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CLIMATE CHANGE IMPACTS ON HEALTH AND LIVELIHOODS: **MYANMAR ASSESSMENT**

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EXECUTIVE SUMMARY

Myanmar is the second largest country in South-East Asia with several agro-climatic zones, including the coastal (1,930km of coastline), central dry, and hilly zones. Myanmar is already exposed to a multitude of hazards, including extreme temperatures, droughts, cyclones, flooding and storm surges along with heavy rainfall events, and half of the population lives in a 'multi-hazard' region. The existing pronounced regional differences in climate will be affected differently by climate change. Sea-level rise will cause the flooding of a large portion of the Ayeyarwady Delta (high confidence). Populations in the Delta area (i.e. the Rakhine, Southern Coastal and Yangon Delta) are likely to experience more flooding in addition to recurring tropical storms, cyclones and storm-surges (highly likely). Populations in the central dry zone area (northern and eastern hilly regions) will experience more heatwaves, droughts, flash floods and landslides (highly likely). Myanmar is also likely to see increased yearly rainfall, increased temperatures (especially inland and throughout March–May) leading to an increased number of 'hot' days (high confidence). The impacts these changes will have on livelihoods and health, without substantial global action and national adaptation, are significant.

Climate change has the potential to trigger wide-ranging and strong negative feedback loops between livelihoods and health.

On one side of the equation, a loss of livelihoods will negatively impact people's ability to afford healthcare. Already one of the poorest countries in the region with almost one-quarter – 24.8 per cent in 2017 – of the people living in poverty, climate change threatens all major livelihood sectors. The coastal region – known as the 'rice basket' – is the most urbanized region. Here, sea-level rise, cyclones and storm surges are a major risk. The central dry zone primarily faces water scarcity and desertification challenges, while the hilly region in the north sees frequent landslides and flash floods as a result of intense rainfall and its topography, which can damage assets and infrastructure, cutting supplies and access to markets. Overall, the agriculture-based society in Myanmar is highly dependent on the rich natural resource base, yet remains vulnerable to climate change-related impacts.

On the other side of the equation, impacts on health (notably via direct mortality from the increased frequency and intensity of extreme weather events; malnutrition and increased food insecurity; and the increased burden of waterborne diseases) will reduce people's ability to work and earn a livelihood. The healthcare inequality gap will likely widen, particularly between internal migrants and local host communities, men and women, and rural and urban areas. A number of adverse sexual and reproductive health outcomes, including risks to maternal mortality and gender-based violence also have links to climatic stressors. Though climate change is the catalyst for these health outcomes, many of these impacts are manifested through destroyed livelihoods, specifically in agriculture and fisheries.

The urgency to act is clear. The purpose of the report is to act as a reference document on the likely impacts – direct and indirect – of the climate crisis on the wellbeing of people in terms of their health and livelihoods. The intention is that this report can act as a springboard for planning and implementing activities and programmes focused on climate action and adaptation. Some recommendations and opportunities for action have been offered, however, these should be considered as only a starting point to further complement and expand existing programmes and projects. Cross-sector and widespread collaboration between National Societies, government agencies and services, the private sector, NGOs, civil societies and our communities is key as no one organization alone can tackle the increased risks posed by climate change nor alleviate the exacerbated risks of vulnerable populations. Together, acting now, with the evidence at hand, it is possible to avert the most dire consequences of the climate crisis.

1. CLIMATE PROJECTIONS

1.1. CLIMATE

Myanmar has a tropical climate with three seasons: a cool winter in November–February, a hot summer season in March–April and a rainy season dominated by the Southwest Monsoon from May–October (MoNREC 2019). The central dry zone receives the lowest annual rainfall in the range 500–1,000 mm, while the eastern and northern hilly regions receive relatively high rainfall. The highest is in the southern and Rakhine coastal regions, which receive annual rainfall in the range of 2,500–5,500 mm (NAPA 2012). Seasonal temperatures also vary greatly throughout most of Myanmar. In the central dry zone, temperatures range from a maximum of 40–43°C during the hot season to a minimum of 10–15°C in the cool season (NAPA 2012). Temperatures in the highlands decrease from 0°C to -1°C. The south of the country, however, does not experience much variation in seasonal temperature (NAPA 2012).

Figure 1. Agro-climatic zones of Myanmar



Central Dry Zone 500-1000mm annual rainfall

Coastal Regions 2500-5500 mm annual rainfall

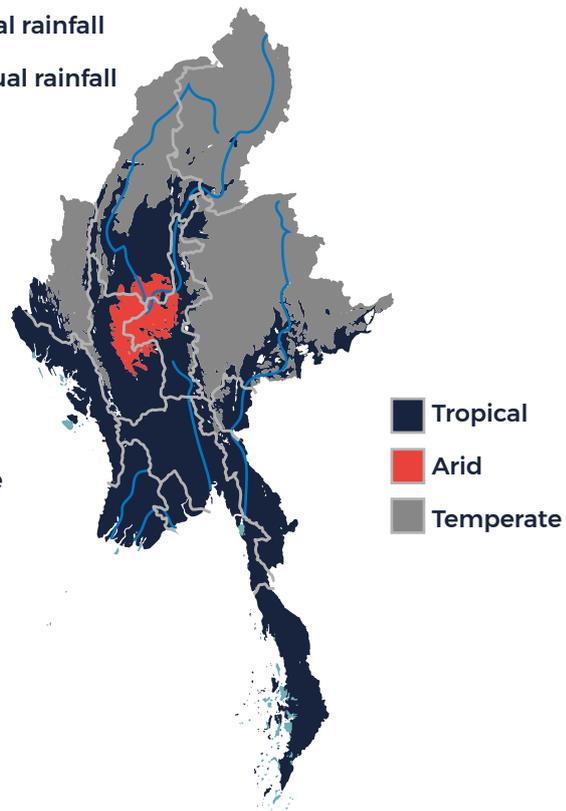


Average annual temperature 20-27°C

Central Dry Zone, temperatures range from a maximum of 40-43°C during the hot season to a minimum of 10-15°C in the cool season (NAPA, 2012).

Temperatures in the Highlands decrease from 0°C to -1°C.

The south of the country however, does not experience much variation in seasonal temperature (NAPA, 2012)



Myanmar receives most of its rainfall during the wet monsoon season. The highest annual rainfall is observed in the Rakhine coastal region, followed by the Ayeyarwady Delta. The lowest annual rainfall is observed in the eastern hilly region, followed by the northern hilly region (Horton *et al.* 2017). Overall, the coastal regions experience much greater amounts of annual rainfall than inland areas (Horton *et al.* 2017).

The largest part of Myanmar's population is concentrated in two main areas: the Delta area (around 50,400km²), which is most exposed to recurring tropical storms, cyclones and floods and potential storm-surge effects, and the central dry zone area, a large inland swathe of the country that is prone to extreme heat events and drought (MoNREC 2019). The rainy coasts, such as the Rakhine, southern coastal and Yangon Delta areas, are prone to flooding. Further inland are the northern and eastern hilly regions, which experience heatwaves, droughts, floods and landslides (Horton *et al.* 2017).

Table 1. Seasonal calendar

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Cool winter		Hot summer		SW Monsoon						Cool winter	

1.2. CLIMATE CHANGE

OBSERVED CHANGES	CLIMATE PROJECTIONS
<p>TEMPERATURE</p> <p>Average daily temperatures in Myanmar increased by about 0.25°C per decade during the period 1981–2010, and daily maximum temperatures have risen at a slightly faster rate of 0.4°C per decade over the same period (Horton <i>et al.</i> 2017). These rates are similar to global averages for the same time period (IPCC 2014).</p>	<p>TEMPERATURE</p> <p>Temperatures will continue to rise: For the 2011–2040 period, annual mean temperatures are projected to rise by 0.7–1.1°C compared with the 1980–2005 base period. However, warming trends may accelerate beyond 2040, raising the average temperatures by 1.3–2.7°C (Horton <i>et al.</i> 2017)</p> <p>For the 2041–2070 period, mean temperatures during the wet season i.e. June–October are projected to increase by 1.1°C to 2.4°C. (Horton <i>et al.</i> 2017). Temperatures in inland areas are projected to warm 0.3–0.4°C more than coastal ones. The eastern and northern hilly regions are likely to see the most dramatic warming among all regions of Myanmar, with mean temperatures during the hot season rising by up to 3°C. (Horton <i>et al.</i> 2017)</p>

OBSERVED CHANGES

RAINFALL

Rainfall is increasing in coastal areas: During 1981–2010, coastal areas experienced an increase of 157mm of rainfall per decade, which is 4.5 per cent of annual total rainfall. The majority of these gains have come from the increase in rainfall during the dry season i.e., November–May (Horton *et al.* 2017). However, the Southwest Monsoon rainfall over major parts of Myanmar has decreased and is more pronounced in the south west region (Satyanarayana, 2020).

Compared to coastal areas, **increases in the annual rainfall in the inland region have been more moderate** (Horton *et al.* 2017).

SEA- LEVEL RISE

Global sea levels are rising: Over the last century, Global Mean Sea Level (GMSL) increased by 1.4mm per year. During the period 2006–2015, the sea level rose at a rate of 3.6mm per year (high confidence) (Oppenheimer *et al.* 2019). However, it is to be noted that sea-level rise is not globally uniform and varies regionally. Regional departures of about ±30 per cent of the global mean are possible, or even greater in the areas of rapid vertical land movements (Oppenheimer *et al.* 2019).

CLIMATE PROJECTIONS

RAINFALL

Wet season rainfall is projected to increase in both the near (2011–2040) and long-term period (2041–2070) relative to the 1980–2005 base period. These changes are expected to raise the average wet season rainfall after 2040, and could exacerbate wet season flooding in some regions (Horton *et al.* 2017). These projections are in alignment with IPCC projections.

Annual rainfall is projected to increase significantly by 2100. A higher increase will be observed in the Rakhine coastal region, while the eastern hilly region will see less increase in the annual rainfall (WBCKKP 2020)

Rainfall is projected to vary based on season: During 2041–2070, rainfall in the hot season is more likely to increase, while rainfall in the cold season is equally likely to decrease or increase (Horton *et al.* 2017)

SEA- LEVEL RISE

By 2100 and under high emission scenario RCP8.5, GMSL will rise in the likely range of 0.61–1.10m relative to 1986–2005 period (medium confidence) (Oppenheimer *et al.* 2019).

Myanmar will be impacted by sea-level rise: During 2020–2029, sea-level rise for the entire coastal area of Myanmar is projected in the range 5–13cm above the baseline level (2000–2004) (Horton *et al.* 2017). For the 2050–2059 time period, sea level may rise in the range 20–41cm above the baseline (Horton *et al.* 2017). Under high emission scenarios, sea level may rise up to 122cm for the 2080–2089 time period (Horton *et al.* 2017).

Since Myanmar’s coastline consists of large low-lying areas, including the Ayeyarwady Delta, these sea-level rise projections will result in the submergence of a large portion of the coastal areas (Horton *et al.* 2017). It has been estimated that a 0.5m rise in sea levels could lead to a retreat of the coastline by approximately 10km in Myanmar’s lowest lying areas (NAPA 2012).

OBSERVED CHANGES	CLIMATE PROJECTIONS
<p>EXTREME EVENTS</p> <p>The duration of the rainy season is becoming shorter in Myanmar due to the late onset and early withdrawal of the monsoon (DMH & NMI 2017). However, there has been an increase in extreme rainfall frequency during 1981–2010 in Myanmar (Satyanarayana 2020).</p> <p>During 1981–2010, about one extreme heat day per month was observed (Horton <i>et al.</i> 2017).</p> <p>Cyclones in Myanmar are increasing: Since 1990, the total number of tropical cyclones reaching Myanmar has increased, and there has been a rise in tropical cyclone events occurring just before the monsoon season, while those occurring after the monsoon season have decreased (Horton <i>et al.</i> 2017). Compared to the 20th century when destructive cyclones used to make landfall once every three years, these extreme events have now become an annual phenomenon in Myanmar (NAPA 2012).</p>	<p>EXTREME EVENTS</p> <p>Extreme heat days will increase: During 2011–2040, the incidence of extreme heat days for the months March–May is predicted to rise substantially from two to six days per month. This will further rise in the range of four to 17 days per month for the period 2041–2070 (Horton <i>et al.</i> 2017).</p> <p>There will be an increase in the frequency and magnitude of coastal flooding (Horton <i>et al.</i> 2017)</p> <p>There is inconclusive evidence to link increased activity, including future changes with regard to frequency, intensity and duration, of cyclones in the Bay of Bengal with anthropogenic climate change (Horton <i>et al.</i> 2017)</p>

1.3. CLIMATIC VARIABILITY AND EXTREME WEATHER

There are pronounced regional differences in climate in Myanmar. Inland regions are warming faster than coastal ones. The average temperature in inland regions has increased by 0.35°C per decade, while the increase in the coastal region is limited to 0.14°C per decade. A similar trend is also observed for maximum temperature, with a 0.57°C increase per decade in the inland region and 0.23°C increase per decade along the coasts (Horton *et al.* 2017). The highest warming (approximately 0.32°C per decade) has been experienced in Kayin State (NAPA 2012). Despite overall trends of increasing temperatures, five regions have experienced decreases in temperature. The most appreciable decreases were seen in Magway (-0.23°C per decade) and Bago (-0.16°C per decade).

“ We are quite aware of climate change issues – heat stroke is also increasing and other temperature-related diseases. That is also the result of climate change. Therefore, we should also promote the preparedness activities for climate change effects.” (KI 6)

SUMMARY: PAST CLIMATE TRENDS AND FUTURE CLIMATE PROJECTIONS

Myanmar is likely to see increased yearly rainfall, increased temperatures (especially inland and throughout March–May), leading to an increased number of ‘hot’ days. Sea-level rise will cause flooding of a large portion of the Ayeyarwady Delta. Myanmar is already experiencing an increase in the frequency, duration and intensity of extreme weather events (storms, cyclones etc.). Populations in the Delta area (Rakhine, southern coastal and Yangon Delta) are likely to experience more flooding, recurring tropical storms, cyclones and storm surges. Populations in the central dry zone area (northern and eastern hilly regions) will experience more heatwaves, droughts, flash floods and landslides.

RECOMMENDATIONS

1. Raise awareness of the main climate change stressors and shocks to be experienced by the coastal and inland populations.
2. Work towards getting weather alerts, forecasts and climate projections to reach the ‘last mile’ so people remain aware and prepared.
3. Develop Early Warning Early Action protocols and pilot Forecast-based Financing for coastal communities faced with increasing rainfall as well as for heatwaves.

2. MOST AT-RISK POPULATIONS

2.1 POPULATION LOCATED IN LOW-LYING AREAS

Low-lying coastal areas are among the highest populated areas of the country, with 5,837,445 people residing here. Residents are employed in the agriculture, fisheries and forestry sectors that make up the bulk of the economy in Myanmar (NAPA 2012). People here are highly vulnerable to climate change-related hazards such as sea-level rise, salinity ingress, intense and frequent storm surges, high wind speeds and coastal floods. A 0.5m rise in sea level could result in the loss of about 10km of coastal land (NAPA 2012). The Ayeyarwady Delta region is highly likely to be one of the most affected areas. Cyclone Nargis – one of the world’s deadliest – made landfall in Ayeyarwady on 2 May 2008, the first cyclonic landfall since 1977. It killed an estimated 140,000 people due to the residents’ lack of preparedness for such severe storms (Horton *et al.* 2017). The downstream economic impacts of these natural hazards can be felt by retailers who rely on price stability of products sourced from this region (NAPA 2012).

2.2 POOR HOUSEHOLDS

High poverty levels throughout the country impact the capacity of poor people to prepare for and respond to climate change-related hazards (NAPA 2012). When these hazards strike, poor households face limited access to healthcare and other critical infrastructure as well as greater economic and livelihood losses. A variety of factors – including distance, lack of transportation, cost and isolation among others – contribute to these challenges. Further compounding them are extreme weather events, which exacerbate poor households’ vulnerability (NAPA, 2012). Households in low-lying coastal areas use seasonal migration as one coping mechanism to reduce poverty and inequality (Shwe 2020). In the Ayeyarwady region, for example, 60 per cent of those who migrate are men and about a third are women (World Bank, 2016).

2.3 WOMEN AND CHILDREN

Among those most at risk are women and children. Women do most of the farming tasks like sowing, planting, seeding, harvesting and processing and, therefore, will be more directly impacted by higher temperatures, erratic rainfall patterns and longer dry days. Children, meanwhile, face the additional struggle of being able to attend school because they are needed to help with their mothers’ work (NAPA 2012). Though this population may experience the direct impacts of disasters through economic or livelihood losses, the indirect impacts of these events have been documented to increase the risk of abuse, violence and exploitation by affected family members.

This pattern holds true for urban women too, who face inequalities in the public and private spheres. The ILO (2019) reports that more women (61.3 per cent) work in vulnerable employment compared to men (53 per cent). The rate at which urbanization is occurring in Myanmar threatens to sustain or even increase this inequality (Williscroft). Women and children are particularly vulnerable to non-communicable diseases resulting from air pollution, while also facing increased vulnerability to food insecurity and malnutrition. Women have been disproportionately impacted by historic disasters for a number of socio-cultural reasons which mean they are more likely to be home-based or do not know how to swim. For example, 61 per cent of the dead and missing in the aftermath of Cyclone Nargis were women (Care 2010).

“Water problems are affecting women mostly. They are the persons mostly dealing with water in a household and taking care of children and other people. The water scarcity problem will affect women the most.” (KI 5)

2.4 MINORITY POPULATIONS

Minorities in the Rakhine and Chin States, where poverty levels exceed 73 per cent, are particularly vulnerable to the effects of climate change. These conflict-ridden States are laden with poor public services, lack of resources and institutions and active conflict, thereby increasing the risks faced by these already vulnerable communities. Climate change is likely to exacerbate these vulnerabilities through shifting rainfall patterns, sea-level rise and reduced agricultural production. Stateless people (e.g., the Rohingya, IDPs and other minorities) live in informal settlements that are prone to disasters and lack entitlements to what little official aid is available

(Thomas 2016). Minority populations also face additional vulnerabilities to critical infrastructure and healthcare.

“Migrant workers in urban areas, women, elderly people, children and those with disabilities (are vulnerable populations). In urban areas there are a lot of migrant workers. We must programme for migrant workers.” (KI 3)

2.5 INTERNAL MIGRANTS

Many internal migrants (34.3 per cent) leave low-lying coastal areas (which are among the highest populated areas of the country) as well as the rural inland dry

zone of central Myanmar for cities for a chance to earn a better living. However, migrants are largely engaged in informal, low-skilled employment and face discrimination, health risks and natural hazards. Because internal migration involves the poorest sections of communities, landless households are more likely to migrate (UNESCO 2017). Most internal migrants find work in construction (28 per cent) or manufacturing (25 per cent) (Griffiths and Ito 2016). Across Myanmar's major cities, the percentage of residents born outside of the metropolis they live in are: Taunggyi (85 per cent), Yangon (77 per cent), Mandalay (77 per cent), Monywa (55 per cent) and Mawlamyine (47 per cent) (Asia Foundation 2020). In urban areas, migrants often live in overcrowded, informal settlements without access to basic amenities that include water as well as healthcare and sanitation services (Su-Ann Oh 2019). With climate change, warming city temperatures, urban floods and sea storms threaten to lead to unsanitary conditions as well as heat-induced and water-borne diseases. This will affect migrants who live in informal settlements often located in vulnerable, flood-prone areas of the city.

SUMMARY: MOST AT-RISK POPULATIONS

People living in the low-lying coastal areas, internal migrants, resource-poor women, children and minority populations are among the most at-risk groups to the impacts of climate change. There is a wide gender gap in rural and urban areas. There are also layered vulnerabilities. Migrants come from resource-poor families while the female-headed families left behind are not always able to adapt to recurrent climate stressors and shocks. These at-risk groups often face multiple climate shocks which exacerbate impacts on their health and livelihoods.

RECOMMENDATIONS

1. Prioritize intersectionality and the use of disaggregated data to plan and design programmes as well as for monitoring and evaluation.
2. Include the voices of these groups in community assessments and in community-based health and livelihoods committees.
3. Prioritize these groups to understand and implement feasible medium-term adaptation strategies towards health and livelihoods security.
4. Engage with local authorities and government agencies to give a voice to these at-risk groups in the development of adaptation plans and programmes.
5. Ensure interventions bridge the pervasive gender gap.

3. HOW WILL LIVELIHOODS BE AFFECTED BY CLIMATE CHANGE?

According to the IPCC (2014), there is high confidence that climate change, climate variability and climate-related hazards exacerbate other stressors, worsen existing poverty, deepen inequalities, trigger new vulnerabilities and typically have negative outcomes on livelihoods.

The following sections briefly outline the main livelihood strategies in Myanmar, focusing on agriculture, fisheries, forestry and livestock to highlight how climate change will impact these sectors as well as household assets. In Myanmar, farm-based work, fishing and forest-based livelihoods are particularly sensitive to climate change. A summary of the impacts of climate change on livelihoods in Myanmar can be found in Annex B.

3.1. COUNTRY LIVELIHOODS PROFILE

Although urbanization is accelerating in Myanmar, the majority of people still live in rural areas (60 per cent) and are employed in the agricultural sector (49 per cent) and, as such, are vulnerable to climate change (ILO, 2019). See Table 2 for the main rural and urban livelihoods sectors. More than half of the population (51 per cent) lack formal working arrangements and are considered to be in 'vulnerable employment' (Census 2014), where the shocks or stresses of climate change may exceed these households' ability to cope and adapt. Extreme events like Cyclone Nargis in 2008 and the floods and landslides in July–August 2015, which damaged up to 20 per cent of the total cultivated area, also resulted in a significant setback for the country's GDP (MCCS 2019).

Table 2. Main rural and urban livelihoods

RURAL LIVELIHOODS	URBAN LIVELIHOODS
Farming, including landowners and landless labourers, and allied activities like livestock rearing	Small, informal businesses in trade, retail, services and manufacturing (CSO 2019)
Non-farm work: unskilled construction work, production of livestock products, food processing, cottage industries (such as handicrafts) and small shops	Formal sector jobs in government, private sector, development organizations, media and academia (the formal sector accounts for only 11 per cent of employment in Myanmar)
Fishing (sweet and saltwater) is an important source of domestic food security, but only employs a small section of the population – primarily in Ayeyarwady, Rakhine and Magway (WB 2016)	Service sector
Remittances following seasonal/permanent migration of family members either within the country or abroad	Home-based work
	Only 10 per cent of the urban population receives income from agriculture

The number of **urban** settlers is expected to grow from 25 per cent of the total population to 33 per cent by 2030 (MCCS 2019). Generally, urban areas offer more diverse livelihood options than rural areas, have lower poverty rates and higher incomes per household (CSO 2019). Much of the employment in the urban areas is in micro-, small- and medium-sized enterprises (MSMEs), which have limited access to finance and credit and so generate low income jobs. About 63 per cent of the total labour income comes from micro-enterprises, most of whom also employ migrants who often get subsistence wages. Factories, services and home-based work are other sources of income in cities.

In **rural** areas, 75 per cent of people are employed in small-scale landholding agriculture, livestock and fisheries (FAO 2016; NAPA 2012; MCCSAP 2017). There is a strong link between rural agricultural work and poverty (CSO 2019). Households' livelihood strategies often vary with the seasons and constitute both agricultural and non-agricultural activities, depending on the availability of work (CSO 2019). An individual living in rural Myanmar may work on the fields in the morning, tend to their livestock around noon and operate a small produce vending stall along the road later in the day (CSO 2019). Recently, there has been a rise in non-farm businesses, attributed to improved access to credit and government programmes (World Bank 2016). Climate change will undoubtedly affect the agricultural sector and, therefore, may have an effect on rural households' livelihood strategies.

3.2. AGRICULTURE AND FISHERIES

A majority of the population of Myanmar is dependent on the rich natural resource base of the country, which is being affected by both climate change and other forms of human activity. However, most of the people depend on rainfed agriculture. The following trends related to the changing climate are going to impact rural livelihoods in the near- and long-term:

Land degradation: Although land erosion is a natural process as a result of water and wind erosion, salinization, alkalinization and water logging, climate change is accelerating erosion (along with human activity such as deforestation) through more frequent heavy rain showers (Weine 2013). The central dry zone area and coastal regions are particularly affected (Weine 2013).

Coastal regions: Driven by rapid onset floods, due to coastal storms and cyclones as well as slowly progressing sea-level rise, the coastal agricultural lands are suffering from saltwater intrusion (Horton *et al.* 2017). Longer inundation of fields, predominantly paddy, by seawater causes lower soil productivity, long-term soil degradation and flushes away the fertile topsoil. This limits rice harvests, for example, in the Ayeyarwady region rice harvests are limited to one instead of two harvests per year (World Bank 2016).

Inland river catchments: Changes in rainfall patterns are causing more frequent riverine floods in the major catchments of Myanmar, leaving those living in the floodplains and working on alluvial agricultural land particularly vulnerable. Changes in the Ayeyarwady River, for example, has decreased available land from 250 acres in 2012 to 60 acres in 2016 in a village in Magway Region (World Bank 2016). Changes in river flows are driven by climate factors, but also influenced by the construction of large dams, the withdrawal of water for irrigation purposes and urbanization along rivers (IFC 2018).

Fish catch declines: Fisheries are a crucial source of income and protein intake for the population. Small-scale and subsistence fishing are a particularly important livelihood strategy of coastal poorer communities (MCCSAP 2017). Myanmar is witnessing catch declines in both marine and inland fisheries as a result of the degradation and damage to coral reefs and mangrove forests (important fish breeding and feeding grounds) as a result of cyclones, sea-level rise, ocean temperature rise and ocean acidification (as well as human activity and overfishing). Declines are also due to changes in inland river flows and deteriorating water quality mediated in part by changing rainfall patterns, but significantly by human activity.

Water availability varies greatly throughout the seasons, and is largely consumed by the agricultural sector (70 per cent), with only 7 per cent used for domestic purposes (NAPA 2012). The reliance of the agricultural sector on freshwater resources makes it particularly vulnerable to the hydrological effects of climate change (MCCSAP 2017; MoNREC 2017).

Heat stress will affect the production of crops and feed for livestock (NAPA 2012). It will also reduce rice production and increase the occurrence of pests and crop diseases (NAPA 2012). Drought and land degradation will further reduce crop and feed yields (NAPA 2012).

Figure 2.

CLIMATE CHANGE TREND	IMPACT ON AGRICULTURE
 <p data-bbox="279 638 646 728">Increasing rates of snow and glacial melt</p>	<p data-bbox="694 627 1412 772">Changing river flow seasonality to earlier in spring, causing more unpredictable flooding events and decreasing groundwater recharge potential (MCCSAP 2017).</p>
 <p data-bbox="279 806 646 929">Increased extreme rainfall events and reduced vegetation cover</p>	<p data-bbox="694 795 1412 862">Decreased rainfall infiltration, reducing crop productivity (MCCSAP 2017).</p> <p data-bbox="694 884 1412 952">Intense rainfall damages crops, causing crop losses (NAPA 2012; FAO 2016).</p>
 <p data-bbox="279 985 646 1064">Variability in extreme weather events</p>	<p data-bbox="694 974 1412 1120">Inevitable droughts will put pressure on irrigation systems, reducing yields and damaging fields. This will also result in saltwater intrusion in coastal regions (World Bank 2016).</p>
 <p data-bbox="279 1153 646 1232">Southwest Monsoon shorter and more unpredictable</p>	<p data-bbox="694 1142 1412 1243">Water issues for rainfed agriculture and particularly implications for corn, monsoon paddy, sesame and pigeon pea harvests (World Bank 2016).</p>

Food insecurity

According to the FAO (2001), “food security is a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” Whilst food security relates to nutrition, food insecurity relates to malnutrition insofar as poverty is often linked to poor diets.

Already a challenge in many regions in Myanmar, food insecurity is likely to increase as a result of climate change. Extreme weather events impact agricultural productivity, increasing rates of malnutrition (Horton *et al.* 2017; WFP & FAO 2016). Farmers who are impacted by natural hazard-related disasters experience sharp and unpredictable drops in income and food access as well as significant productivity and crop yield losses (WFP 2018). Farmers and fishers are particularly vulnerable to the effects of climate change; and, because fish serve as a critical source of protein for an already malnourished population, climate change-induced damage to fisheries may have a large impact on food security and nutrition (RIMES 2011). Further, it is projected that Myanmar will see increasing episodes of extreme heat, which have the potential to stress crops and increase insect and pest habitats, damaging crops and reducing yields. Climate change is increasing food insecurity, decreasing the quality and quantity

of crops, and resulting in negative health impacts (Forced Migration Review 2015). In addition to those working in the agricultural sector, children and women are particularly vulnerable because they often face sub-standard diets (NAPA 2012).

3.3. FORESTRY

With half of its land covered by forests, in Myanmar revenue from forest products support much of the rural population (World Bank 2019). Rural communities depend on forest resources for fuel, building materials, food, animal feed and cultural values (Tint *et al.* 2011 cited in World Bank 2019). Women are more involved in the subsistence collection of forest products than men (mostly through foraging), and deforestation is impacting their access to these resources directly (World Bank 2019). Woodfuel is a power source for 60–80 per cent of domestic cooking and heating in rural areas (World Bank, 2019).

Climate change is increasing the pressure on this already heavily exploited ecosystem. Firstly, more erratic rainfall patterns combined with an increasing frequency of extreme weather events are causing damage to forests (NAPA 2012), particularly in Myanmar's dry zone. Secondly, more frequent and intense extreme temperatures and droughts increase evapotranspiration from the forest canopy and raise the risk of forest fires, recognized as an increasing hazard to human settlements and wellbeing (NAPA 2012). Mangroves are a particular type of coastal forest, important for preserving biodiversity, fish development and coastal protection. The disappearance of mangrove forest leaves the coastal region highly vulnerable to coastal erosion, storm surges and floods (Veettil *et al.* 2018). The causes of mangrove disappearance are: the use of wood as fuel, damage from previous weather-related disasters and the conversion of mangroves to shrimp farms (aquaculture) and paddy fields. Meanwhile, the coastal poor depend on mangroves for their livelihood for woodfuel, timber and other forest products and suffer from the mangrove's disappearance most (Feurer, Gritten, and Than, 2018).

3.4 PHYSICAL ASSETS (HOUSES AND WORKPLACES)

The Asian Development Bank (2014) emphasizes the need for an expansion of the transport infrastructure to ensure sustainable economic growth and the connectivity of communities. The road network density in Myanmar is very low, which leaves communities vulnerable to access issues in the case of floods and landslides – in terms of receiving assistance and seeking assistance or accessing markets. In 2015, after Cyclone Komen and the associated floods, more than 1.6 million people were displaced, 525,000 houses were affected and the transport network was severely damaged thereby disrupting access to market as well as to social facilities in both urban and rural areas (Wai 2018).

The degradation of mangroves has exposed people's houses to more intense winds and sea-storms, besides higher beach erosion because of sea-level rise. In forested areas, denuded forests and mangroves, coupled with extreme rainfall, have led to more frequent landslides, threatening houses and other infrastructure (MCCS 2019).

“The lowest income people can be considered the most vulnerable. If the weather is more extreme, if we can stay inside there is more protection, but if people do not have a safe home this is not the case.” (KI 5)

Typically, households living in or close to poverty suffer the most when livelihoods are disrupted or property and assets damaged. The FAO observed that the restoration of the physical assets of farming and fishing communities were crucial to recovery (FAO 2016). For farmers in the coastal regions, floods have, in the past, severely damaged their seed reserves and harvest equipment. Fishing boats and equipment offshore, inland and inshore are also at risk of damage from cyclones (NAPA 2012).

3.5. FINANCIAL IMPACTS

A household's access to financial services and credit are a major determinant of their ability to cope with climate change-related disasters (World Bank 2016; FAO 2016). Myanmar has very high annual expected economic losses from disasters (0.9 per cent of annual GDP) which puts pressure on government response mechanisms and financial aid to help households recover in the event of a disaster (MAPDRR 2017). Where financial help is given, the loans system favours those with land rights and larger farmers, while women, youth and landless workers face significant barriers to access credit as they have less collateral to offer (World Bank 2016).

For farming households, income gaps due to lost harvests, the need to repurchase seeds and restoring machinery following a natural disaster were the main financial burden, which required them to take out additional loans and credit (FAO 2016). Furthermore, financial pressures can force farmers into more insecure, informal labour as they have to sell their assets to repay debts in times of hardship (World Bank 2016). There is also high gender inequality in labour rates in agriculture.

The livelihoods of the landless and day labourers are particularly vulnerable after a natural disaster has damaged a harvest. The informality of their work and loss of job opportunities results in an income gap. With less access to loans and capital from government sources such as the MADB, landless and day labourers have to borrow at higher costs, resulting in a high debt burden on already disadvantaged workers (FAO 2016).

Given the association between climate change, food and health security and livelihoods, collective village governance is an important social safety net in Myanmar;

where, for example, collateral for loans is arranged at village level. Research by the World Bank (2016) suggests that increasing mobility and migration away from rural areas is weakening village bonds (i.e., social networks). Although no studies explore the direct influence of climate change on social relations, weather shocks and reduced livelihood opportunities are a major driver of migration in Myanmar (Asia Foundation 2019). Any weakening of the village social fabric will disproportionately affect women (Williscroft 2012).

SUMMARY: HOW WILL LIVELIHOODS BE AFFECTED BY CLIMATE CHANGE?

The health of natural resources impacts the livelihoods of people in both cities and rural areas. A majority of the population is rural and highly dependent on climate-sensitive agriculture, livestock or fisheries as well as agro-processing and agro-businesses for livelihoods. Rural-urban migration is common from areas where extreme events are occurring more frequently, affecting the viability of the livelihoods of rural households. More men than women migrate and remittances may not be adequate for women-headed households to adapt to climate changes. In urban areas, migrants usually have insecure, low-paid livelihoods for reasons that include conflict, the informal nature of the employment and/or inconducive working conditions.

RECOMMENDATIONS

1. Pilot and promote nature-based solutions to help farming communities and fisherfolk protect their natural resource base.
2. Facilitate communities to revive, review and apply their traditional knowledge and skills to implement adaptation interventions to safeguard their livelihoods and health. Women especially have a treasure trove of traditional knowledge on both health and the use of natural resources.
3. Help urban informal workers and migrants to build their resilience to extreme events and rising temperatures by providing weather information and knowledge, upgrading their skills and improving hygiene and health interventions.
4. Support the livelihoods of female-headed households in rural and coastal areas through community assessments, access to development programmes as well as productive resources, and capacity development.

4. HOW WILL HEALTH BE AFFECTED BY CLIMATE CHANGE?

4.1. MORTALITY AND NONCOMMUNICABLE DISEASES

Emissions and climate change projection models posit that populations, particularly the elderly, will face increased heat-related mortality – from five deaths per 100,000 in 1990 to 15 deaths per 100,000 by 2030 – as emissions increase (WHO & UN 2015). Over 45,000 deaths were attributed to air pollution in 2017 alone, primarily due to airway diseases such as Asthma or acute respiratory infections. Among cities in South-East Asia, Yangon and Mandalay in Myanmar have the highest air pollution concentration, making air pollution in the country almost two times as deadly as in neighbouring countries (Raitzer *et al.* 2015). The combined threats of extreme heat and air pollution are concerning, particularly in Myanmar where both are expected to increase with climate change. Extreme heat events are associated with stagnant air, which traps pollutants and increases surface ozone levels. These fine particulates associated with ozone create additional health risks for those in urban areas. Adolescents aged 5–14 years are particularly vulnerable to the impacts of air pollution; particulate matter pollution is the leading risk factor for death in this age group (UNESCAP 2019).

Women are disproportionately burdened by high levels of particulate matter through household air pollution (HAP) generated by cooking with solid fuel (UNESCAP 2019). In 2017, HAP caused 7.6 per cent of the total deaths – or 50 deaths per 100,000 people – in Myanmar (World Bank 2019). The implementation of climate pollutant reduction measures could have dramatic impacts on the country, potentially avoiding 16,000 premature deaths by 2030 (p. 6 WHO & UN 2015).

4.1. VECTOR-BORNE DISEASES

Vector-borne diseases pose significant health impacts and are highly sensitive to changing climatic conditions (temperature, precipitation, humidity), which exert a strong influence on the life cycles of the vectors (such as mosquitoes) (WHO & UN 2015). Vector-borne diseases are also influenced by anthropogenic factors such as population growth, urbanization and prevention and control measures, which are not the focus of this report. Vector-borne diseases such as Dengue Fever and Malaria are emerging as significant climate change-related public health challenges in Myanmar.

Dengue Fever is endemic to Myanmar, with a cyclical pattern corresponding to seasons and rainfall. A recent study demonstrated the association between mean temperature increase and the incidence of Dengue Fever in Myanmar, highlighting a correlation

between climate change and infectious disease transmission (Anwar *et al.* 2019). This trend is also seen when looking at global emissions and the vectorial capacity of Dengue Fever; an increase in emissions is associated with increased vectorial capacity for the disease (WHO & UN 2015).

Climate change has also led to a re-emergence of *MDR Plasmodium falciparum*, the parasite that causes Malaria, as an insecticide-resistant vector (WHO, 2014). This association demonstrates the ability of infectious disease vectors to increase with climate change.

4.3. WATER, SANITATION AND HYGIENE

This section covers the main health issues related to Water, Sanitation and Hygiene (WASH) and how they will be impacted by climate change. Water is also related to vector-borne diseases which are explored in Section 4.2.

“Waterborne diseases are still a problem for Myanmar. Issues relate to access to safe drinking water at community level in school and hospital settings. (KI 2)”

Water supply

Many people in rural Myanmar depend on streams and rainwater for drinking water, but longer dry seasons and less rainfall force the use of alternative poor quality sources of water (CSO 2019). In urban Myanmar, seasonality has less impact on access to drinking water. The coastal and conflict-affected areas already experience the lowest access to safe drinking water, with 50 per cent of the population depending on rivers, lakes and ponds for drinking water, which are considered unsafe and vulnerable to contamination from flooding as well as drying up due to increased temperatures and longer dry spells (World Bank 2017).

Piped water is available only in urban areas but to just 4.1 per cent of the households. This also varies across towns (WHO 2014) with 31.3 per cent of households in one area receiving water through the innovative use of bamboo pipes to bring the resource from protected springs, to less than 1 per cent of households in another area. In the two main cities of Yangon and Mandalay, untreated surface water from open reservoirs is part of the piped water supply system (ADB 2013). Piped water reaches up to 50 per cent of city dwellers in Yangon while the remaining population depends on water from tube wells which are also untreated. The water supply infrastructure is old, delivering water at low pressure, at times with saline intrusion which impairs its quality (ADB 2013). Combined with rising temperatures and urban floods, water shortages in cities could lead to a higher cost of living and threaten people's incomes and livelihoods (MCCS 2019).

A little over 10 per cent of Myanmar people rely on surface water, while others rely on open wells. At least one-third of the people treat water at home, using boiling and cloth filters to clean the water (WHO 2014) and this needs to be scaled up to ensure clean drinking water is available to all.

“Our health department in MRCS is still very weak in using weather data. We use the basic indicators like maternal mortality rates, malnutrition etc. – they are somewhat related, but we are not using climate data enough. Apart from maybe in the dry zone, we consider the area important for water and sanitation issues; weather is also important. Consider it an important gap. We see no workshops or training on this, we would like to have support.” (KI 5)



9% of deaths among children > 5 are a result of **DIARRHEAL DISEASES**

The rising temperatures and decreasing rainfall in inland areas will lead to severe water shortages (MCCS 2019). At the same time, the increase in rainfall has been less in the central dry zone than in coastal areas, and streams are already drying up. Combined with rising temperatures and greater evaporation, this could lead to severe water problems in the dryland unless corrective measures are taken to harvest water, replenish the groundwater and recharge streams and rivers. In the coastal zones, the destruction of mangroves and the increased damage from salinity ingress, floods and storms also threaten water security.

Water quality is expected to deteriorate with increasing desertification, higher temperatures and decreases in rainfall in the central dry zone. In the coastal regions, water quality will be impaired by increasing saline intrusion and floods, especially in the many urban areas where water quality for poor and overcrowded communities is already a challenge. Myanmar suffers from a heavy burden of waterborne diseases, particularly during the rainy season and flooding events (Roobthaisong *et al.* 2017). The major waterborne and water-related diseases in Myanmar are: Cholera, Dysentery, diarrhoeal diseases, Gastroenteritis, Leptospirosis and Schistosomiasis (WHO, 2014).

Sanitation

Improved sanitation is estimated to cover approximately 81 per cent of the population (JMP 2017). There is also a divide between rich and poor households. In Yangon, for instance, improved sanitation facilities are available to over 98 per cent of the rich households compared to less than 60 per cent of the poorest households. Most houses lack proper drainage and sewerage networks (ADB 2013). Repeated floods, elongated dry days and heatwaves may lead to severe health impacts for people. Open defecation has decreased to less than 10 per cent, though in rural areas almost 13 per cent of the people still practice it (World Bank data).¹ Community-led sanitation programmes have been quite successful. Heatwaves and the increasing incidence of extreme weather in coastal areas requires sanitation to be universal in rural and urban areas.



81% of the population have access to **'IMPROVED SANITATION'**

Solid waste management was identified as a major environmental challenge in Myanmar by the World Bank (2019), particularly issues with waste dumping, overflowing landfills, uncontrolled fires from waste burning that cause surface and groundwater contamination and excessive methane. The recent National Waste Management Strategy and Master Plan (2018–2030) aims to reduce the open disposal and burning of waste, yet financing remains a major problem (World Bank 2019).

In urban Myanmar, sanitation and waste disposal issues paired with flooding risk and higher temperatures are major contributors to the spread of waterborne diseases (CSO 2019). A study in a peri-urban area demonstrated that even “improved” sources (e.g. chlorinated wells and bottled water) were of poor quality with high faecal contamination, and prevalence of acute diarrhoea among children aged under five was high (Myint *et al.* 2015). This emphasizes the complexity of water quality management, from source to point-of-use, and the importance of safe household handling of water.

“WASH issues are particularly problematic in the delta region. Where climate change is causing higher rainfall – and a long rainy season. Sanitation is not that good: in the delta system there is a lot of open defecation and pit latrines. These flood and contaminate water sources in the regions. Salmonella, Schistosomes etc are prevalent. The government is geared to end open defecation, but it is taking a lot of time. This has knock-on effects on health: malnutrition, waterborne diseases and stunting are prevalent in these regions.” (KI 2)

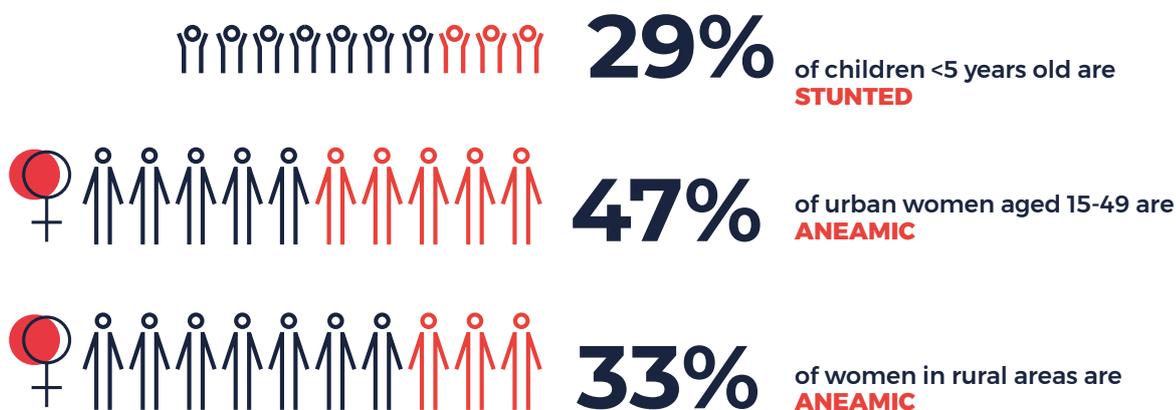
4.4. MALNUTRITION AND MALNOURISHMENT

Micronutrient deficiencies in Myanmar contribute to up to 6 per cent of all deaths of under fives, and the least access to nutritional food is among the rural poor (MCCS 2019). A common indicator of a nutritional deficit is stunted growth, which occurs when a child’s height for a given age is below the 5th percentile (WHO 2006). In Myanmar, the prevalence of stunting among children under 5 years old is trending downwards, from 35.1 per cent in 2009 to 29 per cent in 2016 (UNICEF 2020). Although stunting rates are improving in Myanmar, nearly one-third of all Myanmar’s children remain stunted, with rates of up to 41 per cent in poor regions (UNICEF 2020).

Current estimates show that the world’s poorest children have stunting rates which are twice those of the richest (Watkins *et al.* 2016). This trend is found in Myanmar where 38 per cent of the poorest children are stunted, compared to 16 per cent of the wealthiest children (UNICEF 2020). Babies born in Myanmar are 44 per cent less likely to be born an average size. This may be because their mothers are malnourished during pregnancy. Micronutrient deficiencies such as anaemia vary between rural and urban contexts: 47 per cent of women aged 15–49 are anaemic and compared to 33 per cent of women in rural areas (MoHS and ICF 2017).

“Here climate change impacts are mainly felt through nutrition, with knock-on effects on health. Climate change impacts on crop productivity, diversification options, seasonal and routine crops, availability of nutrients and diversification of food basket, all impact health.” (KI 1)

Figure 4:



Agricultural, fisheries and livestock products contribute to nutritional security of both rural and urban populations in Myanmar. The impacts of climate change on these primary sectors threaten the nutritional standards of the population, especially women and their offspring whose nutritional standards tend to be poorer.

Climate-resilient interventions to protect natural resources, especially in the coastal belt and the arid/semi-arid central inlands, and linking agriculture adaptation policies with national food and livelihoods security policies (MCCS 2019) will ensure nutritional security in the country.

4.5. DISPLACEMENT AND MIGRATION

This section focuses on the risk of communicable diseases and the increased risk of mental health issues as a result of climate-induced displacement and migration. For more information on migration in Myanmar, see the MRCS report *Understanding Migration and Displacement in the Context of Myanmar*. The majority of internal migration (rural to urban) is occurring in the areas (such as the central dry zone and Irrawaddy region) where even small environmental and climatic fluctuations disproportionately affect agriculture and natural resources on which the communities rely. Flooding and natural disasters have created groups of people seeking economic stability in urban areas (Asia Foundation 2020).

Internal migrants comprise nearly 20 per cent of the population (approximately 10.7 million people) (Census 2014; MRCS 2020). The impacts of internal conflicts in Myanmar are likely driving an increase in both internal and external migration patterns. WHO has estimated that more than one million people are internally displaced in the eastern border area of Myanmar (WHO 2015). This rural to urban migration, driven by climate change, is overwhelming the already deficient healthcare and education systems in cities (Asia Foundation 2020). This is particularly true for women and children, who are disproportionately impacted by this lack of services (UNESCO 2017; Griffiths and Ito 2016).

“There is a lot of rural to urban migration, especially of small landholding farmers who are not able to make ends meet. They then move to urban areas. When they move to urban areas, they do not have any skills for urban jobs. For men they can still find labour jobs (but for women it is difficult).” (KI 12)

4.6. MENTAL HEALTH

Internal migration is often the result of extreme poverty, exacerbated by climate change, meaning that internal migrants are often the poorest sections of communities and, therefore, their health and wellbeing are at increased risk – particularly, their mental health (UNESCO 2016). Their marginalized status in their new environment leaves them particularly vulnerable to natural hazard-related disasters due to poor housing, lack of access to information, and employment in dangerous environments (UNESCO Bangkok 2016). As climate change drives an increase in rural to urban migration, the degradation of weak healthcare systems and poor mental health will follow. The Government of Myanmar has made an attempt to address this looming mental health crisis – a disaster preparedness plan for mental health exists, but has not been updated since 2006 (WHO, 2015).

4.7. CRITICAL INFRASTRUCTURE AND HEALTH SYSTEMS

The high poverty rates in Myanmar results in unequal and inadequate access to critical infrastructure and healthcare systems. People living in poverty have lower levels of adaptive capacity, making them more vulnerable to natural hazard-related disasters associated with climate change, such as droughts, floods and other extreme weather events (WHO 2014). These natural hazard-related disasters have been found to contribute to lower levels of healthcare access and poorer infrastructure; a finding that compounds the existing vulnerabilities of those living in poverty due to climate change (WHO 2014). Because these events are predicted to increase in frequency and duration, people living in poverty are especially vulnerable to the effects of climate change.

“ Cultural norms might make women belonging to some ethnic groups more vulnerable where they usually stay inside homes and may not be able to escape (e.g. from floods or heatwaves) in time.” (KI 1)

Conflict-affected regions, and the vulnerable populations who live within them, also lack access to healthcare and other critical infrastructure. Restrictions on aid delivery, compounded by a paucity of resources, left families in Rakhine State less likely to receive aid following the 2015 floods as compared to other affected communities (Thomas 2016). In addition to emergency aid, these conflict-affected communities have significant barriers to access to healthcare due in part to the pervasive conflict, and in part due to inadequate distribution of resources (The Asia Foundation 2017).

Internally displaced people in Myanmar often do not have access to adequate healthcare. This is particularly true for minorities fleeing ethnic or religious persecution, as is the case in much of the conflict areas in Myanmar. This lack of healthcare access leaves displaced people vulnerable to communicable diseases that

are easily preventable through vaccinations, such as Hepatitis, Measles and Meningitis (WHO 2018). Further, these displaced people are particularly susceptible to the negative effects of the disease because of the lack of treatment options.

4.8. SEXUAL, REPRODUCTIVE, MATERNAL, NEWBORN AND CHILD HEALTH

Climate change already is, and will continue to, affect men and women as well as boys and girls differently. Key areas of concern from global studies have shown how a changing climate is altering the dynamics and risk of negative maternal health outcomes, forced child marriages, human trafficking, sexual exploitation, and gender-based violence (Castañeda Carney *et al.* 2020; Women Deliver 2021). Due to poor access to healthcare services, especially in rural areas, the knowledge of a connection between climate change impacts on sexual and reproductive health and rights is limited.

Some key trends bear consideration with regards to sexual, reproductive, maternal, newborn and child health and climate change:

- **Sexual health:** The role of men has traditionally been absent in family planning and reproductive healthcare services, though men have been the decision-makers with regard to issues like sexual relations, whether and when to have a child and when to seek healthcare (Myanmar WCO 2007). Gender-based violence (including sexual violence) is prevalent in Myanmar. Half of both men and women (49 per cent and 51 per cent, respectively) believed that in certain cases it is justifiable for husbands to beat their wives (MoHS and ICF 2017). Already, 15 per cent of women above 15 years of age have experienced physical violence with 21 per cent of married women experiencing spousal violence (MoHS and ICF 2017). Gender-based violence has been shown to increase in some countries when disaster strikes and stress levels increase. Individuals may rely on harmful coping mechanisms such as substance abuse, which can contribute to increases in violent behaviour (Castañeda Carney *et al.* 2020). Domestic violence also increases with higher financial and economic stress (Narayan-Parker 2000).
- **Reproductive health:** Early marriages are prevalent and can affect women's lifelong reproductive health. Available data shows that marriage before the age of 15 is uncommon (MoHS and ICF 2017) in Myanmar but, in general, women marry earlier than men. One-in-five women is married before 18 years of age, which indicates that women are exposed to pregnancy and sexually transmitted diseases (STIs) like HIV very early (MoHS and ICF 2017). Knowledge about HIV prevention methods seems to be low for both men and women at 22 per cent for men and 20 per cent for women (MoHS and ICF 2017). On average, women in rural areas marry three years earlier than women in urban areas.
- **Maternal health:** For prenatal and medical care for women living in high-risk multi-hazard regions, access to services is 76 per cent lower compared to women living in low risk areas (UNESCAP 2019). In Myanmar, 81 per cent of women receive antenatal care from a skilled worker – 94 per cent of women in urban areas and 77 per cent in rural areas – which is critical to reducing maternal mortality rates (MoHS and ICF 2017). With

regard to maternal health, 43 per cent of women in urban areas, compared to 33 per cent in rural areas, receive postpartum vitamin A supplements (MoHS and ICF 2017). Women's access to healthcare, contraception devices, antenatal care and postnatal care increases with higher education, as they are more likely to make independent decisions for themselves to decrease their vulnerabilities (MoHS and ICF 2017).

- **Newborn and child health:** High levels of undernutrition may affect a child's development with lifelong consequences. The risk of undernutrition is heightened with climate change.

There is a need for a comprehensive study on the impacts of climate change on sexual and reproductive health and rights (SRHR) that is not just limited to access to contraception, but also focuses on women's hygiene, affordable SRHR services, women's decisions on when to have children, violence against women, forced marriages, plus other issues that may be exacerbated by the impacts of climate change. There is an overall lack of research to establish clear linkages between these factors, SRHR and their lack of prominence in climate policies and strategies.

SUMMARY: HOW WILL HEALTH BE AFFECTED BY CLIMATE CHANGE?

Climate change is likely to impact health in a variety of ways. Firstly, mortality is expected to increase (especially in coastal zones) from an increased frequency and intensity of extreme weather events (typically more women than men die in natural hazard-related disasters). Secondly, the incidence of waterborne diseases and the prevalence of malnutrition is expected to increase due to food and water insecurity. Thirdly, the healthcare inequality gap will likely widen, particularly between internal migrants and local host communities, men and women, and rural and urban areas. Child marriages may also increase as a coping mechanism. Though climate change is the catalyst for these negative health outcomes, many of the impacts are manifested through destroyed livelihoods, specifically in agriculture and fisheries.

RECOMMENDATIONS

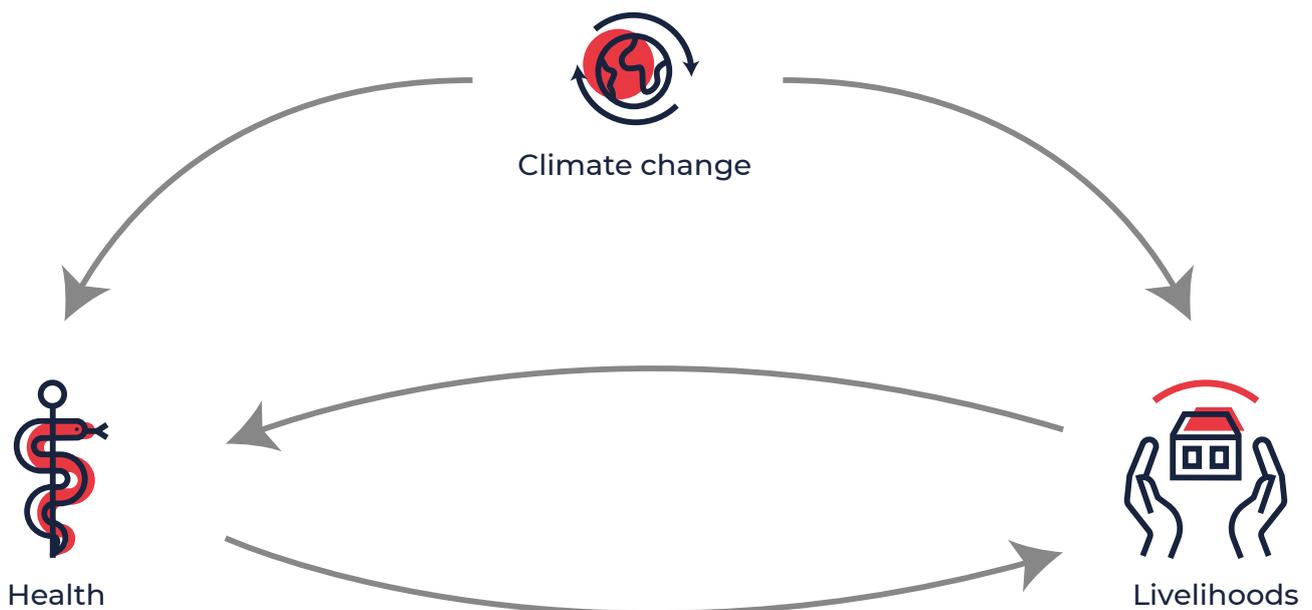
1. Support local communities experiencing climate change-induced risks – like the shifting seasons of vector- and water-borne diseases – through community-based vulnerability health assessments that take into account shifting seasonal incidence.
2. Develop nature-friendly solutions to heat-risk management in cities and the eastern and northern hilly regions.
3. Prioritize women's sexual and reproductive health by raising awareness of the influence of extreme events, like heat and floods, on behaviour. In tandem, strengthen links with the healthcare infrastructure to help women adapt better to climate change-induced stresses and shocks.



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5. LINKAGE BETWEEN CLIMATE IMPACTS ON HEALTH AND LIVELIHOOD

“The Red Cross relies on government assessments and data for early warning and met. information, primarily for water hazards (river water levels, rainfall intensity and coastal flooding). RC is also an active participant in government committees, forums and other platforms. However, no link of these data sources is made with our health department and livelihoods work.” (KI 5)



Climate change is likely to cause a negative feedback loop between health and livelihoods. When climate change negatively affects livelihoods, people do not have sufficient money to ensure good health and pay for healthcare, causing a spiralling of acute or chronic conditions. Likewise, when climate change negatively affects health, people may be unable to work and thereby earn sufficient money to pay for the healthcare they need, further reducing their ability to get better. A popular idiom in South Asia says: *jaan hai to jahan hai* - “the world exists when life exists” where ‘life’ denotes a healthy, well-provisioned existence.

The Myanmar Red Cross Society has already been operationalizing some of these links, especially for areas like the central dry zone, which is more prone to higher levels of water scarcity, peak temperatures and desertification and the resultant

deepening of food and water security. These links are becoming more explicit in the arid and semi-arid inland and also in the heavily populated coastal zone where loss of livelihoods is also leading to food insecurity, which has a direct impact on health. Temperature increases (certain) are expected across the country, but will be felt the most inland where heatwaves are expected to increase in frequency and duration in the central dry zones (northern and eastern hilly regions). The increased temperatures will lead to more 'hot' days especially throughout March–May. It is expected that the burden of heat exhaustion and stress will increase as the number of hot days increases, which will reduce productivity as working during day hours becomes impossible. This has the potential to affect both rural (farmers) and urban outdoor workers (street vendors, construction workers, traffic police personnel, sanitation workers) without access to shade. Home-based workers and those working in cramped and ill-situated, non-ventilated factories and MSMEs also face higher health risks due to heat, leading to health problems.

In the coastal zones, women do almost all the on-shore post-harvest work, including building nets and selling fish, but do not have access to land rights and fishery resources which are with men (MCCS 2019). With higher migration due to adverse impacts on the availability of fisheries following sea-level rise, floods, sea-storms and salinity ingress, more women-headed households will become vulnerable to food and health-related problems, especially as they have very little access to training and information (MCCS 2019). This will impact their productivity further and may lead to a downward spiral to poverty and malnutrition.

In urban areas, migrants often live in overcrowded, informal settlements without access to basic amenities that include water and health and sanitation services. This reduces their productivity levels and recurring heatwaves and/or urban floods deepen this vicious circle .

Climate change is also making seasons less predictable (likely); for example, it is projected that the Southwest Monsoon will be shorter and more unpredictable, which will affect agricultural reliability and productivity. This may increase the rural-urban migration with impacts on food security for both rural and urban populations, who will be faced with increased food prices. Reduced food intake, coupled with heatwaves, urban flooding and a lack of adequate and clean local environment and basic amenities, that include safe drinking water and sanitation, are the determining factors for the nutritional status of a population. The nutritional status of children below five years of age is at particular risk in Myanmar, along with that of their mothers. Children in poorer households are twice as likely to be malnourished as children from wealthier households. Malnutrition in childhood impacts individuals throughout their lives, but reduced calorie intake in adulthood can also negatively affect the health of the daily wage labourer, potentially leading to fewer days being able to work and consequently less income, thereby having less money for food and continuing the downward spiral.

SUMMARY: WHAT ARE THE KEY LINKAGES BETWEEN CLIMATE CHANGE, HEALTH AND LIVELIHOODS?

People in both rural and urban contexts as well as in coastal and inland areas, will face negative health outcomes and impacts on their livelihoods, which can lead to higher indebtedness and a reduced ability to access healthcare systems. Lower food production will lead to malnutrition, affecting people's ability to work and earn a living. In urban areas, climate change will exacerbate already dire situations of poor water and hygiene coupled with higher food prices, lower access to clean drinking water, cramped living conditions and substandard working conditions, which can lead to significant health problems and an inability to work. Lower incomes will then result in poor health outcomes, leading to a downward spiral resulting in higher deprivation.

RECOMMENDATIONS

- 1. Address health and work opportunities together for at-risk populations in urban, rural and coastal areas through programmes that will build resilience on both fronts.**
- 2. Build awareness of linkages between health and work in climate change awareness-building campaigns and information dissemination.**
- 3. In health and hygiene programmes, measure both health and productivity outcomes through, for example, a reduction or gain in the number of workdays alongside intra-household nutritional status.**

6. EXISTING CAPACITIES, STAKEHOLDERS AND PROGRAMMES

6.1. POLICY LANDSCAPE

Figure 2: Institutional framework



In recent years, several new general and sectoral climate-related policies, plans and strategies have been published, and readers are encouraged to explore these documents further (See Annex D, Table 3). The National Adaptation Program of Action (NAPA 2012) is a guiding document on climate action in Myanmar. Five priority levels have been identified: i) resilience in the agriculture sector, developing early warning systems and forest preservation measures; ii) public health protection and water resource management; iii) coastal zone protection; iv) energy and industry sectors; and v) biodiversity preservation.

- Key actions for **health adaptation**: providing climate-resilient healthcare facilities in the Rakhine State and Ayeyarwady region; preventing heat-related disorders in agricultural and industrial workers; supporting Intensive Care Units (ICU) in hospitals to treat heat-related disorders; providing safe water supplies and sanitary latrines.
- Key action for **livelihoods adaptation**: improving climate-smart agricultural practices and technology use.

Key actions for Disaster Risk Reduction (DRR): improving weather observation capacity; developing flood and drought warning systems. More recently, the Intended Nationally Determined Contribution (INDC 2015) submitted to the UNFCCC outlined the Government's commitments to the mitigation of global greenhouse gas emissions and adaptation to the impacts of climate change:

- **Livelihoods:** sectoral adaptation in irrigation water, cropping, poverty reduction, livestock and forestry are the main action points.
- **DRR:** expansion and improvement of **early warning systems** for riverine floods as well as droughts.

The NAPA (2012), NDC (2015) and subsequent climate change action plans (See Annex C) dedicate much attention to rural livelihood protection and adaptation. However, there is little information on policies for urban livelihoods resilience or on health. While health was a key sector identified in the NAPA (2012), the INDC (2015) does not address adaptation strategies to minimize the climate change impacts on health. More recent climate change-related government documents do address the health risks of climate change, however; and the Myanmar Climate Change Strategy 2018–2030 (MCCS 2019) recognizes “climate risk management for people’s health and wellbeing” as the fifth key priority.

Integration of climate change in development strategy. The MCCS states that the gains so far achieved in sustainable development are under threat from the country's exposure to natural hazards and the impacts of a changing global climate (2019). In the Myanmar Sustainable Development Plan 2018–2030 (2018), the second strategic area under the 5th goal ('Natural Resources & the Environment for National Prosperity') lists 'increasing climate-resilience and shifting to a low-carbon growth pathway' as a crucial activity. Additionally, climate change adaptation is mentioned under the other four goals in the Plan. See Annex D for a table listing climate change and environmental action documents in Myanmar.

6.2. CAPACITIES

GOVERNMENT

STRENGTHS

- Strong governmental commitment to address challenges
- Particular focus on the rural poor
- Recent uptick of climate change policies published



CHALLENGES

- Sectoral policies do not include climate change
- No financial calculations available for adaptive and mitigation strategies
- Limited technical and financial resources.
- Lack of sex-disaggregated data on impacts of climate change
- Limited awareness at government and community levels, especially at sub-national levels

MYANMAR RED CROSS SOCIETY

- Leveraging widespread presence of MRC on government platforms
- Use of volunteer network
- Listening to and collaborating with the public
- Embedded in the community



- Limited funding
- Lack of climate change guides for programmatic work
- Limited knowledge of weather and climate data, especially application of data
- Reduced capacity and knowledge at the NS level

7. RECOMMENDATIONS AND OPPORTUNITIES

RECOMMENDATION 1: Prioritize vulnerable groups in all programming in Myanmar

Gap: The cycle of vulnerability in Myanmar will only be exacerbated by climate change. There is a gap in ensuring special protections for the groups identified as vulnerable in this report.

Opportunity for action: Prioritize vulnerable populations as identified in this report. These groups of people include workers employed in natural resource-dependent sectors, poor households, women and children, minority populations and migrants in urban settings. **Support anticipatory action and adaptation interventions on access to healthcare, water and sanitation, DRR and livelihoods** as climate change deepens their vulnerabilities across all these dimensions, often with a cascading effect.

RECOMMENDATION 2: Explore methods for strengthening agriculture in rural communities

Gap: The economy in Myanmar is highly dependent on agriculture and other rural sectors that are at risk from climate change. Climate change is already driving rural-urban migration, which then exacerbates its impacts in urban areas.

Opportunity for action: Facilitate the diversification of income and livelihoods in rural communities through innovative communicative 'green' activities. These could include the protection and **nurturing of mangrove plantations** in coastal areas and the **promotion of small-scale rainwater harvesting systems** in Myanmar's dry zone. These interventions support diversified livelihoods, and augmented clean water has positive health and hygiene outcomes. There is also a need to **promote diversification of agricultural produce** as an adaptation technique, which will also contribute to the availability of more diverse nutritive foods at the household level, reduce distress migration and contribute to better health outcomes. **Farmers supported to access and follow weather forecasts** and alerts will be able to adopt weather-informed farming operations. **Collaborating with agriculture universities and research institutions** will facilitate field-to-lab linkages for men and women farmers and help to encourage the use of more resilient seeds, other farming inputs and adaptive farming techniques.

RECOMMENDATION 3: Focus on urban resilience

Gap: Cities are home to migrants and informal labourers who are among the most vulnerable and there is an urgent need to build resilience in cities to protect their health and livelihoods opportunities.

Opportunity for action: Cities are facing climate risks like heatwaves, floods, landslides and salinity ingress, all pointing to the urgent need for **community-based assessments** and **prioritizing actions on safeguarding the health and livelihoods** of vulnerable communities. Other adaptation interventions can be **citywide heat action plans** in collaboration with local authorities and **disseminating weather forecasts and alerts** to reach at-risk groups. Cities also give the opportunity to work with authorities and ministries to **enhance food and water security** for certain sections of at-risk people, **upgrade healthcare services** to factor in seasonal shifts in disease patterns and the breakout of epidemics and pandemics and **promote skills building programmes** for urban poor. All these will contribute to helping at-risk people adapt better to increasing extreme events and slow onset disasters like sea-level rise.



RECOMMENDATION 4: Strengthen climate change knowledge for MRCS staff, volunteers and community members and engage constructively on the National Adaptation Plan (NAP) process with the Government

Gap: There is an urgent need to build knowledge on climate change within the MRCS to effectively design and implement climate change programmes for the communities they serve and to engage with the Government on the development and implementation of the NAP.

Opportunity for action: **Build capacities on climate change** and programming for the staff and volunteers. **Integrate climate dimensions across programmes** – health and hygiene, water and sanitation, DRR and livelihoods. Collaborate with the national meteorological service to access and disseminate early warnings through community volunteers. As an auxiliary to the Government, **engage with the development of the NAP to make this participatory and inclusive.**

Continued learning as a key priority:

The Red Cross Society would be in a good position to stimulate the conversation in areas where there was a near-emergency, to increase disaster preparedness and learning. For example, in the recent monsoon season: What about the areas where the river water level rose to almost critical levels? What happened to the population in the flood-prone area? What happened when the meteorological warning came? This would help us to have a constant improvement and reflection of near- and small-scale emergencies." (KI 1)

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ANNEX A

NEAR-TERM CLIMATE PROJECTIONS MYANMAR BY 2020–2039²

Basic climatology. For monthly temperature (average, minimum and maximum) there is a general increase observed by 2020–2039 of 0.63–1.04°C (RCP2.6) up to 0.79–1.17°C per month (RCP8.5) – slightly lower compared to other Asian nations. The highest rise in temperature is projected for the month of April, which falls in the dry inter-monsoon season. Nationally an increase of rainfall is projected for the Southwest Monsoon months (especially July–September), with the most pronounced increase in the east and central regions and a general decrease in rainfall for Shan and Tanintharyi provinces.

Climatic extremes. Extreme rainfall trends are highly heterogeneous across Myanmar, with little change in the number of extreme rainfall days (either more than 20mm or 50mm). The distribution of rainfall across the year does change, as nationally up to 18 per cent more rain may fall during ‘very wet days’ under RCP8.5 (mean) – especially in the central dry zone and Rakhine region. However, the most pronounced trend is the increase in the amount of rain falling during extreme events with a 10- and 25-year return level, especially in the northern hilly region. This may have implications for flooding risk and soil erosion in the steep sloping terrain. Interestingly, while under RCP8.5 the coastal region will see a strong increase in the amount of extreme rainfall, under RCP2.6 this trend is reversed.

The general rise in temperatures will also result in an increase in the number of hot days (temperatures exceeding 35°C) by 9 (RCP8.5 mean) to 13 days (RCP2.6 mean), especially in the dry inter-monsoon months of March–June. This may have implications for water scarcity issues as well. The warming trends affect the already hot and dry central regions more. In the central dry zone, extremely hot days (temperature exceeding 40°C) may even increase by 10 to 14 days (RCP2.6 and RCP8.5 mean). Nationally warm spells will become longer, increasing by 10 to 14 days (RCP2.6 and RCP8.5 mean). The most pronounced regional rise is in the Ayeyarwady coastal region, which may see a rise in warm spell duration by up to 20–24 days (RCP2.6 and RCP8.5 mean).

2 Projections in this Annex are based on the AR5 CMIP5 dataset used by the IPCC, sourced from the World Bank Climate Portal – supplied under the Creative Commons 4.0 license. For more information, please refer to the Methodology section.

Agricultural conditions. As a result of changing rainfall and temperature trends, dry spell duration may increase slightly in the hilly regions, while general trends across Myanmar are difficult to establish. Generally, Myanmar is projected to shift to a wetter climate in this century, although in the next 20 years the drought conditions are projected to remain stable under RCP2.6 and RCP8.5 and regional differences may persist. Variability in rainfall between months and years is generally projected to increase.

SUMMARY OF KEY POINTS:

1. Climate change will already affect Myanmar in the next twenty years, although impacts will be felt differently across the different regions.
2. Temperatures are rising, resulting in more hot and extremely hot days across the country, especially affecting the central dry zone.
3. Rainfall is generally increasing, especially during the Southwest Monsoon months, although regional differences persist.

ANNEX B

SUMMARY IMPACTS OF CLIMATE CHANGE ON LIVELIHOODS

CLIMATE CHANGE TRENDS	PHYSICAL IMPACT	IMPACTS ON RURAL LIVELIHOODS	IMPACTS ON URBAN LIVELIHOODS
Coastal Storms and cyclones more frequent and intense	Floods from tidal surges and swells	<p>Inundation of fields and villages → natural assets damaged (fields and housing)</p> <p>Damage to critical infrastructure and fishing equipment</p> <p>Transport sector hindered, access to markets for rural communities impaired</p> <p>Loss of life and increased exposure to diseases</p> <p>Damage to houses and infrastructure</p> <p>Short-term impacts due to loss of harvests; long-term impact on soil quality and yields from salinized land</p>	<p>Infrastructure damage, disturbed access to markets, food price spikes, urban flash floods and damage to property</p>
	Strong winds	<p>Damage to critical infrastructure</p> <p>Transport sector hindered, access to markets for rural communities impaired</p>	<p>Damage to physical assets – critical infrastructure</p>
Erratic precipitation	Soil water deficit/irrigation water deficit/less groundwater recharge	<p>Agricultural yields lower (natural assets)</p>	<p>Lower groundwater table – increased costs of water and health implications</p>
	Landslides in mountainous regions	<p>Damage to crops, infrastructure and basic services</p>	<p>Impact on the transportation of agricultural products affects urban food security and prices</p>

CLIMATE CHANGE TRENDS	PHYSICAL IMPACT	IMPACTS ON RURAL LIVELIHOODS	IMPACTS ON URBAN LIVELIHOODS
Sea-level rise	Delta inundation	Loss of habitat, cropland and livelihoods	Loss of habitat; threat to coastal megacities and transport systems
	Change in rainy season	Local water stress more frequent and prolonged, especially in central dry zone Changes in precipitation patterns will increase the likelihood of short-term crop failures as well as long-term production declines	Water and sanitation problems, landslides
Higher temperatures (increasing trend, does vary across regions)	More frequent extreme hot days	Extreme temperatures – particularly affecting the dry zone cause a decline in work productivity and increase in heat stress in outdoor workers	Construction workers and outdoor vendors suffering heat stress; work productivity decline Home-based workers with poor ventilation and small confines also at risk
	Increased evapo-transpiration	Agricultural yields lower (natural assets); higher temperatures will reduce yields of desirable crops (e.g. rice, wheat, maize, soybean and groundnut) and encourage weed and pest proliferation. Loss of forest-based livelihoods due to wildfire	Agriculture productivity declines/ changes in towns dependent on agro-processing and agro-businesses
	Earlier glacial and snowmelt	Agricultural and housing damage in flash floods; infrastructure damage Water security impaired as less groundwater recharge can occur	Increase in flash floods and infrastructure damage; decrease in groundwater recharge
Ocean acidification	Coral reef and mangrove stress	Coastal fisheries under pressure Coastal protection lost, houses and workplaces more exposed	Mangrove loss, fisheries decline in coastal towns

CLIMATE CHANGE TRENDS	PHYSICAL IMPACT	IMPACTS ON RURAL LIVELIHOODS	IMPACTS ON URBAN LIVELIHOODS
Sea-level rise	Increased salinity, coastal erosion and more permanent inundation	<p>Agriculture yields decline, particularly for paddy (natural assets), which impacts related sectors (vendors (often F), workers, transport</p> <p>Water stress and quality decline may become an impairment to capacity to work (human assets)</p> <p>Loss of living area/houses in coastal regions</p>	<p>More rural-urban migration</p> <p>Loss of habitat in coastal cities</p>

ANNEX C: EXISTING PROGRAMMES AND PROJECTS

PLANNED:

Climate Smart Urban Disaster Risk Resilience Programme, which looks at heat impacts on vulnerable populations, drainage and WASH.

Upper Myanmar programme on livelihoods and climate change – a proposal.

ONGOING:

Mangrove replanting in Rakhine.

For livelihoods there is some action being taken under existing responses (e.g. in Rakhine state) but this is limited

“ Previously we did not consider climate change and disaster preparation as our components, but for current projects we took the climate change issues into consideration.” (KI 6)

MYANMAR NATIONAL PROGRAMMES

Myanmar prioritizes climate change action from a disaster risk point of view considering the country’s high risk of natural hazards and disasters. Since Cyclone Nargis (2008), disaster risk reduction has received a lot of attention. In 2017–2020, the Government has accelerated the policy and strategy base of climate action in the country. In cooperation with international development partners, there are many disaster-related projects ongoing in Myanmar, including mitigating climate-induced disasters.

ANNEX D: CLIMATE CHANGE AND ENVIRONMENTAL ACTION DOCUMENTS

Table 3.

CLIMATE CHANGE AND ENVIRONMENTAL ACTION DOCUMENTS	
National Sustainable Development Strategy (NSDS)	2009
National Environment and Health Action Plan (<i>Mentioned in overview documents but available online</i>).	2010
National Adaptation Programme of Action (NAPA) submitted under the UNFCCC Framework	2012
The Environmental Conservation Law	2012
Initial National Communication of Myanmar under the UNFCCC framework	2012
Disaster Management Law	2013
National Water Policy	2014
National Biodiversity Strategy and Action Plan	2015
Intended Nationally Determined Contribution (INDC) of Myanmar under the UNFCCC Framework	2015
Climate Smart Agriculture Strategy (CSAS).	2016
Myanmar Energy Master Plan	2016
Myanmar National Framework for Community Disaster Resilience	2016
Myanmar Action Plan for Disaster Risk Reduction (MAPDRR)	2017
The Myanmar Climate Change Strategy & Action Plan (MCCSAP)	2017
Myanmar Sustainable Development Plan (MSDP) 2018–2030	2018
National Environmental Policy	2018
Myanmar Climate Change Policy	2019
Myanmar Climate Change Strategy 2018–2030 (MCCS)	2019
Myanmar Climate Change Strategy Master Plan 2018–2030	2019
The Green Growth Strategy	<i>Under development</i>
National Adaptation Plan (NAP) [<i>Not found online</i>]	<i>Under development</i>

