Chapter 2
Bridging Systems and People-Centred Approaches in Urban Vulnerability Research: Insights for Resilience from Dawei, Myanmar

Taylor Martin, Melissa Marschke and Saw Win

Abstract Dawei, a coastal secondary city in southeastern Myanmar, is poised to face significant social and environmental change. Dawei's location at the head of the Dawei River estuary, just 30 kilometres from the Andaman Sea and 350 kilometres to the west of Bangkok, has attracted increasing attention from foreign investors. Namely, to develop a Special Economic Zone, build the largest deep-sea port in the region, and connect Dawei by road to the southern economic corridor of mainland Southeast Asia. Little is known about how these developments will affect Dawei, nor how climate change will interact with such changes to shape urban vulnerability. In this chapter, we examine how Dawei's urban systems are exposed to various climatic and non-climatic stresses and investigate how this plays out through people's everyday livelihoods. Our analysis then turns to how people cope and adapt to social and environmental change, illuminating how social capital and the ways that people relate are fundamental to shaping resilience. We situate this analysis within the larger context of Myanmar's political and economic transition, highlighting both the challenges that this transition poses to vulnerability and the possibility of shaping a resilient future.

Keywords Vulnerability · Livelihoods · Environmental change · Urban socio-ecological systems · Secondary cities · Myanmar

Asian cities, where more than half of the planet's urban population lives, are rapidly urbanizing. This trend will continue. By 2050, Asian cities will have grown by 1.25 billion people, with much of this growth anticipated to take place in secondary cities

T. Martin (✉) · M. Marschke
School of International Development and Global Studies, University of Ottawa, Ottawa, ON K1N 6N5, Canada
e-mail: tmart015@uottawa.ca

M. Marschke
e-mail: melissa.marschke@uottawa.ca

S. Win
Maubin University, Maubin, Myanmar
e-mail: prfswwin@gmail.com

A. G. Daniere and M. Garschagen (eds.), *Urban Climate Resilience in Southeast Asia*, The Urban Book Series, https://doi.org/10.1007/978-3-319-98968-6_2

with a population of 500,000 or less (UNDESA 2014). With such rapid urban growth comes a host of social-ecological challenges. Rapid economic development exacerbates environmental change as cities develop and draw on ecosystems for the provisioning of basic services (water, energy, transportation, and food). Such services are not drawn upon equally. The world's poor have limited access to basic water and sanitation, and often live in slums and hazard-prone areas that are extremely exposed to climatic disturbances (Satterthwaite and International Institute for Environment and Development 2007). Understanding these vulnerabilities is a growing area of concern in development research and policy,[1] particularly in rapidly urbanizing smaller cities that often lack basic services, have higher rates of poverty, and have limited institutional and financial capacities to prepare for, mitigate against, and adapt to climate change (Middleton and Krawanchid 2014; Satterthwaite 2006).

Myanmar is experiencing rapid socioeconomic and environmental changes. Although 70% of Myanmar's population of 51.4 million people continue to live in rural areas (Ministry of Immigration and Population 2015a), urbanization has grown steadily between 2000 and 2010 at 2.8% annually (UNDESA 2014; World Bank 2015a). Myanmar's urban growth is low relative to other Mekong region countries. Between 1992 and 2010, cities in Myanmar grew by 24% compared with cities in Vietnam by 880%, Cambodia by 360%, and Laos by 600% (Ouyang et al. 2016). Such low urban growth is linked to Myanmar's political and economic isolation having been subject to almost 50 years of authoritarian military rule (Ouyang et al. 2016; World Bank 2015a, b).[2] Myanmar's current government—democratically elected in 2015—has adopted a policy of economic liberalization that will likely accelerate the country's transition from a largely agrarian society to one that is increasingly urban. Projections estimate that 55% of Myanmar's population will be urban by 2050 (Ganesan 2017; UNDESA 2014). As migrants from rural areas seek perceived opportunities in Myanmar's emerging cities, challenges persist in addressing the financial and human resource constraints of municipal governments to provide basic water supply, sanitation, drainage, and wastewater facilities to existing and growing urban populations (ADB 2013).

Myanmar's urban development challenges are compounded by high levels of exposure to climate-change hazards such as extreme drought, cyclones, intense rainfall, flooding, storm surges, and sea-level rise (Eastham et al. 2008; NECC et al. 2012). Climate data suggest that since 1977 Myanmar has experienced both a gen-

[1] Urban Climate Resilience in Southeast Asia Partnership (UCRSEA); Mekong Building Climate Resilience in Asian Cities (M-BRACE); Asian Cities Climate Change Resilience Network (ACCCRN).

[2] Following the military coup d'état in 1962, the adoption of socialist isolationism led to the steady decline of Myanmar's economy (Rieffel 2012). In response to the eruption of mass democracy protests in 1988 and the perceived failure of the Burmese Way to Socialism, General Than Shwe seized power, pledging to oversee Myanmar's disciplined transition to democracy (Farrelly and Win 2016). Throughout the 1990s widespread cronyism on behalf of the military elite in newly privatized state enterprises and the imposition of western sanctions stifled any real strides in economic liberalization (Rieffel 2012).

eral warming trend and a decreasing level of precipitation (NCEA 2010), while also experiencing a later-onset monsoon. For example, the duration of the rainy season has decreased to 105 days from the average of 145 days, exacerbating already serious water scarcity in many parts of the country at the end of the dry season (Swe et al. 2015). Persistent challenges stemming from multidimensional poverty and low levels of human development (Eastham et al. 2008; World Bank 2015) compound such high levels of exposure.

Poverty and vulnerability to climate change are not synonymous and require careful deliberation when framing research and policy imperatives around vulnerability (Friend and Moench 2015). A part of this challenge is to disentangle the complex dependencies that form between ecological, technological, and institutional systems within and outside the immediate urban area of large urban centres and emerging secondary cities (Friend and Moench 2015; da Silva et al. 2012). Considering cities as complex, adaptive socio-ecological systems can help us to assess the shocks and stresses that affect infrastructure and the basic supply of services to urban areas (da Silva et al. 2012) and that ultimately have an impact upon urban populations. However, the uptake of systems approaches in vulnerability research does not necessarily consider how questions of power and resource access shape vulnerability within the urban environment. In attempts to bridge these questions, researchers have begun to advocate for more people-oriented approaches to consider how vulnerability is differentially distributed across social groups based on system access (Friend and Moench 2013, 2015; Friend et al. 2015). Others have taken these questions further by framing research beyond who is vulnerable and to what to consider the structural-relational drivers behind the vulnerability of certain groups (Cuomo 2011; Tschakert et al. 2013).

In this chapter, we explore how research might bridge systems and people-centred approaches by analyzing vulnerability in one of Myanmar's emerging secondary cities: Dawei. Drawing from systems (Turner et al. 2003a) and livelihoods (Scoones 2009) perspectives, we link a macro-level understanding of the broader systems and processes shaping the vulnerability of urban systems with a micro-level understanding of vulnerability across two areas of Dawei. Specifically, we examine how Dawei's urban systems are exposed to various climatic and non-climatic stresses and how access to infrastructure and services shapes local sensitivities, investigating how this plays out in terms of people's everyday livelihoods. We then turn to how urban vulnerability is manifest for the poorest and most vulnerable groups, while considering how social capital and the ways in which people relate are fundamental to shaping resilience. By situating this analysis of vulnerability in Dawei within the larger context of Myanmar's political and economic transition, we highlight both the challenges that this transition poses to vulnerability and the possibility for shaping a resilient future.

2.1 Bridging Systems and People-Centred Approaches to Vulnerability Research

Vulnerability, as defined by the Intergovernmental Panel on Climate Change (IPCC), refers to the 'degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with adverse impacts of climate change' (2007, 27). Definitions of vulnerability typically share three key elements: exposure, sensitivity, and the ability to cope or build adaptive capacity (Bruno Soares et al. 2012; Carter et al. 2015; Miller and Bowen 2013). Exposure is an external component of vulnerability that refers to the preconditions and positioning of physical assets, infrastructure, and populations in relation to climate-related stimuli and impacts (Costa and Kropp 2013; Pachauri et al. 2014). Sensitivity, in contrast, is an internal component of vulnerability, defined as the extent to which populations or assets are subject to change as a result of being exposed to a given hazard (Krellenberg et al. 2014; Kuhlicke et al. 2012). While exposure and sensitivity interact to determine a given impact's intensity, coping and adaptive capacity shape how systems and populations respond to and manage stress and disturbance (O'Brien et al. 2006).

Broadly speaking, there are three schools of thought that focus on vulnerability analysis: (1) biophysical approaches (Ambraseys and Jackson 1981; Liverman 1990), (2) social approaches (Adger and Kelly 1999; Blaikie et al. 1994; Pelling 2003), and (3) integrated approaches (Ford 2002; Gallopín et al. 2001). The biophysical approach is based in the natural hazards tradition, which conceptualizes vulnerability according to biophysical sources of exposure and its potential impact relative to the sensitivity of the system under analysis (Bruno Soares et al. 2012; Romero Lankao and Qin 2011). Social approaches focus on the inherent and contextual aspects that render systems, areas, and populations vulnerable to climate change (Bruno Soares et al. 2012; Ford et al. 2010; Romero Lankao and Qin 2011). They draw from theories of political economy, political ecology, and livelihoods to emphasize the social, economic, and political determinants that cause populations to be differentially vulnerable to sources of exposure (Romero Lankao and Qin 2011). Although social approaches provide a strong understanding of the contextual and causal sources of vulnerability, scholars criticize them for lacking a complete understanding of biophysical hazards and impacts (Bruno Soares et al. 2012; Cardona 2004). By contrast, integrated frameworks of vulnerability merge approaches to conceptualize biophysical and social systems as interconnected and modelled according to the coupled human–environment system or the social–ecological system (Bruno Soares et al. 2012). Such approaches aim to understand the multiplicity of stresses and processes that contribute to the vulnerability of systems and populations, while regarding these processes as constantly changing based on feedback loops that form within and between system components (Bruno Soares et al. 2012; Folke 2006; Liu et al. 2007).

Despite similarities, approaches vary in their consideration of scale, feedback loops, biophysical and social components, and political economy (Blaikie et al. 1994; Birkmann 2006; Cutter et al. 2000; Reed et al. 2013; Turner et al. 2003a, b). Turner and colleagues' sustainability systems vulnerability framework (2003a) (Fig. 2.1) uses nested scales of analysis to assess vulnerability—which is considered according

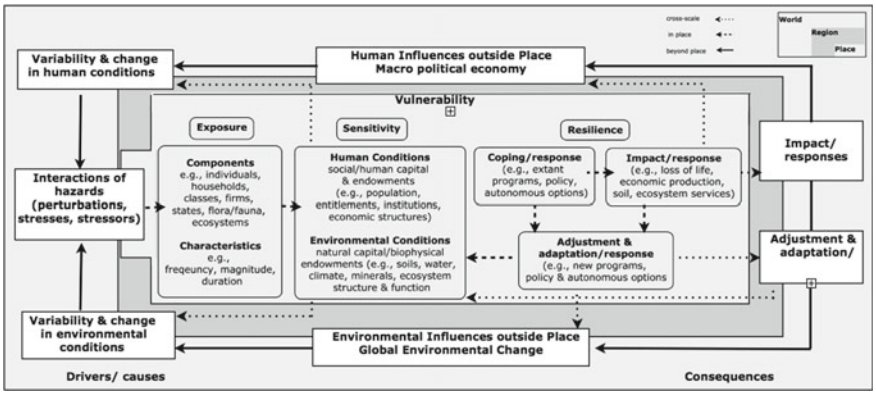

Fig. 2.1 Sustainability systems vulnerability framework. (Adapted from Turner et al. 2003a, b)

to elements of exposure, sensitivity, and resilience in the form of impacts and coping and adaptation responses. Exposure to stresses stemming from wider drivers of socio-ecological change interacts with the sensitivity of specific places, systems, and populations via human and environmental conditions, leading to a range of responses in the form of impacts, coping, and adaptation. The framework is grounded by principles that attempt to balance systems and people-centred approaches by acknowledging the role of local stakeholders in defining issues related to vulnerability and recognizing the differential vulnerability of social groups and households.

Livelihood approaches have been widely applied in vulnerability research to consider households' capacities and assets to pursue livelihood objectives or cope with shocks and stress (Ashley and Carney 1999). Livelihood approaches originally emerged from the seminal work of Amartya Sen in the 1980s, and the work of Chambers and Conway in the early 1990s (Sen 1980; Ashley and Carney 1999; Chambers and Conway 1992; Scoones 1998). A livelihood analysis focuses on the activities and resources that people draw on to earn a living. The capacities and constraints of households to pursue livelihood objectives largely depend on the combination of human, social, physical, financial, and natural capital—in other words, endowments. Institutional structures are fundamental to shaping households' endowments, and in turn their entitlements, meaning people's command over household resources based on access to different capital and services (Ashley and Carney 1999).

In the highly monetized character of cities, financial capital is essential in determining access to goods, food, shelter, and water (Miekle 2002). In the absence of financial capital, however, social capital becomes even more essential to urban survival for the poorest and most vulnerable who may rely on neighbours to access food or water, or depend on networks of relief to cope during times of need (Farrington et al. 2002).[3] To assess vulnerability, we explicitly consider shocks and stresses in relation

[3]Social capital refers to the networks of relationships and mutual support that people draw on to access resources within and external to a community (Farrington et al. 2002; James and Paton 2015).

to people's capital. For example, shocks can destroy and damage assets directly and force people to abandon their homes or dispose of assets, whereas stresses tend to be more benign, often affecting the rates of return to livelihood strategies in the form of seasonal shifts in prices and employment opportunities (Ashley and Carney 1999; Scoones 1998). In response, people draw on their range of available capital to cope with and adapt to shocks and stress.

Our work seeks to bridge systems vulnerability analysis with livelihood approaches to understand how vulnerability is manifest at the community and household level. In combining these approaches, we aim to bridge a macro-level understanding of the broader systems and processes shaping the vulnerability of urban and supporting ecological systems with a micro-level understanding of certain groups' vulnerability. By framing vulnerability according to the livelihoods, entitlements, and priorities of households, we want to understand 'what is it people are concerned about and why, and how can it be addressed?' (Tschakert 2012, 155). These questions are at the heart of our research in which we view social agency, equity, and representation as key to understanding how vulnerable groups frame issues of vulnerability, inclusive of concerns that are directly and indirectly related to climate change.

2.2 Understanding Dawei

Dawei is a coastal secondary city in southeastern Myanmar. Its location on the Andaman Sea, 350 kilometres west of Bangkok, combined with the wealth of natural resources in the region has attracted increasing attention from foreign investors[4] in terms of coal mining and speculation related to a planned special economic zone (SEZ). Large oil and gas companies are keen to further develop the vast offshore natural gas reserves located northwest of Dawei (Rieffel 2012). Developers view the deep-sea port (which will be the deepest in the region) and the SEZ as part of a 135-kilometre development corridor between Dawei's SEZ and Thailand's Kanchanaburi Province, effectively establishing Dawei as a node on the Asian Development Bank's regional economic corridor.[5] Despite the scale of planned industry, Dawei's current economy remains driven by agri-

Network can either be vertical (patron/client) as in the case of bridging social capital or horizontal in the form of bonding social capital (shared interests, familial bonds, and kinship); formal through membership to organizations; or informal based on relationships of trust and reciprocity (Ashley and Carney 1999).

[4]Foreign Direct Investment (FDI) has fueled economic growth in Myanmar—8.4% as of 2016 (Asian Development Bank 2016). Projections suggest that Myanmar may attract up to USD 100 billion in FDI over the next two decades (Chhor et al. 2013). Questions remain about whether FDI will result in broad-based economic development because 98.1% of total investment approvals since 2000 have been in the extractive and power sectors (Bissinger 2012).

[5]Dawei is the final/beginning destination on the Greater Mekong Sub-region/Asian Development Bank's Southern Economic Corridor where the Phu Nam Ron road links Dawei to neighbouring Kanchanaburi Province in Thailand, through Bangkok, Phnom Penh, and onward to Ho Chi Minh City (ADB 2015).

culture, forestry, mining, fisheries, and to a growing extent, tourism (UNDP 2014). Local people struggle to earn their livelihood, however, and underemployment has led to an extensive out-migration of household members from the Dawei District into neighbouring Thailand. More than half of the total population from the Tanintharyi region, where Dawei is located, work in Thailand (Ministry of Immigration and Population 2015b), often in the fishing and construction sectors (Fig. 2.2).

We used qualitative research methods for data collection and analysis in three sequential phases spanning household, community, urban, and district levels. Phase 1 involved a situational analysis of the social, economic, political, and ecological context of the Dawei District through a careful review of secondary data from government documents, grey literature, and newspaper articles. Phases 2 and 3 focused on two sample subgroups to understand how urban vulnerability is manifest at the community and household level. The second phase involved semi-structured key informant interviews ($n = 18$) and focus groups ($n = 2$) with representatives from the Development Affairs Organization (the most decentralized government agency), Dawei University, and nongovernmental and civil society organizations. Questions probed into social and environmental change, urbanization, past and potential shocks and stresses, urban infrastructure and services, and vulnerable populations.

The third phase, completed through snowball sampling, involved household semi-structured interviews ($n = 41$) within two sample subpopulations. Our questions probed into peoples' livelihoods, everyday challenges, coping and adaptive capacities, and access to infrastructure and services. We used NVivo, a qualitative computer software programme, to help with coding and analyzing participant interviews. We shared our findings with community members, civil society groups, and government representatives through project briefing reports and workshops to verify findings and continue the research dialogue.

The first neighbourhood is Karapyien South—a peri-urban area that we selected for its flood exposure and sensitivity in water access and livelihoods. The majority of households moved to the area in the last 10 years and squat on government land because people cannot afford rent or land title. The second neighbourhood is Kyetsarpyien—a semi-urban area we selected based on the exposure of groundwater to saline intrusion and the residents' precarious livelihoods. Kyetsarpyien is a slum where many families live together in the same household (Table 2.1).

Respondents noted that these were two poor, vulnerable areas within Dawei. Names are local, given to these particular micro-neighbourhoods (in Myanmar, cities are broken down into ward tracts, which are neighbourhoods in terms of area and often in terms of social aspects). Neighbourhood A is more recent with households renting land or squatting on land. The rent is cheaper here than in other parts of Dawei since it is located on a flood plain. Neighbourhood B, in contrast, has been established for over 20 years. Its households gain land title through the support of a former factory owner.

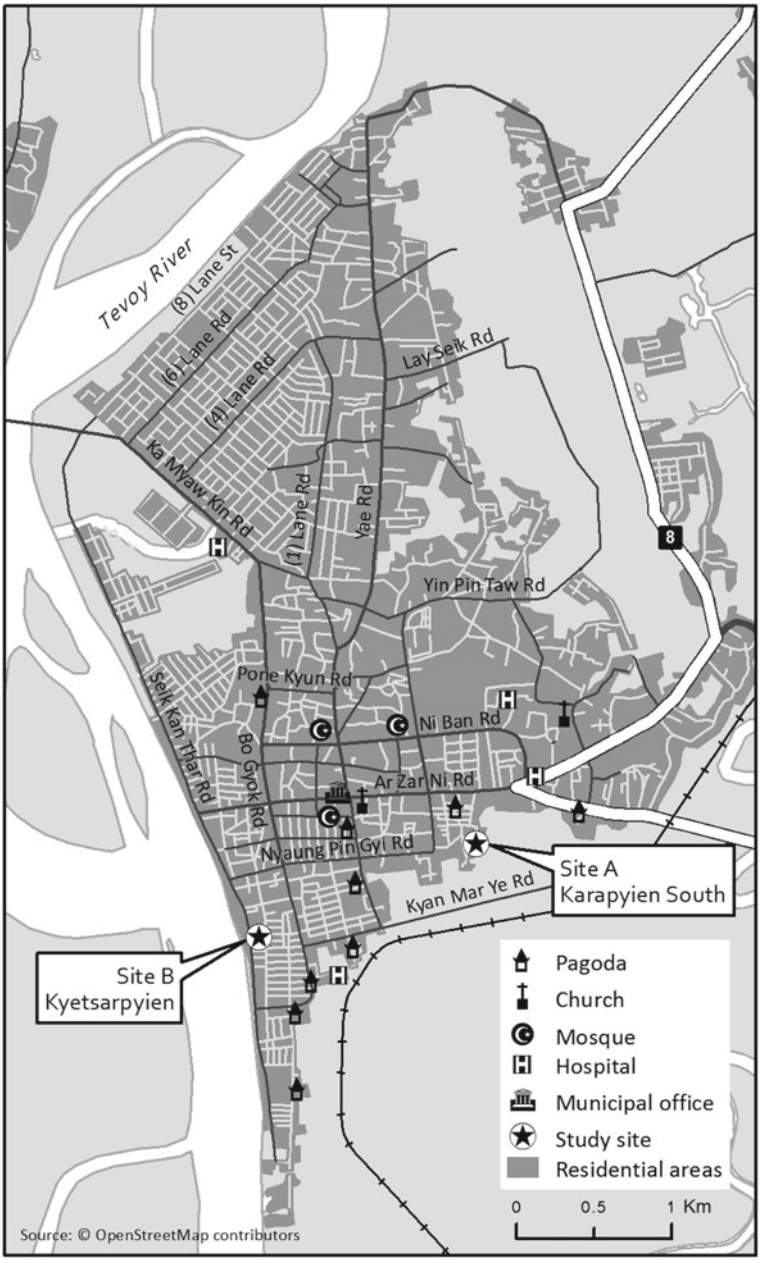

Fig. 2.2 Map of research area. (*Source*: OpenStreetMap contributors)

Table 2.1 Comparison of neighbourhoods

	Neighbourhood A: Karapyien South	Neighbourhood B: Kyetsarpyien
Location	Southeastern Dawei, a peri-urban environment (next to a tributary to the Dawei River, paddy fields, and a monastery)	Southwestern Dawei, a semi-urban environment (next to Dawei River)
Average household size	5.5 persons	9.6 persons
Average time in area	Less than 10 years	More than 20 years
Land title	Home ownership: 16%; renting: 31%; squatting: 53%	Home ownership: 100%

Note: Average household size includes extended family members living within household. Comparison is based on primary field data collected by Taylor Martin and Saw Win and key informant interviews.

2.3 Exposure: Dawei's Urban Systems

Dawei's urban systems are exposed to various climatic stresses, including water supply and flooding, and non-climatic stresses such as land speculation and general development. In terms of climatic stresses, over two-thirds of Dawei Township obtains its groundwater from shallow and tube wells (Ministry of Immigration and Population 2015b). Water scarcity is prevalent in the pre-monsoon season (March to May), and saltwater intrusion is an issue throughout the year in riverbank areas. One interviewee noted that 'about eight metres from the river bank … they cannot dig a well because of salty water' (KI.18). Rising temperatures and the increased prevalence of drought augment exposure to seasonal water scarcity, whereas saline intrusion in riverbank areas is exacerbated by sea-level rise, which is anticipated to increase between one-quarter and one-half metres by 2100 (Ministry of Environmental Conservation and Forestry, Ministry of Transport, and United Nations Environment Programme 2012). Urbanization compounds exposure to existing climatic stresses—growing residential and commercial demand without differentiation of supply will inevitably undermine sustainable rates of groundwater recharge.

Conversely, annual flooding is prevalent in southwest Dawei in the monsoon season (July–August) when periods of heavy rainfall coincide with high tide on the Dawei River. Exposure is highest in lowland riverine and peri-urban areas and along creeks and streams. More concentrated rainfall combined with anticipated sea-level rise is expected to have an impact on the meteorology and hydrology of Dawei and thereby heighten flood exposure (Ibid. Naing 2008). Anticipated population growth and urban expansion in flood-prone areas—a significant aspect of Dawei—will most likely also exacerbate flooding.

Non-climatic stresses affecting Dawei's wider ecological systems also influence exposure to risk. For example, land speculation and resulting deforestation around

Dawei's SEZ and road corridor to Thailand (Woods 2015) are likely to have severe implications for water supply and flooding.[6] Large-scale mines backed by Chinese and Thai investors, such as the Heinda and Bawapin mines (among others), have resulted in the widespread contamination of surface water in the Dawei District (Tarkapaw Youth Group et al. 2015). Rapid development compounds vulnerabilities, including from seven coal-fired power plants that have been developed or are in the works (Ibid.).[7] One interviewee explained, 'water resources … [there is] more and more damage from extracting natural resources, logging, mining … If you go along the road to the border [Thailand], only two to three rivers are maintained as original, so almost every river area is damaged, already polluted' (KI.11). Although these stresses are not necessarily climatic or urban in scale, they have serious implications for the wider ecological systems that support the functioning and provisioning of ecosystem services in Dawei.

2.4 Sensitivity: Access to Dawei's Urban Services

Table 2.2 indicates how urban services vary across the two neighbourhoods within the city of Dawei. Karapyien South (site A) exemplifies the vulnerabilities affecting a peri-urban informal settlement where infrastructure development and the provisioning of services lags behind the growth of the community. In contrast, urban infrastructure and services are relatively more developed in Kyetsarpyien (site B), exemplifying a space in the city that has developed over a longer time frame and is more connected to services. Although both these sites represent low-income communities within Dawei, differences in access to basic infrastructure and services illustrate how entitlements are unevenly distributed between social groups within an urbanizing context.

In neighbourhood A, access to electricity, sanitation, and drainage is limited and infrastructure is rudimentary. The majority of households depend on the nearby monastery for drinking water and neighbours for household use. By contrast, the majority of households in neighbourhood B have access to electricity, sanitation, and drainage infrastructure, however rudimentary. Households depend on private suppliers for water, drawing from the municipal system for everyday use and tankers or bottle distributers for drinking water because groundwater is saline. In both study sites, municipal waste collection is limited so households either burn or dispose of waste behind their homes, or for Kyetsarpyien (B) households, by directly disposing waste into the Dawei River.

[6] Deforestation is linked to the loss of surface and groundwater, as well as downstream flooding caused by increased sedimentation and the loss of natural drainage in upstream areas (Rays of Kamoethway Indigenous People and Nature and Tensasserim River and Indigenous People Network 2016).

[7] According to Tarkapaw Youth Group et al. 2015, coal-fired plants are approved through high-level connections, without the appropriate environmental or social impact assessment or local consent.

Table 2.2 Access to basic urban services in two neighbourhoods

	Neighbourhood A	Neighbourhood B
Electricity	Majority of households lack electricity because of unaffordable operating and installation costs. Insecurity of land tenure is a disincentive to invest in installation.	Majority of households have electricity. The electricity company provided subsidies to households to enable installation.
Sanitation infrastructure	Pit latrines constructed from bamboo baskets; some households share with neighbours. A few households connect their latrines directly to the stream.	Pit latrines constructed from concrete rings; a minority of households either share or have flush toilets. Sanitation infrastructure improving in this area over time.
Waste collection	No municipal waste collection: households either burn waste in the dry season or dispose of waste behind their homes where it collects in the nearby stream.	Municipal waste collection but service is irregular and unreliable. Households burn waste in the dry season or dump waste into the Dawei River.
Drainage	No built drainage infrastructure. Water collects in shallow pools underneath homes in the rainy season. Any natural drainage is blocked by the build-up of sediment and garbage.	A wooden trough lines the road in front of households. Drainage channels are littered with waste and filled with stagnant water.
Water supply	Water comes from a limited number of private shallow wells that are affected by seasonal fluctuations in temperature and rainfall. Drinking water is collected from the monastery and available throughout the year.	Ground water is saline. Drinking and household water is bought from private suppliers. Households' water is piped in from the municipal system for everyday use (not drinking) whereas drinking water is serviced from tankers or bottled distributers. Some households collect rainwater in the rainy season.

Note: Based on primary field data collected by Taylor Martin and Saw Win and key informant interviews.

Differential access to infrastructure and services between study sites shapes the sensitivity of each community to stresses affecting groundwater. In Karapyien (A), seasonal fluctuations in groundwater quality and quantity in household wells are exacerbated as a result of demand exceeding supply, so households have to travel greater distances to access water. In contrast, although groundwater is saline in Kyetsarpyien (B), the various means of supply mitigate its sensitivity. Differences between study sites illustrate how the entitlements available to households shape sensitivity, while highlighting differences within poor urban areas in terms of access to basic infrastructure and services.

Both neighbourhoods experience annual flooding in the monsoon season although the duration, intensity, and resulting impacts are far greater in Karapyien (A). Here, flooding occurs two or three times annually with water levels upwards of two metres and lasting between two to seven days. The severity of flooding has increased in recent years, which households attribute to the decreasing quality of natural drainage

which is blocked by sediment and solid waste. During severe floods, transportation is difficult or impossible and household infrastructure is damaged.

In Kyetsarpyien (B), flooding is modest and limited to the western edge of the ward occuring when periods of heavy rainfall coincide with high tide on the Dawei River. Flood levels reach up to people's ankles and last between one and two hours. Although flooding in Kyetsarpyien does not pose any immediate impacts on households, flooding in Dawei at large negatively affects those engaged in livelihoods dependent on the transportation of goods from surrounding areas. Cascading impacts from flooding on transportation and access to markets illustrate the direct and indirect impacts of flooding on peoples' livelihoods.

2.5 Livelihoods in Dawei

By analyzing people's livelihood strategies, we can contextualize households' sensitivity to shocks and stress. Although in both neighbourhoods people rely on a mix of seasonal livelihoods, in Karapyien (A) households rely on wage labour to a greater extent than in Kyetsarpyien (B). Common livelihoods in Karapyien include construction and transportation for men, while women engage in plantation processing or selling goods and vegetables. In Kyetsarpyien (B), fishing is a common livelihood activity. Men catch fish and shrimp in the Dawei River, and women sell the products in the market. Both women and men work as porters transporting goods.

Extremely wet and unfavourable working conditions during the southwest monsoon result in depressed local economic activity in the rainy season. Consequently, nearly 60% of households interviewed are engaged in seasonal livelihood activities in which transportation, construction, and fishing predominate. One interviewee explained, 'in the rainy season, we have no work. We earn no money. At this time it is very difficult' (HH3.S1.M). To cope, households adopt secondary livelihoods as casual labour but employment is unstable and income unreliable. Consequently, households struggle to afford their daily expenditures: more than half of the households we interviewed in neighbourhood A mentioned this challenge, relative to less than a quarter of households in neighbourhood B. Even so, across both neighbourhoods, the most vulnerable were those living from 'hand to mouth', namely, female-headed households, the elderly, and those suffering with chronic illness.

As a result of unstable livelihoods, many households borrow money in the rainy season, reflecting the seasonal cycle of household finances. One household explained, 'we have no regular jobs. For example, my husband has no job today—he has to do daily wages or hard labour. If he can do he [can] pay for our household. If he cannot we borrow money' (HH1.S1.F). The challenge of seasonal debt is more widespread across households in Karapyien (A) (26%) than Kyetsarpyien (B) (14%), highlighting differences between study sites in the severity of impacts from seasonal livelihoods on household finances. The lack of stable employment for many households in turn undermines their capabilities to pursue livelihood objectives, buffer shocks and stress, and address underlying drivers of vulnerability.

Table 2.3 Livelihood challenges across two Dawei neighbourhoods

Challenges	Description
Health	Health shocks and chronic illness negatively affect households through lost income, healthcare costs, and not being able to work. Health has a seasonal dimension: wet environmental conditions in the rainy season combined with poor drainage are linked to an increase in dengue fever.
Work	Seasonal livelihood opportunities and low earnings mean households have limited financial resources to buffer shocks and stresses.
Debt	Low earnings and limited savings lead households to borrow money to pay for health costs and cover expenditures during periods of seasonal unemployment. Households are caught in a poverty trap caused by a seasonal cycle of earning, saving, spending, and borrowing.
Living costs	Rising food and living costs compound the financial difficulties that households experience.
Education costs	The inability to afford tuition costs hinders the development of human capital and the upward mobility of households.
Land title	Lack of home ownership presents a source of insecurity for households (neighbourhood A).
Relocation	Squatting households fear relocation from government. Rising land and housing prices compound the financial strains facing landless households (neighbourhood A).

Note: We conducted 41 household interviews across the two neighbourhoods.

Across both neighbourhoods, health and finances emerged as two outstanding themes in the discussion of challenges that households face (Table 2.3). Health shocks and chronic illness were the most widespread challenge in light of unaffordable healthcare costs, impacts on livelihood activities, and the incurrence of debt to compensate for lost income. In the words of one interviewee, 'I have a bitter experience about this. I got this problem and I have to take a rest for ten days. At this time there is no income so I need to borrow money from other people … My earning just covers the daily spending. When there is a health problem, I cannot control' (HH.12.S2.MF). Households are highly sensitive to falling into debt as a result of sudden illness, highlighting the relationship between health, livelihoods, poverty, and ultimately, vulnerability.

The lack of land title among households also affects peoples' livelihood security. In Karapyien (A), households squat on government land or rent property in the rice fields. While renting households struggle to pay rent, squatting households face a great deal of insecurity because they fear they will be relocated. Even in areas such as Kyetsarpyien (B) where households hold land tenure, the incurrence of high debts causes households to sell their homes. For example, during the time we were conducting fieldwork, four households (of 22) sold their homes because of their need to pay off debts. The instability of land tenure and home ownership for low-income households illustrates how vulnerability is shaped by the causal chain of exposure, sensitivity, and coping strategies that can lead to even more precarious situations for the urban poor.

Households adopt various coping and adaptation strategies to mitigate the impacts of shocks and stress on well-being. For example, in response to high flood levels, households collectively mobilized resources to build a bamboo raft used to transport households to the nearby monastery. The monastery serves as a place of sanctuary while also managing resources donated from the wider community to aid in flood relief. Households have adapted coping strategies in response to the increasing severity of flooding—communities can learn from past experience and mobilize resources in response to increasing levels of risk. One community member who was instrumental in building the raft explained, 'the water level used to take time so we had time to prepare and carry things. In recent years it is very quick so this is why I suddenly got the idea that I need to make some options' (HH14.S1.M). Despite community efforts to adapt coping responses, households noted the need for more coordinated efforts to improve natural drainage to reduce the severity of flooding and its impacts.

In Kyetsarpyien (B), the contribution of multiple earners and remittances to household income help to buffer the impact of seasonal livelihoods on finances. One interviewee explained: 'so even if we are not in good condition for business we are so-so. Our daughter works in the porter service in the market, and our son is the same. We have the same challenges, and even so, we face the challenge like a forest. There is the wind and the storm—if there is only one tree, it is easy to collapse. How about the forest? We can prevent together' (HH19.S2.M). In Karapyien (A), given the smaller household size, individual households depend on networks of support within the community to cope during times of need. They often spoke of neighbours sharing food or lending money during difficult times: 'we are living as a family and we support each other. Each family. Everybody supports each other. If one family suffers, other families support' (HH8.S1.M). Despite differences between study sites, the strategies that households used to cope and adapt to stress illustrate the role of family and community in supporting one another, both of which indicate the importance of social capital in resilience.

2.6 Bridging People and Systems in Dawei

The analysis of vulnerability in Dawei illustrates the interconnectedness and, ultimately, political nature of socio-ecological systems. Stresses borne from climatic- or human-induced environmental change that are not necessarily urban in scale ultimately have place-based implications for urban systems, such as water supply or flooding. However, the wider context of political and economic transition in Myanmar allows for a greater understanding of the drivers of human and environmental change in Dawei's urban areas and supporting ecological systems. Regional integration and the influx of FDI into the Dawei SEZ and the extractive sector drives environmental change in the district: integration drives speculative deforestation,

and the extractive sector pollutes water resources (Tarkapaw Youth Group et al. 2015). Consequently, there is significant cause for concern in how Myanmar's newly democratically elected government plans for and manages the environmental risks that come with greater economic liberalization (UNDP 2015). Myanmar's rural-to-urban transition is also being played out in Dawei, and is likely to accelerate with greater regional integration as the Phu Nam Ron road corridor to Thailand is further developed. Given existing gaps in the basic supply of infrastructure and services in Dawei, formidable challenges face local government attempts to keep up with the demands of a growing urban population and economy.

Climate change coupled with stresses from economic liberalization represent the 'double exposure' of ecological and urban systems and populations. This double exposure exacerbates existing stresses and compounds institutional challenges to manage Myanmar's political, economic, and demographic transition. In Dawei, climate change compounds issues posed to water supply and flooding: rising sea levels augments the exposure of groundwater to saline intrusion, while interacting with stresses of groundwater depletion as a result of growing urban demand. Rising temperatures and the increased prevalence of drought exacerbate existing issues of water scarcity in the late dry season, while more concentrated rainfall compounds flooding in the monsoon. Given the weak organizational capacity and limited resources of the municipal office, civil society and religious organizations are integral to mobilizing resources to cope with impacts. While recognizing the importance of civil society in aiding relief, long-term adaptive measures will require greater planning and coordination on behalf of municipal, township, and district-level governments—a significant challenge considering the legacy of Myanmar's highly centralized governance structure. As we have seen with other countries in the region that have undergone decentralization, building capacity for local government takes time, both in terms of local staff capacity but also buy-in from civil society and the national level (Marschke 2012).

Despite the wider context of how stresses driving human and environmental change in Dawei are shaped by political economy, vulnerability is ultimately manifest at the local level. Although Dawei's urban systems are exposed to water scarcity and flooding, vulnerability is differentially distributed across the urban environment based on people's access to resources and social power. The most vulnerable groups are engaged in precarious livelihoods and situated in hazard-prone areas with limited access to infrastructure and services (Swyngedouw and Heynen 2003). Although both Karapyien (A) and Kyetsarpyien (B) are representative of lower income groups, their relative vulnerability to stresses affecting urban systems differs based on their access to infrastructure and services, and locale within the urban environment. In Karapyien (A), households' sensitivity to stresses affecting water scarcity and flooding is heightened by their limited entitlements to sources of water supply or drainage infrastructure. Comparatively, in Kyetsarpyien (B), despite the direct exposure of groundwater to saline intrusion, the varied forms of water supply for households mitigate the neighbourhood's sensitivity. Differences between neighbourhoods illustrate how access to infrastructure and services shapes vulnerability within the urban

environment, while also highlighting how challenges in the supply of basic services in urbanizing areas ultimately manifest in low-income communities.

However, using a systems lens to analyze household vulnerability falls short in really understanding how people experience vulnerability in their everyday lives beyond access to particular services. Adding a livelihood lens enables us to assess how people view vulnerability in light of their capabilities and daily struggles, in which questions are not necessarily framed according to 'how do you get water?' but 'what is it people are concerned about and why?' (Tschakert 2012). In raising these questions, we find that the most poignant sources of vulnerability for households concern those related to health shocks and chronic illness, unstable livelihoods, debt, and insecure land tenure. Although not necessarily synonymous with vulnerability, poverty traps households in a cycle in which low returns and seasonal income undermine people's capabilities to buffer shocks and stress, achieve livelihood objectives, reduce vulnerability, and improve well-being. Households experience vulnerability differentially, each facing their own unique challenges that shape their respective sensitivity and coping and adaptive capacities based on their portfolio of human (labour supply, health), natural (groundwater, natural drainage, and livelihood resources), financial (earnings, savings), physical (land tenure, housing, and infrastructure), and social (support networks) capital.

While shocks and stress have the potential to cause households to fall deeper into poverty, we also find that they present opportunities to showcase the resilience of human beings in mobilizing resources and supporting one another to cope and adapt to changing social and environmental conditions. For example, during periods of low seasonal earnings, households cope by adopting alternative livelihood strategies while also depending on one another—multiple earners make even the most destitute conditions bearable through shared household earnings. In the absence of financial capital, strong social networks also aid people in coping and adapting to stress. For example, households in Karapyien rely on one another by sharing food, resources, and loaning money among neighbours in periods of financial need. Bonding social capital helps households adapt coping strategies to respond to increasing exposure and sensitivity. For example, Karapyien households adapt coping strategies in response to increasingly severe flood levels, demonstrating how communities can learn from past experience and mobilize resources to increase resilience.

Wider social networks that bridge social capital also play a role in supporting communities to cope and respond to shocks and stress. Monasteries provide drinking water to low-income households and a place of sanctuary during floods. They also mobilize resources from civil society groups to enable wider efforts to relieve affected communities. Although the role of social capital in coping with stress is widely documented in the literature, its relation to resilience in Dawei is in part situated in the deeply rooted culture of Theravada Buddhism in Myanmar, where relieving the suffering of others is an important concept (Jaquet and Walton 2013). For the poorest and most vulnerable groups, social norms help in the face of stresses and shocks (but see also Okamoto 2011). The monastery is a literal source of relief (water, shelter) while also representing a space where social norms and kindness can be mobilized.

2.7 From Vulnerability to Resilience: Implications for Governance and Transformative Change

Although the discussion of how people cope and adapt in the face of adversity presents an uplifting view of resilience to vulnerability, it does not detract from the need to consider the structural–relational drivers that lead to the vulnerability of low-income groups. Accordingly, 'the overemphasis on human, physical, natural, social, and financial resource deprivation among urban slum residents … distracts from the larger structural and relational drivers that keep the balance tipped towards persistent marginalization' (Tschakert et al. 2013, 345). In considering households' entitlements to land, livelihood opportunities, and infrastructure access, we can move beyond the discussion of differential exposure and sensitivity to understand how institutional structures and processes shape the spatial distribution of resources, social power and vulnerability in urban environments. Larger questions arise when considering the drivers of vulnerability for low-income groups stemming from weaknesses in Myanmar's wider social protection and health environment. Framing the analysis of vulnerability according to these structural relational drivers is essential to address systemic inequality for climate change adaptation or resilience for the poorest or most vulnerable.

Vast changes in Myanmar's political and economic environment continue to unfold under the recently elected democratic government and evolving process of decentralization. These changes pose risks that have serious implications for vulnerability. Although economic liberalization presents great opportunity for growth, weaknesses in governance and environmental safeguards raise concerns about whether and how drivers of environmental change will be managed. Economic liberalization and greater regional connectivity will likely rapidly accelerate Myanmar's rural-to-urban transition. How the government manages this process at the local level will have profound implications for shaping vulnerability in years to come as climate change impacts become increasingly more pronounced and the breadth and density of Myanmar's cities increases. Significant structural challenges and needs remain, including improving local services, better urban planning, and building capacity of decentralized government actors to fulfil their roles and responsibilities (Arnold et al. 2015).

It is critical to consider what kind of future the Myanmar government wants to work toward. Will it be one that widens discrepancies between the haves and have-nots and exacerbates drivers of vulnerability via unsustainable resource extraction and industrial development? Or will it be one that addresses structural inequalities and builds resilience by considering social and environmental values in decision making and long-term planning in view of human and environmental change? How democracy is translated at the municipal level will be critical in determining whether local institutions will be more accountable and responsive to the needs and priorities of civil society, or address structural inequality in access to infrastructure and

services. This moment in Myanmar's history has the potential to either exacerbate vulnerability and structural inequality or pave the way for a deliberate transformation that considers environmental decision-making, social equality, and climate change in how the country develops in years to come.

Acknowledgements This chapter was written as part of the research programme called Urban Climate Resilience in Southeast Asia (UCRSEA). We greatly appreciate the time that households, NGO staff, CSOs, and municipal officials took to meet with two of the authors for this research, along with the support of UCRSEA and MercyCorps, Myanmar in facilitating this work. Discussions with Nilan Fernando, Dr. Richard Friend, and Dr. Pakamas Thinphanga at the design stage of this research were most helpful. We also thank Dr. Amrita Daniere, Dr. Matthias Garshagen, and Yanjun Cai for feedback on an earlier draft of this chapter. The authors gratefully acknowledge the financial support provided by Canada's Social Sciences and Humanities Council (SSHRC) and the International Development Research Centre (IDRC).

References

Asian Development Bank (ADB) (2013) Sector assessment (summary): urban development and water sector, interim country partnership strategy: Myanmar 2012–2014

Asian Development Bank (ADB) (2015) Connecting South Asia and Southeast Asia. Asian Development Bank Institute, Tokyo, Japan

Asian Development Bank (ADB) (2016) Asian development outlook 2016 update: meeting the low-carbon growth challenge

Adger WN, Kelly PM (1999) Social vulnerability to climate change and the architecture of entitlements. Mitig Adapt Strat Glob Change 4(3–4):253–266

Ambraseys NN, Jackson JA (1981) Earthquake hazard and vulnerability in the northeastern Mediterranean: the Corinth earthquake sequence of February-March 1981. Disasters 5(4):355–368

Arnold M, Aung YT, Kempel S, Kyi PCS (2015) Municipal governance in Myanmar: an overview of development affairs organizations. Discussion Paper No. 7. July 2015. The Asia Foundation, MDRI

Ashley C, Carney D (1999) Sustainable livelihoods: lessons from early experience. Dept. for International Development, London

Birkmann J (ed) (2006) Measuring vulnerability to natural hazards: towards disaster resilient societies. United Nations University, New York

Blaikie P, Cannon T, Davis I, Wisner B (1994) At risk: natural hazards. Routledge, People's Vulnerabilities and Disasters

Bissinger J (2012) Foreign investment in Myanmar: a resource boom but a development bust? Contemp Southeast Asia: J Int Strateg Aff 34(1):23–52

Bruno Soares M, Gagnon AS, Doherty RM (2012) Conceptual elements of climate change vulnerability assessments: a review. Int J Clim Change Strat Manage 4(1):6–35. https://doi.org/10.1108/17568691211200191

Cardona O (2004) The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective risk management. In: Bankoff G, Frerks G, Hilhorst D (eds) Mapping vulnerability: disasters. Development and People, Earthscan, London

Carter JG, Cavan G, Connelly A, Guy S, Handley J, Kazmierczak A (2015) Climate change and the city: building capacity for urban adaptation. Progr Plann 95:1–66. https://doi.org/10.1016/j.progress.2013.08.001

Chambers R, Conway G (1992) Sustainable rural livelihoods practical concepts for the 21st century. IDS Discussion Paper 296. UK Institute for Development Studies, Brighton

Chhor H, Dobbs R, Hansen DN, Thompson F, Shah N, Streiff L (2013) Myanmar's moment: unique opportunities, major challenges. McKinsey & Company. https://www.mckinsey.com/featured-insights/asia-pacific/myanmars-moment

Costa L, Kropp JP (2013) Linking components of vulnerabiity in theoretic frameworks and case studies. Sustain Sci 8(1):1–9. https://doi.org/10.1007/s11625-012-0158-4

Cutter SL, Mitchell JT, Scott MS (2000) Revealing the vulnerability of people and places: a case study of Georgetown County, South Carolina. Ann Assoc Am Geogr 90(4):713–737

Cuomo C (2011) Climate change, vulnerability, and responsibility. Hypatia 26(4):690–714

da Silva J, Kernaghan S, Luque A (2012) A systems approach to meeting the challenges of urban climate change. Int J Urban Sustain Dev 4(2):125–145. https://doi.org/10.1080/19463138.2012.718279

Eastham J, Mpelasoka F, Mainuddin M, Ticehurst C, Dyce P, Hodgson G, Ali R, Kirby M (2008) Mekong River Basin water resources assessment: impacts of climate change. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.457.9113&rep=rep1&type=pdf

Farrelly N, Win C (2016) Inside Myanmar's turbulent transformation: inside Myanmar's turbulent transformation. Asia Pacific Policy Stud 3(1):38–47. https://doi.org/10.1002/app5.124

Farrington J, Rasamut T, Walker J (2002) Sustainable livelihood approaches in urban areas: general lessons and illustrations from Indian cases. Swedish International Development Cooperation Agency, pp 1–64. https://www.odi.org/publications/2009-sustainable-livelihoods-approaches-urban-area-general-lessons-illustrations-indian-case-studies

Folke C (2006) Resilience: the emergence of a perspective for social–ecological systems analyses. Glob Environ Change 16(3):253–267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Ford J (2002) Vulnerability: concepts and issues, Ph.D. scholarly filed paper. University of Guelph, Guelph

Ford JD, Keskitalo ECH, Smith T, Pearce T, Berrang-Ford L, Duerden F, Smit B (2010) Case study and analogue methodologies in climate change vulnerability research. Wiley Interdisc Rev: Clim Change 1(3):374–392. https://doi.org/10.1002/wcc.48

Friend RM, Thinphanga P, MacClune K, Henceroth J, Tran PVG, Nghiem TP (2015) Urban transformations and changing patterns of local risk: lessons from the Mekong Region. Int J Disaster Resilience Built Environ 6(1):30–43. https://doi.org/10.1108/IJDRBE-08-2014-0061

Friend R, Moench M (2013) What is the purpose of urban climate resilience? Implications for addressing poverty and vulnerability. Urban Clim 6:98–113. https://doi.org/10.1016/j.uclim.2013.09.002

Friend R, Moench M (2015) Rights to urban climate resilience: moving beyond poverty and vulnerability: rights to urban climate resilience. Wiley Interdisc Rev: Clim Change 6(6):643–651. https://doi.org/10.1002/wcc.364

Gallopín GC, Funtowicz S, O'Connor M, Ravetz J (2001) Science for the twenty-first century: from social contract to the scientific core. Int Social Sci J 53(168):219–229

Ganesan N (2017) Appraising Myanmar's democratic transition and evolving challenges. Jpn J Polit Sci 18(1):196–215. https://doi.org/10.1017/S1468109916000372

Intergovernmental Panel on Climate Change (IPCC) (2007) Fourth assessment report (AR4) of the intergovernmental panel on climate change. Cambridge University Press, Cambridge

Helen J, Douglas P (2015) Social capital and the cultural contexts of disaster recovery outcomes in Myanmar and Taiwan. Global Change, Peace Secur 27(2):207–228. https://doi.org/10.1080/14781158.2015.1030380

Jaquet C, Walton MJ (2013) Buddhism and relief in Myanmar: reflections on relief as a practice of Dāna. In: Kawanami H, Samuel G (eds) Buddhism, international relief work, and civil society. Palgrave MacMillan, New York, pp 51–73

Krellenberg K, Link F, Welz J, Harris J, Barth K, Irarrzaval F (2014) Supporting local adaptation: the contribtion of socio-environmental fragmentation to urban vulnerability. Appl Geogr 55:61–70 https://doi.org/10.1016/j.apgeog.2014.08.013

Kuhlicke C, Kabisch S, Krellenberg K, Steinfuhrer A (2012) Urban vulnerability under conditions of global environmental change. Conceptual reflections and empirical examples from growing and

shrinking cities. In: Kabisch S, Kunath A, Schweizer-Ries P, Steinführer A (eds) Vulnerability, risk and complexity: impacts of global change on human habitats. Hogrefe, Cambridge, MA
Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, et al (2007) Complexity of coupled human and natural systems. Science 317(5844):1513–1516
Liverman DM (1990) Vulnerability to global environmental change. In: Understanding global environmental change, the earth transformed program, Worcester, MA, pp 27–44
Marschke M (2012) Life, fish, mangroves: resource governance in Coastal Cambodia. University of Ottawa Press, Ottawa
McEntire D, Gilmore Crocker MPH C, Peters E (2010) Addressing vulnerability through an integrated approach. Int J Disaster Resilience Built Environ 1(1):50–64. https://doi.org/10.1108/17595901011026472
Middleton C, Dusita K (2014) Urbanization and sustainable development in the Mekong Region
Miller F, Bowen K (2013) Questioning the assumptions: the role of vulnerability assessments in climate change adaptation. Impact Assess Project Appraisal 31(3):190–197. https://doi.org/10.1080/14615517.2013.819724
Miekle S (2002) The urban context and poor people. In Rakodi C, Lloyd-Jones T (eds) Urban livelihoods: a people-centred approach to reducing poverty. Earthscan, London, UK, pp 37–51
Ministry of Environmental Conservation and Forestry, Ministry of Transport, and United Nations Environment Programme (2012) Myanmar's National Adaptation Programme of Action (NAPA) to climate change. Ministry of environmental conservation and forestry and ministry of transport, Naypyidaw.
Ministry of Immigration and Population (2015a) 2014 myanmar population and housing census: a changing population: union figures at a glance.
Ministry of Immigration and Population (2015b) The 2014 Myanmar population and housing census. Tanintharyi region report. Census report volume 3-F. Department of Population Ministry of Immigration and Population, May 2014. Office No. 48. Nay Pyi Taw.
NCEA (2010) Myanmar's initial national communication report draft copy. National Commission for Environmental Affairs, Yangon
Naing K (2008) Geographical analysis on Dawei river and flood conditions in the rainy Season of Dawei Town. Dawei University
National Environmental Conservation Committee (NECC), Ministry of Environmental Conservation and Forestry, Department of Meterology and Hydrology, Ministry of Transport, & United Nations Environment Programme (2012) Myanmar's National Adaptation Programme of Action (NAPA) to climate change
O'Brien G, O'Keefe P, Rose J, Wisner B (2006) Climate change and disaster management. Disasters 30(1):64–80
Okamoto I (2011) How do poor rural households in Myanmar cope with shocks? Coping strategies in a fishing and farming village in Rakhine State. Developing Econ 49(1):89–112
Pachauri RK, Allen MR, Barros VR, Broome J, Cramer W, Christ R, et al (2014) Climate change 2014: synthesis Report. Contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change. IPCC. Retrieved from http://epic.awi.de/37530/
Pelling M (2003) The vulnerability of cities: natural disasters and social resilience. Earthscan Publications, Sterling, VA.
Rays of Kamoethway Indigenous People and Nature, and Tensasserim River and Indigenous People Network (2016) We will manage our own natural resources. Dawei District, Tanintharyi Region, Myanmar. http://www.burmapartnership.org/2016/03/we-will-manage-our-own-natural-resources-karen-indigenous-people-in-kamoethway-demonstrate-the-importance-of-local-solutions-and-community-driven-conservation/
Reed MS, Podesta G, Fazey I, Geeson N, Hessel R, Hubacek K, Letson D, Nainggolan D, Prell C, Rickenbach MG, Ritsema C, Schwilch G, Stringer AD, Thomas AD (2013) Combining analytical frameworks to assess livelihood vulnerability to climate change and analyse adaptation options. Ecol Econ 94:66–77. https://doi.org/10.1016/j.ecolecon.2013.07.007

Rieffel L (2012) Myanmar on the move: an overview of recent developments. J Curr Southeast Asian Aff 4:19

Romero Lankao P, Qin H (2011) Conceptualizing urban vulnerability to global climate and environmental change. Curr Opin Environ Sustain 3(3):142–49. https://doi.org/10.1016/j.cosust.2010.12.016

Satterthwaite D (2006) Outside the large cities; the demographic importance of small urban centres and large villages in Africa, Asia and Latin America, human settlements discussion paper—urban change 3. IIED, London

Satterthwaite D, International Institute for Environment and Development (2007) Adapting to climate change in urban areas: the possibilities and constraints in low- and middle-income nations. International Institute for Environment and Development, London

Scoones I (1998) Sustainable rural livelihoods: a framework for analysis. IDS, 22

Scoones I (2009) Livelihoods perspectives and rural development. J Peasant Stud 36(1):171–196. https://doi.org/10.1080/03066150902820503

Sen AK (1980) Equality of what. In: McMurrin SM (ed) The tanner lectures on human value. University of Utah Press, Salt Lake City, pp 195–220

Swe LMM, Shrestha, RP, Ebbers T, Jourdain, D (2015) Farmers' Perception of and adaptation to climate-change impacts in the dry zone of Myanmar. Clim Dev 7(5):437–453. https://doi.org/10.1080/17565529.2014.989188

Swyngedouw E, Heynen NC (2003) Urban political ecology, justice and the politics of scale. Antipode 35(5):898–918

Tarkapaw Youth Group, Dawei Development Association, Tenasserim Rver & Indigenous People Networks (2015) We used to fear bullets now we fear bulldozers. Retrieved from http://www.burmapartnership.org/2015/10/we-used-to-fear-bullets-now-we-fear-bulldozers-dirty-coal-mining-by-military-cronies-thai-companies-ban-chaung-dawei-district-myanmar/

Tschakert P (2012) From impacts to embodied experiences: tracing political ecology in climate change research. Geografisk Tidsskrift-Danish J Geogr 112(2):144–158. https://doi.org/10.1080/00167223.2012.741889

Tschakert P, van Oort B, Clair AL, LaMadrid A (2013) Inequality and transformation analyses: a complementary lens for addressing vulnerability to climate change. Clim Dev 5(4):340–350. https://doi.org/10.1080/17565529.2013.828583

Turner BL, Kasperson RE, Matson PA, McCarthy JJ, Corell RW, Christensen L, Eckley N, Kasperson JX, Luers A, Martello ML, Polsky C, Pulsipher A, Schiller A (2003) A framework for vulnerability analysis in sustainability science. Proc Natl Acad Sci 100(14):8074–8079

Turner BL, Matson PA, McCarthy JJ, Corell RW, Christensen L, Eckley N, Hovelsrud-Broda GK, Kasperson JX, Kasperson RE, Luers A, Martello ML, Mathiesen S, Naylor R, Polsky C, Pulsipher A, Schiller A, Selin H, Tyler N (2003) Illustrating the coupled human-environment system for vulnerability analysis: three case studies. Proc Natl Acad Sci 100(14):8080–8085

UNDP (2014) Local governance mapping: the state of local governance: trends in Tanintharyi. UNDP Myanmar. United Nations Development Program Myanmar

UNDP (2015) UNDP Myanmar annual report 2015.

United Nations, Department of Economic and Social Affairs, Population Division (2014) World urbanization prospects: the 2014 revision: highlights

Woods K (2015) Commercial agriculture expansion in Myanmar: links to deforestation, conversion timber, and land conflicts. Forest trends report series. Forest trade and finance. Forest Trends and DFID

World Bank (2015a) East Asia's changing urban landscape: measuring a decade of spatial growth. The World Bank. https://doi.org/10.1596/978-1-4648-0363-5

World Bank (2015b) Least developed countries: UN classification |Data. Retrieved 20 Nov 2016, from http://data.worldbank.org/region/least-developed-countries:-un-classification

Zutao O, Peilei F, Jiquan C (2016) Urban built-up areas in transitional economies of Southeast Asia: spatial extent and dynamics. Remote Sens 8(10):819. https://doi.org/10.3390/rs8100819

Taylor Martin is a development practitioner specializing in climate adaptation and local governance. Her training is in socio-ecological systems, vulnerability analysis, and urban climate resilience with a geographic focus on Southeast Asia. In addition to her research with UCRSEA, she is involved in the management and implementation of donor-funded projects in the water, sanitation, and environment sector.

Melissa Marschke is an associate professor at the School of International Development and Global Studies at the University of Ottawa. Marschke's training is in human-environment relations with a geographical focus on Southeast Asia. In addition to her work with the UCRSEA project, she is involved in research projects examining labour issues in the seafood sector, sand mining, and social well-being and ecosystem services bundles in coastal areas.

Saw Win is a retired rector of Maubin University, and since 2008 an executive director of the Renewable Energy Association Myanmar (REAM). In addition to his work with UCRSEA, he collaborates with Chulalongkorn University in Myanmar on research related to the Salween River. Saw Win is an advisory board member of the Understanding Myanmar Development Project at the Regional Center for Social Science and Sustainable Development at Chiang Mai University.