Multi-Stakeholder Urban Resilience Workshop
Promoting Shared Learning and Inclusive Urban Resilience in Dawei

Myanmar is highly vulnerable to climate change due to its high exposure to climate shocks and stresses, and the limited capacity of local governments to plan for, cope with, and adapt to climate change. Rapid urbanization compounds existing vulnerability as growing urban populations heighten exposure to climate shocks and stress, while placing increasing pressure on weak local governments to provide for basic infrastructure and services. In light of these vulnerabilities, Mercy Corps in collaboration with the Urban Climate Resilience in Southeast Asia (UCRSEA) partnership has undertaken a Vulnerability Assessment of the city of Dawei, Tanintharyi Region.

The Vulnerability Assessment sought to understand the exposure of urban systems in Dawei to climate and non-climate shocks and stress, as well the most salient shocks and stresses that are impacting the socioeconomic well-being of populations in Dawei with a particular emphasis on the poor and marginalized. Data collection involved the review of secondary literature and existing data; key informant interviews with stakeholders from local government, civil society, and non-governmental organizations; and in-depth household level interviews that focused on the perspectives and priorities of vulnerable groups. This document outlines major findings from the Vulnerability Assessment in light of the exposure of key urban systems in Dawei to climate and non-climate stresses, and how exposure is manifest at the household level.

Climate Stress

Temperature Rise

- Trends from climate data derived from the Department of Meteorology and Hydrology suggest that from 1960-2000, Myanmar experienced a significant upwards trend in average and high temperatures (Ministry of Agriculture and Irrigation, 2010). It is expected that by the end of the century, average temperatures are expected to rise between 1-4°C (World Bank, 2012)

Rainfall Fluctuations

- An analysis from 1955-2008 suggests that there has been a significant decrease in the monsoon duration, approximately 0.5 days per year on average (Ministry of Agriculture and Irrigation, 2010). Fluctuating rainfall patterns were also noted across scoping and household interviews, in which changing rainfall patterns are becoming more erratic and irregular, and shifting between periods of heavy rain and drought. Rainfall is projected to increase by approximately 10 percent, which will be more concentrated in fewer rainfall days and more extreme events (World Bank, 2012).

Sea Level Rise

- Sea level rise presents a slow-onset stress that is linked to greater coastal erosion, heightened flood risk along coastal areas and river estuaries, and saline intrusion of coastal aquifers.

Non-Climate Stress

Urbanization and Population Growth

- Urbanization and population growth in Dawei is being driven by regional integration insofar that the road link to Thailand and economic developments surrounding the Dawei Special Economic Zone are resulting in urban and population growth in Dawei. In light of current urbanization trends, there is a need to consider prospective urban growth in planning for future infrastructure and resource needs.

(!) ***The lack of urban planning in Dawei poses issue for the future infrastructure and service needs of the city in light of increasing economic activity and population growth. As one key informant explained, "without town planning, the infrastructure, traffic, the water supply, everything… they should think how much the city will grow, in how many years, how much our population will grow" (KI.11).***

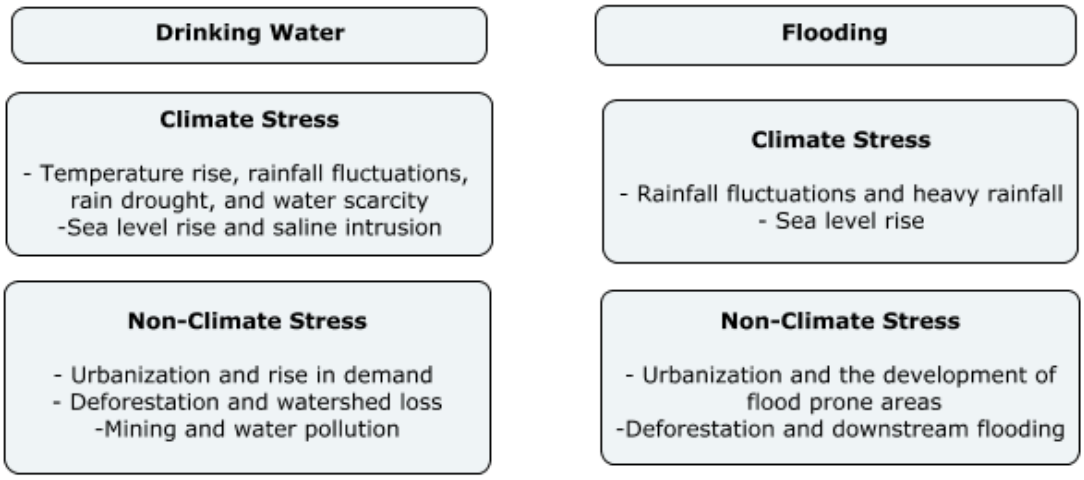
Land Speculation and Deforestation

- The rise of land speculation in Dawei is driving the rise in land, housing, and rental prices in Dawei as well as land use changes in surrounding areas. The expansion of rubber plantations and land grabbing by large businesses and to lesser extent small holders is causing rampant deforestation in the district. According to regional government data, the area of rubber planted in the Tanintharyi Region increased by 50 percent between 2008-2009 to 200,000 acres, and from 2012-2013, up to 300,000 acres (Woods, 2015). Most of these rubber plantations were cultivated in the northern half of the region, especially in Dawei, which increased by 120,000 acres from 2012-2013 (Woods, 2015).

Mining and Extractive Industries

- Mining operations in tin, tungsten, coal, iron, and lead pose another serious environmental stress that is linked to impacts ranging from air pollution, land confiscation from road construction, and the contamination of surrounding rivers and streams from toxic chemicals (Tarkapaw et al., 2015). The most notable and contentious mining projects in the district are the Heinda mine and the Ban Chaung coal mine.

Climate and Non-Climate Stresses and Systems Exposure



Water Supply

Climate Stress

- Findings indicate that groundwater in Dawei is dependent on seasonal rainfall patterns, as water levels in shallow and tube wells are higher during the monsoon season when rainfall is abundant. Conversely, water levels are lower towards the end of the dry season in March, April, and May. As a result of seasonal fluctuations in water levels, water scarcity in the dry season is an issue in surrounding areas of Dawei during the pre-monsoon season.
- **Rising temperatures and rainfall fluctuations** augment **seasonal water scarcity** as groundwater is highly dependent on seasonal rainfall conditions. Current and prospective trends of rainfall fluctuations and increasing rain drought may augment seasonal variations in water availability in the dry season given existing issues of seasonal water scarcity in surrounding areas of Dawei.
- **Sea level rise** is a slow onset stress that exposes Dawei's groundwater in riverbank areas to **saline intrusion**. Findings indicate that saline intrusion of ground wells is present in areas alongside the Dawei River estuary.

Non-Climate Stress

- **Urbanization and population growth** in Dawei adds compounding stress to groundwater in which greater demand and increasing water withdrawal places increasing pressure on finite groundwater resources. Population growth and the corresponding rise in demand for groundwater compounds issues of seasonal water scarcity and saline intrusion.
- **Lack of management and regulation of sewage** in Dawei poses a potential threat to groundwater sources due to poor construction of pit latrines and their proximity to shallow wells. Across scoping interviews, respondents raised concerns over the potential contamination of groundwater from sewage, pointing to the need for urban planning in order to mitigate exposure of water sources to contamination from sewage.

Case Study 1: Karapyien

Findings indicate that shallow wells in Karapyien experience seasonal fluctuations in water levels and water quality, with higher water levels and better quality water in the rainy season than the dry season. Respondents noted how water levels and water quality is decreasing over time, pointing to the need to consider the interaction of climate and non-climate stresses affecting water availability in shallow wells in Dawei. **Seasonal fluctuations in water quantity is augmented by discrepancies between supply and demand for water from households.** Households in Karapyien are dependent on only two shallow wells for household water, in which demand for water outstrips supply, leading households to venture to other wells for household water in the dry season. The case of Karapyien illustrates the sensitivity of households to stresses affecting the availability of groundwater in light of seasonal fluctuations in water levels and water quality and discrepancies between the supply of household water and demand.

Case Study 2: Kyetsarpyien

Saline intrusion and the overproduction of groundwater from industry and increasing demand illustrates the interaction of climate and non-climate stresses affecting water availability in Dawei. Piped water supplied to households in Kyetsarpyien is exposed to saline intrusion due to close proximity to the Dawei River. Overproduction of groundwater by the ice factory is linked to reduced piped water quality, in which greater demand than water recharge causes the water table to lower and salt water from the Dawei River to intrude. **As a result of growing demand for water and increasing withdrawal, the water supplier indicated that water levels in tube wells are decreasing over time:** "it is deeper between 6 inches to 1 feet, year after year, for example, last year, 2014, the pipe reached to twenty feet, this year it reaches to 20.5 or 21 feet. The water table is getting lower and lower each year… So 6 years ago I am starting to notice that it is getting lower and lower, lower and lower, year after year…. it has been affected, by more population, more demand, and pollution" (WS1). The case of Kyetsarpyien illustrates the interaction of stresses stemming from saline intrusion and overproduction of groundwater, which outpaces rates of groundwater recharge. However, the diverse sources water supply (piped water, private suppliers, rainwater collection) for households in Kyetsarpyien mitigates sensitivity to exposure to climate and non-climate stresses affecting water availability in the quarter.

"The water security of a city must be considered in the context of the management of the river basin or basins in which the city is located" (Asian Water Development Outlook, 2013).

- Land use change surrounding extractive industries in Dawei present a source of stress on groundwater insofar that deforestation and mining projects undermine watershed health. Rampant deforestation through the expansion of rubber plantations needs to be considered in light of impacts on groundwater supply, particularly in relation to dry season flow.
- Mining and extractive industries is linked to the widespread pollution of water resources in the Dawei District as a result of the release of chemicals and wastewater from tin and tungsten mines. The issue of wastewater pollution from extractive industries heightens the exposure of Dawei's existing and prospective water supply to potential contamination.

(!) It is important to consider the exposure of Dawei's water supply in light of the interaction of climate and non-climate stresses. As one key informant explained, "I think to say climate change, it is difficult, but we can say it is interlinked, but normally what you can see, lost forest, urban expansion, the plantation area increases, the water volume decreases, the infrastructure projects are more and more, the watershed area. It's the main cause than climate change" (KI.11).

Flooding

Flooding occurs annually in Dawei during July and August when rainfall is heavy and continuous due to strong monsoon conditions. The hydrology and climate of Dawei informs flood exposure as flood exposure is highest when periods of heavy continuous rainfall coincides with periods of high tide on the Dawei River. Localized flooding along streams and creeks that flow throughout Dawei is also common during periods of heavy rainfall, especially along Pauktaing Chaung Stream.

Climate Stress

- Fluctuations in rainfall may alter the severity and/or frequency of flooding in Dawei in which increases in concentrations of rainfall may cause more serious flooding in Dawei.
- Sea level rise heightens the exposure of riverbank areas and creeks and streams that flow throughout Dawei into the Dawei River to localized flooding.

Non-Climate Stresses

- Population growth and urban development in flood prone areas heightens the exposure of Dawei to flooding. As urban growth continues in Dawei, urban expansion and the growth of formal and informal settlements in flood prone areas heighten the exposure of Dawei to flooding. Urban expansion in flood prone areas is tied to the need to consider urban planning and the need for the development of drainage infrastructure to coincide with urban growth.
- The expansion of rubber plantations and resulting forest loss is linked to heightened flood risk downstream. Forest loss and the loss of streams and creeks in upstream reaches of a watershed heightens the exposure of flooding downstream. This is informed by the loss of natural drainage as cleared forests results in the loss of upstream tributaries and higher sedimentation rates, resulting in reduced storage capacity in downstream water channels. Research outlining the relationship between deforestation and flooding is well established as "the partial or complete removal of tree cover may accelerate water discharge and increase flood risk during the rainy season" (Calder et al., 2015).

Sensitivity to Flood Exposure

Sensitivity to flood exposure in Dawei is informed by the inadequate provisioning of drainage infrastructure and maintenance of streams and creeks that flow through Dawei. Issues of waste management heighten sensitivity to flooding as streams and creeks are blocked by the build-up of garbage and debris, reducing stream flow and storage capacity. Moreover, issues of sewage and sanitation heighten sensitivity to flood exposure as pit latrines overflow as a result of floodwaters. Finally, the lack of disaster preparedness and risk reduction measures taken by the city also factors into sensitivity to flood exposure, as measures to mitigate flood exposure fall short of addressing systemic issues of waste management.

(!) ***Poor and lagging drainage infrastructure raises health and sanitation issues as stagnant wastewater and localized flooding results in outbreaks of dengue in the rainy season. As one key informant explained, "they do not care about drainage… the city is***

growing, the infrastructure for the roads is improving, but they don't care about sanitation, drainage… it is blocked and mosquitoes can grow, they need to care… because we can get dengue in the rainy season" (FG.1).

Drainage Infrastructure

- Inadequate drainage infrastructure heightens sensitivity to flooding, as current drainage infrastructure is unsystematic and sporadic throughout the city. Drainage culverts and channels are limited to main roads, while drainage infrastructure in wards and peri-urban areas is either non-existent or rudimentary.

Natural Drainage

- The poor maintenance of natural drainage in Dawei heightens sensitivity to flooding. The sedimentation of creeks and streams that flow throughout Dawei heightens flood exposure insofar that the build up of sediment and waste materials reduces the depth and storage capacity of natural drainage.

Waste Management

- Issues stemming from waste management compounds poor natural drainage in Dawei as streams flowing throughout Dawei are blocked by garbage and debris. The build up of sediment and garbage in natural drainage channels results in decreased storage capacity and stream flow, and in turn heightens flood exposure.
- Heightened flood exposure as a result of the blockage of streams and creeks by garbage is informed by the inadequate provisioning of waste collection in Dawei, in which garbage collection is limited to main roads in the city, with the frequency of collection varying from weekly to monthly. The limited service provisioning of garbage collection informs the widespread culture of littering in Dawei, leading to the build up of garbage in creeks and streams in the city.

Sewage and Sanitation

- Flooding presents issues of sewage and sanitation as it is common for pit latrines to overflow with floodwaters in flood prone areas. The lack of proper sewage infrastructure heightens the sensitivity of exposed flood areas to sanitation and health hazards.
- As one household explained, "it floods all the pit. It is not covered properly. So it goes everywhere. The level of the waste is higher because the water intrusion from the flood" (HH3.S1.M). The leakage of sewage into surface water presents concerns surrounding the potential contamination of drinking and household water in shallow wells by human waste.

Disaster Risk Reduction

- Findings indicate that there is limited capacity and coordination mechanisms in place for preparing for, mitigating against, and responding to serious flooding at the municipal level. Although there is a committee for emergency resilience and rehabilitation under the DAO composed of the fire brigade, ministry of health, the ministry of social welfare, police and civil society organizations, there is little

capacity and coordination between ministries to mitigate disaster risk. One respondent summarized the arrangement for disaster risk reduction in Dawei as "at the time, we have a Myanmar term, when it happens we do it. They never prepare. They have a management committee on paper." The lack of a systematic and coordinated approach to disaster risk reduction and preparedness heightens the sensitivity of Dawei to flooding. Municipal actions to mitigate flood exposure are limited to small efforts to clear drainage channels and culverts and raise road levels, which respondents highlighted as insufficient to reduce overall flood potential.

- In light of limited measures on behalf of government to prepare for and respond to hazards, respondents highlighted the strong role of civil society organizations and monasteries in helping affected communities to cope with localized flooding. This is best represented through the case of Karapyien.

Case Study 1: Karapyien

Serious flooding occurs annually 2-3 times per year in Karapyien during periods of heavy continuous rainfall in July and August. Flooding lasts between 2-7 days, and on serious occasions, flood levels reach up to "neck deep" (HH15.S1.F), "height level" (HH14.S1.M), and "chest height" (HH7.S1.F). Flooding in Karapyien is becoming increasingly severe due to the lack of drainage infrastructure and the decreasing quality of natural drainage. The decreasing quality of natural drainage is related to waste management as stream flow is blocked by the build up of garbage and waste. As one household explained, "in the rainy season there is more garbage and so it is more blocked" (HH17.S1.M). Government efforts to improve natural drainage by clearing garbage and deepening the stream channel has done little to mitigate flood exposure insofar that efforts remain symptomatic rather than addressing systematic issues of waste collection and management.

(!) More coordinated efforts are required to address waste management and poor natural drainage in Karapyien between local community and government.

In response to serious flooding, households relocate to the monastery, however high water levels make ground transportation difficult and dangerous. For immediate flood response, an informal rescue team is assembled to ensure the safe transportation of households to the nearby monastery through the use of a bamboo raft. As one household explained, "shwe ya myo [means family-community in Myanmar], the men come and help us... from our house. We help each other by taking families to the monastery by the bamboo boat" (HH11.S1.F). In addition to the social capital demonstrated on behalf of the community to cope and respond to flooding, households rely on the wider community to cope with flood impacts. During episodes of serious flooding, households move to the monastery and stay there between 3-7 days while the water levels are high.