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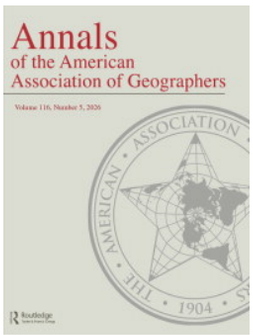

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Transformative Capacity of Vulnerable Populations in Indonesia and Myanmar for Adapting to Coastal Flooding

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Transformative adaptation interventions protect vulnerable populations from the dreadful consequences of climate change. Current debates emphasize system change and collective agency, leaving the concept of transformative individual adaptation undefined. This article aims to present a fuller account of transformative action and capacity at the microlevel (i.e., individual and household). Our study examines adaptation responses of different levels of disruptive impact and their relationships with the inherent and acquired capacities of individuals. Evidence was collected from coastal areas in Indonesia and Myanmar through structured questionnaire surveys. Results show that voluntary migration and social mobilization are a function of transformative capacity. Incremental action is only predicted by indicators of coping capacity, representing assets, capabilities, and entitlements. These findings suggest that enabling transformative individual adaptation requires the strengthening of individual agency, encompassing perception of change, flexibility, interest in undertaking significant change, and autonomy. A conceptual framework is presented in this article, integrating these considerations with other contextual factors, including socioeconomic characteristics, values, and power relations. This study reveals key determinants for capacity-building initiatives to facilitate transformative individual adaptation. Fostering collective agency through participatory and bottom-up processes is important. Research, policy, and practice can expedite microlevel transitions by orienting these processes toward the enhancement of individual agency for transformation. *Key Words: climate change adaptation, flooding, Indonesia, Myanmar, transformation.*

Prominent climate scientists expect that global temperature is unlikely to fall much below the +1.5 °C level (Hansen et al. 2025). Radical interventions are required for severely affected systems and vulnerable populations to adapt to the changing climate (Morrison et al. 2022). Few adaptation actions are deemed to be transformative, however (Sovacool, Linnér, and Klein 2017; Fedele et al. 2020; O'Neill et al. 2022). Policymakers and business stakeholders have a preference for incremental measures (Lo et al. 2020; Eriksen et al. 2021). Some people directly affected by climate change also resist major overhauls, such as planned relocation or retreat (Hayward 2008; Marshall et al. 2012). Reversing these tendencies is crucial for shifting toward alternative development pathways that are compatible with the anticipated shifts in climatic regimes and planetary boundaries.

The Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) has indicated that behavioral change is the most common form of climate change adaptation reported (O'Neill et al. 2022, 2433). Other independent reviews have shown nuanced differences. For example, Wilson et al. (2020) suggested that "[b]ehavioural adaptation research is in its infancy" (205). Singh (2025)

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contended that "behaviour change as a critical lever of individual and societal adaptation remains understudied" (71). More specifically, costly, disruptive, and path-shifting individual adaptation actions are less commonly documented.

Current research has focused on how individuals or households avoid, mitigate, or cope with proximate impacts of climate change. In a review of 106 published studies, van Valkengoed and Steg (2019) identified five groups of adaptation behaviors—namely, preparedness, evacuation, taking out insurance, seeking information, and policy support. In the literature, preparedness is often associated with the act of "coping" with disasters (Tierney 2007; Bamberg et al. 2017). Examples of preparatory actions include having an emergency kit or moving furniture (van Valkengoed and Steg 2019, 158). Such coping strategies can be described as short-term and incremental (Moser and Ekstrom 2010; Wilson et al. 2020). Evacuation, taking out insurance, and seeking information do not necessarily address the root causes of vulnerability and are more aligned with the notion of incremental adaptation than a transformative one. Questions remain as to whether this large body of literature has properly engaged in ideas of radical change and disruption in the personal sphere.

What explains transformative adaptation? Studies have found evidence about stakeholders (Ely 2022; Ziervogel et al. 2022), socioecological systems (Goulden et al. 2013), and cities and communities (Burch et al. 2014; Shi and Moser 2021). Considerably less research has been reported about individual-level shifts to a different way of living that involves a fundamental alteration of established routines, social relations and networks, and livelihood strategies. In particular, the different dimensions of individual capacity for fostering these shifts are poorly understood.

A limited number of studies have examined the role of inherent and acquired capacities for managing significant change. Marshall et al. (2012), for example, highlighted the importance of individual capacity for managing risks, developing skills, and being willing to undertake change. Barnes et al. (2020) tested the statistical relationships between transformative action and a wider range of adaptive capacity domains, such as assets and agency.

Our research advances the emerging research agenda by further developing the capacity approach and introducing the entitlement approach (Leach, Mearns, and Scoones 1999) to the study of transformative adaptation. It makes contributions by examining individual adaptation responses of different levels of disruptive impact and comparing between transformative and coping capacities. We present a fuller account of what capacities transformative individual adaptation requires, and discuss aspects of microlevel transition (e.g., individual and household) that should be prioritized in capacity development initiatives. Our inquiry into the microlevel human capacities identifies what needs to be integrated into the more advanced literature on the transformative capacity of larger systems, such as communities, cities, institutions, and socioecological systems.

Evidence was solicited from Indonesia and Myanmar, where coastal residents are highly exposed to flooding and sea-level rise. Enabling individual adaptation is imperative, but we know little about the conditions and factors underlying such action. To develop a contextual understanding of the capacities for individual action, we gathered information from 370 coastal residents facing a high risk of flooding and experiencing livelihood struggles. The remainder of this article begins with a literature review, followed by a description of study design and data collection locations. Results are then discussed and a conceptual framework is presented.

Transformation, Human Capacity, and Agency

Defining Transformative Individual Adaptation

Can individual adaptation be described as transformative? There has been a "transformative turn" in sustainability studies, arising from the belief that incremental adaptation to global environmental change does not suffice (Blythe et al. 2018). There are various framings of transformative adaptation, converging in their advocacy for addressing the root causes of vulnerability through system change (Pelling, O'Brien, and Matyas 2015; Fazey et al. 2018; Shi and Moser 2021; Filho et al. 2022; Hellin et al. 2022). Fundamental shifts (Tschakert et al. 2013; Feola 2015) and radical interventions (Morrison et al. 2022) are considered necessary. The degree of change required is hard to specify and measure, however. It remains unclear what change is

significant or fundamental enough to be described as transformative or transformational1 (Fekete et al. 2022).

Few et al. (2017) suggested that some mechanisms of change are potentially constitutive of transformation. One of these mechanisms is reconfiguration of social values and social relations, which is most widely discussed in critical adaptation studies. These studies emphasize the making of profound and deep-rooted change to system functioning that challenges existing structures and relations of power (Pelling 2011; O'Brien 2012; Tschakert et al. 2013; Morchain et al. 2019). According to Eriksen, Nightingale, and Eakin (2015) and Eriksen et al. (2021), climate change adaptation has to be disruptive to contest and reshape power relations. Transformative shifts require fundamentally altering the distorted and inequitable sociopolitical relations that drive vulnerability, and involve "the questioning of values, the challenging of assumptions, and the capacity to closely examine fixed beliefs, identities and stereotypes" (O'Brien 2012, 670). This critical approach received approval from the IPCC AR6, which suggests that "changes to underlying values, worldviews, ideologies, structures, and power relationships" are crucial for human society to adapt to climate change (Schipper et al. 2022, 2668).

Other mechanisms of change are easier to track and evaluate, particularly innovation and expansion. Innovation refers to a completely new activity or application of an activity in a new location, whereas expansion refers to an application of an existing activity at a much higher scale or intensity (Few et al. 2017). This approach is influenced by established theories about transitions and disaster risk management. Park et al. (2012), for example, drew on transition management theories and defined transformation in practical terms: a change from one form, function, or location to another. Kates, Travis, and Wilbanks (2012) viewed transformational adaptation as a response to risks, without explicitly addressing the structures or relations that reproduce these risks. They define transformational adaptation in terms of scale or intensity, novelty, and the shifting of location.

The IPCC AR6 adopted a more comprehensive but decontextualized approach for determining the degree of transformation. It solicited global evidence of transformational adaptation by asking whether an adaptation intervention is implemented widely, reflects major shifts, occurs rapidly, and challenges limits to adaptation, which are framed as scope, depth, speed, and limits, respectively (O'Neill et al. 2022). These dimensions not only involve operational aspects of change, such as scope and speed, but potentially also structural ones, such as depth and limits. Like other theoretical accounts described earlier, this comprehensive approach does not account for the context in which transformation occurs. Limits, for example, vary across culture and place. An action that challenges limits, such as voting in a general election, can be regarded as transformative in one place, but not others.

Despite their nuanced differences, most of the existing accounts recognize the change of system (Fekete et al. 2022) and question the efficacy of technical or technocratic solutions alone (Few et al. 2017). The ontological focus on system makes defining transformative individual adaptation difficult. Individual action does not normally constitute a systemic intervention. An ordinary individual can hardly revamp existing sociopolitical structures or governing institutions, or create new ones. Their adaptation response commonly involves the use of domestic technologies and small-scale structural modifications (e.g., air conditioning, home insurance, and house elevation), the use of a new crop or farming technique, or a change of livelihood by the individual or household. The notion of transformative individual adaptation does not perfectly cohere to most of the existing conceptual frameworks concerning broader societal transformation, which emphasize a change of system, structure, power relations, governance configurations, and development pathway.

As a result, the notion of transformative individual adaptation remains ambiguous and has created confusion. Planned relocation and migration involve fundamental changes at the personal and household level (Alexander, Ryan, and Measham 2012; Mach and Siders 2021; Wang and Lo 2022; Lo, Cheung, and Liu 2024). Confusion arises as to whether such an action is a coping strategy or not. For example, Filho et al. (2022) described the relocation of "people" away from risk-exposed locations as a short-term coping strategy (2), while calling the relocation of "communities" an example of transformative adaptation (5). The nuanced differences are captured in Wilson et al.'s (2020) typology.

Wilson et al. (2020) classified behavioral adaptations based on their potential benefits for the individual and the society. Actions are considered

incremental to the extent to which their benefits are short-term and limited to the individual or household, whereas transformative ones produce long-term collective benefits and potentially involve a change of practice of other people or entities. Under this framework, voluntary migration is regarded as transformative for individuals, whereas political and social engagement is described as potentially transformative for the society. Incremental actions include emergency management measures, such as storing food and evacuation planning. An action can be personally incremental (e.g., reducing home water consumption) but transformative if it is adopted by a critical mass of individuals (Wilson et al. 2020).

Transformative Capacity

Although transformative adaptation often focuses on collective and systemic shifts, this section explores individual capacity to initiate or participate in it. We critically examine how the literature conceptualizes this capacity and its consideration of individual agency within current frameworks.

There is a tendency for explaining transformative action in terms of collective agency. For instance, Eakin et al. (2022) concluded their research about Mexico by suggesting that "transformative spaces must be community-building spaces: spaces that cultivate collective agency" (151; see also Pereira et al. 2018). Based on a South African case study, Ziervogel, Cowen, and Ziniades (2016) specified three foundational aspects of transformative capacity: reconnection to life-support systems, a well-developed sense of agency, and social cohesion. Participatory, inclusive, and coproduction and creation processes are considered to be crucial for building (collective) capacities that are needed to inform transformation adaptation (Ziervogel 2019; Ely 2022; Ziervogel et al. 2022). Brodnik and Brown (2018) identified several transformative capacity domains in the stormwater management sector in Australia. These include inclusive governance, leadership, empowered communities of practice, and system awareness and memory, among others.

Common across these studies is the normative premise that the agency of people is a key element of transformative capacity. Although there is a broad agreement that individual agency contributes to collective agency (O'Brien et al. 2015; Eakin et al. 2022), the transformative capacity discourse has focused on collective agency and the agency processes involving organizational actors, stakeholders, and active members of the community (Park et al. 2012; Brodnik and Brown 2018; Ely 2022).

Marshall et al.'s (2012) Australian study is one of the early attempts to understand and measure the transformative capacity of individuals for adapting to climate change. They specified four dimensions of transformative capacity: (1) perception of risks associated with transformational change; (2) skills in planning, learning, and reorganizing livelihood activities; (3) financial and emotional flexibility; and (4) interest in undertaking transformational change. Waters and Adger (2017) adopted similar indicators for measuring the adaptive capacity of individuals in Uganda, which include feelings of control, belief in change, readiness to move, job flexibility, planning and preparedness, and so on.

Some of the indicators used by Marshall et al. (2012) and Waters and Adger (2017) are couched in terms of individual agency, but their frameworks do not include individual capacity for influencing collective decision-making and perception of power. These relational aspects of agency are included in Barnes et al.'s (2020) study, which examines the relationship between various adaptive capacity domains and transformative action in Papua New Guinea. Barnes et al. (2020) concluded that agency can encourage incremental adaptation, but discourage transformative action. Their study provides clues as to how different domains of individual capacity for managing change influence the tendencies for undertaking transformative action at the microlevel.

These empirical studies contribute to a capacity approach for explaining what transformative individual adaptation entails. Different forms of individual capacity are linked to different types of adaptation behavior, but there is a lack of consistency and depth in research design. Marshall et al. (2012) and Waters and Adger (2017) used similar indicators. These indicators are used by Marshall et al. (2012), however, to represent "transformative capacity," but framed as "adaptive capacity" in Waters and Adger (2017). In Barnes et al. (2020), an "adaptive" action is defined as incremental, rather than transformative. Their adaptive capacity domains encompass some elements of Marshall et al.'s (2012) transformational capacity scale and policy engagement, alongside coping capacity. This coping capacity, including past experience and remittances, drives reactive responses

to immediate, known threats to maintain stability. Their agency scale consists of only two indicators. It is unclear what type of capacity this scale represents due to these methodological choices. The capacity approach for understanding the conditions and determinants of transformative individual adaptation remains incomplete.

There is a contested tendency for understanding transformative capacity primarily in terms of collective agency. Consequently, some key terms are used inconsistently, and the notion of transformative individual adaptation remains confusing. In this research, we seek to advance the capacity approach by accounting for the multiple dimensions of individual agency for managing significant change. We examine individual adaptation responses of different levels of disruptive impact and identify factors underlying transformative individual action, in comparison with incremental action. We identify differences between transformative and coping capacities by exploring their linkages with transformative action and propose a nuanced framework for understanding individual agency in climate adaptation.

Study Design

Research Hypotheses

This research examines the relationship between individual adaptation responses and capacities for managing change. Specifically, it identifies the impacts of individual agency, assets, capabilities, and entitlements on adaptation actions of different levels of disruption. We have two main research hypotheses:

1. Transformative capacity is more strongly associated with disruptive adaptation response.
2. Generic coping capacity is more strongly associated with less disruptive adaptation response.

Research Instrument

The research is based on structured questionnaire surveys. The surveys generated data on respondents' adaptation responses and their capacities for managing change. Flood damage, risk awareness and perception, and socioeconomic characteristics were included as control variables.

Four actual adaptation responses were recorded. These include voluntary migration away from a flood-prone location and social mobilization aimed at driving collective action for managing flood risks. These two types of adaptation behavior can be regarded as personally transformative and potentially transformative for society, respectively (Wilson et al. 2020). The other two adaptation responses involve domestic technologies. Floor elevation is a common coping strategy in the coastal areas of Indonesia for mitigating the risks of inundation in near and medium terms. Acquiring a water pump to remove floodwater is an end-of-pipe solution. It might be cheaper than elevating house floors but only has short-term effects. Neither elevated floors nor water pumps offer a long-term solution. These four types of adaptation behavior range from transformative to incremental, presenting a gradient of disruptive impact. Respondents were asked directly if they had adopted each strategy before.

The level of transformative capacity was measured using Marshall et al.'s (2012) scale with modifications The survey items used in the Marshall et al. (2012, 5) study were articulated in the context of long-term planning for severe droughts and described as representing "transformational capacity." They identified and tested four dimensions of adaptive capacity, including (1) perception of risks associated with change, (2) planning skills, (3) financial and emotional flexibility, and (4) interest in undertaking change. This transformational capacity scale recognizes individual agency as well as capabilities. Our modified transformative capacity scale focused on agency and excluded the skills dimension, which is represented in the scale of coping capacity described later. We added an autonomy dimension to our modified scale, drawing on social psychology (Bekker and van Assen 2006). In our study, this dimension was expressed in terms of the respondents' power and influence on key decisions affecting their well-being. We created three statements for each dimension, resulting in a twelve-item scale.

Respondents' capacity for coping with change of unspecified magnitude was measured by fifteen items. The development of these items was informed by the environmental entitlements framework, which includes attributes of environmental endowments, entitlements, and capabilities (Mearns 1995; Leach, Mearns, and Scoones 1999). In our study, the scope of these dimensions is broadened to account for a

wider range of resources in urban settings. The endowment dimension was broadly understood as the economic, physical, and social assets the respondents possessed, including property and land, savings, linking social capital, and familial ties. Entitlements refer to the legitimate effective command over assets from which alternative sets of utilities are derived (Leach, Mearns, and Scoones 1999). Our entitlements items involved the respondents' self-assessed ability to use and sell assets, command of labor, access to social benefits, and rights to select representatives. Capabilities included prior training, qualifications, skills, physical fitness, and Internet access. Each dimension was measured by five items on a dichotomous scale.

The questionnaire also asked whether the respondents had experienced home damage due to flooding and were aware of the fact that the local area was under risk of sea-level rise. Flood risk perception was assessed by four items pertaining to the anticipated likelihood and severity of flooding and the perceived impact on the respondents' standard of living. Respondents' age, sex, income, and education attainment were recorded as control variables. Details of all items described above are presented later.

Data Analysis

We performed a probit regression analysis for each of the adaptation behaviors reported. The dependent variable was a discrete, binary value representing whether or not an adaptation action had been taken. Probit regression was considered to be appropriate for this study, as it is commonly used to model the relationship between a set of predictors and a binary outcome. In our analysis, the model is specified as:

$$p(y_i) = \alpha_2 + \beta_j x_{j_i} + \beta_k x_{ki} \ldots + \beta_w x_{wi} + \varepsilon_{i2}$$

where $p(y_i)$ represents the probability of the respondent having performed a given activity or strategy (1) or not (0). α is the intercept. β is a vector of regression coefficients. $x_{ji} \ldots x_{wi}$ denotes explanatory variables, which include flood damage, sea-level rise awareness, flood risk perception, transformative capacity, generic coping capacity, and the respondent's socioeconomic characteristics $j \ldots w$. ε_i is the error term.

We report the values of regression coefficients and marginal effects. Marginal effects are interpreted in terms of a percentage change in the likelihood of reporting the dependent variable outcome for a one-unit or discrete change in the independent variable. The model's goodness of fit was examined using the Hosmer–Lemeshow test.

Study Area

Southeast Asia

Understanding and building transformative capacity for adapting to climate change is particularly important for Asia. As the most exposed region to sea-level rise, many coastal areas of Asia urgently need to adapt to the escalating risks of flooding and transform their coastal practices. One of the significant issues to address is people's capacity for undertaking fundamental shifts in their coastal livelihoods in response to sea-level rise. Chapter 16 of the IPCC AR6 has noted that behavioral adaptation is most frequently documented in Asia (along with Africa and small island states; O'Neill et al. 2022), indicating the importance of individual action.

Southeast Asia experiences additional challenges. Coastal flooding is posing threats to the highly populated low-lying cities of Southeast Asia. Many of these cities are struggling over land subsidence, which increases their vulnerabilities to flooding during high tides and storm surges. Kulp and Strauss (2019) showed that 70 percent of the global population exposed to sea-level rise and land subsidence are in eight Asian countries, four of which are in Southeast Asia (Vietnam, Indonesia, Thailand, the Philippines). Southeast Asian cities are building their infrastructural capacity for adapting to coastal flood risks, but evidence on behavioral adaptation is fragmented.

Chapter 10 of the IPCC AR6 reviews evidence on adaptation options in three large Southeast Asian cities, Jakarta, Kuala Lumpur, and Ho Chi Minh City. Behavioral adaptation across these cities either shows limited progress or existing evidence is not clear enough (Shaw et al. 2022, 1501). Shaw et al. (2022) identified a number of adaptation constraints, including "human capacity" (1521). Southeast Asia is the only subregion of Asia where human capacity is marked as a strong barrier to adaptation.

Pekalongan and Kyimyindaing

Enabling radical adaptation interventions is imperative for the most vulnerable populations in Southeast Asia. Strong capacities for managing fundamental alteration of established routines are required, but they are limited in disadvantaged areas characterized by high risk exposure and high social vulnerability. Our research was implemented in two locations in Southeast Asia with these characteristics, namely, Pekalongan City of Indonesia and Kyimyindaing Township of Myanmar.

Indonesia is ranked fifth in the world in terms of population inhabiting lower elevation coastal zones vulnerable to sea-level rise (Syam, Wengi, and Gandapurnama 2021; Setiadi et al. 2026). Pekalongan City is situated in Indonesia's Central Java Province (Figure 1). The north shores of Pekalongan are highly exposed to tidal flooding, due to low elevations and sea-level rise (Setiadi and Lo 2019). Historically, the sea levels to the northern shores rise by approximately 5 mm per year. This is higher than the rise of the Java Sea, which is generally 3.9 mm per year (Kismawardhani, Wirastriya, and Berlianty 2018). Moreover, Pekalongan is known as the national center of batik production. The manufacturing of batik textiles consumes a significant amount of water, resulting in water stress. Communities meet their water needs by extracting groundwater, but this groundwater extraction has resulted in massive land subsidence. The rate of land subsidence in Pekalongan is estimated to be 10 to 17 cm per year (2012–2018; Syam, Wengi, and Gandapurnama 2021). Combined with rising sea levels, land subsidence is making Pekelongan extremely vulnerable to flooding.

Figure 1. Map of Pekalongan and study area.

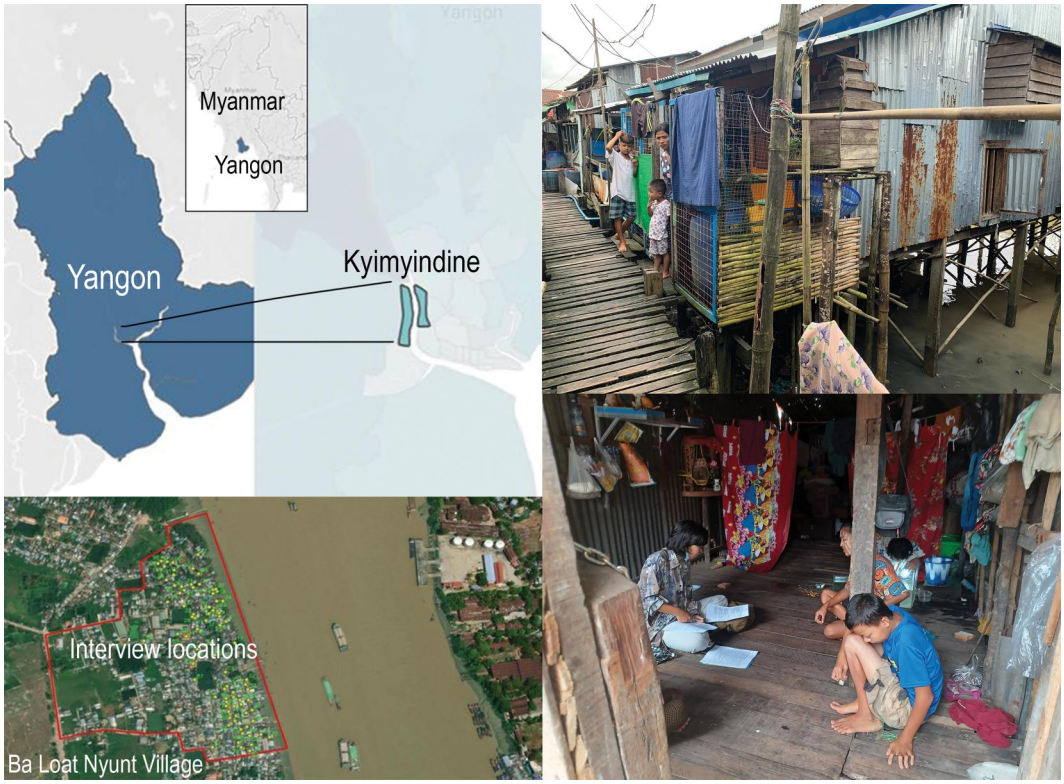

Figure 2. Map of Kyimyindine and study area.

Our research was conducted in North Pekalongan, one of the districts within Pekalongan experiencing severe tidal flooding. The local government has made various efforts to manage flood risks, which include preventing tidal floods from entering the mainland, using polders or pool retentions to regulate the water before flowing downstream, pumping the water from the polders to the sea regularly, and increasing the capacity of rivers. Flood-resilient infrastructure projects include the development of dykes, long storages and pumping stations, increased river embankments, river normalization, dredging, and development of collector drainage. These efforts are insufficient, though, for protecting the city from the accelerating sea-level rise and land subsidence. Villages within the district are becoming uninhabitable, as localized flooding occurs on a daily basis (as shown in Figure 1). The district is home to many domestic batik producers whose livelihoods depend on the availability of water from local rivers. Not every home business and household can afford the costs of relocation and house or asset upgrades as a way to reduce their flood vulnerability. Our field site in Indonesia, therefore, is characterized by high risk exposure and recurrence of tidal flooding.

Myanmar is a climate change hot spot with a tropical climate, long coastlines, and a large population in climate-sensitive areas. It is the world's fourth most affected country by climate change and has had an exceptionally high number of fatalities attributed to climate change (Adil et al. 2025). Myanmar's delta region, facing Andaman Sea, will be significantly affected by anticipated sea-level rises (Oo, Huylenbroeck, and Speelman 2018). Many low-lying areas are found in Yangon, which is highly exposed to riverine flooding (Wuit-Yee-Kyaw and Dudley 2020). Furthermore, cyclones frequently affect the delta region encompassing Yangon and Ayeyarwady, which are regarded as the two most populated areas at risk in the country (Myanmar Information Management Unit 2022). Cyclone Nargis in May 2008 killed nearly 140,000 people, and Cyclone Mocha in May 2023al, though less deadly, exposed the fragility of local communities due to declining state assistance.

Kyimyindine Township (also known as Kyeemyindaing) is located within the Yangon Region. The eastern and western shores of the township are separated by the Hlaing River (Figure 2). The east of Kyimyindine is more developed and

close to the central business district of Yangon City. The west bank of Kyimyindine is impoverished. Residents endure poor living conditions, low incomes, and low socioeconomic status. The west bank is compromised by poor transport connections. City center access is difficult, limited to infrequent artisanal boat service or lengthy road journeys. Frequent flooding and saltwater intrusion create poor soil and unusable groundwater, despite a shallow water table. Residents rely on this contaminated water for basic cleaning, due to the absence of municipal services and functional government. Urban service failures are aggravated by the military coup in 2021 and the lingering political instability.

Our data were collected from Ba Loat Nyunt (16.8067° N, 96.1182° E), one of the western wards of Kyimyindine. There are approximately 2,000 households inhabiting an area of 0.21 km^2. Water supply infrastructure, sanitation facilities, and drainage systems are lacking or deteriorating, resulting in water shortages, poor health outcomes, and flooding. Houses are densely packed along the river and poorly maintained, making Ba Loat Nyunt village an urban slum harboring a flood-vulnerable population. Our Myanmar field site, therefore, is socially marginalized and left with no functioning government.

Data Collection

In North Pekalongan, the questionnaire survey was administered to the residents of eleven subdistricts,2 which consist of approximately 24,300 households. To ensure representativeness, the study areas were divided into fifty-four clusters according to their subdrainage system, road access, and settlement availability (as displayed in Figure 1). Five households were selected from each cluster for face-to-face interviews. The selection was based on a systematic approach by dividing the number of house units in each cluster with its quota (five). The result was in the range of every twenty-right to forty-three houses depending on the cluster. The questionnaire was pretested prior to full implementation. A total of 270 questionnaires were completed in July 2023.

In West Kyimyindine, data were collected from the urban village of Ba Loat Nyunt, which has about 2,000 households. The field work was limited to part of the west bank community and involved only 100 households, due to mobility and time constraints related to social unrest and security reasons.3 Eight project assistants walked through the main streets across the upper-middle section of the riverside settlement (as displayed in Figure 2). They approached every third household where someone was present on the day of visiting (i.e., 27 and 28 July 2023) and managed to interview members of 100 households.

Findings

Descriptive Statistics

The research achieved a sample size of 370. The sample consists of 165 (45 percent) individuals over age fifty and 215 (58 percent) females. Thirty-four (9 percent) had no income and 187 (51 percent) had never received formal education. The majority of respondents (75 percent) had their home damaged by coastal flooding before. Over 94 percent of them were aware of the risk of sea-level rise to their community.

As expected, voluntary migration was adopted by a small proportion of respondents (8 percent). Mobilizing other community members to drive collective action for managing flood risks is potentially transformative but does not normally result in as much livelihood disruption as migration. Twenty-nine percent of respondents reported experience in social mobilization. The most common form of adaptation behavior was floor elevation, adopted by 58 percent of respondents. This is higher than the 44 percent found in Semarang City, which is located about 80 km from Pekalongan (Setiadi and Frederika 2022). The least transformative action was pumping floodwater out of the house, which had an adoption rate of 21 percent.

Flood risks were perceived to be very high (Table 1). More than 60 percent of respondents believed that flooding in their local area would become more damaging in the next ten years, and more than 70 percent of them believed that flooding is becoming more frequent. The large majority (> 90 percent) suggested that the higher intensity and frequency of flooding would affect their standard of living. A composite scale was created to represent the level of flood risk perception, which has an average value of 4.02 (out of 5.00) and a Cronbach's alpha of 0.74, indicating an acceptable level of scale reliability. It was normalized on a one-point scale for subsequent analysis.

Table 1. Flood risk perception of respondents

Flood risk perception	Range	M	*SD*
R1: I believe my area will suffer from more damaging flooding in the next 10 years	1–5	3.74	0.98
R2: More damaging flooding will affect my standard of living	1–5	4.26	0.77
R3: I believe my area will suffer from severe flooding more frequently in the next 10 years	1–5	3.80	1.02
R4: More frequent severe flooding will affect my standard of living	1–5	4.28	0.70
Average	1–5	4.02	0.66
Normalized total[a]	0–1	0.75	0.16

Note: Scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree.
[a]Sum of the four items normalized on a scale of 0–1. Cronbach's alpha = 0.74. $N = 370$.

Table 2. Transformational capacity of respondents

Transformational capacity	Range	M	*SD*
Perception of risk associated with change			
T1. We are confident that we can deal efficiently with unexpected events	1–5	3.55	1.06
T2. We can remain calm during flooding because we can rely on our abilities	1–5	3.53	1.11
T5. We can find several options for coping with flooding	1–5	3.49	0.96
Financial and emotional flexibility			
T3. We don't mind changing job or school if this would help cope with flooding better	1–5	2.84	1.23
T4. We don't mind relocating to another place if this would help coping with flooding better	1–5	3.01	1.27
T11. My household would need a lot of time to get accustomed to a new environment[a]	1–5	2.52	1.08
Interest in undertaking change			
T6. We want to do something to reduce flood risks	1–5	3.86	0.81
T10. In Pekalongan/Kyimyindine, it is hard for my household to start new activities on our own[a]	1–5	2.95	1.08
T12. My household does not have a strong opinion on community issues[a]	1–5	3.05	0.94
Autonomy			
T7. In Pekalongan/Kyimyindine, we cannot make decisions independently about how we manage our home[a]	1–5	3.44	1.21
T8. In Pekalongan/Kyimyindine, we cannot make decisions independently about how we make a living[a]	1–5	3.49	1.20
T9. In Pekalongan/Kyimyindine, we don't have much influence on how flood risk is managed[a]	1–5	2.95	1.11
Average	1–5	3.22	0.51
Normalized total[b]	0–1	0.56	0.13

Note: Scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. Cronbach's alpha = 0.67. $N = 370$.
[a]Reverse coded. Higher values denote higher transformational capacity.
[b]Sum of the twelve items normalized on a scale of 0–1.

Table 2 displays a list of items measuring transformative capacity, based on Marshall et al.'s (2012) scale. Results show that the capacity was neither low nor high in the surveyed communities. Our respondents had some confidence in their ability to manage uncertainties, but indicated a modest level of financial and emotional flexibility for navigating significant pathway shifts. There was also a modest level of interest in undertaking change, but most people were keen to take action to reduce flood risks. Nonetheless, there was a comparatively higher level of autonomy in making household decisions. Most people did not have a strong influence on the local authorities' decisions about flood risk management. The value of the composite scale (3.22) indicates a moderate level of agency. The value of Cronbach's alpha (0.67) is close to the usual cutoff level (0.70).

Table 3 shows the three main components of our coping capacity scale. Respondents possessed various forms of assets. Most people owned the property they currently lived in (84 percent), but few of them reported ownership of a second property or land (16 percent) and had more savings than five years ago (21 percent). Above 40 percent can be considered to have strong linking social capital and familial ties. The level of capabilities varied. Few household members had received training to cope with flooding (12 percent) and tertiary education (39 percent).

Table 3. Generic coping capacity of respondents

General coping capacity[a]		Range	M	*SD*
Asset 1	Acquaintance–linking capital	0–1	0.42	0.49
Asset 2	Own other property or land	0–1	0.16	0.37
Asset 3	Frequency of visiting family–familial ties	0–1	0.41	0.49
Asset 4	Own the property currently live in	0–1	0.84	0.37
Asset 5	More savings than 5 years ago	0–1	0.21	0.41
Capability 1	Flood training	0–1	0.12	0.32
Capability 2	Internet access	0–1	0.77	0.42
Capability 3	Physical fitness	0–1	0.78	0.41
Capability 4	Home repair skills	0–1	0.74	0.44
Capability 5	Household's tertiary education	0–1	0.39	0.49
Entitlement 1	Social security benefits	0–1	0.52	0.50
Entitlement 2	Ability to sell assets	0–1	0.35	0.48
Entitlement 3	Freedom of using assets	0–1	0.56	0.50
Entitlement 4	Command of people	0–1	0.24	0.43
Entitlement 5	Rights to select representatives	0–1	0.68	0.47

Note: Scale: 0 = no, 1 = yes. $N = 370$.
[a]See Supplemental Material for full survey statements.

Table 4. Descriptive statistics

Independent variable		Range	M	*SD*
Older	Age over 50; 0 = no, 1 = yes	0–1	0.45	0.50
Female	0 = male, 1 = female	0–1	0.58	0.49
No income	0 = no, 1 = yes	0–1	0.09	0.29
Never get education	0 = no, 1 = yes	0–1	0.51	0.50
Flood damage	Has your home been damaged by coastal flooding before? 0 = no, 1 = yes	0–1	0.75	0.44
Awareness of sea level rise	Are you aware that Pekalongan/Kyimyindine is under the risk of sea-level rise? 0 = no, 1 = yes	0–1	0.94	0.24
Flood risk perception	Normalized total of 4 items (R1–R4)	0–1	0.75	0.16
Transformative capacity	Normalized total of 12 items (T1–T12)	0–1	0.56	0.13
Dependent variable				
Voluntary migration	Moved to a different place that is not prone to flooding. 0 = no, 1 = yes	0–1	0.08	0.27
Social mobilization	Mobilized other members of this community to drive collective action for managing flood risks. 0 = no, 1 = yes	0–1	0.29	0.45
Floor elevation	Elevated the floor of my house. 0 = no, 1 = yes	0–1	0.58	0.49
Water pumping	Obtained a water pump for removing floodwater. 0 = no, 1 = yes	0–1	0.21	0.41

Note: $N = 370$.

More than 70 percent, however, had Internet access and skills for repairing their home, and considered themselves physically fit for coping with flooding. More than half of the respondents had access to social security benefits (52 percent) and could use their assets in any way they wanted (56 percent). Fewer believed that they could sell their assets for cash at any time (35 percent) and command other people (through employment, apprenticeship, or contract work, etc.; 24 percent). Sixty-eight percent had the rights to select community representatives. The fifteen items presented in Table 3 do not yield a satisfactory degree of scale reliability and are therefore separately listed in the following analysis.

Regression Analysis

The key variables for the regression analysis are presented in Table 4. The small size of the Myanmar subsample prevented a separate analysis. Location dummies are included to control for unobserved heterogeneity between the two subsamples. Results of

Table 5. Transformative capacity of respondents by socioeconomic characteristics

Socioeconomic characteristics		Transformative capacity (M)	*F* statistic
Age over 50	Yes	0.556	0.000
	No	0.556	
Female	Yes	0.535	14.257***
	No	0.585	
No income	Yes	0.528	1.856
	No	0.559	
Never get education	Yes	0.571	5.278**
	No	0.541	
Country	Indonesia	0.559	0.733
	Myanmar	0.547	

Note: $N = 370$.
**Significant at 0.05.
***Significant at 0.01.

Fisher's Exact tests indicate statistical differences between the Indonesia and Myanmar subsamples in the adoption of three adaptation behaviors (i.e., migration, floor elevation, and water pumping; $p < 0.05$), but not social mobilization ($p > 0.05$). *F* tests suggest that the mean values of transformative capacity are lower among female respondents and those who never received education (Table 5).

Table 6 shows the results for two forms of adaptation behavior. The regression model for voluntary migration had the greatest explanatory power, indicated by the R^2 value of 0.625. Migrants were more likely to be younger and have experienced damage by flooding. The likelihood of migration was positively related to the level of transformative capacity. It also increased with the ability to sell personal assets (Entitlement 2), but decreased with ownership of a second property or land (Asset 2) and physical fitness (Capability 3). The statistical effects of access to social security benefits (Entitlement 1) were marginal. The likelihood of mobilizing other community members increased with transformative capacity and three indicators of coping capacity, including familial ties (Assets 3), training (Capability 1), and the ability to sell personal assets (Entitlement 2).

As indicated in Table 7, female respondents who had experienced flood damage were more likely to report that their home was elevated to reduce the impact of surface flooding. Floor elevation was also associated with transformative capacity, linking capital (Asset 1), and home ownership (Asset 4). This regression model, however, does not appear to be a good fit, as the significance value of the Hosmer–Lemeshow statistic is less than 0.05.

The regression analysis for water pumping shows differences. Transformative capacity was not a significant predictor. Socioeconomic characteristics, flood damage, and risk perception also did not have an impact. The practice of water pumping was related to seven indicators of assets, capabilities, and entitlements. There was no clear direction of effects, however. This behavior was associated with training (Capability 1), Internet access (Capability 2), physical fitness (Capability 3), and command of people (Entitlement 4). The negative signs in Table 7 suggest that it is linked to weaker and limited familial ties (Assets 3), access to social security benefits (Entitlement 1), and control over asset use (Entitlement 3). Although only indicators of generic coping capacity achieved significant effects, they resulted in the second highest value of R^2.

Discussion

Agency and Entitlements

This research explores the linkages between individual capacities and climate change adaptation responses of different levels of disruptive impact. We assess the effects of a modified scale of transformative capacity, which includes indicators of people's agency in managing risks, and their flexibility and interest in undertaking significant change. Results show that the level of transformative capacity increases with the probability of taking action.

Data collected from Indonesia and Myanmar suggest that voluntary migration and social mobilization are a function of transformative capacity. The former of these adaptation behaviors is likely to have

Table 6. Probit regression: Voluntary migration and social mobilization

	Voluntary migration				Social mobilization			
	β	Marginal effect	95% confidence interval		β	Marginal effect	95% confidence interval	
Older (over 50)	−1.635*** (0.533)	−0.099*** (0.028)	−0.154	−0.043	0.097 (0.163)	0.028 (0.047)	−0.064	0.119
Female	0.015 (0.431)	0.001 (0.026)	−0.050	0.052	−0.280 (0.163)	−0.080 (0.046)	−0.170	0.010
No income	−0.356 (0.500)	−0.021 (0.030)	−0.080	0.037	0.410 (0.268)	0.117 (0.076)	−0.031	0.266
Never get education	0.327 (0.433)	0.020 (0.026)	−0.031	0.070	0.150 (0.167)	0.043 (0.048)	−0.050	0.136
Flood damage	2.225*** (0.746)	0.134*** (0.039)	0.058	0.210	0.137 (0.190)	0.039 (0.054)	−0.067	0.145
Awareness of sea-level rise	−0.951 (0.586)	−0.057 (0.034)	−0.125	0.010	0.290 (0.354)	0.083 (0.101)	−0.115	0.281
Flood risk perception	2.236 (1.163)	0.135 (0.066)	0.005	0.265	0.040 (0.531)	0.011 (0.152)	−0.286	0.309
Transformative capacity	7.922*** (2.294)	0.478*** (0.119)	0.246	0.710	2.688*** (0.683)	0.768*** (0.184)	0.408	1.128
Asset 1	0.486 (0.420)	0.029 (0.025)	−0.020	0.078	0.236 (0.163)	0.068 (0.046)	−0.023	0.159
Asset 2	−1.260** (0.625)	−0.076** (0.035)	−0.145	−0.007	−0.378 (0.231)	−0.108 (0.066)	−0.237	0.020
Asset 3	0.088 (0.411)	0.005 (0.025)	−0.043	0.054	0.401** (0.164)	0.115** (0.046)	0.025	0.204
Asset 4	0.136 (0.459)	0.008 (0.028)	−0.046	0.062	0.154 (0.219)	0.044 (0.062)	−0.078	0.166
Asset 5	0.445 (0.557)	0.027 (0.034)	−0.039	0.093	0.210 (0.190)	0.060 (0.054)	−0.046	0.166
Capability 1	1.255 (0.728)	0.076 (0.041)	−0.006	0.157	0.621*** (0.227)	0.177*** (0.063)	0.054	0.301
Capability 2	−0.648 (0.424)	−0.039 (0.025)	−0.088	0.009	−0.074 (0.199)	−0.021 (0.057)	−0.133	0.090
Capability 3	−1.434*** (0.544)	−0.086*** (0.030)	−0.146	−0.027	0.105 (0.211)	0.030 (0.060)	−0.088	0.148
Capability 4	0.219 (0.376)	0.013 (0.023)	−0.031	0.057	0.391 (0.211)	0.112 (0.060)	−0.005	0.228
Capability 5	0.025 (0.498)	0.002 (0.030)	−0.057	0.060	−0.230 (0.172)	−0.066 (0.049)	−0.161	0.030
Entitlement 1	−0.839 (0.438)	−0.051** (0.026)	−0.101	0.000	−0.006 (0.167)	−0.002 (0.048)	−0.095	0.092
Entitlement 2	1.701*** (0.535)	0.103*** (0.028)	0.048	0.158	0.356** (0.168)	0.102** (0.047)	0.009	0.194
Entitlement 3	−0.719 (0.462)	−0.043 (0.027)	−0.096	0.009	−0.275 (0.180)	−0.079 (0.051)	−0.179	0.021
Entitlement 4	0.436 (0.607)	0.026 (0.036)	−0.045	0.097	0.093 (0.189)	0.027 (0.054)	−0.079	0.132
Entitlement 5	0.225 (0.410)	0.014 (0.025)	−0.034	0.062	−0.009 (0.182)	−0.003 (0.052)	−0.104	0.099
Location dummies	Yes				Yes			
Constant	−10.606 (2.531)				−3.234 (0.703)			
Pseudo R^2	0.625				0.155			
Likelihood ratio $\chi^2(24)$	130.21				68.69			
Prob > χ^2	0.000				0.000			
Goodness-of-fit: Hosmer–Lemeshow χ^2 (10)	8.77				11.47			
Prob > χ^2	0.362				0.177			
Number of observations	370				370			

Note: Standard errors are in parentheses.
**Significant at 0.05.
***Significant at 0.01.

Table 7. Probit regression: Elevate floor and water pumping

	Floor elevation				Water pumping			
	B	Marginal effect	95% Confidence interval		β	Marginal effect	95% Confidence interval	
Older (over 50)	−0.223 (0.162)	−0.065 (0.047)	−0.157	0.027	0.063 (0.207)	0.012 (0.039)	−0.064	0.088
Female	0.335** (0.165)	0.097** (0.047)	0.005	0.190	−0.371 (0.207)	−0.070 (0.038)	−0.145	0.005
No income	0.039 (0.275)	0.011 (0.080)	−0.146	0.168	0.298 (0.395)	0.056 (0.074)	−0.089	0.201
Never get education	−0.215 (0.167)	−0.062 (0.048)	−0.157	0.032	−0.212 (0.214)	−0.040 (0.040)	−0.118	0.038
Flood damage	0.388** (0.185)	0.113** (0.053)	0.009	0.217	0.083 (0.227)	0.016 (0.043)	−0.068	0.099
Awareness of sea-level rise	−0.130 (0.350)	−0.038 (0.102)	−0.237	0.162	0.946 (0.919)	0.178 (0.172)	−0.160	0.516
Flood risk perception	0.919 (0.531)	0.267 (0.153)	−0.032	0.567	−0.207 (0.743)	−0.039 (0.140)	−0.313	0.235
Transformative capacity	2.047*** (0.702)	0.596*** (0.198)	0.207	0.984	0.837 (0.923)	0.158 (0.174)	−0.183	0.498
Asset 1	0.389** (0.166)	0.113** (0.048)	0.020	0.207	0.184 (0.207)	0.035 (0.039)	−0.041	0.111
Asset 2	−0.073 (0.229)	−0.021 (0.067)	−0.152	0.109	0.357 (0.261)	0.067 (0.049)	−0.028	0.163
Asset 3	−0.042 (0.163)	−0.012 (0.047)	−0.105	0.081	−0.573*** (0.213)	−0.108*** (0.039)	−0.184	−0.031
Asset 4	0.556*** (0.210)	0.162*** (0.060)	0.045	0.279	0.102 (0.303)	0.019 (0.057)	−0.093	0.131
Asset 5	0.121 (0.200)	0.035 (0.058)	−0.079	0.149	−0.454 (0.249)	−0.085 (0.046)	−0.176	0.005
Capability 1	0.010 (0.252)	0.003 (0.073)	−0.141	0.146	0.902*** (0.274)	0.170*** (0.049)	0.074	0.266
Capability 2	0.021 (0.195)	0.006 (0.057)	−0.105	0.117	0.850*** (0.327)	0.160*** (0.060)	0.043	0.277
Capability 3	0.012 (0.199)	0.003 (0.058)	−0.110	0.117	0.607** (0.279)	0.114** (0.051)	0.014	0.214
Capability 4	0.259 (0.193)	0.075 (0.056)	−0.034	0.184	−0.180 (0.276)	−0.034 (0.052)	−0.136	0.068
Capability 5	0.148 (0.169)	0.043 (0.049)	−0.053	0.139	−0.258 (0.212)	−0.048 (0.040)	−0.126	0.029
Entitlement 1	−0.027 (0.161)	−0.008 (0.047)	−0.100	0.084	−0.534*** (0.203)	−0.101*** (0.037)	−0.173	−0.028
Entitlement 2	−0.309 (0.173)	−0.090 (0.050)	−0.187	0.007	0.135 (0.218)	0.025 (0.041)	−0.055	0.106
Entitlement 3	−0.108 (0.177)	−0.031 (0.052)	−0.132	0.070	−0.886*** (0.249)	−0.167*** (0.044)	−0.253	−0.081
Entitlement 4	−0.266 (0.186)	−0.077 (0.054)	−0.183	0.028	0.780*** (0.209)	0.147*** (0.037)	0.075	0.218
Entitlement 5	0.149 (0.176)	0.043 (0.051)	−0.057	0.143	−0.298 (0.223)	−0.056 (0.042)	−0.138	0.026
Location dummies	Yes				Yes			
Constant	−2.222 (0.665)				−1.950 (1.139)			
Pseudo R^2	0.241				0.358			
Likelihood Ratio $\chi^2(24)$	121.24				137.28			
Prob >	0.000				0.000			
Goodness-of-fit: Hosmer–Lemeshow $\chi^2(10)$	16.63				9.11			
Prob >	0.034				0.333			
Number of observations	370				370			

Note: Standard errors are in parentheses.
**Significant at 0.05.
***Significant at 0.01.

personally transformative effects, whereas the latter might be personally incremental but have the potential for societal transformation (Wilson et al. 2020). The regression model for voluntary migration showed a greater explanatory power, although the transformative capacity variable created a smaller marginal effect on the dependent variable. The opposite was true for social mobilization.

The tendency for elevating the floor increased with transformative capacity, but the regression model's weak fit prevents a definitive conclusion. Water pumping is clearly an incremental action, similar to other disaster preparedness behaviors, such as "moving valuables to a safer place in the home" and "drilling a new well" (Wilson et al. 2020). This variable is the only one showing no significant relationship with transformative capacity, either in a regression model or a simple *F* test. Our transformative capacity scale therefore does not predict incremental adaptation. These results support our first hypothesis, which states that transformative capacity is more strongly associated with disruptive adaptation response.

Some indicators of assets, capabilities, and entitlements correlate with the four adaptation behaviors. Their effects on voluntary migration and social mobilization are limited to three variables each, however.4 In our regression model, water pumping is predicted by seven variables of assets, capabilities, and entitlements only, which represent generic coping capacity and have created relatively strong marginal effects on the dependent variable. These results confirm our second hypothesis, which states that generic coping capacity is more strongly associated with less disruptive adaptation response.

These findings indicate the importance of exploring diverse human capacities and their measurement scales in the study of transformative individual adaptation. Barnes et al. (2020) found that perceived power, understood as an indicator of agency, would discourage transformative action, because people in powerful positions might stand to lose from fundamental changes that often involve shifts in power. Although our transformative capacity scale includes items related to perceived power, it engages a wider range of factors that contribute to people's capacity to transform their livelihoods when facing escalating climate risks. Many of these factors involve aspects of individual agency.

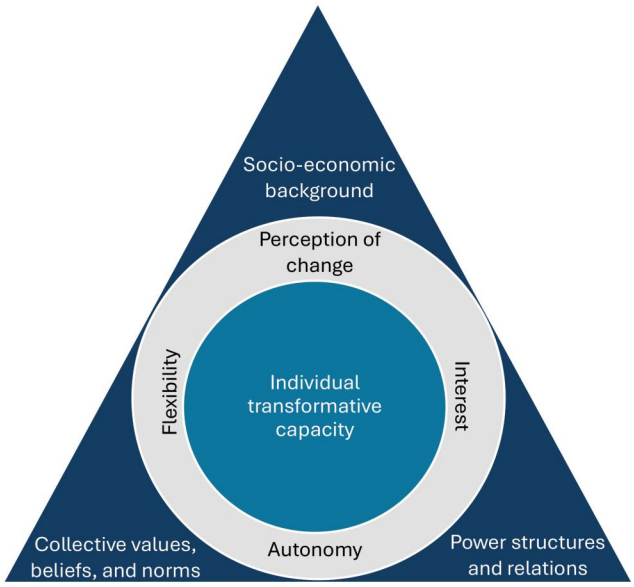

Figure 3. Conceptual framework for individual transformative capacity.

Agency is regarded as key to driving transformation. In a recent review, Nautiyal (2024) indicated that the first condition for capacity building initiatives to enable transformation is enhancing "emancipatory and bottom-up agency," which involves fostering participation, building skills of individuals, and empowering people. Most of the existing studies, however, emphasize collective agency. Our study contributes to this literature by suggesting that transformative *individual* adaptation entails capacities pertaining to individual agency, which involve perception of change, flexibility, interest in undertaking significant change, and autonomy. Based on our findings, an initial framework is developed and presented in Figure 3. It is adapted from Marshall et al. (2012) and draws on Waters and Adger (2017) and Barnes et al. (2020), while adopting a broader scope by including the contextual influences of power structures and relations (Pelling 2011; Tschakert et al. 2013), and values, norms, and beliefs (O'Brien et al. 2015). Evidence on other individual factors, such as self-efficacy and social capital, is required to complete the framework.

Human Capacity and Microlevel Change

The enablers of transformative adaptation at the individual level can be linked to those driving social and community action, which can be enhanced or created through participatory, inclusive, empowering, and bottom-up processes (Ziervogel, Cowen, and Ziniades

2016; Eakin et al. 2022; Ely 2022). Widespread adoption of these processes can potentially shape or reconstruct the contextual environment in which capacity is developed, which encompasses power structures and relations, and values, norms, and beliefs, as depicted in Figure 3. The ways in which such processes can enable transformative individual adaptation through strengthening *individual agency* are yet to be explored. A capacity approach for driving transformation not only requires implementation of such processes, but also an understanding of how they can enhance individuals' livelihood flexibility, build confidence in managing change, strengthen their sense of control and influence, and ultimately enable individual and collective action.

Transformative individual adaptation can be discouraged by socioeconomic vulnerabilities. Gender role, for example, can create barriers to livelihood diversification, which often stem from deeply entrenched social, cultural, and economic norms that dictate roles, responsibilities, and access to resources, particularly for women (Assefa and Gebrehiwot 2023; Kilroy et al. 2025). The relationship between socioeconomic vulnerabilities and the tendencies for adopting disruptive adaptations remains unclear, however. For example, although the importance of wealth and income is obvious, Barnes et al. (2020) found that financial assets are not related to transformative action, which includes livelihood diversification and active engagement in long-term planning. Likewise, in our study, lack of income is associated with neither adaptation behavior nor transformative capacity. Nonetheless, transformative capacity is lower among females and individuals without access to formal education, as shown in Table 5. Getting older would also create difficulties for relocation and retreat from hazard-prone areas. A capacity approach would address the structural constraints on individual agency, which might arise from gender, knowledge and literacy, age, and preexisting health conditions. Transformative individual adaptation therefore requires efforts to strengthen agency by removing such constraints or mitigating their perverse effects. Collaborative capacity-building initiatives that explicitly address equity and power are instrumental (Ziervogel, Cowen, and Ziniades 2016; Ely 2022; Ziervogel et al. 2022), but there is a need for more evidence on the microlevel change processes and outcomes linked to these efforts.

Incremental action shows nuanced differences. Such action is often described in terms of hazard or disaster preparedness (Tierney 2007; Bamberg et al. 2017; van Valkengoed and Steg 2019), addressing immediate threats but typically not the root causes of the problem, such as living in a flood-prone location and unsustainable social practices. Our study suggests that incremental adaptation behavior, notably water pumping, can be explained by existing capacities for coping with everyday challenges and meeting livelihood needs, particularly those related to entitlements. Our coping capacity scale is derived from the key elements of the environmental entitlements framework (Mearns 1995; Leach, Mearns, and Scoones 1999). This seems to suggest that the entitlements framework is more relevant to the study of less disruptive adaptation responses.

There are uncertainties in our results, however. For example, some of the coping capacity indicators form a positive relationship with water pumping, but other ones show a negative relationship. Also, although only one of the twelve transformative capacity items listed in Table 2 statistically changed with the variable of water pumping,5 a few coping capacity indicators are associated with transformative action, implying the relevance of the entitlements framework for explaining transformation. Moreover, although floor elevation can be described as incremental, it is strongly associated with transformative capacity. The regression model is not fit for drawing conclusions.

Conclusions

It has been argued that radical interventions are required to adapt to the changing climate. These interventions would address the root causes of vulnerability and involve a fundamental change in larger systems, such as communities, cities, institutions, and socioecological systems. Microlevel transition, however, has been overlooked in the study of system transformation. Limited evidence on the determinants of transformative individual adaptation has been reported.

This article has presented evidence from Indonesia and Myanmar. Our research shows that transformative capacity is strongly associated with disruptive adaptation response, including moving out of a flood-prone area, but not incremental action, notably pumping floodwater out of the home. Transformative individual adaptation entails the strengthening of individual agency, which is influenced by perception of change, flexibility, interest in undertaking significant change, and autonomy. A sound conceptual framework would integrate these considerations with other contextual factors, such as socioeconomic characteristics, values, and power relations.

These findings help advance a capacity approach for understanding transformative individual adaptation. Participatory, inclusive, empowering, and bottom-up processes are crucial for building adaptive capacity, but a new research agenda would require insights into how these processes can enhance individuals' livelihood flexibility, build confidence in managing change, strengthen their sense of control and influence, and ultimately enable individual and collective action. The key is to identify and strengthen the linkages between macrolevel processes occurring in the larger community and society and microlevel processes involving individuals and households. One of these linkages concerns how structural constraints arising from gender role and poor education influence individual agency for transformation. A capacity approach would also explore other pathways through which assets, capabilities, and entitlements contribute to transformative action, which remain obscure in this study.

The theory of transformative individual adaptation is in its infancy. There is widespread support for system change as a social project. Yet, the concept of transformation is difficult to express in terms of individual action, which does not normally represent a systemic intervention. To inform policy and practice, a working approach that recognizes how "system" and "individual" change processes interact and shape each other is needed.

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Notes

1. There are nuanced differences between transformative and transformational adaptation. See Few et al. (2017) for details.
2. Including Panjang Wetan, Panjang Baru, Kandang Panjang, Padukuhan Kraton, Pasir Kraton Kramat, Tirto, Karang Jompo, Tegaldowo, Mulyorejo, Bandengan, and Jeruksari.
3. Yangon remains under the control of the Myanmar military government (the State Administration Council). The local situations prohibited long-distance travels across local administrative borders and checkpoints over an extended period of time.
4. The marginal effect of Entitlement 1 on voluntary migration is significant but weak.
5. Based on *F* tests. Among these twelve items, the water pumping variable shows a statistically

significant relationship with the statement "In Pekalongan/Kyimyindine, it is hard for my household to start new activities on our own" only ($F = 4.624$, $p < 0.05$).

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