

1 **Building adaptive capacity to climate change in tropical coastal communities**

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3

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29 **Preface:**

30 To minimize the impacts of climate change on human wellbeing, governments,
31 development agencies, and civil society organizations have made substantial investments in
32 improving people's capacity to adapt to change. Yet to date, these investments have

33 tended to focus on a very narrow understanding of adaptive capacity. Here, we propose an
34 approach to build adaptive capacity across five domains: the assets that people can draw
35 upon in times of need; the flexibility to change strategies; the ability to organize and act
36 collectively; learning to recognise and respond to change; and the agency to determine
37 whether to change or not.

38

39 **Main text:**

40 Tropical coastal communities that depend heavily on natural resources are on the front line
41 of climate change. Fisheries and agricultural productivity is likely to be decreased^{1, 2, 3}, and
42 the built infrastructure that supports them will be especially vulnerable to sea level rise⁴. An
43 increasing frequency and intensity of coral bleaching events due to global warming has
44 already significantly affected coral-reef dependent coastal communities⁵. The human effect
45 of such changes varies from place to place and even from person to person, depending on
46 the local manifestations of climate change (i.e. the exposure), the degree to which people
47 depend on affected resources (i.e. their sensitivity), and on their capacity to adapt to or take
48 advantage of the changes they experience (i.e. their adaptive capacity)⁶.

49

50 In light of profound climate change impacts that have already affected both people and the
51 ecosystems they depend on, there is an urgent need to bolster the capacity of tropical coastal
52 communities to adapt. Indeed, many local and national governments, development agencies,
53 and non-governmental organizations are engaged in efforts to build adaptive capacity, yet
54 there is little guidance on how this capacity might be developed. Adaptive capacity refers to
55 the conditions that enable people to anticipate and respond to change, to minimize the
56 consequences, to recover, and take advantage of new opportunities⁷. Earlier research
57 identified key underlying determinants of adaptive capacity as the availability of capital (e.g.,
58 financial, social, human) in times of need^{8, 9, 10}. Yet recent evidence suggests that adaptive
59 capacity is not simply about having the necessary resources at hand, but also about the
60 willingness and capability to convert resources into effective adaptive action^{11, 12}.

61

62 Here, we synthesize research across a range of disciplines to highlight how adaptive capacity
63 could be built across five key domains (Fig. 1). These are: 1) the **assets** that people can draw
64 upon in times of need; 2) the **flexibility** to change strategies; 3) the ability to **organize** and

65 act collectively; 4) **learning** to recognize and respond to change; and 5) the **agency** to
66 determine whether to change or not^{11, 13, 14, 15, 16, 17}. Below, we discuss these five domains of
67 adaptive capacity and highlight strategies for their development. As a focal lens for these
68 issues, our synthesis primarily uses examples from tropical coastal communities because they
69 are at the coalface of significant climate change impacts, and are already receiving
70 substantial adaptation investments. However, we believe that many of our points relate to
71 building adaptive capacity more broadly. Although tropical coastal communities can develop
72 capacity at multiple scales, we primarily focus on the individual, household, and community
73 scales, which are typically the focus of many community development and aid programs that
74 attempt to build adaptive capacity. Critically, many strategies for building adaptive capacity
75 have the potential to interact with other social and ecological dynamics in ways that create
76 unintended and maladaptive changes to the flow of social and ecological goods and services.

78 **Assets**

79 Assets are the financial, technological, and service (i.e. health care) resources to which
80 people have access to, which can be individually owned or public goods. People are generally
81 better able to adapt when they have assets to draw on during times of change^{18, 19}. For
82 example, coastal societies experiencing a shift in the ranges of important fish species^{1, 2} might
83 draw upon financial assets (savings or credit) to purchase bigger boats and freezers to store
84 fish during longer journeys, in order to fish further afield. Likewise, fishers might adapt to
85 altered compositions of fish assemblages by purchasing new fishing gear that selectively
86 targets the species that have increased in abundance^{20, 21}.

88 For tropical coastal communities, building assets could involve: 1) improving productivity
89 through using new technologies and improving efficiencies; and 2) increasing opportunities
90 to access affordable capital, credit, and insurance^{22, 23, 24}. Some coastal residents also benefit
91 from social investments (e.g., healthcare) that help to prevent a decline of existing assets
92 (e.g. household assets critical to sustaining livelihoods)^{22, 24}. For example, Malaria is a cause
93 of morbidity and mortality in many tropical coastal areas, and households affected by death
94 or illness of household members may find their attempts to secure their livelihoods thwarted
95 by having to meet the costs of recurrent illnesses, often having to sell productive assets (land,
96 livestock, and fishing gear) to cope. This then erodes their capacity to adapt to future shocks

97 and adverse trends²³. Interventions to address Malaria (e.g. by improving availability of
98 insecticide-treated bed-nets, or improving availability of anti-malarial drugs and emergency
99 care), could therefore help such households escape these ‘poverty traps’²² and build the
100 household assets that could, in the long term, help them adapt to a changing climate. This
101 illustrates the complex and multi-scale interactions between planned and autonomous
102 adaptive action to multiple stressors.

103

104 Attempts to build or secure assets can focus on individuals (for example, providing micro-
105 credit loans) or community-scale public goods (such as infrastructure or information
106 dissemination). However, investments in public goods may fail to reach the most vulnerable
107 if certain social mechanisms (such as caste systems, gender inequality, etc.) prevent some
108 people from accessing the benefits^{13, 25, 26}. In these situations, attempts to build adaptive
109 capacity can strongly differentiate society, and it is critical to be aware of the power
110 asymmetries and political dimensions that underpin the potential impacts of intervention.

111

112 Although it is often assumed that the wealthy are better able to adapt to change than the
113 poor^{18, 27}, building assets that enhance people’s ability to exploit natural resources may
114 actually increase the vulnerability of coastal communities to climate change by undermining
115 the long-term sustainability of coastal ecosystems. This represents both temporal and social
116 trade-offs inherent in adaptation strategies, which must be heeded when designing
117 interventions to enhance adaptive capacity. For example, in Tanzania, fishers who were more
118 likely to intensify fishing effort in response to lower catches (thereby increasing exploitation)
119 were those who had assets, but lacked flexibility to change livelihood strategies²⁸. Wealthier
120 fishers were thus more likely to catalyse a ‘social-ecological trap’, whereby lower yields
121 increased fishing exploitation, which in turn further decreased yields²⁸. Likewise, investments
122 in basic infrastructure such as roads may increase people’s assets by improving market
123 accessibility, while serving as a catalyst for other types of development (e.g., access to
124 education, healthcare, and markets)²⁹ that can provide greater flexibility and agency to
125 manage climate shocks³⁰. However, access to markets is also a key driver of
126 overexploitation³¹ and habitat destruction³², and may increase social-ecological
127 vulnerability²⁰.

128

129 **Flexibility**

130 The flexibility domain of adaptive capacity reflects opportunities for switching between
131 adaptation strategies and captures the diversity of potential adaptation options available.
132 Organisations and individuals with more flexibility are better able to adapt to climatic
133 impacts. In coastal communities reliant on natural resources, flexibility within people's
134 current occupations (e.g., fishing or marine-based tourism) can enable them to minimize
135 losses or even take advantage of climate-related changes, such as shifting species
136 abundance, species range^{1, 20}, or habitat destruction. Flexibility allows people to change
137 fishing strategies and the location of fishing grounds and tourism operations. For example,
138 fishers in Peru were able to rapidly change from gill and seine nets aboard their fishing boats
139 to trawl nets in response to an abundance of shrimp that appeared with the extreme marine
140 heat wave associated with the 1997-98 El Niño²³. Flexibility also entails the capacity to shift
141 into different occupational sectors (e.g., agriculture and non-natural resource based
142 enterprises), either temporarily or permanently, in response to climate change impacts (e.g.,
143 reductions in fisheries yields or eco-tourism revenue). At a larger scale, the flexibility of
144 organizations and institutions (i.e. both formal and informal rules and norms) to adjust rules,
145 boundaries, partners, and membership helps to manage shocks and perturbations associated
146 with climate change^{23, 33, 34}. For example, in coastal cities in Queensland, Australia, local
147 governments have implemented policies to facilitate the re-building of housing and
148 infrastructure at higher levels after flooding³⁴.

149
150 Building flexibility in tropical coastal communities will require a number of strategies. At a
151 larger scale, organizations and institutions can build flexibility through processes of ongoing
152 monitoring and review, with regular formal revision. At the individual scale, flexibility could
153 be fostered by removing social and legal barriers that can constrain key adaptation actions,
154 such as switching to new fishing gears³⁵. Building the flexibility to change the location of
155 fishing grounds or tourism operations will not only require the removal of barriers to fishing
156 in different locations, but also require developing ecological knowledge about new places³⁶,
157 the capacity to reach them (i.e. potentially larger boats). Efforts to build the flexibility to shift
158 occupations primarily focuses on developing alternative income or subsistence livelihoods
159 that are often implemented in conjunction with interventions to reduce poverty³⁷. For

160 example, in North Sulawesi, Indonesia, the introduction of seaweed farming as an alternative
161 to fishing improved villagers' material assets³⁸.

162

163 There are often interactions between flexibility and other domains of adaptive capacity that
164 potentially create other adaptation trade-offs. For example, as coastal communities become
165 wealthier (i.e., have more assets), they often exhibit lower livelihood flexibility³⁹. As with the
166 building of assets, the building of flexibility also has potential ecological consequences. For
167 instance, since different fishing gears selectively target different sizes and species of fish,
168 there can be ecological consequences of adopting fishing gears that preferentially target
169 specific species, e.g., those that play a critical role in the maintenance and recovery of coral
170 reef ecosystems⁴⁰. In addition, increasing people's spatial flexibility to adapt to climate
171 change may have negative ecological consequences (such as boom and bust episodes for
172 high demand fish species)⁴¹. Increased mobility may also be at odds with property rights-
173 based fisheries management or marine spatial planning initiatives that aim to promote
174 sustainability and reduce conflict by defining and limiting where certain activities can occur⁴².
175 Specifically, fisheries management strategies such as Territorial Use Rights for Fishers
176 (TURFs) that define and limit entry into fishing grounds may limit other aspects of flexibility,
177 such as the ability of fishers to move their fishing activities along the coast⁴². Diversification
178 of livelihood activities can also create unintended ecological consequences. For example,
179 investments in alternative livelihoods in aquaculture lead directly to pollution loading and
180 contribute to salinity intrusion, thereby disrupting ecosystem services and the well-being of
181 others^{43, 44}.

182

183 There are a number of challenges to building flexibility. Alternative livelihood projects often
184 fail for social and cultural reasons⁴⁵. For example, the extent that fishers create a sense of
185 themselves around their occupation ("occupational identity") or their place of residence
186 ("place attachment") can limit whether they are able to re-imagine themselves in other roles
187 or places if the need to change arises^{46, 47}. Additionally, diversification is not always an option
188 for households that are trapped in deep poverty because there can be insurmountable costs
189 and risks associated with trying something new^{24, 48}. In these cases, building the flexibility
190 component of adaptive capacity requires that costs and risks are buffered with the provision
191 of skills and access to capital^{49, 50}.

192

193 **Social organization**

194 Social organization is the domain of adaptive capacity that captures the ways in which society
195 is organized to enable (or inhibit) cooperation, collective action, and knowledge sharing^{16, 51}.

196 Formal and informal relationships between individuals, communities, and organizations can
197 help people deal with change by providing social support and access to knowledge and
198 resources¹⁶. Critically, social organization is by nature multi-scale, containing individual,
199 collective, and organizational dimensions¹⁶. For example, preparing for or recovering from
200 high-intensity storms often requires individual people to help one another and state agencies
201 to coordinate short-term recovery and long-term resilience strategies⁵². Likewise, networks
202 that promote information exchange and cooperation can help communities adapt to changes
203 such as increasingly variable fish catch or weather patterns⁵³.

204

205 Trust and social cohesion within communities (referred to as bonding social capital) can play
206 a key role in whether or not people will support each other in times of crisis, or agree on
207 coordinated action to confront climate-induced threats⁵⁴. Governments, development
208 agencies, and civil society organizations can build bonding social capital by creating
209 opportunities for sustained interaction among groups through community events,
210 recreational activities, and spiritual gatherings⁵⁵. Building connections across communities
211 (bridging social capital), and to people or organizations operating at larger scales, (e.g.,
212 international NGOs and financial organizations; linking social capital) can help to secure
213 access to resources, scientific information, and technological innovations that facilitate
214 adaptation⁵⁶. For example, when climate change impacts are so severe that people must
215 change livelihoods, bridging connections can provide crucial information about new job
216 opportunities⁵⁷. Likewise, linking social capital can provide access to novel sources of
217 information and resources, and give people a voice in adaptation planning and policy
218 occurring at higher levels⁵⁴. Bridging and linking social capital can be fostered by creating
219 shared values and interpretation of experience through dialogue and engagement, through
220 reducing disparities in income and wealth, and by enabling a sense of involvement in working
221 towards collective goals⁵⁸. Such efforts can include developing or strengthening institutions
222 for collective action, such as co-management^{59, 60}. Indeed, collaborative management
223 processes have been shown to improve adaptive capacity by strengthening links among

224 people responsible for disaster planning in Trinidad and Tobago⁶¹, and among fishers in
225 Chile⁶².

226

227 Bonding, bridging, and linking social capital facilitate different types of adaptation. For
228 example, strong bonding ties can be crucial for survival in the face of extreme natural
229 disasters and conflict⁶³, while bridging and linking ties can help national and regional
230 adaptation policies to reflect the goals and objectives of local communities. Robust adaptive
231 capacity depends on having a balance of different types of social capital, where having too
232 much of one type can actually inhibit adaptation. For example, strong cohesive groups can
233 become locked into a particular way of thinking that prevents learning about change or
234 adaptation options⁶⁴. Likewise, when only local elites have bridging and linking connections,
235 the wider community may lack access to the assets needed to effectively respond to
236 change¹⁷. Consequently, efforts to build social capital need to consider whether and how
237 different types of social capital are available to people, and how social organization interacts
238 with the other components of adaptive capacity.

239

240 Empirical examples of building the social organization dimension of adaptive capacity are
241 limited, but emerging evidence suggests that practical efforts can include: 1) establishment
242 and strengthening of networks across scales (e.g. community, provincial, and national)⁶⁵; 2)
243 community currency, or time banking systems, where individuals are incentivised to
244 volunteer⁶⁶. This not only creates novel connections in the community, but also material and
245 mental health benefits among participants⁶⁷; and 3) creation of interaction arenas where
246 people can work together towards shared goals, build trust, and develop social cohesion⁶⁷.
247 Such arenas occur through community meetings and the facilitation of other social events,
248 as well as through town/community planning that creates physical interaction spaces.

249

250 **Learning**

251 Learning reflects people's capacity to generate, absorb, and process new information about
252 climate change, adaptation options, and ways to live with, and manage, uncertainty^{23, 33, 68}.
253 Learning can be experimental or experiential, and occurs within and across multiple
254 organisational, spatial, and temporal scales⁶⁹. For example, in response to climate change,

255 fishers will have to learn about new fishing grounds, gears, weather patterns, technologies,
256 species, and in some cases, new ways of making a living.

257

258 Building the learning domain of adaptive capacity to climate change will require supporting
259 processes that enable people to frame or reframe problems by recognizing change,
260 attributing this change to its causes, and assessing potential responses^{18, 70}. This may involve
261 supporting formal education⁷¹, as well as informal forums for learning.

262

263 Provision of access to critical information, such as market prices and weather forecasts, is
264 central to building the learning domain of adaptive capacity in coastal communities. For
265 example, early warning systems can help fishers assess potential risks, reduce lost or
266 unproductive fishing days, and ultimately reduce deaths²³. Likewise, seasonal forecasts can
267 help coastal farmers to choose crops with the best yields under new climatic conditions⁷, and
268 future rainfall projections can help local governments manage areas vulnerable to flooding³⁴.

269 Learning to adapt to climate change also requires investment in peer-to-peer networks (also
270 referred to as communities of practice)⁷² that allow people to share experiences of ecological
271 surprise from other locations and other knowledge systems (e.g., expert, local, indigenous).
272 Such peer-to-peer networks have not only facilitated learning, but also empowered people
273 to develop novel adaptation strategies⁷³. For example, the Locally Managed Marine Areas
274 network connects and shares experiences among coastal communities across the Indo-
275 Pacific, blending scientific and local ecological knowledge systems to implement a range of
276 community-based fisheries management strategies⁷⁴.

277

278 Learning may emerge in a locally generated or self-organized form triggered by crisis, or
279 because of an active adaptive co-management strategy. Learning provides depth in
280 understanding and occurs across time scales, where instrumental single-loop learning occurs
281 within short-to medium periods, and deeper double-loop learning occurs over longer time
282 scales. Instrumental single-loop learning only informs and changes the most immediate
283 technical operations (e.g. turning on the air conditioner in a heatwave), while deeper double-
284 loop learning may change governance procedures at the organizational level (e.g. local green
285 infrastructure planning), and even overarching values and norms at the policy and
286 paradigmatic levels (e.g. reduction of carbon emissions at a societal level)⁷⁵. Both single and

287 double-loop learning are challenging to orchestrate as they tightly couple with other domains
288 of adaptive capacity, and building this domain can have knock-on effects. For example,
289 supporting formal education opportunities can indirectly reduce poverty and improve
290 health⁷¹. Yet, learning may only enable adaptation when other domains of adaptive capacity,
291 such as agency, flexibility, and social organization, are sufficient.

292

293 **Agency**

294 Effective adaptation to environmental change not only requires that people have assets,
295 flexibility, learning, and social organization, but also that they have the power and freedom
296 to mobilize these components of adaptive capacity to actively shape their future. Agency,
297 our fifth domain of adaptive capacity, generally refers to the ability of people – individually
298 or collectively – to have free choice in responding to environmental change^{11, 12}. It is
299 dependent upon people’s belief in their own ability to perform and manage prospective
300 situations and control events that affect them, encompassing aspects of empowerment,
301 motivation, and cognition^{14, 76}.

302

303 Agency plays a pivotal role in activating the other domains of adaptive capacity. For example,
304 the availability, access to, and interpretation of information about the impacts of climate
305 change on fisheries (which are key aspects of learning) are insufficient to enact adaption
306 unless fishers are willing or able to use this information to support the adaptation process⁷⁷.
307 People have little incentive to adapt unless they believe that their actions can produce
308 desired outcomes or forestall undesired ones⁷⁸. As such, agency is the basis for creating
309 visions of alternative futures when large-scale changes are necessary. For example, fishers in
310 Chile have created a new alternative vision for biodiversity conservation in which they have
311 conservation rights within TURFs⁷⁹. However, agency can also be the source of resistance and
312 opposition to adaptation efforts, particularly when they encroach upon key cultural values
313 such as place attachment and occupational identity⁸⁰.

314

315 Building agency for adaptive capacity to climate change involves three key types of actions:
316 1) incorporating local or customary knowledge, skills, and management into both science and
317 policy^{36, 81}. For example, climatologists and communities have used indigenous knowledge to
318 develop climate history and baseline data, to formulate research questions and develop

319 locally acceptable climate adaptations⁸¹; 2) empowering people through participatory
320 processes such as adaptive co-management^{33, 82}. For example, in the Philippines, people
321 became actively involved in climate adaptation because decentralization devolved
322 management authority to the municipality level⁸³; and 3) removing barriers that may inhibit
323 people's ability to exercise agency^{14, 15}. For example, reduction of regulatory and economic
324 barriers that restrict small-scale water storage has been associated with increased household
325 agency over water security in Small Island Developing States⁸⁴.

326

327 **Frontiers in building adaptive capacity to climate change**

328 Scientific frontiers for the building of adaptive capacity relate to trade-offs between the
329 different domains of capacity, issues of justice and distribution, and management of the
330 complexity of feedbacks. First, where are the important trade-offs in adaptive capacity, and
331 where are investments likely to have greatest benefits? Current models and concepts of
332 adaptive capacity do not resolve critical issues of optimal investment across the different
333 domains of adaptive capacity to influence adaptation. They also fail to determine how
334 investments in adaptive capacity may differ by type, for example, investment in adaptation
335 to long-term environmental stresses from climatic changes will differ considerably to
336 investment in adaptation to short-term weather-related shocks. Future research should
337 address these issues through resolving two dimensions: the substitutability of elements of
338 adaptive capacity and the existence of trade-offs, for example through inadvertently
339 reducing one domain of adaptive capacity through investing in others.

340

341 The analysis and examples reviewed here suggest that there is limited substitutability
342 between domains of adaptive capacity with respect to shocks and long-term change:
343 investment in assets does not provide the same capacity to adapt as increasing social and
344 individual learning or managing risk. The concept of limited substitution means that adaptive
345 capacity may be restricted by the weakest of its underlying determinants—the so-called
346 weakest link hypothesis^{85, 86}. However, the weakest link idea has not been tested, and would
347 require longitudinal and control studies to assess such trade-off effects⁸⁷.

348

349 A further question for trade-off analysis is whether building specific domains of adaptive
350 capacity may actually crowd out or undermine other domains. For example, collective action

351 and civic volunteerism can be crowded out by the provision of certain types of government
352 services (i.e. building assets)⁵⁸. Measuring and monitoring the effectiveness of different types
353 of adaptive capacity building programs will be critical to informing these debates⁸⁸, where a
354 portfolio approach that builds capacity across domains would minimise the risks of significant
355 trade-offs.

356
357 A second critical frontier is the intersection between social justice and the building of
358 adaptive capacity. Better understanding of how social justice affects and is affected by efforts
359 to build adaptive capacity will be crucial to avoiding unintended and even perverse
360 outcomes. For example, rebuilding community-scale infrastructure after a disaster most
361 often exacerbates existing inequalities - making already vulnerable people even more
362 vulnerable and undermining their capacity to adapt in the future. Yet rebuilding
363 infrastructure offers opportunities for progressive planning that redresses past injustices⁶⁸,
364 ^{89, 90}. Likewise, building aspects of adaptive capacity through removing social and cultural
365 institutions that form barriers to adaptation (e.g., customary taboos that restrict where and
366 when people can fish) often has the perverse effect of undermining culturally important
367 beliefs and practices that help to form a basis for agency⁹¹. The issue of social justice and
368 adaptation is particularly relevant because of the politics that drive how adaptation and
369 recovery efforts and investments are targeted towards specific populations, places, and
370 capacities. The differential response of US hurricane relief in Texas and Puerto Rico in 2017
371 highlights how recovery investments can be driven at least as much by politics as need.

372
373 Place attachment and occupational identity are two further examples where building
374 adaptive capacity towards new occupations or living in new regions can isolate or influence
375 resource-users and impact on their capacity to adapt over the longer term⁹². Future research
376 directions include developing insights into where identity and place attachment are
377 important to maintain in order to ensure that system resilience occurs across scales.
378 Communities may need strategies to maintain identity (individual or system identity) or
379 remain in place. Policymakers should guide such interventions according to the principle of
380 leaving no one behind, now embedded in the Sustainable Development Goals.
381 Correspondingly, strategies that are “pro-poor” and focused on sustainable adaptation⁹³
382 highlight the difficulties associated with reaching the poorest and most vulnerable

383 populations. Often the factors that keep people poor keep them vulnerable, so addressing
384 root causes of poverty in some cases will support adaptive capacity. Efforts to build adaptive
385 capacity will also frequently need to move beyond the local, but at the same time recognise
386 that enhancing capacities of one community may have unintended consequences or
387 undermine capacities at another scale.

388

389 The third frontier involves better understanding key linkages and feedbacks to inform
390 improved adaptation outcomes^{33, 54}. These linkages and feedbacks occur between scales,
391 between domains of adaptive capacity, and between social and ecological dynamics. Larger-
392 scale social dynamics such as demographics and governance may set a social or political
393 context that enables or inhibits adaptation at smaller scales⁹⁴. Additionally, adaptation
394 actions or capacity building in one location or scale may undermine the adaptive capacity of
395 other geographies, people, and scales. These issues may be particularly relevant in tropical
396 coastal areas where high rates of migration, ecological change, and shifting governance of
397 natural resources exacerbate issues of resource control and conflict^{94, 95}. Consequently,
398 investigating the multiscale nature of adaptation and the larger-scale conditions that enable
399 or inhibit local-scale adaptive capacity should be a high priority research area. Additionally,
400 certain adaptation responses (such as changing fishing strategies), interact with ecological
401 dynamics in ways that affect the flows of ecosystem goods and services, with knock-on
402 impacts to human wellbeing. Scenarios, modelling, and empirical research into threshold
403 relationships⁹⁶ and feedbacks both between domains of adaptive capacity and between
404 social and ecological systems^{97, 98} will be critical to identifying how to minimize the negative
405 and unintended consequences of building adaptive capacity, and will also help identify where
406 critical trade-offs exist.

407

408 In the wake of major climate-induced threats to coastal systems such as the global coral reef
409 bleaching event associated with the 2015-16 El Niño⁵, many coastal communities around the
410 world are now adapting to the aftermath of multiple interacting stresses on their coastal
411 environments. The need to build adaptive capacity to help these communities anticipate and
412 deal with these changes will only continue to escalate. To date, ad hoc and localised
413 documentation and monitoring of efforts to build adaptive capacity has rendered it difficult
414 to assess success. Yet parties to the 2015 Paris Agreement underscored the realisation that

415 adaptation is no longer just a local issue but “a global challenge faced by all”⁹⁹. Assessment
416 of past and ongoing efforts to build adaptive capacity across the five domains we identify
417 here will be critical to effective adaptation to this global challenge across multiple scales and
418 places.

419

420

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433

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789 **Fig. 1| Five domains of adaptive capacity to climate change: Assets, Flexibility, Social**
790 **Organization, Learning, and Agency. The five domains are interlinked; feedbacks and**

791 **interactions can occur among any of the domains, not just the neighbouring ones**
792 **graphically represented by connecting arrows.**
793