4 ACM as a pathway to mitigate Jakarta's flood impacts in a changing climate

Trikurnianti (Yanti) Kusumanto, Gusti Ayu Ketut Surtiari, Chris Zevenbergen, Annisa Triyanti, D. Ary A. Samsura, Tristam Pascal Moeliono and Yus Budiyono

Introduction

It was over two decades ago that Kusumanto began CIFOR's field research to apply and investigate the adaptive collaborative management (ACM) approach to forest management in Baru Pelepat village in Jambi Province, central Sumatra (see Chapters 2 and 3, this volume). The endeavour was a partnership between CIFOR, a Jambi-based nongovernmental organisation, and Jambi University and was supported by the Bungo District Government. The team's involvement as process facilitators and action researchers lasted from 2000 until 2006 and has left traces of social, relational, and institutional changes at community and forest landscape levels.

CIFOR's ACM conceptual underpinnings (Prabhu, McDougall, and Fisher 2007) have been imperative for generating the above as well as other outcomes and are inspired by Paulo Freire's philosophy of 'reflection and action upon the world in order to transform it', Holling's ideas on adaptive management of large ecosystems, Habermas' 'communicative action', the social theory of Giddens, Kolb's learning in development, and social learning in contexts of forest and natural resources (Maarleveld and Dangbegnon 1999; Wollenberg et al. 2001).[1] ACM's focus is on transforming social-ecological systems by employing participatory action research (PAR) as a framework for engaging stakeholders. It is an approach that potentially offers a pathway for dealing with larger scale, so-called 'wicked problems'. Underlying values and causes of such problems are typically ambiguous and contested (Lönngren and van Poeck 2020). They are in essence unsolvable and addressing them can at best be done by attempting to improve the situation and learn from the effort (Sol et al. 2018). The governance of natural resource management is characterised by mutual dependencies between the many actors, each with different interests, perspectives, and values, having a stake in the problem. The circumstances in which a given problem occurs can include social plurality, lack of trust among stakeholders, environmental change, scientific disagreement, inadequate legal tools, and varied policy framing. Examples of societal problems with a wicked attribute include environmental degradation, economic crises, or failing educational systems (Rittel and Webber 1973).

DOI: 10.4324/9781003325932-7

Here, we build on thoughts expressed earlier in ACM's history: "Although climate change issues were just a faraway twinkle in the eyes of the original ACM researchers, the relevance of ACM results to climate change adaptation has become increasingly clear" (CIFOR Website, accessed in June 2022). Now we think it is time that the potential of ACM is assessed as a pathway to address the flooding problem of Greater Jakarta, Indonesia – a notorious wicked problem which calls for adaptation with multiscale and equitable participation, learning, and innovation. ACM can arguably offer a path forward in a world subject to a changing climate and other global environmental change. Our present team is particularly interested to see if ACM offers avenues for transboundary collaboration and transformation at various levels and scales in the Jakarta region. Lessons from our investigation may nonetheless also benefit other global regions with similar wicked problems. The urban setting is a relatively new arena for ACM; only a few studies have been conducted on this approach in such a context. Furthermore, our assessment entails a cross-border endeavour which necessarily reaches out to forest-related realms, and geographically to the upstream parts of the Jakarta delta.

In this chapter we assess ACM's applicability by means of a thought experiment to identify, explore, and develop alternative approaches to better understand and hopefully better manage Jakarta's flooding problem. We believe that these are direly needed. The chapter is not based on an in-depth analysis of empirical work but an exercise whereby our team of experts envisions the application of ACM in Greater Jakarta.

Our multidisciplinary team represents diverse science and development disciplines, comprising human ecology, social learning, flood resilience, urban and regional planning, environmental governance, spatial planning and environmental law, and system dynamics. The lead author specialises in social learning and inclusivity in sustainability governance; she co-led CIFOR's ACM research in Jambi in 2000–2006.

In the following sections, we first describe the background of Jakarta's flooding problem. We then discuss in general terms the wicked problem concept in connection to water governance. A discussion of the ACM concept and applicability follows, including a brief account of why ACM, as our Jambi team applied and experienced it, was successful in delivering positive outcomes. The chapter proceeds with pinpointing the objective of our study and presenting its methodology which, as mentioned above, is essentially a thought experiment. It allows us to draw on the lessons from ACM application in Jambi and link these with our team's expertise, while amalgamating with relevant literature. The chapter continues by framing Jakarta's flooding as a wicked problem and subsequently discussing the results of our thought experiment. Concluding remarks highlight the significance and potential of ACM as a pathway for mitigating the impacts of Greater Jakarta's flooding in the context of climate change.

Background

Greater Jakarta covers a land area of 7,062 km^2 (Kamarzuki 2020) and stretches over the province of the Special Capital Region of Jakarta (DKI Jakarta) and

parts of West Java and Banten provinces (Figure 4.1). Major parts of the metropolitan area are the five satellite cities of Depok, Bekasi, Bogor, Tangerang, and South-Tangerang; and the regencies of Bogor, Bekasi, and Tangerang. The low-lying delta is known as one of the most flood-prone metropoles globally (Marfai, Sekaranom, and Ward 2015), through which 13 rivers and two canals flow for the discharge of water into Jakarta Bay (Budiyono et al. 2017). In 2020, Greater Jakarta was home for 35.5 million people (BPS 2021) and is projected to accommodate around 75.6 million in 2039 (Florczyk et al. 2019). The region already experienced floods during the ancient Hindu Kingdom Tarumanegara[2] (4th–7th centuries CE) and they have persisted through colonial Batavia until today's super city.[3] Yet, it has been only since the 1970s that, due to urbanisation and rapid economic growth, land use-land cover change (LULCC) has become a key driving factor of flooding (Rustiadi et al. 2015).

LULCC potentially reduces the area for water catchment and adversely affects drainage systems. Especially LULCC due to urbanisation can importantly influence hydrological behaviour by reducing surface infiltration and increasing surface runoff and flow volumes (Goudie 2018; Rogger et al. 2017). Jakarta's urbanisation is marked by a fast increase in built-up area,[4] thereby rapidly reducing green space surface area and hence also the region's water retention capacity (Maheng, Pathirana, and Zevenbergen 2021). Furthermore, disturbance of the area's hydrology has been due to the loss of upstream forests and of water catchment and urban forest areas in more downstream localities (Afriyanie et al. 2022).[5]

In the case of Jakarta, land subsidence has been another key driving factor of flooding (Budiyono et al. 2016; Yan et al. 2020). The megacity is sinking fast, crucially driven by excessive extraction of deep groundwater which has occurred since the mid-1970s and has resulted in subsidence up to four metres in parts of northern Jakarta (Kooi and Yuherdha 2018). Forty per cent of DKI Jakarta is under sea level (Koto and Negara 2017). Land subsidence has also been caused by soil compaction due to loads from infrastructural construction and buildings associated with urban development (Hasanuddin et al. 2011).

Climate change is posing Greater Jakarta with yet another challenge. Sea level rise, intense rainfall, and extended wet monsoons induced by climate change have increasingly become causal factors that drive the occurrence of flooding and ensuing social and economic disasters. In the occasional case where high volumes of water flow down from the upstream rivers and high rainfall locally together meet up with (tidal) water coming from the sea, these result in disastrous flood levels.[6] Given LULCC, land subsidence, and climate change in the foreseeable future, Jakarta's flood hazards are expected to intensify.

The increasingly frequent and severe flooding has been among the arguments of the incumbent government to relocate the country's capital to East Kalimantan (on Borneo island) by 2024 (Van de Vuurst and Escobar 2020; Yusriyah et al. 2020).[7] Since the 2007 flood in Greater Jakarta – the largest flood over the last two and a half decades (see Figure 4.1), the region has been stricken by devastating floods in 2013, 2015, 2018, and 2020. Yet, while moving the capital may help to evade potential loss and damage associated with flooding (Januariyadi et al. 2020), it could merely mean a transfer of the problems confronting Jakarta to the new

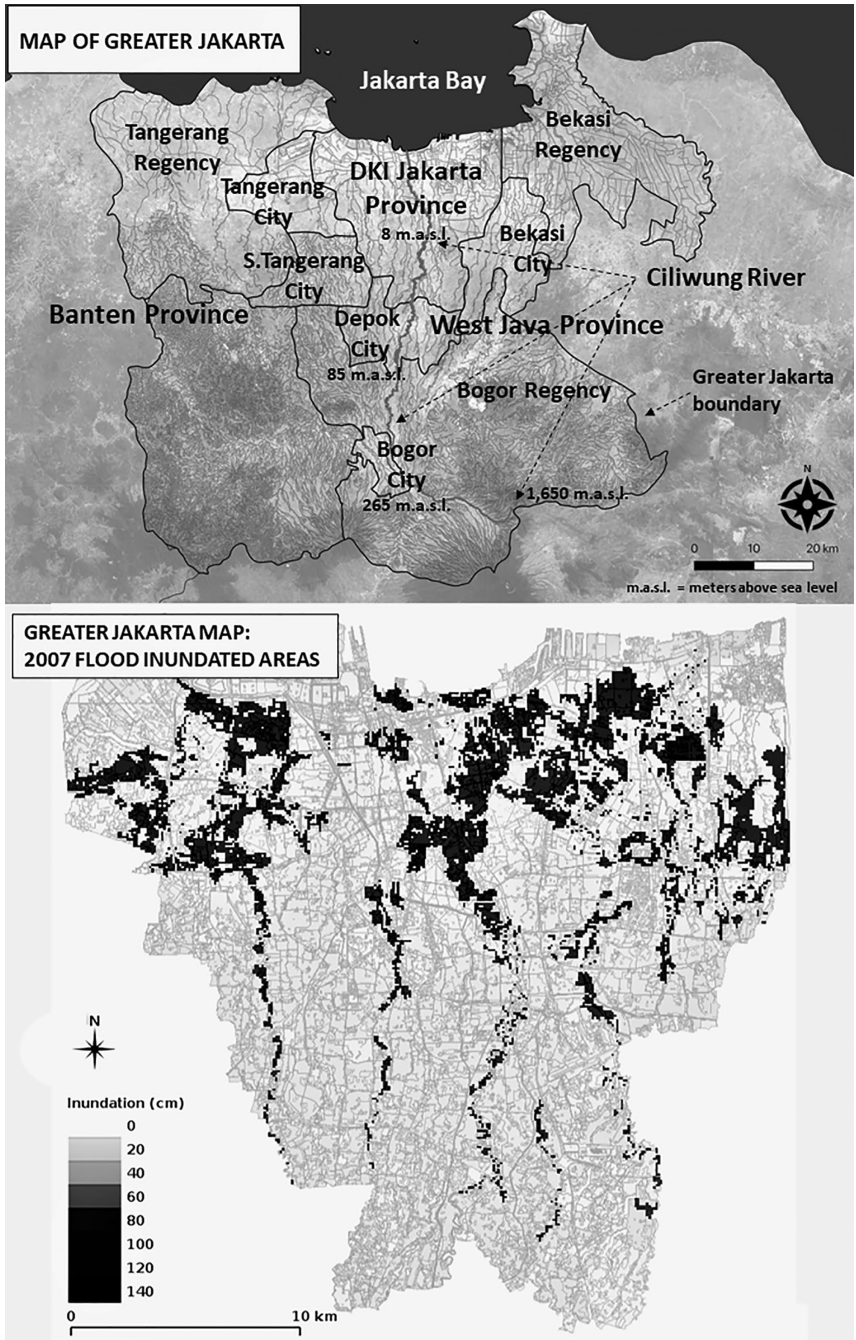

Figure 4.1 Maps of Greater Jakarta showing the different jurisdictions and its most flood-prone Ciliwung River, with inundated areas at village administrative level due to the 2007 flood

capital (Van de Vuurst and Escobar 2020). Moreover, without any doubt, the current capital – and Greater Jakarta – must still be protected from future flooding.

Early flood mitigation measures date back to 17th-century Dutch colonial times (Caljouw, Nas, and Pratiwo 2009; Garschagen, Surtiari, and Harben 2018; Octavianti and Charles 2018). With a view to obtaining control over the city's hydrology, for 400 years, infrastructure-focused engineering solutions – e.g., structured canal systems, flood reservoirs, and the giant sea wall – have been the mainstream paradigm in flood management (Octavianti and Charles 2018). Limited attention has been paid to the anthropogenic root causes of flooding and recent studies revealed that responses to Jakarta's flooding problem should be sought beyond the engineering and technocratic realms (Asdak, Supiah, and Subiyanto 2018; Cao et al. 2021; Garschagen, Surtiari, and Harben 2018).

'Wicked problems' and water governance

Since Rittel and Webber introduced the wicked problem concept in 1973, literature on this idea has grown exponentially, dispersed across a wide variety of scientific disciplines with distinct epistemological assumptions (Lönngren and van Poeck 2020). We position our investigation in a multidisciplinary context which is informed by a social constructivist understanding of wicked problems. From this perspective, there is no 'true' definition of a given wicked problem; it is rather a social construct. Following sociological literature, theoretical concepts function in research as descriptive/analytic tools, sensitising/creative tools, or critical/emancipatory tools (ibid.). The utility of the wicked problem concept as a sensitising tool, particularly, fits well in our assessment of ACM to explore the approach's applicability to Jakarta's flooding. Because of its multifaceted and suggestive character, the concept creates space for reflection, creativity, and surprises in developing understanding of the flooding phenomenon and, importantly, in finding decentralised and equitable pathways for dealing with it.

In general terms, a wicked problem is a situation of high complexity, uncertainty, and divergence which involves multiple stakeholders with distinct needs, values, interests, knowledges, and expectations (Kharel, Romsdahl, and Kirilenko 2018). Following Sol et al. (2018), the most realistic effort for addressing such problems is to make improvements in problematic situations and learn from such efforts. With wicked problems, optimising prevailing practices, routines, and systems – that is, 'doing better the things we do' – will not help much (see Prabhu and Colfer, this volume); rather, the values and assumptions on which actions are grounded are reconsidered so that we 'do better things' (Sol et al. 2018, 1385). This implies a need for alternative policy pathways, relationship building, ways of thinking and perceptions, behaviours and lifestyles, and at the heart of all these: novel processes for the production of knowledge and social learning.

The multiplicity of jurisdictions often associated with wicked problems implies that the solutions as preferred by the various stakeholders may diverge or even be contradictory. Only an unbounded time frame offers chances to appraise the efficacy and consequences of potential solutions (Kharel, Romsdahl, and Kirilenko

2018), learn from our attempts, and accordingly improve these (Sol et al. 2018). For solutions are consequential and can create new problems. Flexibility and adaptability are therefore warranted through learning or trial-and-error (ibid.; Rittel and Webber 1973). Governmental planning tends nevertheless to have limited room for adaptations (Kharel, Romsdahl, and Kirilenko 2018) and largely responds to short-term time horizons (Adams-Schoen 2016).

Water governance problems are arguably ill-defined (Kharel, Romsdahl, and Kirilenko 2018). They greatly vary in scope and nature in terms of causes and consequences and resolving them tends to rely on elusive political judgement. While conventional expert-driven and administrative routines can solve many of the problems, they may provide little solace in solving wicked problems and can create stalemates for policymakers and flood managers. Among the challenges confronted when dealing with water-related wicked problems are (ibid.; Adams-Schoen 2016) (i) the transboundary nature across jurisdictions, sectors, and institutions; (ii) ignorance in governmental planning of hydrological processes at watershed scales; (iii) limited scope and enforcement of policies to resolve newly emerging water management problems, such as those caused by climate change; and (iv) water conflicts arising between economic, environmental, and social objectives.

Concept and applicability of adaptive collaborative management

When CIFOR coined the term 'adaptive collaborative management' around 1997, it was intended to investigate adaptive management (Lee 1999) in varying social (stakeholder) contexts (Plummer et al. 2012). Since the early stages of ACM scholarship, its focus has gradually broadened to also comprise collaborative management in connection to complexity science and resilience thinking in social-ecological systems (Armitage, Marschke, and Plummer 2007), including in connection to climate change (CIFOR Website). Hence, ACM is conceptually a convergence of adaptive management and collaborative management. A substantial body of literature between 1997 and 2010 views ACM as "an emergent governance approach for complex social-ecological systems that connects the *learning function* (experimental and experiential) of adaptive management with the *linking function* (vertically and horizontally) of co-management" (Plummer et al. 2012; emphasis added).

ACM's instrumental rationale is twofold. Equipped with the learning and linking functions as modalities, the approach is expected to "deal with the complexity of interdependent social-ecological systems and enhance the fit between ecosystem dynamics and governance systems" (Olsson, Bodin, and Folke 2010, 263). Furthermore, ACM is also postulated as a *continual and iterative process of action and reflection* whereby outcomes shape pre-conditions for the process to continue (Colfer 2005a; Plummer et al. 2017).

ACM has received much attention from scientists and practitioners alike, including criticists. The relationship between learning and outcomes, in particular, is often referred to as troublesome. ACM is a relatively young field and

the absence of a framework to organise the many considerations, definitions, variables, driving factors, and outcomes makes it difficult to analyse plausible relations between process, social interactions, and outcomes of an empirical case (Plummer et al. 2012). CIFOR's extensive investigation asserts that ACM is highly contextual and hardly any variable is deterministic (Colfer 2005a). Yet, various empirical works have evidently established positive relationships between ACM process and outcomes – i.e., ecological and livelihood effects (Colfer 2005b; Guijt 2007; Plummer et al. 2017). Interestingly, some scholars attach ACM's value to its evocative nature which suggests pathways for transitionary changes in attaining desirable resource and environmental governance objectives, rather than that it provides particular benchmarks (Huitema et al. 2009).

While not always explicitly labelled 'adaptive collaborative management', the approach has been widely applied to addressing various resource and environmental management and governance challenges (e.g., concerning agriculture, water management, or restoration). Plummer's ACM literature review (2012) reveals that the approach is predominantly applied in 'typical' common-pool resources, such as forestry, water resources, and fisheries. Not much can be found about the extent to which ACM potentially contributes to climate change adaptation and mitigation, nor to risk reduction of climate-induced disasters.

Crucially, the utility of ACM in research and practice for dealing with the diverse challenges lies particularly in the convergence of collaboration and knowledge-oriented processes. In Jambi's empirical work (Adnan et al. 2008; Colfer 2005a; Diaw and Kusumanto 2005; Indriatmoko 2002; Kusumanto 2006, 2007a, 2007b; Kusumanto et al. 2005), learning and linking processes were crucially connected to the pragmatic character of our team's role as action researchers and process facilitators. The team encouraged linking and learning to be organised and maintained between diverse community stakeholders, and vertical linking and learning between community stakeholders and village institutions, as well as between community representatives and the district government. The use of PAR as a framework crucially enabled the collaborative and learning processes to take place: (i) *substantively* (by way of locally prioritised issues); (ii) *structurally and relationally* (through PAR's joint plan-act-reflect iterations); and (iii) *via transdisciplinary/transboundary* learning between different social and institutional entities – including our Jambi ACM team. In this way, ACM's facilitated intervention is essentially a blended assortment of smaller-scale interventions grounded in systems thinking; smaller interventions were linked horizontally and vertically and nested in ACM in its entirety.[8]

Investigation by thought experiment: objective and methodology

The objective of our investigation is twofold. First, we position the flooding problem of Greater Jakarta within a wicked problem framing, which allows us to develop understanding about the way flooding governance has evolved over time in response to a changing flooding context. Second, we assess the applicability of

ACM to addressing Jakarta's flooding as a wicked problem in the climate change context so as to deliver recommendations with long-term objectives.

We employ a methodology referred to as a 'thought experiment', which originates in philosophy – essentially relying on human intuition and imagination – and its use has gradually expanded to the natural and social science disciplines (Brown and Fehige 2022). The methodology can be applied to investigate phenomena with the purpose of thinking through a hypothetical situation and its probable human and societal consequences. In our case, we obtain new insights by using already known information based on previous ACM empirical work from the Jambi research and rearranging this information from the new perspective of Jakarta's flooding context. Prior lessons that draw on ACM Jambi research are combined with insights from our team's expertise and the literature.

Our choice for a thought experiment has a practical and conceptual rationale. Not an empirical investigation, our study uses prior ACM Jambi research outcomes while relying on the team's expertise and empirical works by others in a different locale and context. An actual ACM investigation at the scale of Greater Jakarta would at present not be affordable. Nevertheless, it should be cautioned that the cost of a 'business as usual' approach to Jakarta's flooding could presumably be significantly higher. The conceptual rationale of our thought experiment is that outcomes derived from our study can offer insights for handling Jakarta's flooding problem, applying ACM, or scaling-up initiatives using ACM or similar approaches.

Framing Greater Jakarta's flooding as a wicked problem

The flooding problem of Greater Jakarta is characterised in the literature as complex, uncertain, and multijurisdictional (Cao et al. 2021; Dwirahmadi et al. 2019; Simarmata and Surtiari 2020). The problem cannot easily be defined. As discussed previously, these attributes are typical of wicked problems, which have seriously challenged Jakarta's flood policymakers.

Viewing the metropolitan area as a typically deltaic megacity in the Global South can cast some light on the issue. Population growth, urbanisation, and urban sprawl in the megacities situated in deltas of this global region tend to manifest themselves in the conversion of waterways to other uses and in an expansion of informal settlements in flood-prone areas, both of which complicate flood management (Cao et al. 2021). In such areas, water supply for household use, as well as for urban and industrial development, typically relies on the over-extraction of groundwater, resulting in land subsidence. An increased risk of coastal flooding is often the consequence. Greater Jakarta is among the delta megacities with the most severe flood risk in the future (Cao et al. 2021; Garschagen, Surtiari, and Harben 2018; Marfai, Sekaranom, and Ward 2015; Rukmana 2021).

Different stakeholders perceive Jakarta's flooding problem differently and envisage therefore distinct solutions. Governments and other stakeholders of downstream flood-prone parts of the region – particularly low-lying areas in DKI Jakarta Province – view Jakarta's flood problem primarily as an outlet problem. They seek

solutions for the protection of people, resources, and infrastructures through flood mitigation – which means diverting flood water away from flood-prone zones and/or relocating communities living there to flood-safe localities. For vulnerable people living in informal settlements, flooding can affect water quality and hinder a safe, healthy, and productive life. Many of these groups consider these localities as key to making a living, and government relocation programmes mean to them a loss of livelihood (Dovey, Cook, and Achmadi 2019; Simarmata and Surtiari 2020). For these groups, leaving these areas does not resolve the flooding problem and they seek solutions in informal, small-scale flood adaptation measures, such as raising the floor of dwellings or building simple water barriers (ibid.; Cao et al. 2021). Downstream stakeholders have often scapegoated upstream stakeholders, such as the government of Bogor Regency, upstream farmers, or plantation holders for flooding occurring downstream. Greater Jakarta's flooding is an intricate transboundary issue that involves multiple jurisdictions, sectors, and institutions, each with its own preferred solutions, which can lead to conflicts.

The 'wickedness' of Jakarta's flooding problem is obvious as well from the nature of the diverse adaptation pathways followed by stakeholders in response to changing flooding contexts. We follow Cao et al. (2021) who define adaptation pathways as "sequences of measures that can be implemented to reduce the impacts of changes in environmental conditions" (88). The discussion that follows, makes clear that whatever pathway is pursued by the different stakeholders, most proposed solutions tend, borrowing Rittel and Webber's (1973) wicked problem terminology, to be a 'one-shot operation'. The tendency exists that solutions are expected to immediately resolve the flooding problem. However, negative consequences or side-effects of solutions may not be reversible and new problems are likely to arise. Furthermore, it is difficult to determine how long Greater Jakarta's flooding will continue. This temporal uncertainty – yet another attribute of wicked problems – implies that 'there is no stopping rule' (ibid.): there is no point in time that establishes that the handling of a problem is complete. This temporal aspect is exacerbated in Greater Jakarta by the emerging challenges of land subsidence and climate change. While Jakarta's current flooding governance may tame the flooding problem temporarily, the risk is real that future problems are much more severe. Below, we describe how the 'wickedness' of adaptation pathways in Jakarta's flooding case has manifested itself in contemporary times.

Although in response to changing flooding contexts, Jakarta's flood governance has been continually adapted over time, yet the core paradigm has remained largely focused on 'taming nature' by attempting to control hydrology (Garschagen, Surtiari, and Harben 2018). Floods have been perceived as an annual recurrence linked to the monsoon cycle, hence requiring tactical, short-term responses and a focus on controlling flow from outlets. Consequently, a canal and drainage system connecting the city's waterways, initially developed by the Dutch in the 17th century, has been the main flood management strategy (Caljouw, Nas, and Pratiwo 2009). It diverts flood discharge of the Ciliwung – the region's largest and most flood-prone river – and other waterways to the city's peripheries and further into Jakarta Bay.

The devastating flood in 2007, shown in Figure 4.1, led to a significant adaptation of the outlet-based flood governance. Extreme precipitation accumulations in the metropolitan area met with water coming from the sea pushed by an extremely high tide. This event triggered the government to expand its flood governance to also include coastal protection and the enhancement of the city's water retention capacity (Garschagen, Surtiari, and Harben 2018). In 2011, the Jakarta Coastal Defense Strategy (JCDS) was adopted by the Indonesian government in collaboration with the government and experts from The Netherlands. Subsequent revisions and expansion of JCDS delivered in 2014 the National Capital Integrated Coastal Development (NCICD) Masterplan with the 46-kilometre Giant Seawall that closes off Jakarta Bay from the sea as a main component, complemented by a large pumping system for the metropolitan area's flood drainage.[9] The various infrastructural works – i.e., dredging canals, dykes, and the giant sea wall – have demanded space for which around 4,000 households were relocated between 2015 and 2018 (Simarmata and Surtiari 2020), sometimes involving coercion (ibid; Padawangi and Douglass 2015).

Despite the changing course of flood governance, hard engineering-infrastructural solutions have remained central. Yet, Cao et al. (2021) remark that NCICD's main component – the sealing off of Jakarta Bay from the sea – is not going to solve the fundamental cause of Jakarta's flooding, namely land subsidence.[10] New problems and critics have also emerged from civil society and from within the government itself – namely, the Ministry of Maritime Affairs and Fisheries. These officials foresaw significant environmental degradation in Jakarta Bay, including changes in local currents, a decrease in fish stocks, and rapid sedimentation of the seabed, thereby adversely affecting the bay's ecosystem and putting the livelihoods of fishing communities at risk.

It was not until 2017 that the government drastically refocused its flood governance in response to mounting criticism on, particularly, the relocation of communities and exclusion of residents from decision-making and planning. As envisioned in the 2017–2022 medium-term development plan of DKI Jakarta, flood risk management measures should include the strengthening of water institutions and human capital, besides a stricter policy on the use of groundwater (Simarmata and Surtiari 2020). Obviously, in Jakarta, the dominant formal adaptation pathway applied by the government is not really connected to the informal adaptation trajectories of many, often-times vulnerable, local communities and in some instances has even hampered their capacities to adapt (Cao et al. 2021).

Results of thought experiment and discussion

Viewing Greater Jakarta's flooding as a wicked problem leads to the question whether ACM would be applicable in this context and, if so, what outcomes could be expected from applying the approach. In the sections below, we assess ACM's applicability and focus on the following three interconnected points of discussion: (i) can ACM be applied, given Greater Jakarta's flood governance

structure; (ii) will ACM's social learning work in Jakarta's flooding context; and (iii) if ACM were applicable to the case of Jakarta, what operational indicators could be used.

Can ACM be applied, given Jakarta's flood governance structure?

Assessment of ACM's applicability

Our central thesis is that Jakarta's flooding risks can effectively be managed *if* adaptation is strategic – which we see as encompassing and connecting sufficiently large spatial and temporal horizons. This means that the governance of adaptation must include and interconnect all necessary nested levels and scales of decision-making. We have shown, based on our past ACM research in Jambi's forest environs, that a multilayer, nested governance structure, organised around interdependent formal and informal decision-making nodes at various levels and scales where stakeholders are represented, is key to effective adaptation in complex and uncertain forest settings (Diaw and Kusumanto 2005; Kusumanto 2007a). Such a structure allows for a more balanced power distribution in the social-ecological system, transboundary learning, and stakeholder communication, resulting in the construction of shared values and knowledges. Our ACM research made clear that a polycentric governance structure for attaining sustainability in the forest system is crucial, necessarily comprising formal as well as informal structures and mechanisms. In Jambi, it became clear to us that informal decision-making in polycentric systems was a critically important, and often missing, adjunct to formal structures. Literature on collaborative governance also underlines the importance of informal structures and mechanism (Emerson, Nabatchi, and Balogh 2011) but the link with polycentric decision-making is usually less explicit than in our Jambi case.

Huitema et al. (2009) have similarly underlined the importance of polycentric decision-making for fostering adaptation and collaboration in social-ecological systems. Translating this into the context of water governance, a polycentric structure implies that the lowest possible jurisdictional level should hold decision-making authority for the implementation of flood policies, spatial plans, and flood disaster protocols (Becker, Huitema, and Aerts 2015). The central government would thereby be responsible for oversight of legal procedures, with well-functioning coordination between different levels as a prerequisite (ibid.).

Bringing these insights to bear in the case of Greater Jakarta's governance structure, we see a rather weak resemblance to a polycentric governance system, potentially hindering effective implementation of flood policy measures. This situation is further complicated because of the multiplicity of jurisdictions – namely, the different administrative areas (Figure 4.1) and sectoral mandates (Samsura, Kusumanto, and Triyanti 2022). In current decentralised Indonesia, decision-making authority in the water and land sectors is held by regional governments – to wit, provincial, and municipality/regency governments (Simanjuntak et al.

2012). In reality, however, flood risk management and strategic authority tend to remain concentrated at the central level (Rukmana 2016). The Ministry of Public Works and Public Housing has essentially the sole authority over the most flood-prone river of the region, the Ciliwung, including efforts to improve its discharge and retention capacity. Besides, the upstream parts of the Ciliwung watershed have remained the responsibility of the Ministry of Environment and Forestry,[11] leaving limited space for decision-making by local governments. Furthermore, local governments are involved in public infrastructure development and services only when permitted by the Ministry of Public Works and Public Housing (Simanjuntak et al. 2012). All of this is further compounded by poor inter-sectoral and inter-agency coordination and collaboration (ibid.; Samsura, Kusumanto, and Triyanti 2022; Simarmata and Surtiari 2020).[12]

Hence, we assess that Jakarta's flood governance structure is weakly appropriate for shaping the enabling conditions for adaptation that is strategic. As noted previously, we consider adaptation to be strategic, if it incorporates and interconnects sufficiently large spatial and temporal horizons and, as such, could effectively address Jakarta's flooding. Nevertheless, we have identified a unique opportunity for improving Greater Jakarta's flooding governance structure and in that way develop the necessary conditions to apply ACM to Jakarta.

Window of opportunity for improving Jakarta's flood governance structure

Presidential Regulation No. 60 of 2020 concerning the Greater Jakarta Urban Area Spatial Plan offers room for improving Jakarta's flood governance structure. With the main aim to transform the metropolitan area into an economic stronghold for industrial development, trade and service delivery (Kusumanto et al. 2022), it directs development in the region by regulating spatial patterns and area utilisation (Afriyanie et al. 2022). A recently established regional body affiliated with the Ministry of Agrarian and Spatial Planning holds the mandate for implementation. The regulation, however, does not include climate change impact considerations and despite its flood mitigation and adaptation directives, little guidance is provided on how spatial planning should be linked to flood risk management under the pressing conditions of economic growth, urban development, and rapid land use change.

We view these missing elements in the new regulation as a window of opportunity for applying ACM and, simultaneously, carrying through the necessary adjustments in the current flood governance structure. The central aim would thereby be transforming the governance structure into a polycentric system. By using ACM as a framework, we argue that restructuring would be operational with limited need for investments in financial and human resources. Structural adjustments would be implemented under the new spatial plan regulation and specific flood policies could be developed that pertain to subsets of relevant jurisdictions. Jurisdictions should be given sufficient space for self-governance and

decision-authority at relevant scales. The new coordinating regional body, previously mentioned, would be responsible for supervision over legal procedures and be mandated to establish a legal framework and formal regulations, as well as to improve inter-agency coordination and simplify governance mechanisms. The engagement of civil society groups in the interactions and communication with local stakeholders are both crucial, facilitating local participation in decision-making.

Time and effort would be needed to institutionalise the adjustments to Jakarta's flood governance structure as discussed above. In the following section, we seek to understand whether social learning – at the heart of ACM – would work for bringing these about and, if so, what role it could play, and with what outcomes.

Would social learning in ACM work in Jakarta's flooding context?

Assessment of ACM's social learning

By definition, social learning in ACM connects collaboration with the adaptive process by encouraging a continuous reflection and revisits of plans, relationships, knowledges, and worldviews, fostering agency and transforming structures and social systems (Prabhu, McDougall, and Fisher 2007). Hence, as a concept, ACM should be well-equipped for addressing Jakarta's wicked flooding problem because of its multiple perspectives, systematic and iterative protocol, and sustainability (long-term) objectives. The question remains, however, if social learning in ACM could effectively address the complexities inherent in the megacity's flooding problem. We assess below ACM's applicability to dealing with this wicked problem, focusing on the central role which social learning is expected to play in fostering institutional adaptations, collaboration, and policy change.

It is obvious that the region's flood governance structure, as discussed previously, is rather weak for creating a culture of social learning and a collaborative and adaptive environment. As discussed, Jakarta's water and flood governance are relatively centralised and fragmented over different ministries, government units, and implementing agencies with disparate viewpoints and weak horizontal and vertical communication. Where collaboration across institutions, sectors, and jurisdictions is required, existing communication mechanisms tend to be along hierarchical lines. Hence, space is limited for learning or the exchange of values and knowledges. Inadequate social learning between government and communities is common as well, except for some cases where civil society organisations facilitate participatory interactions between the two (Padawangi and Douglass 2015; Rukmana 2016) or public agencies are endowed with the necessary communication capacity.

We argue here that social learning in ACM can only work in Jakarta's flooding context *if* transboundary communication channels and mechanisms are put in

place for a systematic and iterative exchange of values, perspectives, and knowledges. In CIFOR's ACM, PAR was central for building these. Viewing Jakarta's flooding as a wicked problem as previously discussed, communication channels and mechanisms would ideally encourage a continual appraisal of possible consequences of joint plans and actions as well as of implemented solutions. As also noted above, it is important that informal mechanisms complement formal structures and processes. Furthermore, crucial as well are effective facilitation for learning at the boundaries between different stakeholders and how to ensure that all relevant stakeholders are justly represented in the learning and collaboration. It is also obvious that sufficient financial, human, and time resources, as well as political support are key prerequisites.

It has become clear at this point that for social learning to work in Jakarta's context, the core issue is how to develop communication channels and mechanisms for a systematic, participatory, and just exchange of perspectives, values, and knowledges. In other words, how to shape the enabling conditions for transboundary learning that encourages collaboration and adaptation. To this end, below we envision the initiation of *nested platforms for transboundary learning and collaboration* using ACM as a framework.

Shaping opportunities for transboundary learning and collaboration in nested platforms

For this particular initiative, we define

> a transboundary learning platform as consciously constructed opportunities for multiple stakeholders to jointly learn about a particular flood policy issue by iteratively exploring, implementing, and appraising flood adaptation policy and measures and their consequences, improving circumstances accordingly, and learning from the efforts.

Following Buck, Wollenberg, and Edmunds (2001), we consider that unlike stakeholder meetings or forums, the way platforms are designed and facilitated influences what is perceived and experienced by platform participants and what can be achieved. Platforms involve human as well as non-human entities, such as technology, a given resource, and data (Steins 2002). Over time, meanings, perceptions, and social experience are reshaped through collective human action with the non-human entities making part of the collective action itself. Uncertainty is inherent in complex problem-solving as the full implications of neither the process, nor the outcomes of the activity can be known (Aarts and Van Woerkum 2002). Rationality is one of the key emergent properties from platform processes (Steins 2002) and in circumstances of uncertainty, collective decisions should be made by platform participants each of whom has his or her own starting rationality (Aarts and Van Woerkum 2002). A carefully designed platform can assist participants in dealing with uncertainties more creatively and effectively. The role of facilitation is thereby pivotal (see, e.g., Hagmann et al.,

this volume). Uncertainty external to the platform (or for that matter, to any collaborative endeavour), such as uncertainty of flood risk or of possible impacts of climate change, can act as a '*driver*' (Emerson, Nabatchi, and Balogh 2011) or '*trigger*' (Kusumanto et al. 2005) for different stakeholders to seek collaboration for managing the problem at hand.

To ensure legal and policy support, the initiative would be implemented within the legal framework of Greater Jakarta's urban spatial plan issued in 2020, mentioned previously. The new regulation is helpful instrumentally in three ways: first, high-level institutional coordination has been put in place, headed by the Minister of Agrarian Affairs and Spatial Planning and run by heads of government at provincial and municipality/regency levels, creating opportunities for fostering institutional adaptations and collaboration at the various levels. Second, the regulation provides an excellent learning opportunity for collaborative governance between state agencies, as well as between government, community, the private sector, and civil society. Third, the regulation provides a basis from which cognition can be improved and awareness enhanced among policymakers about the links between Jakarta's course of development and increasing flood risk, potentially complicated by climate change, and how to curtail potential impacts of flooding.

The overall objective of the proposed nested platforms for transboundary learning and collaboration is two-fold: (i) improve compatibility between river basin ecosystems and the institutions that manage human activities affecting these; and (ii) foster Jakarta's regional transition towards collaborative water and flood governance and management. The adjective 'nested' emphasises the incorporation of multiple jurisdictional and social-ecological landscapes into official policy and plans. A given platform constitutes cross-cutting jurisdictions specialising in or affected by a specific flood policy issue. We discuss below an example of envisioned transboundary learning platforms.

CILIWUNG RIVER ACM NESTED PLATFORMS

The Ciliwung River ACM initiative is envisioned to shape learning conditions that foster creativity and discovery towards new problem framings and alternative solutions. The platforms provide a learning track which functions in parallel to and delivers policy options to the formal policy track. We discuss the four core components of the initiative: key stakeholders; challenges; platform design; and facilitation of transboundary learning.

Following the World Meteorological Organization and Global Water Partnership (WMO and GWP 2009), **key stakeholders** for an effective urban flood risk management and basin development include the following categories: government ministries, departments, and agencies; communities in flood-prone areas; other basin communities; research institutions; NGOs; and voluntary organisations. The 119-km long Ciliwung River crosses DKI Jakarta Province, West Java Province, Bogor Regency, Bogor City, and Depok City. Box 4.1 lists the key stakeholders of the Ciliwung ACM platforms.

Box 4.1 Key stakeholders of Ciliwung River's proposed ACM nested platform*

- **Government** includes relevant departments and agencies of the Ministry of Agrarian Affairs and Spatial Planning (ATR/BPN), Ministry of Environment and Forestry, Ministry of Public Works and Housing, National Development Planning Agency, Regional Development Planning Board, Ciliwung-Cisadane River Basin Agency**; Ciliwung-Citarum Watershed Management and Protection Forest Agency**; Indonesian Agency for Climatology, Meteorology, and Geophysics; National Disaster Management Agency; Provincial and relevant Municipality Governments of DKI Jakarta Province, Provincial Government of West Java, Bogor Municipality Government, Bogor Regency Government, Depok Municipality Government.
- **Communities in flood-prone areas** along the Ciliwung, Citarum, and Cisadane rivers include those in DKI Jakarta areas such as Manggarai, Tanah Abang, Tomang, Jembatan Lima, Pluit, Duren Sawit, Pondok Kopi, and Cakung; and in Depok City areas such as Sukmawijaya, Pancoran Mas, Cipayung, and Sawangan.
- **Other river basin communities** include upstream Ciliwung, Puncak sub-regency, and Bogor Regency, and Action Consortium for Saving Upstream Ciliwung communities.
- **NGOs** include Telapak, Ciliwung Merdeka (Free Ciliwung), and Friends of Ciliwung.
- **Voluntary organisations** include Gerakan Ciliwung Bersih (Clean Ciliwung Movement) and Komunitas Peduli Ciliwung (Community Concerned about Ciliwung).
- **Research institutions** include Indonesian National Research and Innovation Agency (BRIN), Institute of Technology Bandung, Bogor Agricultural University, and University of Indonesia.
- **Business** includes Indofood, Indonesia Power, Perusahan Listrik Negara (PLN, National Electricity Company), and Perusahaan Air Minum (PAM Jaya, Drinking Water Company).

*Stakeholder list not exhaustive.

**Located in Greater Jakarta, the Cisadane watershed is west and adjacent to the Ciliwung watershed; they and two smaller watersheds make up the Ciliwung-Cisadane river basin area (Arifin, pers. communication, 24 June 2022). The middle and downstream parts of the Citarum watershed are located in Greater Jakarta; these are east and adjacent to the Ciliwung watershed (Julian, pers. communication, 24 June 2022); the Citarum watershed is part of the Citarum river basin area (Website Major Office of Citarum River Basin).

A testing **challenge** which the platform design should particularly take into account is the value-laden policy and institutional context of Jakarta's flooding. In such a setting, the platforms can encounter a compounded challenge beyond the common lack of a social learning culture and collaborative environment in public institutions, as previously mentioned. In our Jambi ACM research, when social learning occurred at the formal level and community stakeholders interacted with district/regency officials, learning was at points influenced, even hindered by prevailing bureaucratic and institutional requirements (Kusumanto 2006).[13] We anticipate a similar but more extreme challenge in the Ciliwung platforms because of their specific policy and institutional setting.

Ward et al. (2013) note that in global delta cities, including Jakarta and Rotterdam (The Netherlands), changing flood governance or paradigms is not easy because of institutional path-dependency and deep-rooted policy beliefs. In interactive policymaking, policymakers must work with contradictory views and interests, but approaches that encourage multiple perspectives are not common in policy practice (Wagemans 2002). The incorporation of multiple perspectives, however, is the bottom line for any policy to effectively address wicked problems. The policy system can be a learning barrier for those with a formal position, even when exposed to new perspectives. To a relatively limited degree, officials are likely to be receptive to alternative problem framings and new solutions that are brought onto the platforms by new stakeholders. It is unrealistic to expect public officials to ignore institutional mandates and responsibilities because of risks of being sanctioned institutionally. Due to this impasse, policy processes tend to reduce diverse perspectives to a single perspective that is acceptable from a formal standpoint and conforms with existing legal and policy frameworks. Nonetheless, the wicked nature of Jakarta's flooding problem requires a form of learning that allows for the incorporation of new values and multiple problem perceptions and concepts. Breaking through this policy and institutional deadlock is a trying task. In this context, the platforms must offer participants a new way of learning which they derive from collaboration and experimenting, without bearing the risk of becoming punished institutionally.

Bearing in mind this challenge, the **platform design** constitutes three central elements: its core idea, structure, and learning focus. The **core idea** of the design of the platforms is to shape learning conditions that stimulate creativity and discovery outside the policy system and, hence, independent from existing flood policy. Platform participants are assigned to collaboratively experiment with new problem framings and solutions, monitor experiences, and learn from the efforts. Official platform participants are not expected to evaluate and approve policy innovations in accordance with legal and policy frameworks. Successful flood policy options or alternative policy measures resulting from the platform processes are eventually mainstreamed in the existing flood policy. As such, the platforms provide a learning track or learning pathway which functions in parallel to, is independent from, yet delivers policy options that feed into the formal policy track.

Because the platforms proceed in parallel to the formal policy process, the **platform structure** should provide supports to the multilayer, multiscale, and nested

polycentric governance system. In analogy with the way we structured system-wide ACM learning in Jambi, the platforms' transboundary learning comprises a blend of smaller-scale subsystems nested in wider-scale subsystems. The lowest level jurisdiction is framed by wider subsystems – e.g., a spatial plan legislation or land tenure policy. Importantly, the use of PAR as a framework for bringing structure into platform activities effectively encourages learning and collaboration. Through PAR's joint plan-act-reflect iterations, relations become more structured and actor networks within platforms take shape organically. Figure 4.2 illustrates the nested structure of the Ciliwung River ACM platforms, as we propose.

For proposing the **focus of learning and collaboration** of the platforms, we argue that attempts to solve Jakarta's flooding have exhausted legal instruments and policy measures currently available. Given the wickedness of the flooding problem and the fragmentation of water and flood governance over different sectors, institutions, and jurisdictions as previously described, the platform should use a basin-wide, cross-sectoral programmatic approach. This approach can become an impetus for different sectors, institutions, and jurisdictions to integrate spatial planning more effectively with the multiple social, economic, and environmental values. At the same time, they will be able to maintain implementation of their projects and formal duties as well as, where relevant, deliver public services (e.g., improving drainage, sanitation, or waste management). Slightly adapted from the Global Environment Facility's definition (GEF 2009, 7), we view a 'programmatic approach' as "a long-term and strategic arrangement of individual or sectoral yet interlinked projects aimed at achieving large-scale impacts on the (global) environment". Learning and collaboration from the platforms would deliver policy measures in connection to the above-mentioned Greater Jakarta spatial plan. The

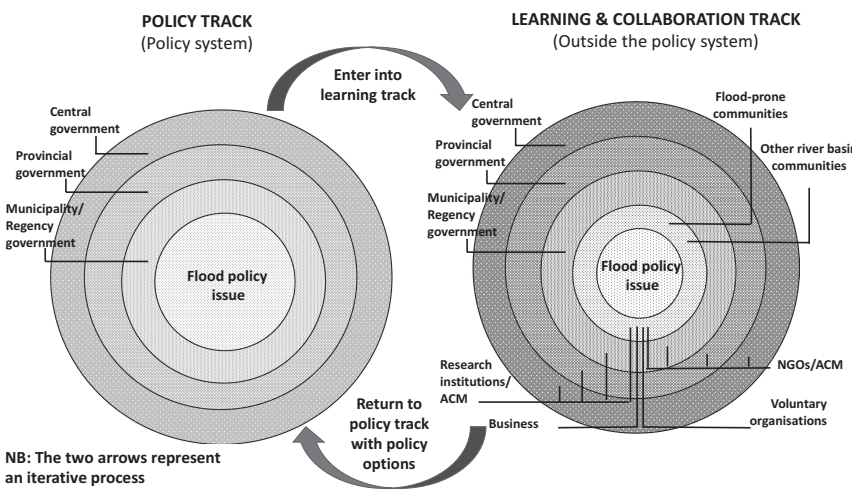

Figure 4.2 Ciliwung River ACM nested platforms for transboundary learning and collaboration

programme should allow connecting problems that are currently addressed by different policies, sectors, and/or institutions.

The **facilitation of transboundary learning** is challenging. Some learning points from past ACM research can be of benefit here. In handling the flooding problem, it is imperative that the social diversity of the platform be made salient to platform participants (Diaw and Kusumanto 2005). The researcher-facilitator is engaged in real-world processes and should maintain stakeholder boundaries as they are, up to the point that the stakeholders themselves decide to enter into cooperation. The building of trust between 'would-be collaborators' is thereby one of her/his key tasks (see Chapters 2 and 3, this volume). 'Collaboration' and 'adaptation' are platform outcomes that must fully be in the interests of platform members. The facilitator's role in this is no more and no less than helping them in attaching meaning to these concepts from their own perspective (see Hagmann et al., this volume).

The facilitation of system-wide learning across boundaries of (stakeholder) subsystems goes beyond the mere convening of stakeholders: from a wicked problem perspective, the facilitator mobilises multiple stakeholders, each with their own problem framing and preferred solutions; mediates or advocates where these are contradictory; facilitates the collaborative development of platform ground rules; and safeguards platform processes (rather than taking decisive action). Facilitation, therefore, also includes the following, approaching, and enrolling of actors, especially those who are less visible. This requires the facilitator's engagement rather than neutrality, sensitivity for hidden relationships and needs, and openness to acknowledge research or facilitation biases. It is clear that the facilitator must be credible, equitable, and considered authoritative by platform participants, including on technical matters. The role of an ACM researcher-facilitator could also be played by the so-called boundary organisations, in the literature referred to as those enabling collaboration between stakeholders by intervening structurally and cognitively (Perkmann 2016).

The facilitation of system-wide change in connection to Jakarta's flooding has inevitable drawbacks because facilitation would almost always need to work through mechanisms of stakeholder representation. However, in circumstances of stakeholder conflict or gridlock, a representation system may offer a way out from stalemates. Although working through stakeholder representatives may not be the ideal, there is much to gain from carefully designed representation mechanisms. While this is beyond this chapter's scope, a major issue that we need to pinpoint here is the contingent nature of representation. In our Jambi case, some representatives perceived their involvement in ACM activities as a privilege rather than as a mandate that was provided by the constituents they represented (Kusumanto 2006). It is therefore crucial that system-wide facilitation ensures that learning processes encompass the representatives, the stakeholders at the subsystem level, and, most crucially, that representation checks and balances are put in place.

Hagmann et al., this volume, discuss some ACM facilitation methods. Facilitation does not necessarily mean that platform participants should meet in person;

it can, in some cases, make good use of, for example, computer modelling (as we did for ACM in forest contexts, see, e.g., Purnomo, Mendoza, and Prabhu 2004; for flooding contexts, see, e.g., Teng, Jakeman, and Vaze 2017) or satellite imaging for facilitating collaborative planning and monitoring exercises. Yet, when stakeholders need to meet in close encounters, the facilitator should make sure that conventional dominance patterns of communication are not replicated (Sarmiento Barletti 2022).

What operational indicators could be used for applying ACM to Greater Jakarta's wicked flooding problem?

Our thought experiment on ACM's applicability to Greater Jakarta's flooding problem has resulted in the following key points: first, ACM can be applied to Jakarta's flooding if adjustments are made to the flooding governance structure and in this way enabling conditions are created for a strategic adaptation that can effectively address the problem. Second, time and effort would be needed to institutionalise the envisaged structural adjustments. To this end, ACM can be of benefit to accelerate the process by shaping conditions for transboundary learning, collaboration, and adaptation in handling the wicked problem. In Box 4.2, we provide operational indicators that reflect the structural adjustments to flooding governance as well as those for transboundary learning, collaboration, and adaptation.

BOX 4.2 Operational indicators for applying ACM to Greater Jakarta's flooding*

- Substantive authority in flooding governance at the municipality/regency level.
- National and provincial governments responsible for supervision over legal procedures.
- Solving problems is the responsibility of multiple parties, some of whom compete with one another.
- Mechanisms for the discussion of novel approaches exist at the national and sub-national levels.
- Space for diversity of problem framing and experimentation, including innovative competition, cross-fertilisation.
- Formal and informal water management and flooding governance structures go hand in hand so as to create space for learning and interactions.
- Formal and informal structures and mechanisms allow for redundancy and overlaps in the system.

- Horizontal and vertical stakeholder representative structures and processes are in place and effective.
- To some extent formalised, (facilitated) PAR is deployed as a foundation for learning (adaptation) and linking (collaboration).
- Government, nongovernmental organisations, educational and research institutions' officials, staff and field facilitators are trained in PAR.

* Based on Jambi ACM research in 2000–2006 and Huitema et al. (2009)

Concluding remarks

In this chapter, we reflect on the ACM approach as previously applied to investigate its ecological and livelihood effects in a local forest setting in Sumatra. Our reflections form the basis of a thought experiment to assess ACM's applicability as a pathway to address a much larger, complex, long-lived, and even more multiscale 'wicked problem', namely the flooding problem of Greater Jakarta. In this context, our central thesis is that Jakarta's flooding risks can effectively be managed *if* adaptation is strategic, which we see as encompassing and connecting sufficiently large spatial and temporal horizons. In addition, Jakarta's future flood risks may be greatly exacerbated by climate change, for which long-term projections and effective pathways to a climate proofing future are urgently needed.

Our assessment could not have been carried out at a better time. Globally, flood management is undergoing a shift from approaches focusing on flood control towards adaptive approaches aimed at reducing the impacts of floods. This trend can be observed in Greater Jakarta as well. Yet, in spite of the current ambitions to apply adaptive approaches to flood management, this chapter shows that some adaptation measures have led to 'maladaptation' – a term we borrow from the Intergovernmental Panel on Climate Change (IPCC 2022).[14] This has manifested itself in increased vulnerabilities of flood-prone communities and of the region's economies and ecosystems. Hence, the governance of adaptation for solving Jakarta's flooding problem has obviously fallen short. In responding to changing flooding contexts, adaptation governance has shown a predominantly *ad hoc* character while lacking a long-term vision and being locked into institutional frameworks, ingrained policy beliefs, and a technological engineering paradigm.

We see this stalemate as offering a window of opportunity for Greater Jakarta to play a leading role in the global quest for and application of flood adaptation approaches with long-term sustainability and, importantly, one that would be less likely to deliver 'maladaptive' outcomes. Jakarta's past and current infrastructural flood mitigation projects clearly show that the Indonesian government has been decisive in taking bold steps in the pursuit of the adaptation measures it deems necessary. This has been the case, regardless of the large investments in finance

and technology needed. We anticipate an urgent need for a new form of leadership and recommend that Greater Jakarta (the Indonesian Government) take up this leadership role. The multiple gridlock, discussed in this chapter, can become a stimulus for the government to be a leader in this by leaving behind well-worn paths and entering new avenues.

We recommend as the first step of the pathway using an ACM framework that this new leadership encourage the proposed adjustments to the current flood governance structure. An adjusted adaptation governance should take into account ecological and societal impacts, stakeholder engagement, long-term effectiveness, and climate resilience. The adaptation governance we recommend has the following characteristics: a long-term goal that accommodates short-term interests and needs; a multilayer, multiscale, more balanced basin-wide distribution of decision-making authority with the lowest jurisdiction level (municipality/district level) holding full substantive authority; space for a diversity of problem framing and experimentation; and cross-boundary formal and informal structures for stakeholder collaboration and communication, thereby fostering redundancy and system-wide learning.

The recommended structural adjustments can be implemented under Presidential Regulation No. 60 of 2020 concerning the Greater Jakarta Urban Spatial Plan. The regulation provides unique opportunities for the integration of social, environmental, and economic values into the region's spatial plans and as such feeds into the region's climate-resilient development and flood risk policies.

Despite observed formal ambitions in exploring alternative adaptation trajectories in the face of flooding and climate change, adjusting the current flood governance structure cannot happen overnight. Political-will and open minds will not suffice for breaking open Jakarta's lock-ins; and time will be needed before the adjustments in governance structures are institutionalised and enable processes of change. Yet, our assessment makes clear that the main hurdles for change processes at the formal level are a weak social learning culture and the lack of a collaborative and adaptive environment. In interactive policymaking, the traditional policy system can be a learning barrier for policymakers: they may be less likely to be receptive to alternative problem framings and new solutions, hindered by strict institutional mandates and responsibilities.

As the second step of the pathway with an ACM framework, we recommend the initiation of nested platforms for shaping excellent learning conditions that stimulate creativity in and discovery of new problem framings and solutions outside the policy system and, hence, independent from existing flood policy. Official platform participants do not need to evaluate and approve policy innovations in accordance with legal and policy frameworks. Flood policy options or alternative policy measures resulting from the platform processes are eventually mainstreamed in the existing flood policy. As such, the platform provides a learning track or learning pathway which functions in parallel to, is independent from, yet delivers policy options that feed into the formal policy track. A basin-wide, cross-sectoral programmatic approach can become the basis for different sectors, institutions, and jurisdictions to integrate spatial planning more effectively with

multiple social, economic, and environmental values. At the same time, participants will be able to maintain implementation of their own projects, formal duties and mandates as well as, where relevant, deliver public services. The basin-wide and cross-sectoral approach will allow the linking of problems that are currently addressed by different policies, sectors, and/or institutions.

This second step should be implemented under the regional spatial plan presidential regulation, referred to above. As such, learning and collaborative platform processes would deliver policy options for the benefit of Greater Jakarta's spatial planning policy process and support the region's climate-resilient development.

In this chapter, we acknowledge that the challenges that would confront ACM when addressing the flooding problem of Greater Jakarta are considerable. At the same time, we emphasise that the megacity's flooding problem has reached a crisis stage and, therefore, there is a pressing need for approaches that can break the cycle of long-established paradigms and maladaptive path-dependency processes. We hope this chapter encourages further discussion, with on-the-ground action, examining the potential as well as the drawbacks of ACM and similar approaches for mitigating the impacts of the flooding of Jakarta and elsewhere and, for that matter also, the impacts of climate change.

Acknowledgements

The authors would like to express special thanks of gratitude to Carol J. Pierce Colfer and Ravi Prabhu for the opportunity to undertake this exciting journey, the results of which are presented here. Their continued encouragement, critical feedback, and patience were invaluable in experimenting with ideas, writing the work, and completing the project. We also wish to acknowledge Dr. Hendricus Andy Simarmata, of the University of Indonesia, with whom at the start of our endeavour we discussed possible foci of our exploration. He was, however, unavailable to join us in the writing. Finally, we would like to thank Y.H. (Wiwi) Tjiook and Y. Yulia of the Liveable Cities Task Force of the Indonesian Diaspora Network in The Netherlands for providing us with a basic map of Greater Jakarta, which we modified for presentation purposes.

Notes

1 See also Colfer, Prabhu, and Larson (2022), for a systematic rendering of ACM's theoretical and conceptual forebears.
2 See Wessing (2011) and Tarumanagara – Wikipedia.
3 See National Geographic Indonesia, 27 February (2019) and Ward et al. (2013).
4 Between 1972 and 2012, the region's built-up area increased from 65 to 2,015 km^2 (Rustiadi et al. 2015).
5 Fifty-seven hundred hectares of forest in upstream Puncak vanished between 2000 and 2016 and 3,925 hectares of water catchment and urban forest areas in DKI Jakarta were lost between 1985 and 2006 (Afriyanie et al. 2022).
6 The single-day rainfall of 377 mm on January 1, 2020 led to devastating floods, and was preceded by a strong trans-equatorial monsoon flow (Yesi et al. 2021). Under current climatic conditions, the probability of rainfall extremities, including increasing

surface temperature, is already higher than 100 years ago and still higher risk is likely in the future.

7 Other factors behind the relocation of Indonesia's Capital are environmental degradation, rapid urbanisation, economic disparity and other societal problems, and traffic congestion in Greater Jakarta.

8 The embeddedness of smaller interventions in one larger ACM intervention can be referred to as a nested system approach (Groot et al. 2002).

9 At time of writing (June 2022), 12.6 kilometres of the giant dyke had been built.

10 Present solutions for Jakarta's land subsidence – predominantly due to groundwater extraction for drinking water – are sought in improving water management and/or sea dyke construction (Yan et al. 2020). A renewed water management design is planned for accomplishment over a ten-year period. Main challenges include a decrease in surface water resources due to pollution of the 13 rivers flowing through Jakarta; as well as a decrease of water retention areas resulting from massive land acquisition for buildings and infrastructures. Rain harvesting is one solution, which is at present beyond the agenda.

11 By means of the Watershed Management and Protection Forest Agency (*Balai Pengelolaan Daerah Aliran Sungai dan Hutan Lindung*, BPDAS-HL), which is a technical unit of the ministry at central level or an agency under the ministry at lower government levels (Pambudi and Kusumanto, in press).

12 Marshall Murphree calls this 'a socially constructed stalemate', which occurs when external agencies impose their agendas upon local populations. Interestingly, Murphree argues that such a stalemate can be broken when local communities are given the authority and responsibility necessary to create 'internally legitimate regimes', Local level scenario planning, iterative assessment and adaptive management : final technical report, July 2006 to November 2011 (https://agris.fao.org/agris-search/search.do?recordID=QD2021004709)

13 Nonetheless, learning occurred at the individual level with some public officials. For instance, officials felt encouraged to improve government programmes and sought new, creative ways to go about this – hence, *triple loop* learning clearly occurred here (Kusumanto 2006).

14 IPCC (2022) defines "*maladaptation*" as

> actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence.

References

Aarts, N., and C. van Woerkum. 2002. "Dealing with Uncertainty in Solving Complex Problems." In *Wheelbarrows Full of Frogs. Social Learning in Rural Resource Management*, edited by C. Leeuwis and R. Pyburn Leeuwis, 421–435. Assen, The Netherlands: Koninklijke van Gorcum.

Adams-Schoen, S. 2016. "Taming the Super-Wicked Problem of Waterfront Hazard Mitigation Planning: The Role of Municipal Communication Strategies." In *Contemporary Issues in Climate Change Law and Policy: Essays Inspired by The IPCC 123*, edited by Robin K. Craig and Stephen R. Miller, 123–141. New York: Touro Law Center.

Adnan, H., D. Tadjudin, E.L. Yuliani, H. Komarudin, D. Lopulalan, Y.L. Siagian, and D.W. Munggoro (eds.). 2008. *Belajar dari Bungo: Mengelola Sumber Daya Alam di Era Desentralisasi*. Bogor, Indonesia: CIFOR.

Afriyanie, D., T.P. Moeliono, A. Triyanti, and T. Octavianti. 2022. "Policy Brief 3. Working towards an Adaptive Spatial Planning Policy for Flood Risk Management in Greater Jakarta." In *Policy Brief Series. Dealing with Greater Jakarta Floods in Times of Climate*

Change, edited by T. Kusumanto, A. Triyanti, and Y.H. Tjiook 39–48. Delft, The Netherlands; Utrecht, The Netherlands; Jakarta, Indonesia: TYK research & action consulting, Liveable Cities, IDN-NL, Utrecht University, and Indonesian National Research and Innovation Agency (BRIN).

Armitage, I., M. Marschke, and R. Plummer. 2007. "Adaptive Co-management and the Paradox of Learning." *Global Environmental Change* 18, no. 1: 86–98. doi: 10.1016/j.gloenvcha.2007.07.002.

Asdak, C., S. Supiah, and Subiyanto. 2018. "Watershed Management Strategies for Flood Mitigation: A Case Study of Jakarta's Flooding." *Weather and Climate Extremes* 21: 117–122. doi: 10.1016/j.wace.2018.08.002.

Becker, G., D. Huitema, and J.C.J.H. Aerts. 2015. "Prescriptions for Adaptive Comanagement: The Case of Flood Management in the German Rhine basin." *Ecology and Society* 20, no. 3: 1. doi: 10.5751/ES-07562-200301.

BPS. 2021. *Statistik Indonesia 2021* (*Statistical Yearbook of Indonesia 2021*). Jakarta, Indonesia: Badan Pusat Statistik (Central Bureau of Statistics).

Brown, J.R., and Y. Fehige. 2022. "Thought Experiments." In *The Stanford Encyclopedia of Philosophy*, edited by Spring 2022. Stanford, CA: Stanford University. https://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=thought-experiment

Buck, L., E. Wollenberg, and D. Edmunds. 2001. "Social Learning in the Collaborative Management of Community Forests: Lessons from the Field." In *Social Learning in Community Forests*, edited by D. Edmunds, E. Wollenberg, L. Buck, J. Fox, and S. Brodt, 1–20. Bogor: Indonesia: CIFOR.

Budiyono, Y., J.C.J.H. Aerts, D. Tollenaar, and P.J. Ward. 2016. "River Flood Risk in Jakarta under Scenarios of Future Change." *Natural Hazards and Earth System Sciences* 16, no. 3: 757–774. doi: 10.5194/nhess-16-757-2016.

Budiyono, Y., M.A. Marfai, J. Aerts, H. de Moel, and P.J. Ward. 2017. "Flood Risk in Polder Systems in Jakarta: Present and Future Analyses." In *Disaster Risk Reduction in Indonesia. Progress, Challenges, and Issues*, edited by M. Garschagen, R. Djalante, F. Thomalla, and R. Shaw, 517–537. Cham, Switzerland: Springer.

Caljouw, M., P.J.M. Nas, and M.R. Pratiwo. 2009. "Flooding in Jakarta: Towards a Blue City with Improved Water Management." *Bijdragen tot de Taal- Land- en Volkenkunde/Journal of the Humanities and Social Sciences of Southeast Asia* 161, no. 4: 454–484. doi: 10.1163/22134379-90003704.

Cao, A., M. Esteban, V.P.B. Valenzuela, M. Onuki, H. Takagi, N.D. Thao, and N. Tsuchiya. 2021. "Future of Asian Deltaic Megacities under Sea Level Rise and Land Subsidence: Current Adaptation Pathways for Tokyo, Jakarta, Manila, and Ho Chi Minh City." *In Environmental Sustainability* 2021. *Themed Issue on Slow Onset Events Related to Climate Change*, edited by S. Adamo, R. Djalante, P.G.D. Chakrabarti, F. Renaud, A.W. Yalew, D. Stabinsky, and Z. Zommers, 87–97. Amsterdam: Elsevier B.V. doi: 10.1016/j.cosust.2021.02.010.

Colfer, C.J.P. (ed.). 2005a. *The Equitable Forest: Diversity, Community and Resource Management*. Washington, DC: RFF and CIFOR.

Colfer, C.J.P. 2005b. *The Complex Forest: Communities, Uncertainty, Adaptive Collaborative Management*. Washington, DC: RFF and CIFOR.

Colfer, C.J.P., R. Prabhu, and A. Larson. (eds.). 2022. *Adaptive Collaborative Management in Forest Landscapes: Villagers, Bureaucrats, and Civil Society*. London: Earthscan and Routledge.

Diaw, M.C., and T. Kusumanto. 2005. "Scientists in Social Encounters. The Case for an Engaged Practice of Science." In *The Equitable Forest: Diversity, Community and Resource Management*, edited by C.J.P. Colfer, 72–109. Washington, DC: RFF and CIFOR.

Dovey, K., B. Cook, and A. Achmadi. 2019. "Contested Riverscapes in Jakarta: Flooding, Forced Eviction and Urban Image." *Space and Polity* 23, no. 3: 265–282. doi: 10.1080/13562576.2019.1667764.

Dwirahmadi, F., S. Rutherford, D. Phung, and C. Chu. 2019. "Understanding the Operational Concept of a Flood-Resilient Urban Community in Jakarta, Indonesia, from the Perspectives of Disaster Risk Reduction, Climate Change Adaptation, and Development Agencies." *International Journal of Environmental and Public Health* 16, no. 20: 3993. doi: 10.3390/ijerph16203993.

Emerson, K., T. Nabatchi, and S. Balogh. 2011. "An Integrative Framework for Collaborative Governance." *Journal of Public Administration Research and Theory* 22: 1–29. doi: 10.1093/jopart/mur011.

Florczyk, A.J., M. Melchiorri, C. Corbane, M. Schiavina, M. Maffenini, M. Pesaresi, P. Politis, S. Sabo, S. Freire, D. Ehrlich, T. Kemper, P. Tommasi, D. Airaghi, and L. Zanchetta. 2019. *Description of the GHS Urban Centre Database 2015*. Luxembourg: Publications Office of the European Union.

Garschagen, M., G.A.K. Surtiari, and M. Harben. 2018. "Is Jakarta's New Flood Risk Reduction Strategy Transformational?" *Sustainability* 10, no. 8: 2934. doi: 10.3390/su10082934.

GEF. 2009. *Adding Value and Promoting Higher Impact through the GEF's Programmatic Approach*. Washington, DC: Global Environment Facility.

Goudie, A.S. 2018. *Human Impact on the Natural Environment*. New York: John Wiley & Sons.

Groot, A., N. van Dijk, J. Jiggins, and M. Maarleveld. 2002. "Three Challenges in the Facilitation of System-wide Change." In *Wheelbarrows Full of Frogs. Social Learning in Rural Resource Management*, edited by C. Leeuwis and R. Pyburn, 199–213. Assen, The Netherlands: Koninklijke van Gorcum.

Guijt, I. (ed.). 2007. *Negotiated Learning: Collaborative Monitoring in Forest Resource Management*. Washington, DC: RFF and CIFOR.

Hasanuddin, Z.A., I. Gumilar, Y. Pohan, H. Andreas, Y. Fukuda, and T. Deguchi. 2011. "Land Subsidence of Jakarta (Indonesia) and Its Relation with Urban Development." *Natural Hazards* 59, no. 3: 1753–1771.

Huitema, D., E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, and R. Yalci. 2009. "Adaptive Water Governance: Assessing the Institutional Prescription of Adaptive (Co-) management from a Governance Perspective and Defining a Research Agenda." *Ecology and Society* 14, no. 1: 1–19.

Indriatmoko, Y. 2002. "Penelitian Aksi Bersama secara Adaptif dan Interaksi berbagai Domain Pengetahuan: Pengalaman dari Desa Baru Pelepat, Kabupaten Bungo, Jambi." Presented at The 2nd International Symposium of Journal Antropologi Indonesia, Padang, West Sumatra.

IPCC. 2022. "Climate Change 2022. Impacts, Adaptation and Vulnerability. Summary for Policymakers." Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva, Switzerland.

Januariyadi, N.F., S. Kazama, I.R. Moe, and S. Kure. 2020. "Effectiveness of Structural and Nonstructural Measures on the Magnitude and Uncertainty of Future Flood Risks." *Journal of Water Resource and Protection* 12, no. 5: 401–415.

Kamarzuki, A. 2020. *Jabodetabekpunjur Spatial Policy Direction*. Presented as 1st Webinar of Regional Development Studies Webinar Series, Jabodetabek Study Forum, P4W-LPPM IPB University. 11 June 2020. IPB University: Bogor, Indonesia. Jabodetabek Study Forum (ipb.ac.id)

Kharel, G., R.J. Romsdahl, and A.P. Kirilenko. 2018. "Managing the Wicked Problem of Devils Lake Flooding along the US–Canada Border." *International Journal of Water Resources Development* 35, no. 6: 938–958. doi: 10.1080/07900627.2018.1523050.

Kooi, H., and A.T. Yuherdha. 2018. "Updated Subsidence Scenarios Jakarta." In *MODFLOW SUB-CR Calculations for Sunter, Daan Mogot and Marunda*. Delft, The Netherlands: Deltares.

Koto, J., and R.B. Negara. 2017. "Review Study on Rainfall Characteristics in DKI Jakarta." *Journal of Aeronautical Science and Engineering* 9, no. 1: 1–16.

Kusumanto, T. 2006. Social Learning, Policymaking and Customary Forest: Lessons from Jambi (Central Sumatra). Unpublished Report. Bogor, Indonesia: CIFOR.

Kusumanto, T. 2007a. "Shaping Opportunity for Improving Forest Quality and Community Livelihoods in Central Sumatra and East Kalimantan, Indonesia." In *Adaptive Collaborative Management of Community Forests in Asia. Experiences from Nepal, Indonesia and the Philippines*, edited by R. Prabhu, R. Fisher, and C. McDougall, 93–133. Bogor, Indonesia: CIFOR.

Kusumanto, T. 2007b. "Learning to Monitor Political Processes for Fairness in Jambi, Indonesia." In *Negotiated Learning: Collaborative Monitoring in Forest Resources Management*, edited by I. Guijt, 124–134. Washington, DC: RFF and CIFOR.

Kusumanto, T., G.A.K. Surtiari, S. van Bemmelen, P. Wijayanti, T.P. Moeliono, and D. Elhasani. 2022. "Policy Brief 4. Dealing with Greater Jakarta Flooding Inclusively from Social, Environmental and Economic Perspectives." In *Policy Brief Series: Dealing with Greater Jakarta Floods in Times of Climate Change*, edited by T. Kusumanto, A. Triyanti, and Y.H. Tjiook, 51–63. Delft, The Netherlands; Utrecht, The Netherlands; Jakarta, Indonesia: TYK research & action consulting, Liveable Cities, IDN-NL, Utrecht University, and Indonesian National Research and Innovation Agency (BRIN).

Kusumanto, T., E.L. Yuliani, P. Macoun, Y. Indriatmoko, and H. Adnan. 2005. *Learning to Adapt. Managing Forests Together in Indonesia*. Bogor, Indonesia: CIFOR.

Lee, K.N. 1999. "Appraising Adaptive Management." *Conservation Ecology* 3, no. 2: 3.

Lönngren, J., and K. van Poeck. 2020. "Wicked Problems: A Mapping Review of the Literature." *The International Journal of Sustainable Development and World Ecology* 28, no. 6: 481–502. doi: 10.1080/13504509.2020.1859415.

Maarleveld, M., and C. Dangbegnon. 1999. "Managing Natural Resources: A Social Learning Perspective." *Agriculture and Human Values* 16, no. 3: 267–280.

Maheng, D., A. Pathirana, and C. Zevenbergen. 2021. "Study on the Impact of Landscape Pattern Changes Due to Urbanization: Case Study of Jakarta, Indonesia." *Land* 10, no. 2: 218. doi: 10.3390/land10020218.

Marfai, M.A., A.B. Sekaranom, and P. Ward. 2015. "Community Responses and Adaptation Strategies toward Flood Hazard in Jakarta, Indonesia." *Natural Hazards* 75, no. 2: 1127–1144.

Octavianti, T., and K. Charles. 2018. "The Evolution of Jakarta's Flood Policy over the Past 400 Years: The Lock-in of Infrastructural Solutions." *Environment and Planning C: Politics and Space* 37, no. 6: 1102–1125. doi: 10.1177/2399654418813578.

Olsson, P., Ö. Bodin, and C. Folke. 2010. "Transformative Capacity for Ecosystem Stewardship in Social–Ecological Systems." In *Adaptive Capacity and Environmental Governance*, edited by D. Armitage and R. Plummer, 263–385. Berlin: Springer-Verlag.

Padawangi, R., and M. Douglass. 2015. "Water, Water Everywhere: Toward Participatory Solutions to Chronic Urban Flooding in Jakarta." *Pacific Affairs* 88, no. 3: 517–550.

Pambudi, A.S., and T. Kusumanto. In press. "Water Resources Governance towards Environmental Sustainability along with Social and Economic Development." In *Environmental Governance in Indonesia*, edited by A. Triyanti, R. Djalante, M.A. Marfai, M. Indrawan, and L. Nurhidayah. Cham, Switzerland: Springer. doi: 10.1007/978-3-031-15904-6.

Perkmann, M. 2016. "How Boundary Organizations Facilitate Collaboration across Diverse Communities." In *Managing Knowledge Integration Across Boundaries*, edited by C. Berggren, F. Tell, S. Brusoni, and A. van de Ven, 155–170. Oxford: Oxford University Press.

Plummer, R., B. Crona, D.R. Armitage, P. Olsson, M. Tengö, and O. Yudina. 2012. "Adaptive Comanagement: A Systematic Review and Analysis." *Ecology and Society* 17, no. 3: 11. doi: 10.5751/ES-04952-170311.

Plummer, R., J. Baird, A. Dzyundzyak, D. Armitage, Ö. Bodin, and L. Schultz. 2017. "Is Adaptive Co-management Delivering? Examining Relationships between Collaboration, Learning and Outcomes in UNESCO Biosphere Reserves." *Ecological Economics* 140: 79–88. doi: 10.1016/j.ecolecon.2017.04.028.

Prabhu, R., C. McDougall, and R. Fisher. 2007. "Adaptive Collaborative Management: A Conceptual Model." In *Adaptive Collaborative Management of Community Forests in Asia. Experiences from Nepal, Indonesia and the Philippines*, edited by R. Prabhu, R. Fisher, and C. McDougall, 6–49. Bogor, Indonesia: CIFOR.

Purnomo, H., G.A. Mendoza, and R. Prabhu. 2004. "Model for Collaborative Planning of Community-Managed Resources based on Qualitative Soft Systems Approach." *Journal of Tropical Forest Science* 16, no. 1: 106–131.

Rittel, H.W.J., and M.M. Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 2: 155–169. doi: 10.1007/BF01405730.

Rogger, M., M. Agnoletti, A. Alaoui, J.C. Bathurst, G. Bodner, M. Borga, V. Chaplot, F. Gallart, G. Glatzel, J. Hall, J. Holden, L. Holko, R. Horn, A Kiss, S. Kohnová, G. Leitinger, B. Lennartz, J. Parajka, R. Perdigão, S. Peth, L. Plavcová, J.N. Quinton, M. Robinson, J.L Salinas, A. Santoro, J. Szolgay, S. Tron, J.J.H. van den Akker, A. Viglione, and G. Blöschl. 2017. "Land Use Change Impacts on Floods at the Catchment Scale: Challenges and Opportunities for Future Research." *Water Resources Research* 53, no. 7: 5209–5219.

Rukmana, D. 2016. "Flood Governance in Jakarta: The Role of CBOs in Mitigating Annual Floods." In *Essay Series Governing Megacities in the MENA and Asia*. Washington, DC: Middle East Institute (mei.edu).

Rukmana, D. 2021. "Participatory Governance in Mitigating Annual Floods in Jakarta." In *The Routledge Handbook of Planning Megacities in the Global South*, edited by D. Rukmana, 317–326. Abingdon, UK: Routledge.

Rustiadi, E., D.O. Pribadi, A.E. Privatisari, G.S. Indraprahastra, and L.S. Imam. 2015. "Jabodetabek Megacity: From City Development Toward Urban Complex Management System." In *Urban Development Challenges, Risks and Resilience in Asian Mega Cities*, edited by R.B. Singh, 421–445. Tokyo, Japan: Springer.

Samsura, D.A.A., T. Kusumanto, and A. Triyanti. 2022. "Policy Brief 5. Multi-Stakeholder Collaboration for Integrating Flood Risk Management with Spatial Planning in Greater Jakarta." In *Policy Brief Series. Dealing with Greater Jakarta Floods in Times of Climate Change*, edited by T. Kusumanto, A. Triyanti, and Y.H. Tjiook, 67–79. Delft, The Netherlands; Utrecht, The Netherlands; Jakarta, Indonesia: TYK research & action

consulting, Liveable Cities, IDN-NL, Utrecht University, and Indonesian National Research and Innovation Agency (BRIN).

Sarmiento Barletti, J.P. 2022. "Learning from Adaptive Collaborative Management. A Participatory Tool to Support Adaptive and Reflective Learning in Multi-stakeholder Forums." In *Adaptive Collaborative Management in Forest Landscapes. Villagers, Bureaucrats, and Civil Society*, edited by C.J.P. Colfer, R. Prabhu, and A. Larson, 159–184. Abingdon, UK: Earthscan and Routledge.

Simanjuntak, I., N. Frantzeskaki, B. Enserink, and W. Ravesteijn. 2012. "Evaluating Jakarta's Flood Defence Governance: The Impact of Political and Institutional Reforms." *Water Policy* 14: 561–580. doi: 10.2166/wp.2012.119.

Simarmata, H.A., and G.A.K. Surtiari. 2020. "Adaptation to Climate Change: Decision Making and Opportunities for Transformation in Jakarta, Indonesia." Research Paper 2020–3, prepared for the UNRISD Project Transformative Adaptation to Climate Change in Southeast Asian Coastal Cities. United Nations Research Institute for Social Development (UNRISD) and Rosa Luxemburg Stiftung, Geneva, Switzerland.

Sol, J., M.M. van der Wal, P.J. Beers, and A.E.J. Wals. 2018. "Reframing the Future: The Role of Reflexivity in Governance Networks in Sustainability Transitions." *Environmental Education Research* 24, no. 9: 1383–1405. doi: 10.1080/13504622.2017.1402171.

Steins, N. 2002. "Understanding Platform Processes through Actor-network Theory." In *Wheelbarrows Full of Frogs. Social Learning in Rural Resource Management*, edited by C. Leeuwis and R. Pyburn, 407–419. Assen, The Netherlands: Koninklijke van Gorcum.

Teng, J., A. Jakeman, and J. Vaze. 2017. "Flood Inundation Modelling: A Review of Methods, Recent Advances and Uncertainty Analysis." *Environmental Modelling and Software* 90: 201–216.

Van de Vuurst, P., and L.E. Escobar. 2020. "Perspective: Climate Change and the Relocation of Indonesia's Capital to Borneo." *Frontiers in Earth Science* 8: 5. doi: 10.3389/feart.2020.00005.

Wagemans, M. 2002. "Institutional Conditions for Transformations. A Plea for Policy Making from the Perspective of Constructivism." In *Wheelbarrows Full of Frogs. Social Learning in Rural Resource Management*, edited by C. Leeuwis and R. Pyburn, 245–258. Assen, The Netherlands: Koninklijke van Gorcum.

Ward, P.J., W.P. Pauw, M.W. van Buuren, and M.A. Marfai. 2013. "Governance of Flood Risk Management in a Time of Climate Change: The Cases of Jakarta and Rotterdam." *Environmental Politics* 22, no. 3: 518–536. doi: 10.1080/09644016.2012.683155.

Wessing, R. 2011. "Tarumanegara: What's in a Name?" *Journal of Southeast Asian Studies* 42, no. 2: 325–337. doi: 10.1017/S0022463411000075.

WMO, and GWP (World Meteorological Organization and Global Water Partnership). 2009. "Urban Flood Risk Management: A Tool for Integrated Flood Management." In *Associated Programme on Flood Management (APFM) Technical Document* 11, Flood Management Tools Series. Geneva, Switzerland; Stockholm, Sweden: WMO and GWP.

Wollenberg, E., D. Edmunds, L. Buck, J. Fox, and S. Brodt (eds.). 2001. *Social Learning in Community Forests*. Bogor, Indonesia: CIFOR.

Yan, X., T. Yang, Y. Xu, L. Tosi, E. Stouthamer, H. Andreas, P. Minderhoud, A. Ladawadee, R. Hanssen, G. Erkens, P. Teatini, J. Lin, R. Boni, J. Chimpalee, X. Huang, C. Da Lio, C. Meisina, and F. Zucca. 2020. "Advances and Practices on the Research, Prevention and Control of Land Subsidence in Coastal Cities." *Acta Geologica Sinica* (English Edition) 94, no. 1: 162–175. doi: 10.1111/1755–6724.14403.

Yesi, U.S., Siswanto, H. Andhika, A. Tamima, Marzuki, E. Trihadi, Nasrullah, and Herizal. 2021. "Extreme Rainfall Causes 2020 Flood in Jakarta: A Climate Change Perspective." Presented at: The 2nd International Conference on Tropical Meteorology and Atmospheric Sciences (ICTMAS), Virtual Conference, 23–25 March 2021.

Yusriyah, K., S. Sudaryanto, A. Fatoni, and M.A. Mansyur. 2020. "Communication Networks Analysis on Information Dissemination of the Moving of Capital City from Jakarta to East Kalimantan." *Aspiration Journal* 1, no. 1: 31–55.