and access across society.
60 This may involve fairness in the distribution of benefits and hazards across space (Shrader-Frechette, 2002),
61 and also in the *processes* through which decisions are made (Paavola and Adger, 2006).

62

63 The core theoretical and practical concern of this paper is therefore to understand means through which
64 these social and cultural drivers of vulnerability and the ways in which they affect people in their daily lives
65 may be taken into account within the kind of environmental management processes outlined in Section 1.1.
66 The aim is to understand how the most vulnerable members of society can have equitable access to
67 ecosystems in a way that (a) reduces physical exposure to extreme events through the adaptation benefits
68 realised by effective management, yet (b) allows realisation of tangible benefits that allow improvement of
69 socio-economic status and hence reduction of vulnerability. This balance is especially significant in
70 ecosystem-based adaptation and biodiversity protection discussions, where it has been claimed that issues
71 of how social relations and cultural practices can both be affected by and guard against environmental
72 change have been sidelined, if not actively suppressed, in the drive for consensus on rapid practical action.

73 Discourses of ‘ecosystem services’ aim to build consensus on the value of ecosystems to society and gain
74 broad-based buy-in for environmental protection actions (e.g. Perrings et al, 2011). Yet such thinking has
75 been argued to make the complex social processes underpinning environmental issues appear as simpler
76 techno-scientific issues (Norgaard, 2010), or even intensify existing inequalities by replicating current market-
77 based ways of thinking (Kosoy and Corbera, 2010). Similarly, the proliferation of political interest in ‘resilient’
78 social and ecological systems has led to concerns (e.g. Lockie, 2016; Kaika, 2017) that questions of fairness in
79 exposure to environmental changes have gone unaddressed in favour of maintaining the social and political
80 status quo.

81

82 Equitable ecosystem-based adaptation of the kind discussed in Section 1.1. hence means not only preserving
83 access to ecosystems for the most vulnerable, but also creating room in governance processes for reflection
84 on what it is that leads to uneven development so that this can be addressed as part of climate adaptation
85 and development policy measures. Whilst 40% of the world population lives in coastal regions (UN, 2017),
86 policy and governance procedures to balance these competing pressures are far less developed for marine
87 environments than they are for land (e.g. Boyes and Elliot, 2014; Mabon et al, 2017). Coastal communities
88 may be more exposed to environmental hazards, and can also be more marginalised socially and politically
89 due to their peripheral location (Allen, 2006; Chang et al, 2015). In LMICs, reliance on coastal ecosystems
90 may be especially high (Saleem Khan et al, 2012), and there is concern that marine resource development in
91 the national interest may have negative impacts at the community level (Mai et al, 2008). In a coastal context,
92 socially just adaptation to climate-related hazards therefore means understanding how benefits brought by
93 the sea at a national or international level balance with well-being and socio-cultural values locally.

94

95 1.3. Significance and aims

96

97 The aim of this study is therefore to elaborate challenges that arise when we consider social and cultural
98 factors within environmental management frameworks, and to suggest policy and management actions that
99 ensure the most vulnerable are not further disadvantaged within climate adaptation actions. The value of
100 our study lies in bridging more technical, scientific and managerial understandings of climate adaptation
101 responses with thinking on the community-level implications of economic, social and environmental change.

102

103 We assess actions and processes in Xuan Thuy National Park (XTNP), Nam Dinh Province, Vietnam (Section
104 2). This is an environmentally and socially vulnerable coastal region, where extreme events and
105 environmental changes are already being linked to climate change. XTNP and Nam Dinh Province more widely
106 is a location where policymakers and governors need to balance socio-economic development, climate
107 change adaptation and environmental protection imperatives in the present. A single case study of course
108 cannot provide ‘solutions’ which can be applied everywhere. We use the XTNP case to contribute to theory

109 (Yin, 1984), especially reconciling scholarly thinking on justice and vulnerability with environmental
110 management strategies based on thinking in terms of ecosystem health. Our findings add insight into the
111 lived experience of a changing environment. This acts as a starting point for reflection on how discourses of
112 climate change adaptation rooted at the regional, national or international level sit with the daily experiences
113 of the people these policies ought to benefit – namely, physically and socially marginalised people living in a
114 coastal community where extreme events and also longer-term ecosystem changes are manifest in the
115 present. This is significant given increasing interest in bringing indigenous and local knowledges (ILK) into
116 environment management and policy-making processes, as evidenced by both the Convention on Biological
117 Diversity (CBD, 2018) and Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES, 2018)
118 devoting specific tasks to ILK.

119 120 2. Case study introduction: Xuan Thuy National Park and Nam Dinh Province

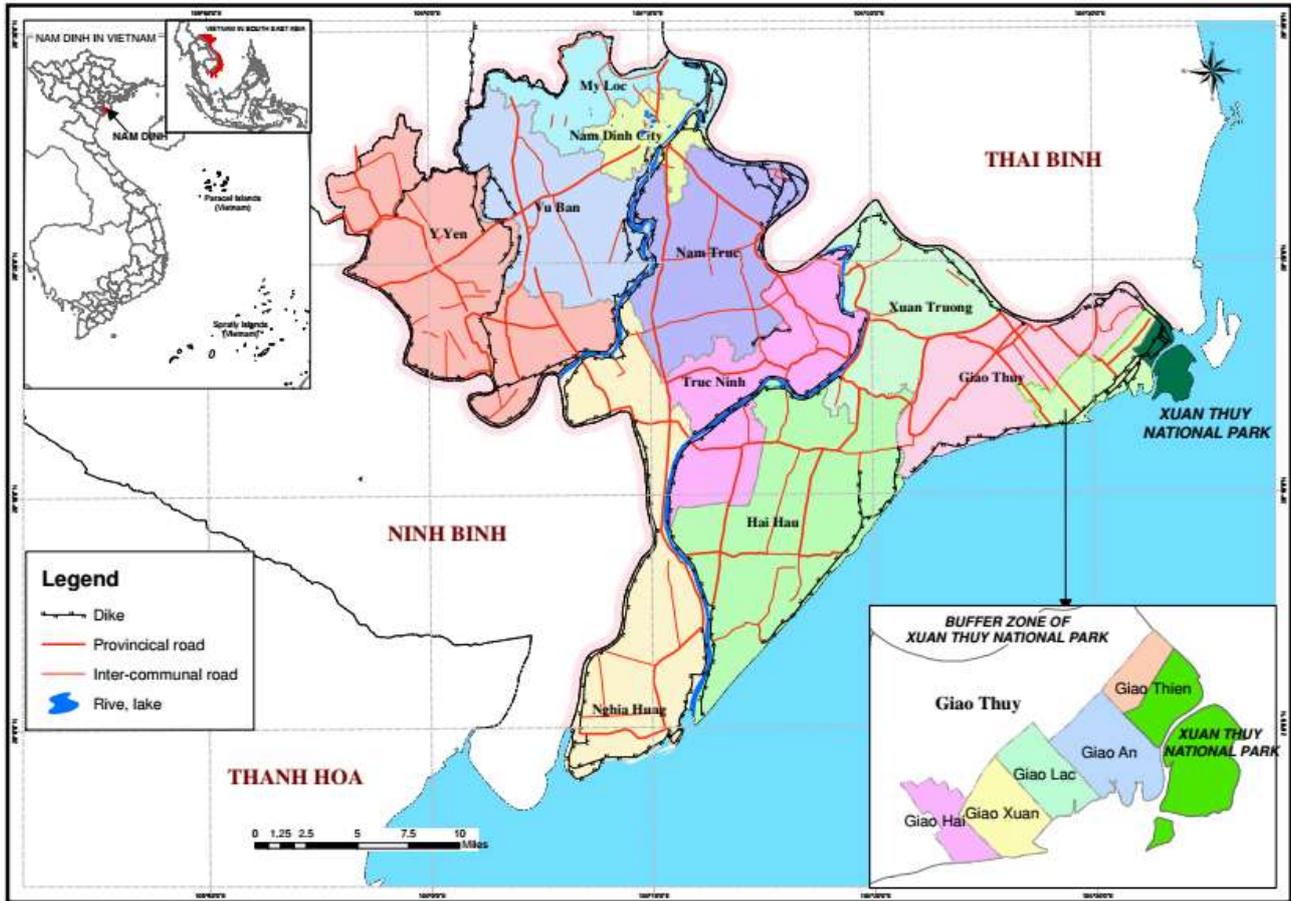
121
122 We first outline Xuan Thuy National Park and Nam Dinh Province (see Figure 1), and describe the current
123 understanding of climate change and associated counter measures in the area. This is by necessity
124 descriptive, but forms the basis for the evaluative work in Section 4.

125 126 2.1. Social and environmental characteristics of Nam Dinh Province and Xuan Thuy National Park

127
128 Nam Dinh Province has 72km of coastline divided into 10 administrative units, and is a strategically important
129 area for defence and security. Its nature and natural resources have the characteristics of an environment
130 formed by coastal encroaching activity. Xuan Thuy National Park (XTNP) is a wetland floodplain, which
131 belongs to the core zone of the Red River Delta Biosphere Reserve with a total area of 151 km². It is ranked
132 as having (a) the highest biodiversity; (b) the largest biological yield; and (c) the most sensitive ecosystem in
133 the south-east Asian region. With over 3,000 hectares of mangroves, 220 bird species (of which 9 are listed
134 in the IUCN Red List), over 500 aquatic plant and animal species, 120 species of vascular plant, and 10
135 mammal species (Nguyen, 2015), XTNP is important to economic development, environmental protection,
136 aquaculture cultivation and ecotourism. Nam Dinh has a dense population with approximately 1.9 million
137 people, and a population density of 1,110 people/km² (2016), of which 59% of people are labour force. The
138 economy maintains relatively stable growth (12.3% GDP growth rate) with gradual increase in the
139 construction industry sector and gradual reduction of the agricultural sector. In the XTNP buffer zone, labour
140 force accounts for 50% of the population (25,771 people in 2014) (XTNP, 2014). Also in this area, the main
141 activity is farming, divided into two subregions: (i) inside the dykes, diverse cultivation activities, of which
142 paddy rice fields account for nearly 40%; (ii) outside the dykes, fishing and aquatic cultivation are major
143 activities.

144

145 Despite its resource advantages and stable development trajectory, Nam Dinh faces environmental problems
146 such as saline intrusion, typhoons and floods. These problems are becoming increasingly extreme in the
147 context of climate change, and are already seriously affecting biodiversity on the coastal area of Nam Dinh
148 Province, especially in XTNP.
149



150
151 Figure 1: Location of Xuan Thuy National Park within Nam Dinh Province (Xuan Thuy National Park and buffer
152 zone in inset) (produced by authors)
153

154 2.2. Current environmental change in Nam Dinh Province and Xuan Thuy National Park

155

156 The Asian Development Bank (2013) note that limits on technical and financial capacity raise challenges in
157 Vietnam for understanding the local specificities of climate change within Vietnam, especially with regards
158 to understanding effects at a very local level and undertaking studies focused on climate change impacts.
159 Nonetheless, we summarise what is known about likely environmental impacts in Nam Dinh Province and
160 XTNP (both extreme events and longer-term), as well as the current policy actions in response.

161 162 2.2.1. Environmental change in Nam Dinh Province

163

164 Climate change has had environmental, social and economic impacts in Nam Dinh Province, especially
165 agriculture production, rural areas and the livelihood of coastal residents. Salinization reduces rice cultivation
166 soil and increases soil salinity, reducing cultivation productivity. 20,000 hectares of paddy land are flooding
167 in spring seasons, and over 5,000 hectares of cultivated land suffer extreme salinization. Sea level rises of
168 2.15mm per year reduce mangrove areas and affect the biodiversity of mudflats at the mouth of the Red
169 River. This also reduces the available area of aquaculture land, and negatively impacts on coastal households
170 (see Section 4). Salt water intrusion onto land harms aquaculture species' habitat, thus depleting fish stocks
171 and creating difficulty for residents whose livelihoods depend on catching fish (Department of Agriculture
172 and Rural Development of Nam Dinh Province, 2017).

173
174 Extreme weather phenomena have negatively impacted on thousands of hectares of cultivated and
175 aquaculture land, resulting in losses reaching hundreds of billions of Vietnamese Dollars. The first storm in
176 2016 damaged 74,100 hectares of rice land in 220 flooding communes; 8,500 hectares of vegetables and 130
177 hectares of aquaculture land, causing an estimated VND 3,100 billion of total damage. In the dry season,
178 drought problems and saline intrusion cause difficulty in managing irrigation systems and directly affect rice
179 cultivation in coastal districts (IHGeo, 2015). Warmer winter weather and increasing frequency and intensity
180 of extreme weather phenomena also leads to increasing prevalence of pests on plants and animals. The cost
181 for pesticides reaches approximately 200 billion VND each year. Recently, new diseases have emerged such
182 as white spots, white trees, yellow head in aquaculture raising, foot and mouth disease, blue ear, and flu in
183 breeding.

184 185 2.2.2. Environmental change in Xuan Thuy National Park

186
187 Sea level rises have led to more frequent flooding of alluvial groups, and to saltwater intrusion towards land.
188 Salinity directly impacts on the living environment of fauna and flora, leading to decline of multiple species
189 such as *sonneratia caseolaris* and *casuarina equisetifolia* (Daibieunhandan, 2016). Temperature increases
190 have also resulted in bird migration. Some bird species listed in the Red Book that previously appeared in
191 Xuan Thuy National Park are declining, especially endangered species such as *Anastomus oscitans*,
192 *Limnodromus semipalmatus* and *Tringa guttifer* (Tran, 2015).

193
194 Residents in the five buffer communes have also been affected through cultivation land loss, decreased
195 productivity, salinity of water source, and lack of fresh water. Areas of aquatic cultivation are decreasing, and
196 the cost for aquaculture breeding is increasing due to the need for farmers to improve infrastructure facilities
197 in response. Many species are unable to adapt to increasing temperatures, reducing fisheries resources.
198 Other aquatic species also have reduced biological products such as nails, and red clams. This decline
199 adversely affects those living in the area who are reliant on the ecosystems for livelihood.

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2.3. Climate change adaptation policy in Nam Dinh Province and Xuan Thuy National Park

As per Spalding et al (2014), Nam Dinh Province can be considered a coastal region where climate adaptation measures are already required. Policy and technical measures are being implemented to this end, as we now summarise.

2.3.1. Climate change adaptation policy in Nam Dinh Province

Authorities in Nam Dinh Province recognize that without appropriate and early action, environmental change will have potentially disastrous effects for many areas of the province, especially the coast. There is awareness that adaptation actions are required to avoid or reduce adverse climate impacts, and to ensure the province can take advantage of any co-benefits (e.g. increases in productivity, benefits to ecotourism) that may arise from these actions. Therefore, in recent years, both the central government and local authorities have issued policies and action plans for climate change adaptation in Nam Dinh Province:

- *Decision No.120/QĐ-TTg* (January 22, 2015) issued by the Prime Minister on Approval of the Forest Protection and Development Plan in the Coastal Areas to Respond to Climate Change for the period of 2015 – 2020. Nam Dinh is one of the provinces listed in this plan;
- *Decision No.1721/QĐ-UBND* (October 13, 2011) on the Approval of Action Plan for Climate Change Response of Nam Dinh Province for the period 2011 - 2015 with a vision towards 2020;
- *Decision No.458/QĐ-UBND* (April 4, 2012) on the Establishment of the Steering Committee on Climate Change Response of Nam Dinh Province for the period 2011 - 2015 with a vision towards 2020;
- *Action Plan No.14-CTr/TU* (July 22, 2013) on Active Response to Climate Change, Enhancement of Natural Resources and Environmental Protection.

Additionally, all provincial departments and districts have developed plans and programs based on existing circumstances to respond to climate change. For example, Nam Dinh Department of Natural Resources and Environment (DONRE) has developed a Climate Change Adaptation Plan and updated it based on climate change and sea level rise scenarios for 2016 (Ministry of Natural Resources and Environment, 2016). DONRE has also developed a database system on storm surges and sea-level rise, which is designed to assist local authorities in generating risk maps in different districts.

2.3.2. Climate change adaptation measures implemented in Xuan Thuy National Park

236 Sea level rise of 2.15 mm per year and changeable weather has affected production activities, and reduced
237 mangrove forest and biodiversity in XTNP. The park management board has implemented a series of
238 measures towards natural resources conservation and sustainable socio-economic development. First is
239 strengthening the XTNP organizational structure. Many divisions under the Nam Dinh Department of
240 Agriculture and Rural Development and commune authorities are involved in management of XTNP. The
241 Management Board of XTNP takes lead in core zone management, with financial support from three sources:
242 state budget; government support; and non-government organizations, cooperatives and other
243 organizations. Second is policy implementation. To enhance local capacity to cope with climate change, the
244 National Park has started renovating and upgrading infrastructure, planting mangrove forests, benefits
245 sharing through co-management of mangrove resources in the core zone, and raising awareness among local
246 communities on sustainable use of natural resources and environmental protection. Finally, the National Park
247 also calls for international and domestic funding to adapt to climate change, implementing projects in the
248 buffer zone with technical and financial support from local and international organizations (both
249 governmental and non-governmental) to reduce pressure on natural resources and generate sustainable
250 employment possibilities.

251

252 In sum, changes in the environment are already a serious issue for XTNP and Nam Dinh Province, and
253 authorities at the provincial and local level are aware of this and working to implement policy. This paper
254 further evaluates the socio-cultural dynamics at play by assessing the lived experience of environmental
255 change and extreme events in and around XTNP, and considering how maintaining coastal ecosystem health
256 in XTNP may aid daily living and act as part of a climate adaptation strategy.

257

258 3. Methodology

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260 Data was collected through: (a) structured review and synthesis of existing research; (b) in-depth interviews
261 and subsequent analysis through a grounded technique; (c) site visits to decision-maker offices and to
262 affected areas of XTNP. A fuller overview of research design and execution is included as Supplementary
263 Data. In keeping with social science thinking on different knowledge systems that exist globally (de Sousa
264 Santos, 2014), the involvement of a team of Vietnam-based scholars was crucial to ensure the study's
265 research design, data collection, data analysis, collation of findings and development of appropriate policy
266 recommendations were all informed by rich contextual knowledge. The unequal power relations that can
267 exist within the process of producing knowledge (Cook et al, 2005) made it all the more important to involve
268 such researchers with significant knowledge of the Vietnamese social, political and environmental situation
269 in data collection, analysis and the writing-up process as far as possible (see Cassells et al, 2011). Limited time
270 available for data collection 'in the field' and for face-to-face collaborative working to make sense of (and
271 translate) Vietnamese-language data also meant the involvement of a relatively large team of scholars across

272 the research process was necessary to collect sufficiently rich data and analyse it in-depth with the resources
273 available.

274

275 For qualitative research, *rigour* is considered a more appropriate measure of the quality of the work than
276 representativeness or statistical validity (Mays and Pope, 1995). Teel et al (2018) suggest rigour in the context
277 of social science research aimed at informing environmental management may involve: use of mixed
278 methods to triangulate findings; the grounding of the study in established theory; the clear definition of
279 concepts; and the use of appropriate methods. We seek to meet these criteria by: clarifying what we
280 understand key relevant terms relating to ecosystem management to mean in Section 1.1.; laying out a
281 theoretical basis for the work in the socio-cultural dimensions of vulnerability in Section 1.2.; triangulating
282 findings through narrative review, interview work and field observation as described below; and using similar
283 qualitative techniques to understand the lived experience of environmental changes to those that have been
284 utilised in analogous research (e.g. Allen, 2006; Measham et al, 2011).

285

286 3.1. Narrative review of existing research into social and environmental change in Xuan Thuy National Park,
287 its surroundings and Nam Dinh Province

288

289 Narrative literature reviews gather data from existing literature on a topic, collating, comparing and
290 synthesising the findings to draw new conclusions about the topic (Green et al, 2001). The focus in this case
291 was social and environmental change in XTNP, its buffer zones and surrounding communes, and Nam Dinh
292 Province. This provides a baseline for the empirical research in Sections 3.2. and 3.3. Jones (2004) argues
293 narrative reviews are more appropriate than systematic literature reviews when the material being reviewed
294 is itself qualitative in nature - as much material reporting social and environmental issues in XTNP is. Jones
295 holds that narrative reviews allow the researcher to engage more flexibly with the stories contained in the
296 qualitative material itself, and also to include 'grey' literature such as policy documents which lie outside the
297 peer-reviewed literature but are nonetheless significant and influential. Greenhalgh et al (2005) add that
298 narrative-type reviewing techniques can help researchers make sense of large sets of complex evidence
299 drawn from differing sources. As such, a narrative literature review was deemed suitable for synthesising
300 current work in and around XTNP, which covers a range of topics from varying disciplinary perspectives and
301 uses a breadth of methodologies.

302

303 Relevant documents were initially identified through Google Scholar (scholar.google.com), searching once
304 with the term 'Xuan Thuy National Park' and once with the term 'Nam Dinh Province'. Documents were
305 further analysed if they (a) made explicit mention of XTNP or the surrounding communes in Nam Dinh
306 Province; and (b) addressed environmental change from a management, policy or societal perspective, or
307 discussed societal change in the context of environmental factors. As well as peer-reviewed academic

308 articles, research or consultancy reports and conference papers were reviewed, and relevant references were
309 followed up where appropriate through a 'snowball' sampling technique. Only English-language material was
310 sampled due to language constraints.

311

312 Sampled texts were read to note (a) social and environmental changes in XTNP and its buffer zone over the
313 last twenty years, and their causes; (b) which sections of society are defined as 'vulnerable' or being affected
314 most negatively by these changes; (c) management and policy measures undertaken in response to these
315 challenges; and (d) the perceived effectiveness of these management and policy actions. Findings from the
316 studies were noted, and similar types of findings were grouped together to draw out overarching themes.
317 This is summarised in Table 2. and discussed in Section 4 in relation to our empirical findings.

318

319 3.2. In-depth interviews

320

321 Five in-depth interviews were undertaken in XTNP and Nam Dinh Province in May 2017 (see Table 1).
322 Sampling was targeted on organisations (and the people within them) with important roles in setting
323 immediate policy for climate adaptation (Vice-Director, Department for Agriculture and Rural Development,
324 Nam Dinh Province); in undertaking practical management actions 'on the ground' in response to changes
325 (Vice-Director and Management Board, Xuan Thuy National Park); and in facing the most immediate risk from
326 changing conditions on a daily basis (commune chief; fisher/female head of household; and farmer).
327 Recruitment was facilitated through existing contacts held by the research team from previous activity in the
328 area.

329

330 Interviews took a semi-structured approach, whereby the researcher has a pre-determined series of
331 questions to ask the interviewee, but is able to vary the order of these questions and ask follow-up questions
332 in order to further explore areas they deem significant based on the interviewee's responses – rather like a
333 guided conversation (Bryman, 2012). Areas of questioning (see below) were developed collaboratively
334 through facilitated discussion among the research team to determine precise areas of enquiry that could be
335 addressed with the available data (i.e. available interviewees and underlying policy documentation).
336 Question development was guided by the researchers' theoretical knowledge of potential drivers of
337 vulnerability in coastal settings, and also the team's understanding – from previous research in XTNP – of
338 factors that may warrant further exploration. Referring back to underpinning scholarship and pre-existing
339 data in this way is considered an appropriate means of developing interview questions that explore new
340 themes and generate appropriate data (Tracy, 2012).

341

342 The interviewers used these open-ended questions to guide the interviews, probing and asking follow-up
343 questions to elicit further information from the respondents. Whilst the order of questioning differed from

344 interview to interview according to the flow of conversation, based on the question development outlined
 345 above each sought to elicit (a) a narrative of changes in the local environment and society over time; (b) the
 346 respondent’s views on what was being done at a local and regional level about climate change; (c) the
 347 respondent’s knowledge and awareness of climate issues; and (d) how they felt about daily living under a
 348 changing climate. Analysis of the information received in the interviews followed a grounded theory
 349 approach (Strauss and Corbin, 1997). The researchers worked together in a facilitated group setting to draw
 350 out points from each of the interviews, collaboratively grouping these to identify themes and sub-themes.
 351 The themes that were identified through this dialogic process form the sub-headings in Section 4. As
 352 previous, given the cultural and linguistic context, Vietnam-based researchers were crucial here in data
 353 development, and in cross-checking the analysis and resulting scientific output.

354
 355 Whilst the sample may seem small, given the social and environmental complexity of the topic it was decided
 356 to focus on interviewing the people most directly feeling the effects of environmental change, and the
 357 organisations with the most significant roles in deciding courses of action to be taken in response. Marshall
 358 (1996) adds that the information provided by key respondents may be richer than that of others. When
 359 combined with documentary analysis techniques, focused samples of comparative size have been used in
 360 analogous environmental governance research to nuance and further develop existing scholarship around a
 361 specific case (e.g. Shih and Mabon, 2017). It is worth acknowledging the limited number of female
 362 participants, due to local challenges in recruiting female heads of household. Working towards means of
 363 recruiting female interviewees is something future research in XTNP ought to consider, especially given the
 364 significance of gender that emerged in the findings and the fact that women are themselves the 'experts' in
 365 their own lived experiences of gender and impacts of environmental change (Section 4.1.).

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Respondent	Location	Number of people
Department of Agriculture and Rural Development, People’s Committee of Nam Dinh Province	Nam Dinh City	5
Vice-Director and Management Board, Xuan Thuy National Park	Xuan Thuy National Park	2
Head of household	Xuan Thuy National Park	1
Commune chief	Xuan Thuy National Park	1
Mushroom farming cooperative representative	Xuan Thuy National Park	1

367 Table 1: summary of interviews

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369 3.3. Site visits

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371 Field study was undertaken to add contextual background to the review and interview data. This involves
372 actions such as observation and informal conversation to understand everyday practice, recording
373 descriptive observations via note-taking and photography (Blomberg et al, 1993). Site visits were made to
374 the offices of the Department of Agriculture and Rural Development (DARD) in Nam Dinh City; to the park
375 management offices of XTNP; and to mangroves in the buffer zone and core areas of the park. Observations
376 were taken by the research team in the form of field notes and photographs. Where appropriate, these are
377 referred to Section 4 to illustrate and support points raised in the interviews.

378

379 4. Findings

380

381 The narrative review findings fall into four broad categories (Table 2): (a) technical and scientific work on
382 threats posed to coastal ecosystems – in particular mangroves – by the expansion of aquaculture in XTNP,
383 and the potential for mangroves to mitigate impacts of sea level rise and extreme events; (b) policy and
384 management responses to social and environmental pressures in XTNP, with an emphasis on payments for
385 ecosystem services and building cross-sector consensus for conservation; (c) assessment of social dynamics
386 at the community level in the communes around XTNP, and the awareness that the effects of social and
387 environmental changes are neither distributed evenly within communities nor easy to delineate (in particular
388 Neil Adger’s seminal work on coastal vulnerability at the community level in Nam Dinh); and (d) the potential
389 for ecotourism as an environmentally and socially sustainable activity for residents in the buffer zone.

390

391 As discussed in Sections 4.1.-4.3., our interviews and field visits produced findings broadly consistent with
392 previous work in and around XTNP. Our findings nuance this literature by adding rich, contextualised
393 narrative accounts of what it means to live with environmental change on the Nam Dinh coast. In Section 5,
394 we discuss how this work may feed into developing climate adaptation governance outcomes that are guided
395 by understanding of what the impacts are likely to be and how they can best be avoided, yet are also sensitive
396 to the ways in which the environment (and management actions taken in response) can impact upon socially
397 or culturally significant practices.

398

Theme	Findings from cited literature
Ecosystem threats	<ul style="list-style-type: none"><li data-bbox="515 1767 1430 1906">• Aquaculture putting pressure on mangroves and sensitive coastal ecosystem/biodiversity (Rambaldi et al, 2001; Seto and Fragkias, 2007; Pilgrim et al, 2011; Haneji et al, 2014;)<li data-bbox="515 1924 1430 2011">• At same time, though, aquaculture may be a poverty alleviation strategy (Beland et al, 2004)

	<ul style="list-style-type: none"> • Mangrove planting and rehabilitation seen as low/no regret measure given its climate adaptation potential (Powell et al, 2013) • Potential for controlled shrimp and crab ponds to support biodiversity (Wikle and Nguyen Hong Le, 2013) • Mangrove planting as adaptation strategy – but limited environmental knowledge in local community (Mai Trong Nhuan et al, 2009; Nguyen Thi Hong Lam, 2016) • Some awareness of interdependency of healthy ecosystems and sustainable aquaculture/farming practice (Thi Thu Trang Tran, 2013).
Environmental management-led responses	<ul style="list-style-type: none"> • Payments for ecosystem services-type schemes may help to balance livelihood vs wider storm reduction and carbon sequestration benefits offered by mangroves (Hawkins et al, 2010) • PES trialled in XTNP as means of conserving biodiversity and aiding the worst-off – to mixed success (Pham Thu Thuy et al, 2013) • Co-management as a means of balancing environmental protection and community development – especially among women (Nguyen Thi Bich Hien, 2014) • Broad range of institutions across scales involved in management e.g. Nam Dinh Provincial People’s Committee, districts, communes, central government departments, communities – has helped resolve conflicts between communities and national conservation goals (Nguyen Kim Dung et al, 2016) • Yet challenge of assigning roles and responsibilities for management of XTNP between different stakeholders and institutions (Truong Van Tuyen, 2009)
Vulnerability and social change	<ul style="list-style-type: none"> • Aquaculture (+ other non-agricultural and remittance employment) increasing inequality and enhancing vulnerability to external shocks (Adger, 1999b) • Decentralisation/local autonomy has had effect of increasing vulnerability via effects on strategic planning (Adger, 2000) • Migration and remittances can offset decline in resilience, but may also increase inequality and reduce cohesion (Adger et al, 2002) • Yet drivers and extent of/differences in vulnerability even within Xuan Thuy complex and can differ (Kelly and Adger, 2000)

	<ul style="list-style-type: none"> • Need for training and engagement at community level on climate adaptation (Quyên Dinh Ha et al (2013)) • Gendered dimension to vulnerability -women can take on additional workloads as well as caring duties – but climate change can also offer opportunities for change, dynamic nature of impacts (Resurrecion, 2011; Nguyen Thi Hong Lam, 2016)
Ecotourism	<ul style="list-style-type: none"> • Community-based ecotourism in XTNP a force for good in empowering women (Tran and Walter, 2014) • Ecotourism a means of wider engagement, of drawing wider attention to challenges? (Walter, 2010) • Question of how much ecotourism benefits local communities vs larger tour companies (Wikle and Nguyen Hong Le, 2013)

399 Table 2: summary of current literature on socio-environmental change in Xuan Thuy National Park and Nam
400 Dinh Province.

401

402 4.1. Gender effects

403

404 The first theme identified through the analysis process concerns gender. Specifically, that the way changes
405 in the environment affect people, and the extent to which policy and management actions are viewed as
406 appropriately responding to people’s needs in these situations, vary according to gender. Denton (2002)
407 explains that in LMIC contexts, women play key roles in agriculture and in managing households, so may lose
408 out more if the ecosystems on which they rely to undertake these tasks become damaged. Yet women may
409 also be under-represented in environmental management processes where decisions over how to respond
410 to climatic changes are taken, and can as a result of broader societal inequalities have less access to land,
411 income, education and health services (Denton, 2002; Demetriades and Esplen, 2008). In essence, women
412 are more likely to be reliant on the ecosystems which environmental change puts at threat because of their
413 social position; less likely to have access to money, education and decision-making forums which can help to
414 reduce their vulnerability; and may as a result of such differences in opportunity have fewer possibilities than
415 men to migrate elsewhere and avoid these livelihood pressures.

416

417 This can be seen in extant research in XTNP (e.g. Resurrecion, 2011; Tran and Walter, 2014). Negative health
418 and workload effects for women from climate change have also been demonstrated in Mali (Djoudi and
419 Brockhaus, 2011) and the USA (Laska and Morrow, 2006). Significant for XTNP is that environmental change
420 *intensifies* existing trends as well as creating problems in and of itself. Rather than working in agriculture or

421 fisheries, male workers increasingly go to other provinces to sustain their livelihood¹, which means more and
422 more women working in agriculture, working two crops a year in the area around XTNP². This trend of out-
423 migration and sending remittances back to the coast is not new and can in part be explained by changes in
424 economic and internal migration policy (e.g. Adger, 1999b). Yet migration pressures have been intensified by
425 local-level environmental changes such as saltwater intrusion and spread of infectious disease. These affect
426 the prevalence of livestock and fishing species, making agriculture and fisheries a less profitable – and indeed
427 less sustainable – occupation for those able to move and work elsewhere³. As a result, it is women who are
428 predominately left to sustain agriculture and aquaculture under challenging conditions on diminishing land,
429 on top of household and care duties. This in turn was reported by interviewees as leading for women in
430 particular to longer working hours, increasing pressure to balance household and agricultural commitments,
431 and heightened stress⁴. This does not mean women are somehow less suited to fishing and agricultural
432 activities. Rather, compared to men they have fewer opportunities to seek alternative and more profitable
433 livelihoods, and as such may disproportionately have to shoulder the burden of continuing increasingly
434 unprofitable and difficult agriculture and fisheries.

435

436 This imbalance highlights the value of ecosystem health in sustaining livelihoods and reducing – or at least
437 stabilising – the burden on female heads of household in marginalised coastal areas like XTNP. This works in
438 two ways. First, as raised in interviews, the outflow of male heads of household is leading to a shift in duties
439 for disaster response preparation, with women increasingly taking the lead on contingency planning at the
440 family and community level⁵. Whilst it would be wrong to claim female heads of household are ‘less’ prepared
441 to deal with environmental hazards – indeed there is literature to suggest women have greater awareness in
442 such situations (e.g. Laska and Morrow, 2006; Li et al, 2016) – this demographic change does mean different
443 approaches to risk communication and engagement from the commune and municipal level are required⁶.
444 During this period of transition, the role of mangroves and coastal ecosystems in mitigating the impacts of
445 extreme events – and hence reducing risk exposure for potentially vulnerable populations – becomes even
446 more significant. Second, in and around XTNP it is women who are most reliant on ecosystems for livelihood
447 through agriculture, aquaculture or fisheries (see Figure 2)⁷. Healthy ecosystems are likely to lead to better
448 yields by reducing erosion and increasing biodiversity, as outlined in Section 1. As long as ability to access
449 coastal ecosystems for collecting marine produce can be sustained for the most vulnerable (Powell et al,
450 2011), and as long as conservation decisions are not imposed from on high but rather decided in collaboration

1 Interview with Vice-Director, DARD, Nam Dinh City

2 Interview with Commune Chief, XTNP

3 Interview with XTNP Management Board, XTNP

4 Interview with female household head, XTNP

5 Interview with Vice-Director, DARD, Nam Dinh City

6 Interview with Vice-Director, DARD, Nam Dinh City

7 Interview with Commune Chief, XTNP

451 with female household heads (Nguyen, 2014), then conservation may become a foundation for balancing
452 livelihood and climate adaptation imperatives. Yet as interviewees cautioned⁸ – and as we reflect in Section
453 5 – care must be exercised to ensure such management-led approaches do not inadvertently reproduce
454 existing gender inequalities.

455



456

457 Figure 2: Clam fishers in Xuan Thuy National Park, Nam Dinh Province. Note that all those fishing are female.
458 (Source: authors' own photos)

459

460 At a provincial and local level, there appears to be awareness of the disproportionate burdens climate change
461 places on female heads of household. Respondents reported collaboration with international non-
462 governmental organisations on mainstreaming of gender issues within climate response planning, the
463 establishment of taskforces in affected communities to prepare female heads of household for responding
464 to storms and floods, and initiatives to shift women away from agriculture and towards ecotourism⁹. Yet the
465 pace of such initiatives may be open to question. Interviewees expressed concern that transitions to
466 alternative lifestyles need to happen *now* as opposed to in 5-10 years' time, such is the rate and immediacy
467 of climate change on the Nam Dinh coast¹⁰. This draws attention to potential slippages in the speed at which

⁸ Interview with female household head, XTNP

⁹ Interview with Vice-Director, DARD, Nam Dinh City; Interview with Commune Chief, XTNP

¹⁰ Interview with female household head, XTNP

468 climate responses are imagined and enacted, with the incremental and longer-term way in which institutions
469 imagine responses to climate change running up against the need for immediate action to respond to effects
470 on daily life. Coastal regions like XTNP, where climate change is most manifest due to sea level rise, erosion
471 and saltwater intrusion, may make this contrast even starker.

472
473 The main implication of this section is that environmental management aimed at maintaining ecosystem
474 health is a fundamental part of mitigating the disproportionately negative effects of environmental change
475 felt by women. Yet the XTNP experience also indicates that for such actions to be effective, attention ought
476 to be paid to (a) how measures to improve ecosystem health may be linked with actions to address broader
477 social issues (e.g. unequal opportunities for skills development) which make women more vulnerable in the
478 first instance; and (b) the timeframes over which management actions can be expected to deliver tangible
479 benefit to women's daily lives.

480

481 4.2. Health and wellbeing

482

483 The second emergent theme concerns the effects of changes to the environment on health. There is much
484 scholarship on the physical implications of climate change for human health, encompassing for instance
485 illness and death from higher temperatures (Heo et al, 2016), spread of disease (Rohr et al, 2011), and
486 mortality from more frequent extreme weather events (Woodward et al, 1998). This is supported by our
487 findings, where increases in infectious diseases and respiratory problems were discussed anecdotally¹¹.
488 Perhaps more significant, however, were the effects of environmental change in and around XTNP on
489 *wellbeing* at both individual and community levels. Wellbeing is defined by Dodge et al (2012: 230) as having
490 "the psychological, social and physical resources [people] need to meet a particular psychological, social
491 and/or physical challenge", extending beyond physical health to being equipped with an adequate social
492 environment to cope with challenges that may arise. Linking back to Sections 1.2. and 1.3., there is hence a
493 need to understand how environmental change – and adaptation through healthy ecosystems – affects
494 people's wellbeing at the level of daily living in addition to their physical health.

495

496 Wellbeing implications arose frequently in interviews, on at least two levels. At an individual level,
497 diminishing yields mean longer working hours – reported by one interviewee as an increase from five hours
498 a day to over eight hours¹². The consequences of this include stress, headaches and fatigue – a psychological
499 burden which comes on top of increases in infectious disease reported above. At a community level too,
500 changes in the climate and associated ecosystem effects have affected social relations. The decline in

¹¹ Interview with Commune Chief, XTNP

¹² Interview with female household head, XTNP

501 numbers of people participating in crab hunting was reported as removing (or at least greatly diminishing) a
502 culturally meaningful activity through which people formed and sustained social cohesion and support.¹³
503 Local-level initiatives to shift people to alternative livelihood models – similar to those explored by Walter
504 (2010) and Tran and Walter (2014) - were discussed as having some level of success in retaining community
505 solidarity. For instance, the establishment of mushroom farming cooperatives allows community members
506 to undertake new activities together – yet interviewees acknowledged this solidarity was precarious and
507 dependent on whether their activities could continue in a changing social and environmental context¹⁴.

508

509 These changes in social relations over time – and their implications for already vulnerable people – have been
510 explored extensively in Nam Dinh Province (e.g. Kelly and Adger, 2000). Our findings indicate the importance
511 of ecosystem health as a means of sustaining people’s livelihoods and in turn social relations. Such ‘win-wins’
512 around ecosystem protection and local livelihoods are discussed in existing XTNP work (e.g. Hawkins et al,
513 2010; Powell et al; 2013; Tompkins et al, 2013; Tran, 2014). However, our findings indicate ecosystem health
514 can also have consequential effects for wellbeing going beyond subsistence or climate risk reduction.
515 Stronger yields may mean less need to work long hours, and the possibility to continue traditional activities
516 (or start new ones) which are important conduits for community interaction. Moreover, framing discussion
517 on environmental management in terms of local-level biodiversity, ecosystem health and wellbeing may
518 ‘close the gap’ to larger-scale and longer-term discourses of climate change. For instance, whilst low initial
519 levels of knowledge about the specifics of climate change were reported, community-level interviewees were
520 able to talk in great depth about changes in yields and species over time in the immediate environment
521 around them¹⁵.

522

523 Given our study’s aim of understanding how socio-cultural implications of environmental change can connect
524 with technical and scientific responses, the issues around wellbeing reported above indicate the importance
525 – both in Xuan Thuy National Park and more widely – of understanding how living in an ecosystem under
526 pressure affects social relations, and by extension wellbeing, for those who may already be more vulnerable.
527 In other words, better understanding the lived experience of climate change by connecting the psychological,
528 social and physical (Dodge et al, 2012). The Intergovernmental Panel on Climate Change’s Fifth Assessment
529 Report (2014) does note that mental stress and other effects mediated by human systems are one of three
530 pathways through which climate change can affect health (alongside direct extreme weather impacts and
531 natural system impacts such as disease). Yet these broader dimensions of ‘health’ receive only limited
532 attention in the Assessment Report. For instance, only two short paragraphs on mental health are included,

¹³ Interview with Vice-Director, DARD, Nam Dinh City

¹⁴ Interview with mushroom farming cooperative member, XTNP

¹⁵ Interview with Commune Chief, XTNP

533 noting that “[h]arsher weather conditions such as floods, droughts, and heat waves tend to increase the
534 stress on all those who are already mentally ill, and may create sufficient stress for some who are not yet ill
535 to become so” (Smith et al, 2014: 732). The contrast between this brief treatment of stress and the profound
536 effects on community solidarity and mental wellbeing reported in our XTNP interviews as happening *now*
537 suggests further attention ought to be directed by national and regional policymakers to the wellbeing
538 dimensions of environmental change in the present.

539

540 4.3. Knowledge and policy

541

542 As laid out in Section 1, the challenge faced by coastal environmental managers in locations like XTNP is to
543 simultaneously address the needs of the most vulnerable whilst meeting the requirement for specific
544 technical actions to maximise adaptation potential. Management decisions must be informed not only by
545 equity and justice concerns, but also by knowledge of how the physical environment responds to different
546 pressures. However, our findings show that the way in which techno-scientific knowledge informs people’s
547 actions, and how it transfers across scales, can itself be a social process.

548

549 Understanding what constitutes an appropriate response to climate change carries significant cognitive
550 demands. In previous XTNP-specific research, limitations in capacity at local levels have been cited as
551 restricting mangrove management potential (Mai et al, 2009; Nguyen, 2016). In Nam Dinh Province and
552 XTNP, interviewees explained significant effort has been placed from the national and provincial government
553 level to understand climate risks through the production of flood maps and rankings of provinces by level of
554 risk, and in training officials at the province and commune level to work with hazard assessment software¹⁶.
555 But whilst interviewees expressed pride in these achievements that had already been made in understanding
556 climate risks on the Nam Dinh coast, they were also quick to acknowledge limitations to their capability.
557 These limitations were both cognitive (training, knowledge and competence of staff at the local government
558 level¹⁷), and financial (numbers of staff available to manage coastal ecosystems¹⁸). This reflexivity is also seen
559 in Vietnam’s intended nationally determined contribution to the Paris Agreement, which concedes “Viet Nam
560 has attempted to implement climate change adaptation measures but does not have sufficient capacities to
561 meet the demands, so there is a need for international assistance as well as cooperation with other
562 developing countries” (Socialist Republic of Viet Nam, 2015: 11). Where this knowledge is situated versus
563 where it is required is a point we return to in Section 5.2., however it further illustrates the challenge of

16 Interview with Vice-Director, DARD, Nam Dinh City

17 Interview with Vice-Director, DARD, Nam Dinh City

18 Interview with XTNP Management Board, XTNP

564 turning rhetoric on climate adaptation developed at larger spatial scales into tangible localised changes in a
565 vulnerable coastal context.

566

567 Moreover, complexity may be engendered by the number of sources of knowledge on environmental change
568 and biodiversity, which derive from a range of institutions across a number of scales. Whilst cooperation
569 between institutions has been positively evaluated in building consensus for biodiversity conservation in
570 XTNP (Nguyen et al, 2016), the number of institutions involved in governing XTNP may lead to difficulty in
571 assigning clear roles and responsibilities for environmental management (Truong, 2009). In interviews,
572 knowledge sources mentioned in relation to climate adaptation governance in XTNP included international
573 treaties such as the Ramsar Convention on Wetlands of International Importance¹⁹; ad-hoc international
574 funding and support on environmental and social projects within the province²⁰ (e.g. USAid work on gender
575 mainstreaming and Danish Red Cross funding for forestry); policies and climate data developed at national
576 government level and passed down to provinces²¹; and subsequent communication of this information at
577 community level for storm preparation and evacuation route planning²². Putting climate adaptation through
578 ecosystems into practice requires managers at the local level able to connect to and understand this complex
579 array of knowledges, and then translate this into implications and actions for citizens via initiatives such as
580 evacuation plans and alternative livelihood models. It may also be crucial to identify the specific local leaders
581 and opinion-shapers citizens look to for information on extreme events and longer-term changes - district
582 leaders or park staff in the case of XTNP²³ - and ensure they are well supported to understand and translate
583 environmental knowledge for communities and local users of the environment.

584

585 The first implication of this set of findings for extant thinking on the role of social processes within coastal
586 environmental management is that enthusiasm towards the potential for ecosystem-based adaptation
587 approaches seen in both XTNP (Powell et al, 2013) and in the broader climate adaptation literature (e.g.
588 Roberts et al, 2012) as offering 'win-win' outcomes must be tempered with recognition that realising these
589 multiple benefits requires significant cognitive, financial and staffing resources. This includes ability to work
590 across scales and balance technical and scientific discourses of climate change with residents' lived
591 experiences.

592

593 The second implication arising from how physical environments are understood relates to the direction of
594 flows of knowledge and information about how the environment is changing on Nam Dinh's coast. Residents

19 Interview with XTNP Management Board, XTNP

20 Interview with Vice-Director, DARD, Nam Dinh City

21 Interview with Vice-Director, DARD, Nam Dinh City

22 Interview with Commune Chief, XTNP

23 Interview with Commune Chief, XTNP

595 have their own embodied knowledge of the environments in which they live. As previous, interviewees
596 offered rich and powerful accounts of daily life under a changing climate, encompassing psychological and
597 emotional strain²⁴, community fears and concerns²⁵, and sensitivity to minute changes in the natural
598 environment²⁶. The value of these rich local knowledges (as well as traditional and indigenous environmental
599 knowledges) in developing robust and locally-appropriate outcomes is increasingly recognised by major
600 international opinion-shapers in environmental management (e.g. CBD, 2018; IPBES, 2018). In XTNP at least,
601 developing means to integrate local environmental knowledges into planning and policy-making decisions
602 may hence offer additional nuance to the top-down 'knowledge' and 'capacity' building advocated for more
603 effective ecosystem management in Xuan Thuy National Park (Mai et al, 2009; Nguyen, 2014; Nguyen, 2016).
604 There are moves to consider feedback from the local level within awareness-raising initiatives in XTNP and
605 Vietnam more widely, however within this continued reflection may be needed on the role that local
606 knowledges and perceptions have within the planning and decision-making process.

607

608 5. Discussion and conclusions

609

610 5.1. Implications for policy in Xuan Thuy National Park and elsewhere

611

612 Our findings indicate the following actions may be of value in bringing social and cultural concerns into
613 environmental management in a way that balances physical adaptation with development and equity
614 challenges. Given the nature of the data these are primarily specific to XTNP, but also hold wider relevance
615 for fragile coastal ecosystems:

616

- 617 • Develop regulations on collaboration amongst the local authorities and departments of Nam Dinh
618 Province for monitoring and dealing with infringement. As raised in the narrative review and
619 reinforced through the interviews, there is increasing awareness of the importance of healthy
620 ecosystems to climate change adaptation and social sustainability. Yet organisational complexity may
621 make it difficult in practice to monitor – and, crucially, respond to - activities which threaten
622 ecosystem health. Policy and regulation that encourages cross-sector collaboration at the scales at
623 which actions are put into practice (e.g. the municipal and/or local levels), yet also assigns clear
624 responsibilities, may act to bring together the diverse range of knowledges required to address
625 complex issues;

24 Interview with female household head, XTNP

25 Interview with mushroom farming cooperative member, XTNP

26 Interview with Commune Chief, XTNP

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- Strengthen mechanisms and revise legislation for mangrove protection. This includes clarifying periods for exploitation, building local community commitment to mangrove protection areas, and developing processes for bringing stakeholders and communities together to work in the common direction of mangrove protection for social, environmental and economic sustainability. Clear in the interviews was that declining ecosystem health, whether due to climate change or more direct human activity, had knock-on effects for wellbeing in coastal communities. As such, given the climate adaptation, biodiversity protection and livelihood sustenance potential, mangrove protection should be considered a crucial foundation for the sustainability of Nam Dinh’s coast. At the same time, though, given the time taken for institution-led transitions to alternative lifestyles, this biodiversity and ecosystem protection has to be balanced with allowing communities some exploitation of ecosystems on which they rely;
 - To attain this balance between adaptation and development imperatives, work towards mechanisms for more equitable benefits-sharing in the management, protection and sustainable development of special use forests, which can be applied flexibly depending on case-specific circumstances. As per Section 4.3., knowledge and action at smaller spatial scales is key to putting climate change adaptation actions into practice. Collaboration with the park management council to engage actors at commune- or village-level may hence provide opportunity for management and monitoring of forest products and mangrove protection ‘on the ground.’ Drawing the experiences and understandings of community-level actors into governance processes could make a pathway to ensuring mangrove protection does translate into benefit for more marginalised and vulnerable people, by giving richer accounts of how environmental change affects daily living and also of the kind of access to natural resources that is required to improve living standards in the short term;
 - Develop holistic and gender-sensitive measures that tackle negative social and economic effects on women and seek to maximise the opportunities provided by increased responsibilities and alternative livelihoods. As discussed in Section 4.1., there is an awareness of gender mainstreaming at various policy levels, but this language does not necessarily translate into practical applications at the community and household levels that can effectively deal with the substantial changes in people’s everyday lives brought about by environmental change. To bridge the gap between policy language and implementation, measures should be informed by women’s knowledges and everyday experiences at community and household levels and must involve women from the community in their design and management;
 - Lastly, it is vital to remember mangroves are dynamic ecosystems, which may be altered further by a changing climate. To guide maintenance actions, there is hence a need to ensure that the evidence base on which policy decisions may be made is kept up to date, through continued monitoring of the productive functions of wetland ecosystems in coastal estuaries like XTNP-Ramsar site. This also

661 involves continued monitoring of social ‘systems’ to note shifts in community needs and in
662 relationships with the surrounding environment.

663

664 5.2. Broader implications for climate change and coastal communities scholarship

665

666 We finish with two wider implications from our findings for scholarship into environmental change and
667 coastal communities. The first concerns understanding effects at a local level. As narrated in Section 4.3.,
668 decisions about how to adapt to extreme events and changing conditions on the Nam Dinh coast are derived
669 from national-level models and policies, which filter down to the provincial level and then into advice and
670 actions for the commune and village level (all the while guided by international treaties and consultancies).
671 Challenges associated with downscaling knowledge to understand implications at smaller spatial scales and
672 aid regional or municipal planners have received much attention (e.g. Cooney, 2012; Casson, 2017). The
673 findings from our small-scale study add to this the need for ‘social downscaling’ alongside the interpretation
674 of physical science models at smaller spatial scales. Interviewees provided rich – and in cases emotionally-
675 charged – narratives of what daily living means under rising sea levels, saltwater intrusion and temperature
676 increases. These narratives add granularity to global or national assessments of effects of environmental
677 change on livelihoods and health (e.g. Smith et al, 2014; IPBES, 2016), which by necessity tend to focus on
678 losses in economic terms and health in metrics of mortality and disease.

679

680 Indeed, the profound effects that less ‘tangible’ emotional aspects that living in a changing environment can
681 have has not escaped attention (Calliari, 2016). Just as downscaling climate models is challenging, so too is it
682 difficult to translate predicted environmental changes into effects on community solidarity, sense of identity
683 and psychological wellbeing. When it comes to the role of ecosystems in climate change adaptation, IPBES
684 too adds that “[m]uch more poorly understood are the ways in which nature stabilises and regulates
685 environmental variation; how nature contributes to people’s cultural, psychological and spiritual well-being;
686 and how biodiversity provides options and opportunities for people in the future” (IPBES, 2016: 164). The
687 fact that all interviewees spoke about the hardships engendered by climate changes happening now on the
688 Nam Dinh coast indicates that attempting to assess the lived experience of not only extreme events but also
689 slower-onset changes ought to be a crucial component of planning for the future, including attention to how
690 ecosystem health benefits daily living. Integrating local knowledges into decision-making, and making room
691 for narrative accounts of perceptions and experiences of environmental change alongside ‘hard science’
692 modelling and observation, may be two ways of moving towards acknowledging this lived experience.

693

694 The second concluding point is the importance of evaluating environmental management actions grounded
695 in a technical and scientific knowledge evidence base within their wider social, political and cultural context.
696 A recurring theme in our findings has been the importance of coastal ecosystems in sustaining wellbeing,

697 especially for more marginalised members of society who tend to rely on these very same ecosystems. When
698 one also considers that mangroves in particular offer significant climate adaptation benefits through storm
699 surge reduction, the ecosystem-based adaptation goals discussed at the start of the paper become hard to
700 argue against. There is certainly an important role in climate adaptation for ecosystem management-led
701 responses, guided by physical science knowledge and working towards consensus on the common goal of
702 ecosystem and biodiversity protection to hasten deployment. Yet our findings from XTNP illustrate very well
703 Norgaard's (2010) summation of ecosystem services thinking as a 'complexity blinder.' Many of the trends
704 raised in the interviews – out-migration of young males, gender inequity, limited resourcing at local
705 government level – are intensified by climate factors, but have their roots in much broader social, economic
706 and political change (Adger, 2000). As such, there is a need for climate adaptation actions grounded in
707 ecosystem health to be supported by a wider range of social policy measures to ensure that climate
708 adaptation benefits accrue to the most vulnerable (e.g. training programmes focused on responding to
709 climate change in the present, alternative livelihood models that retain community bonds and solidarity),
710 and that the worst-off are not further disadvantaged by ecosystem protection measures.

711

712 As a peripheral region in a country ranked by the UN as being in the top five at risk from rising sea levels (UN,
713 2017), coastal Nam Dinh Province and XTNP offers significant insight into how environmental change may
714 affect marginalised coastal communities. Our review and interviews indicate that whilst coastal communities
715 like those around XTNP are subject to the same social and environmental pressures as other communities,
716 proximity to the sea serves to intensify the effects and risks from extreme events and ecosystem change,
717 particularly in places where reliance on ecosystems is higher. In turn, coastal managers and policymakers
718 may find themselves facing an even more difficult task in balancing development, biodiversity protection and
719 climate adaptation pressures.

720

721 **Statement of Author Contributions**

722

723 LM provided guidance for development of research questions, participated in interviews and site visits,
724 contributed to synthesis of findings, undertook English-language literature reviewing, and took overall
725 responsibility for drafting the manuscript; NST co-wrote English-language text on climate change in Nam Dinh
726 Province and Xuan Thuy National Park, led development of research and interview questions with PTT, and
727 led collaborative data analysis workshop process with PTT; NTKD co-wrote English-language text on climate
728 change in Nam Dinh Province and Xuan Thuy National Park, developed research and interview questions,
729 conducted Vietnamese-English interpretation during interviews and site visits, and participated in
730 collaborative data analysis (gender theme); PTT co-wrote English-language text on climate change in Nam
731 Dinh Province and Xuan Thuy National Park, co-led development of research and interview questions with
732 NST, and co-led the collaborative data analysis workshop process with NST; CTTN reviewed and evaluated

733 existing policy for biodiversity protection in XTNP, developed research and interview questions, and
734 participated in collaborative data analysis (knowledge and policy theme); LTQ developed research and
735 interview questions, led questioning in the participant interviews, participated in collaborative data analysis
736 (knowledge and policy theme), and produced maps and figures to define the study area; DTT developed
737 research and interview questions, led the collation of field notes and photographs during field work, and
738 participated in collaborative data analysis; NTTH developed research and interview questions, led
739 questioning in the participant interviews, and participated in collaborative data analysis (gender theme);
740 NTBN developed research and interview questions, was responsible for note-taking during interviews and
741 site visits, and participated in collaborative data analysis (knowledge and policy theme); LHN developed
742 research and interview questions, conducted Vietnamese-English interpretation during interviews and site
743 visits, and participated in collaborative data analysis (health and wellbeing theme); TTT developed research
744 and interview questions, was responsible for note-taking during interviews and site visits, and participated
745 in collaborative data analysis (health and wellbeing theme); BTCT developed research and interview
746 questions, conducted Vietnamese-English interpretation during interviews and site visits, and participated in
747 collaborative data analysis (knowledge and policy theme); TNA developed research and interview questions,
748 was responsible for note-taking during interviews and site visits, and participated in collaborative data
749 analysis (gender theme); NMH provided guidance for development of research questions, participated in
750 interviews and site visits, contributed to the synthesis of findings, and made theoretical contributions to the
751 manuscript relating to gender and climate change; CY provided guidance for development of research
752 questions, participated in interviews and site visits, contributed to the synthesis of findings, and made
753 theoretical contributions to the manuscript relating to health, wellbeing and climate change. All authors
754 reviewed and approved the final manuscript.

755

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757

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764

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1105 BRINGING SOCIAL AND CULTURAL CONSIDERATIONS INTO ENVIRONMENTAL MANAGEMENT FOR
1106 VULNERABLE COASTAL COMMUNITIES: RESPONSES TO ENVIRONMENTAL CHANGE IN XUAN THUY
1107 NATIONAL PARK, NAM DINH PROVINCE, VIETNAM

1108

1109 SUPPLEMENTARY MATERIAL – OVERVIEW OF RESEARCH AND WRITING PROCESS

1110

1111 *The purpose of this supplementary document is to provide the reader with an overview of the*
1112 *research design, execution and analysis process. As well as providing additional information as to*
1113 *how this specific study was undertaken, we hope it may be of use to other researchers managing*
1114 *large interdisciplinary and cross-cultural research teams.*

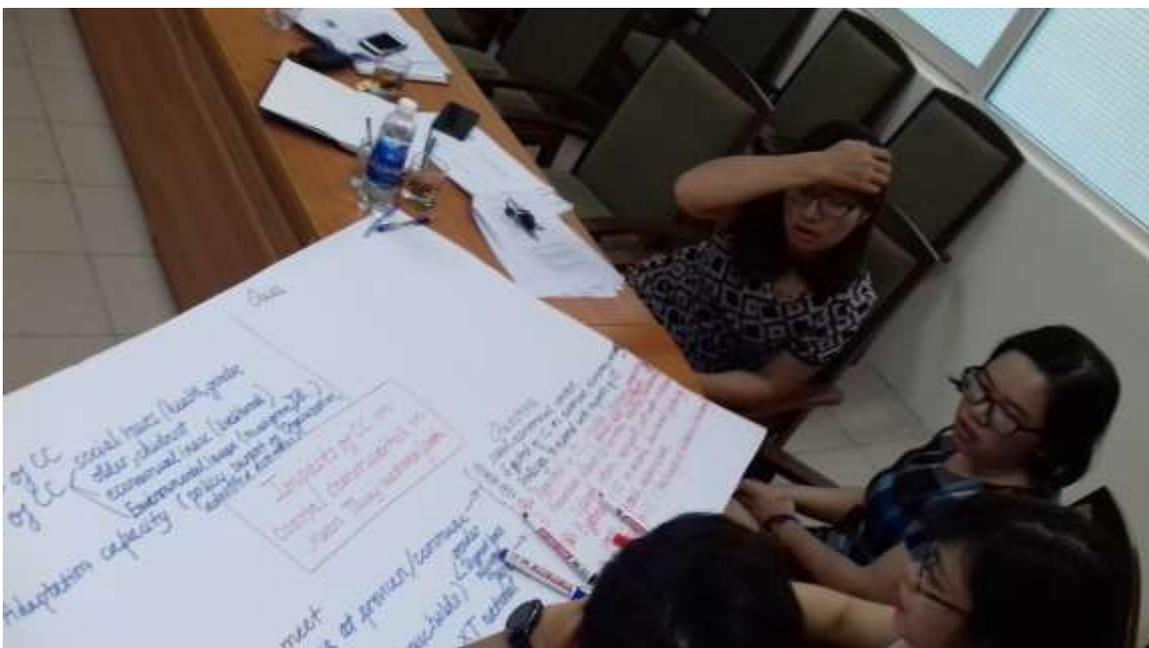
1115

1116 1. Conception and design of research

1117

1118 Underneath the generic title of ‘effects of climate change on coastal communities’ specified in the
1119 funding application, more specific research questions were developed dialogically among the entire
1120 research team during a day-long workshop. This entailed facilitated discussion among the entire
1121 project team to determine more precise areas of enquiry that could be addressed with the available
1122 data (i.e. available interviewees and underlying policy documentation), and then discussion in
1123 smaller groups (see Figure S1) to focus in on the kinds of questions that could be asked of
1124 interviewees to answer these research questions. Through this, the topic of ‘effects of climate
1125 change on livelihoods of citizens in the buffer zone of Xuan Thuy National Park’ was determined, and
1126 interview schedules were produced and agreed upon by the project team.

1127



1128

1129 Figure S1: development of research questions and interview schedules within the research team

1130 (source: authors' own photograph)

1131

1132 2. Execution of research

1133

1134 The narrative review of extant literature into biodiversity and climate change policy in Xuan Thuy
1135 National Park and Nam Dinh Province was led by Lead Author Leslie Mabon, with guidance from
1136 English-language summaries of the current environmental status in the area produced by Nguyen
1137 Song Tung, Nguyen Thi Kim Dung, Pham Thi Tram and Cao Thi Thanh Nga.

1138
1139 The interviews were undertaken collaboratively by the majority of the research team. This
1140 collaborative approach to interviewing was necessary due to language differences and logistical
1141 challenges. The research team split into three groups (see Figure S2). Each group contained one or
1142 two Vietnamese researchers who led on questioning the interviewee, asking follow-up questions
1143 where necessary; one Vietnamese researcher as a note-taker (due to ethical sensitivities around
1144 recording interviews); one UK-based team member; and one Vietnamese researcher as interpreter,
1145 to summarise the key points of discussion for the UK-based team member and translate any follow-
1146 up questions the UK-based team member may wish to ask.

1147



1148
1149 Figure S2: collaborative interviewing in Xuan Thuy National Park (source: authors' own
1150 photograph)

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1155 3. Interpretation of research

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1157 Data collected during the interviews and site visits was synthesised collaboratively during another
1158 day-long workshop involving all project team members. After a brief introduction to grounded

1159 theory techniques of analysis, all team members wrote out points which arose during the interviews
1160 on post-it notes, referring back to the notes taken during the interviews to ensure accuracy. The
1161 research team then worked together to cluster the post-it notes together (see Figure S3), first into
1162 areas of immediate connection and then into larger groupings. This gave themes and sub-themes
1163 reflective of the content of the interviews, which were further refined via facilitated discussion
1164 among the project team. The final groupings, and subsequent notes on their implications for policy,
1165 were photographed in high-resolution to allow later writing up (Figure S4).
1166



1167
1168 Figure S3: group data analysis session (source: authors' own photograph)

1169
1170 Lead Author Leslie Mabon then wrote the first draft of the manuscript, writing up the findings of the
1171 literature review and grounded theory analysis, adding a methodology section and including the
1172 contextual information on Nam Dinh Province and Xuan Thuy National Park provided by Nguyen
1173 Song Tung, Nguyen Thi Kim Dung, Pham Thi Tram and Cao Thi Thanh Nga. This first draft was then
1174 discussed in full at a writing workshop attended by Leslie Mabon, Natascha Mueller-Hirth, Nguyen
1175 Song Tung, Nguyen Thi Kim Dung and Pham Thi Tram, after which point it was amended further by
1176 Leslie Mabon.

1177
1178 After internal circulation and review by all authors for technical accuracy and agreement with the
1179 intellectual content, the final version of the manuscript was agreed upon during a meeting between
1180 Lead Author Leslie Mabon and second/third/fourth authors Nguyen Song Tung, Nguyen Thi Kim
1181 Dung and Pham Thi Tram in October 2017, after which point it was submitted.
1182



1183
1184 Figure S4: grounded data analysis outputs (source: authors' own photograph)

1185
1186 4. A note on authorship

1187
1188 Whilst the case study under review in this paper is relatively small in terms of space and time, the
1189 linguistic constraints and logistical challenges of undertaking empirical research in a marginalised
1190 coastal region mean a significant range of skills and competences were integral to the conception,
1191 design, interpretation and execution of the study. Following Cook et al (2005), it is thus imperative
1192 to acknowledge that a number of people were crucial in producing the knowledge reported here.
1193 Cassells et al (2011) argue this is particularly important when undertaking research with
1194 collaborators in a 'Global South' context, whose local knowledges and infrastructure may be vital to
1195 being able to undertake research in practice. Given that this is the case for our research too, we heed
1196 Cassells et al's call to collaborate fully with local scientists so that they too may be listed as authors
1197 on the final outputs. Moreover, given the specific social and cultural context of the case study area,
1198 involvement of a number of in-country authors across the case study was seen as a guard against
1199 avoiding epistemological assumptions based on a 'Western' understanding of environmental and
1200 social issues (after de Sousa Santos, 2014).

1201
1202 To this end, Table 1 below specifies the role that each author played in making the research possible
1203 and their contributions in line with publishing ethics procedures. We hope that as well as clarifying
1204 authorship arrangements, this will also serve as an example for other researchers working in similar
1205 ocean and coastal contexts about the value of full collaboration with in-country partners across the
1206 full span of the research process.

1207
1208
1209

Author name	Specific actions undertaken across development of paper
Leslie Mabon	Guidance for development of research and interview questions; involvement in field work; synthesis of findings; literature reviewing; overall responsibility

	for drafting manuscript.
Nguyen Song Tung	Drafting English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park; leading development of research and interview questions; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Nguyen Thi Kim Dung	Drafting English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park; development of research and interview questions; Vietnamese-English interpretation during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Pham Thi Tram	Drafting English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park; leading development of research and interview questions; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Cao Thi Thanh Nga	Review and evaluation of existing policy for biodiversity protection in Xuan Thuy National Park, forming contextual basis for paper; development of research and interview questions; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Le Thu Quynh	Development of research and interview questions; lead questioner during interviews; involvement in collaborative data analysis workshop; production of maps to define study area; review and approval of final manuscript.
Dang Thanh Trung	Development of research and interview questions; collation of field notes and photographs during fieldwork; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Nguyen Thi Huyen Thu	Development of research and interview questions; lead questioner during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Nguyen Thi Bich Nguyet	Development of research and interview questions; note-taker during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Le Hong Ngoc	Development of research and interview questions; Vietnamese-English interpretation during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Tran Thi Tuyet	Development of research and interview questions; note-taker during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Bui Thi Cam Tu	Development of research and interview questions; Vietnamese-English interpretation during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Tran Ngoc Anh	Development of research and interview questions; note-taker during interviews; involvement in collaborative data analysis workshop; review and approval of final manuscript.
Natascha	Guidance for development of research and interview questions; involvement

Mueller-Hirth	in field work; refining synthesis of findings; theoretical contributions to draft manuscript; review and approval of final manuscript.
Chris Yuill	Guidance for development of research and interview questions; involvement in field work; refining synthesis of findings; theoretical contributions to draft manuscript; review and approval of final manuscript.

1210 Table S1: Roles and tasks performed by each author

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