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Adapting to Change: People and Policies

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9.1 Introduction

Deltas are shifting, subsiding, morphing environments endlessly adapting to changes in sediment flows, water levels, storms, floods and sea-level rise, both naturally and, increasingly, through human effort (e.g. Chapters 2–4). Human activity and settlements within deltas and their watersheds

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contribute to the vulnerable environment within which deltas produce food, support commerce and residents manage their lives and livelihoods. Delivering secure places while improving ability to adapt and fostering resilience is a huge challenge in rapidly changing delta landscapes in the Anthropocene.

Deltas have been changed by human activity since early human settlement. For example, human modifications in the Ganges-Brahmaputra-Meghna dating are documented for approximately 3000 years, and more recently with the founding of Dhaka in 1604 (Fergusson 1863). The Anthropocene is characterised by a great acceleration in trends of land use and other change. Dhaka for example, has increased in population from around 220,000 in 1941 to 15 million in 2011 (RAJUK 2015). During this period the city has expanded with land reclaimed and more low lying flood-prone areas have been settled.

The abundance of fertile land means that deltas are vital resources in food production. However the context in which this takes place in the Anthropocene is changing. As a result of population increase and demand for land, land tends to be used more intensively. Large engineered interventions are common which can include upstream dams outside the delta to generate hydropower on the Nile and Volta Rivers, and canalisation for irrigation and transport as seen within the Mississippi and other deltas. The Mekong Delta, for example, is central to the rice bowl of Southeast

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Asia and generates around 50% of Vietnam's total rice output and about 90% of its rice export (Ling et al. 2015). Other deltas, such as the Mahanadi in India, have larger proportions involved in small scale and subsistence farming, representing a significant labour and livelihood for extensive populations (Duncan et al. 2017).

Here, the building blocks of adaptation to environmental change in deltas and prospects for the future are examined. The focus is on decisions made by people, not just as individual agents but also in the social context of households. Such decisions are constrained and shaped by collective and policy-driven adaptation. This chapter considers the lived reality and social distribution of vulnerability and reviews evidence on where adaptation is occurring, who is undertaking it, what forms it takes, and what types of adaptation are perceived to be successful. An adaptation typology to organise forms of adaptation is presented which considers the relationship between policy driven adaptation and what households are doing within this adaptation policy context. Adaptation policy has, on occasion, unforeseen negative consequences of adaptation policy and the chapter reflects on the future of adaptation, specifically the relationship between latent and active capacity to adapt, vulnerability and the existence of incentives to adapt.

9.2 Vulnerability Affects People's Ability to Adapt in Deltas

People in deltas are, in many places, highly vulnerable to environmental shocks and stresses. Many elements of this vulnerability are driven by the natural geography of deltas, e.g. river flow and sedimentation, but are amplified by more recent human interference with the delta systems. This includes inappropriate or poorly maintained engineering interventions, such as dams, navigation, flood control works, but also from demographic pressures and changes in land use. The combination of all of these pressures leads to floods, subsidence, storm surges and a highly variable living environment. Deltas also face upstream and externally

driven stresses, such as sediment starvation from dams (Chapter 5), price fluctuations in key crops from global economic issues, and the hazards associated with climate change (Nicholls et al. 2007).

In terms of current vulnerability, the role of sea-level rise remains uncertain. Some argue that present day societal vulnerability is more dependent on risks from river discharge and storm surges, rather than longer term trend changes in sea level (Vermaat and Eleveld 2013). Others argue that sea-level rise and climate change are dominant factors shaping deltaic environments in the future (Szabo et al. 2016). There is no debate that climate change will have an impact on the vulnerability of deltas. The questions to be asked are: is climate change already affecting deltas, if not, when will it start to have an impact, and what can be done about this now?

Levels of economic development play a key role in shaping present day vulnerability (Tessler et al. 2015). Chapter 5, for example, shows how shocks to the regional economies of deltas result in reductions in labour demand, aggregate income levels, and ultimately undermine the resilience of these areas. Deltas in wealthy countries, such as those of the Mississippi and the Rhine, appear to be better placed to cope with current stresses than those in poorer countries, due to levels of investment in protective infrastructure. The distribution of resources, and levels of inequality and poverty, especially in the developing world, make delta populations vulnerable and fragile in the context of environmental shocks. In the Yellow River Delta, China, for example, low levels of education, below minimum wage and general lack awareness of global climatic issues of its many deltaic residents, are considered important factors that contribute to increasing their vulnerability (Wolters et al. 2016). As outlined in Chapter 7, delta areas are characterised by trends towards ageing populations and significant shifts in populations from rural to urban areas (Szabo et al. 2016). At present some rural areas continue to have labour surpluses, but are increasingly facing the implications of an ageing population with high dependency ratios with outfluxes of working age adults to cities.

Even within deltas, experiences vary with the social factors that shape vulnerability and adaptive capacity in deltas (see Chapter 6). Limited

access to resources, low decision-making power and social roles constrain women's capacity to prepare, respond and adapt to climate shocks and stresses (Pearse 2016). The adverse impacts of coastal erosion on land and water have gendered effects linked to social responsibilities and roles. Water salinisation and land loss can force women to walk longer distances to collect water and graze livestock adding further physical and time burden that ultimately affects their adaptive capacity. However, it is worth noting that vulnerabilities are not homogenous among women, but are determined by an interplay of social, economic and cultural factors including age, class, caste and ethnicity (Kaijser and Kronsell 2014). A case study in Odisha, shows that women from upper castes are less vulnerable to cyclones than women from low-castes due to better access to social networks, assets and resources (Ray-Bennett 2009). Age can also be a mitigating factor of vulnerability linked to voice and decision-making in intra-households power dynamics.

Perceptions of risk affect vulnerability and are subjective, reflecting socio-cultural backgrounds. Perceptions influence individual and collective preparedness, response and recovery to short term extreme weather events, as well as people's adaptive behaviours to long term change, such as sea-level rise. Experiential and socio-cultural factors may explain significantly more variance in climate risk perception than either cognitive or socio-demographic characteristics (van der Linden 2015). Previous experiences of loss and damage can also shape expectations about the prevalence and severity of future events such that perception of risk increases sharply after exposure to flooding (e.g. Botzen et al. 2009; Kellens et al. 2012; Gallagher 2014) and makes people more willing to make household level changes and be better prepared (Lawrence et al. 2014). Even within the same household, climate risk perception and adaptive responses differ between genders for the same shock (Mishra and Pede 2017). Individuals may change their perception of risk over time either as the result of direct experience of one or more hazards or based on new information acquired through trusted social networks or other information sources (e.g. Magliocca and Walls 2018).

The challenge in deltas in poorer countries is to address the cyclical and chronic changes in the deltaic environment, the frequent hazards,

poverty and the need for economic development, alongside the increasing ad hoc physical modifications of canals, dykes and polders. For example, in the Mahanadi Delta in India, repeated cycles of disasters coupled with recurrent (and expensive) cultural activities, ineffective livelihood diversification, ineffective formal institutional support and limited access to land all combine to reduce individual and household resilience to hazards (Duncan et al. 2017). The solutions used to address past and present challenges could change the future for delta residents; the following sections address the questions how might that happen? What policies are used in deltas? And, what might future transformational adaptation policies for deltas look like?

9.3 Adaptation Policies and Incentives in Deltas

Many elements of policies for adaptation to environmental risks in deltas mirror planning and policymaking in other low lying coastal areas: policy options are largely described within the broad concepts of protect, accommodate or retreat (Bijlsma et al. 1996), also referred to as armour, adapt or retreat. Deltas are also widely referred to as poverty, climatic and development hotspots (de Souza et al. 2015). Specific delta policies or strategies are largely sets of principles framed around a broad geographical area. They include the Dutch Delta Programme, the 2016–2019 Mississippi Delta Region Development Plan, the Niger Delta Master Plan, the Mekong Delta Plan, or the Bangladesh Delta Plan 2100 (Seijger et al. 2017). However, there are not comprehensive delta plans or processes for many of the world's most significant and populous deltas (see Chapters 2–4, Mensah et al. [2016] and Hazra et al. [2016]).

Policy choices for deltas have been influenced by international cooperation and treaties such as the Sendai Framework for disaster risk reduction agenda, UNFCCC climate change adaptation reporting requirements, and the Sustainable Development Goals (Lwasa 2015). At the subnational scale, adaptation policy appears to be largely focussed on addressing disaster risk, yet there is only limited documentation

of the initiatives that are taking place e.g. managing coastal erosion through creation of barriers, storm surge barriers, adaptation of housing to flooding (Kates et al. 2012). Of all the adaptation policies in deltas, these can be grouped into three main components: addressing pre-existing socio-economic vulnerability, reducing disaster risk and building long term social-ecological resilience, see Fig. 9.1.

In many deltas, much of the current effort in adaptation policy is focussed on reducing vulnerability. For example, Bangladesh formulated the Climate Change Strategy and Action Plan 2009 (MoEF 2009) and established a climate change trust fund in 2010 to fund implementation (Ayers et al. 2014). The strategy and action plan proposed six areas of activity namely: food security, social protection and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening (Islam and Nursey-Bray 2017). Within these areas, 44 programmes have been funded to date, and are categorised in Fig. 9.2 to be distributed among three elements: vulnerability reduction, disaster risk reduction and ecological resilience (Tompkins et al. 2018).

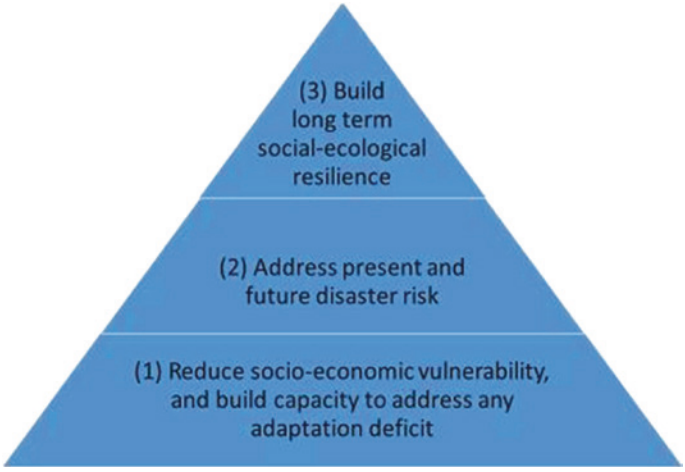

Fig. 9.1 Components of adaptation policy in deltas (Adapted from Tompkins et al. [2018] under CC BY 4.0)

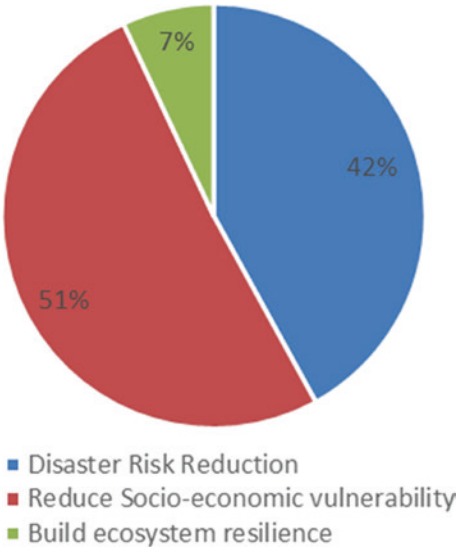

Fig. 9.2 Distribution of types of adaptations across the GBM Delta undertaken by Bangladesh Climate Change Trust (BCCTF) during 2009–2017 (Data from: Annual Reports since 2009 of Bangladesh Climate Change Trust, Ministry of Environment and Forests, Dhaka. Adaptation types follow Tompkins et al. [2017])

Measures in the delta include construction/repair of embankments, river bank protection, cyclone shelters, etc. The vulnerability reducing measures include re-excavation of canals, improving drinking water supply, raising homesteads, etc. Ecosystem based adaptations include coastal mangrove plantation. Of the 231 measures considered, about 80% of the total investment has been made in food security and infrastructure clusters. Very little investment has been made in research and capacity building. Among various ministries in Bangladesh, the Ministry of Water Resources, Ministry of Local Government and Ministry of Environment and Forest received most funds. Local government institutions received much less funding compared to central agencies, but performed better in targeting adaptation deficits and mainstreaming gender considerations (Vij et al. 2018).

Common adaptation policies and programmes that seek to reduce vulnerability are typically incremental (Denton et al. 2014).

Beyond the developing world, some policies seek to be more transformational (Kates et al. 2012) by fundamentally changing the nature of a system, or inducing radical change across systems. Such transformations focus on the future and long term substantial change, and may involve questioning the effectiveness of existing systems (Lonsdale et al. 2015). Examples of transformational adaptation policy include: removal of existing hard protection and barriers to tidal and riverine flow (e.g. riverine and tidal dike removal) in the Mississippi Delta (Mississippi Department of Marine Resources 2011); reactivation of floodplains in the Rhine delta (ICPR 2015); and restoring floodplains that remove embankments and return agricultural polders to floodplains to increase floodwater retention capacity in the Yangtze (Chen et al. 2014). Managed retreat of infrastructure and people from the coastal Mekong (USAID 2014) represents a significant transformation and demonstrates that such radical plans often have significant losers as well as winners. All of these policy choices reveal a dramatic shift away from current and historical adaptation policy choices in the various deltas (Vincent 2017). It is in this context that individual households, businesses and communities are adapting to shocks and stresses. The following sections consider: how are people adapting and how is policy affecting adaptation choices? What adaptations are considered effective and is there agreement on the best way to adapt?

9.4 Adapting to Present Day Stresses

Despite a long history of adaptation to environmental change in deltas, little is known about the specifics of this adaptation, for example, who is adapting, how and why, and how this has changed over time. However, given the ambition to undertake a global stocktake of adaptation by 2023 as mandated by the Paris Agreement to the UNFCCC, documentation of such adaptation practice is urgently required (Tompkins et al. 2018). At present, it is known that households and individuals do not adapt in isolation from the national policy context, but operate within it. Household choices are mediated by a number of

factors, including non-government organisations (NGOs), international advocacy groups, the private sector and the socio-cultural context. Within the current research, drawing on multi-scale governance literatures, a typology of the factors influencing how policy and household choices interact is identified (Fig. 9.3).

Adaptation policy can play a role in supporting adaptation. For example, support to convert land to alternative livelihoods, such as horticulture, or resourcing to support community-based cyclone preparedness activity, can spur on households to undertake adaptive actions. However, the extent to which policies achieve their intended goals is variable. Cyclone shelters are installed to provide shelter during and after extreme events, yet women and girls are often reluctant to stay in public shelters where they may have to interact with men, to maintain honour and avoid shame and harassment (Rashid and Michaud 2002; Juran and Trivedi 2015). Poverty can constrain household adaptation choice. For example, government policy in India provides training for farmers on climate tolerant crop varieties to improve agricultural productivity in increasingly saline or dry conditions. However, poor farmers may not have the time to travel to training on new crop varieties, or have the buffering capacity to take the chance to change crops just in case of crop failure.

While many adaptation policies have been put in place, imperfect implementation can also mean that the social consequences have not always been even (Mimura et al. 2014). In Bangladesh, dykes and polders are essential to protect properties and agricultural fields from tidal

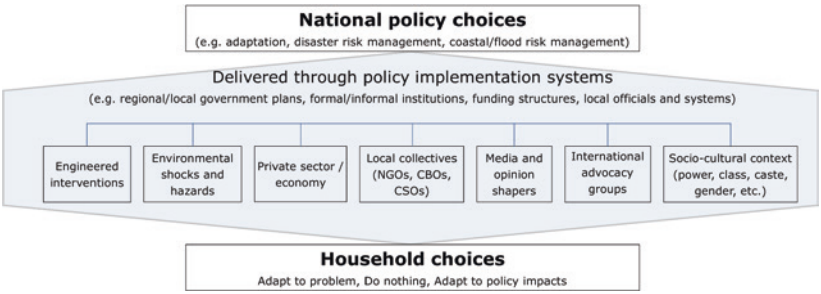

Fig. 9.3 National policy influences adaptation choices by households, mediated by social and environmental factors

flooding. Many of these polders are still awaiting rehabilitation following severe cyclone damage in 2007 and 2009. This has prolonged community suffering due to the continued threat of tidal flooding, income insecurity, lack of freshwater supply and ongoing vulnerabilities due to weak coastal embankments remain a concern long after those cyclones (Sadik et al. 2018). In the Mekong a government programme of dyke building has enabled multiple crops per year, encouraging commercial production and leading to a reduction in small-scale farming and net out-migration of people from the delta (Chapman et al. 2016). As highlighted in Chapter 7, government action is patchy: not all communities that require relocation, or demand it, are necessarily included in plans (Mortreux et al. 2018).

Adaptation policy choices can also lead to unexpected impacts, where individuals have to adapt to the consequences of the adaptation. In the Vietnamese Mekong Delta, the most profound recent effort has been the creation of an extensive high dyke network, spanning thousands of kilometres and encompassing the majority of the delta's rice paddies. Much of the effort in creating this network occurred during the late 1990s and early 2000s. Through household survey (Chapman et al. 2016), creation of a system dynamics model (Chapman 2016) and multi-criteria analysis (Chapman 2016), findings suggest that extending and heightening the Vietnamese Mekong Delta dyke network is an effective adaptation against prevalence of extreme river flood events. However, this finding is only true when greater weight is placed on large-scale short-term food production and export, and the incomes of wealthier (large land-owning) farmers. Should decision-makers take a pro-poor approach, and place an equal or greater weighting on the sustainability of the livelihoods of poorer farmers, and indeed the sustainability of the delta system, the adaptation (the high dyke network) generates a counterintuitive outcome, see Fig. 9.4.

Two key, linked trends in Fig. 9.4 lie at the heart of this counterintuitive result. The first is that under the adapted (high dyke) system, rates of change over time in rice input efficiencies (i.e. yield per tonne of fertiliser) reverse direction. The loss of nutrient-rich sediment deposition (in the unadapted system), historically brought by the now excluded flood, degrades the quality of the soil and pushes farmers

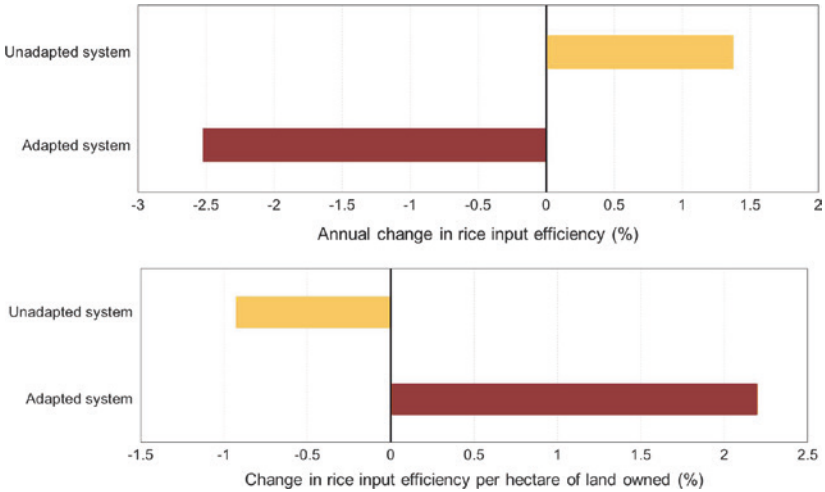

Fig. 9.4 The distributional impacts of adaptation in rice farming systems in the Vietnamese Mekong Delta (Adapted from Chapman et al. [2016] under CC BY 4.0)

towards heavier fertiliser use. The second trend, a direct result of this, is a reversal in the relative advantage of farm size (Fig. 9.4), from favouring smaller operations (unadapted system), to favouring larger operations (adapted systems). Small-scale operations of one hectare or less tend to lack the resources to compete in a fertiliser-intensive system, having previously benefitted from the free provision of sediment-bound nutrients. Chapman et al. (2016) point to the importance of recognising whose priorities count in evaluating the success of adaptation policy choices. They acknowledge that the success of adaptations is normative: there are winners and losers, and trade-offs will always be needed (see also Hutton et al. 2018).

A key issue raised in policy and science is the assessment of success in adaptation. Under what conditions can adaptation be considered a success? And how does success vary with social factors, such as gender, age and caste? There are various criteria by which adaptation can be evaluated, for example effectiveness in terms of long-term sustainable development, cost-efficiency of the action, equity of the distribution of impacts or the legitimacy of the action (Adger et al. 2005).

Despite some work considering no-regrets adaptation and adaptations that generate mitigation or developmental co-benefits (see, for example, Suckall et al. 2015), it is broadly agreed that there is little evidence of such multiple wins and that most adaptations have negative consequences for some (Ficklin et al. 2018). Indeed, there is growing recognition that no adaptations will generate universal benefits, and there will always be people who lose as a result of adaptation, either through paying for adaptation benefits and not receiving them, being affected by others' adaptations, or even because an individual has no choice but to adapt in a way that does not contribute to long-term sustainable development. This is not necessarily a message that policymakers wish to hear, however, it is a realistic appraisal of the impacts of adaptation policy. This leaves the question—how can inclusive adaptation strategies be designed for deltas during the Anthropocene?

9.5 The Design of Inclusive Adaptation Strategies

Adaptation is a spatially and temporally dynamic process with accrued benefits potentially changing with geography, time and circumstances. What might be considered an effective adaptation response in one place at one time may, with time, become less or more effective with associated consequences and potentially bringing into question the sustainability of the adaptive response. An example is the Mekong Delta in Vietnam where short-term benefits of engineering interventions to increase rice production from two annual crops to three are offset by the longer term impacts. The impacts include: soil quality degradation associated with fertiliser use, reduction in fishery co-production and loss of ecosystem services from the introduction of agricultural pest predators associated with flooding (Chapman et al. 2016). In Bangladesh, there can be long term financial benefits of enhanced horticulture production, in lieu of traditional rice farming, but due to the highly variable year on year yields of horticulture (which can create lean years), there is much lower uptake of this adaptation by poorer socio-ecological groups on the delta (Hutton et al. 2018).

Evidence from past adaptations in deltas reveals a spectrum of initiatives, from extensive investments in cyclone preparedness and recovery in Bangladesh (Mallick and Rahman 2013), to dyke and polder building in India, and construction of embankments in the United States. Other significant change has occurred in deltas as a result of social policy. For example, the Mahatma Gandhi Rural Employment Guarantee Scheme in India provides a social safety net for those who are below the poverty line. There is also evidence of attempts to redraw, what often tend to be, entrenched patterns of competition and dominance in the allocation of water and management of river basins (Budds 2013). Adaptation strategies are clearly not simply engineered solutions, nor are they simply social policies, they are a complex web of policies that affect the various components within deltas: land use, ecosystems, rural and urban development, transport, disaster risk reduction, to name a few, see, for example, Mensah et al. (2016), Hazra et al. (2016), and Dey et al. (2016).

Recent research has endeavoured to consider what future strategies in deltas may look like (Suckall et al. 2015). Adaptation is not limited to one sector, but needs to be considered in the light of the bigger picture. Policymakers are often lacking insights into how policy can affect adaptation strategies, and the trade-offs that need to be made to reflect normative goals (for example equitable poverty reduction, or emphasis on national level economic growth). In turn, adaptation policy choices are affected by the costs of adaptation and the extent to which policy change, and political effort, is required.

Suckall et al. (2018) develop narratives of adaptation policy—which comprise multiple policies in the areas of: addressing disaster risk, reducing socio-economic vulnerability and managing landscapes and ecological systems. Each adaptation policy direction requires different levels of investment, resourcing and policy support. *Minimum intervention* brings together policy choices that could be explained as focusing on low cost adaptation policies designed to achieve maximum impact. The focus here tends to on basic emergency response to disasters. *Capacity expansion* encourages climate-proof economic growth, requiring investment, but does not seek to make significant change to the current structure of the economy. *Efficiency enhancement* requires less investment than policy commitment, is an

ambitious strategy that promotes adaptation consistent with the most efficient management and exploitation of the current system, looking at ways of distributing labour, balancing livelihood choices and best utilising ecosystem services to enhance livelihoods and wellbeing under climate change. *System restructuring* requires the greatest level of investment and policy commitment, and is based on pre-emptive fundamental change at every level in order to completely transform the current social and ecological system, and change the social and physical functioning of the delta system. This argues that the system can be restructured in one of three main ways—each with a different focus: protection, accommodating change and retreating/moving away. Each has a different end goal for the delta. Collectively these policy directions offer insight to policymakers by envisioning what policy direction opportunities there are for deltaic regions. Under a changing climate, with an inevitable reduction in sediment in deltas resulting from upstream damming and other land use modifications (see Chapter 6), it is known that the structure of deltas will substantially, and potentially fundamentally, change further in the Anthropocene. What are the implications of these different adaptation policy directions in this context? Chapter 10 considers how these different policy directions can generate different outcomes for deltas, and it considers explicitly the trade-offs that need to be made to achieve policy goals.

9.6 Conclusions

Policies and planning will play a powerful role in creating the human-dominated deltas of the Anthropocene. There is good evidence that active management of deltas can potentially generate sustainability for deltas and their populations. Governments retain the autonomy to identify their priorities for development of many deltas, and choose adaptation policy directions that help to achieve these aims.

The emergence of delta management plans in many developed and developing countries is a positive sign of proactive attempts to manage the complex interactions of natural environments and human systems in the Anthropocene. A key insight is that what deltas will look

like in the future depends substantially on current policy directions and choices. This is not a simple policy choice particularly due to gaps in our information and understanding about what adaptations are most successful over time, and across which population groups. The global stocktake of adaptation mandated by the Paris Agreement of the UNFCCC will provide insights into the prevalence and quality of adaptations, including in deltas, to understand who is gaining and who is losing from alternative adaptation policy directions.

National governments with deltas within their boundaries, and neighbouring countries in watersheds are facing major challenges in managing deltas in a changing climate, not least with limited information about directions and motivations for adaptation of diverse actors. Key dilemmas for governments in delta adaptation policy directions are to decide whose voice should be heard in developing plans, and what trade-offs they would consider to be unacceptable. In this way, planning for an uncertain future can proceed on a sound basis.

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