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Myanmar Climate Change Alliance

LOCAL CLIMATE RESILIENCE PLANNING

(A Handbook for Practitioners)

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I. Introduction

1. About this handbook

This handbook is intended to guide national and local government officials on how to build resilience to climate change and hazards at the local level. Section 2 of the book introduces key issues related to climate change in Myanmar. Section 3 provides a methodological guidance on how to develop local climate resilience action plans. The annex part contains a long list of climate change adaptation (CCA) options applicable at a local level in Myanmar.

2. Which basic terms and concepts should you know?

Adaptation	Undertaking actions to adjust to already observed or expected climate and its effects with the objectives to: ▪ protect natural and human systems against the actual and anticipated harmful effects of climate change; ▪ exploit any opportunities they may generate; ▪ ensure the sustainability of investment and development interventions despite current climate risks and potentially increasingly difficult climatic conditions.[1]
Climate	The average characteristics of meteorological conditions, calculated over a long period (typically 30 years or more).
Climate change	A shift in average climate parameters and/or in the magnitude of climate variability observed and persisting over long periods (typically decades or longer)[2]. To simplify, climate change suggests long-term continuous change of: (i) the average (typical) climate, e.g. average (typical) seasonal temperatures in the coastal zone of Myanmar are getting higher; (ii) variability of temperatures, precipitation, and other climate parameters, e.g. more frequent and severe rainfall and stronger winds are observed in some regions of Myanmar.
Climate change impacts	The effects of climate change (e.g. increasing temperatures and change in seasonal patterns) and extremes (e.g. heat waves, heavy rainfall, severe storms) on human systems and environment. The impacts of climate change include: ▪ Physical impacts – floods, droughts and sea level rise;

[1] MCCA Dictionary (http://myanmarccalliance.org/en/dictionary/)

[2] UN-Habitat, Standardization of DRR Terminology, 2013, Norwegian Ministry of Foreign Affairs, Department of Rural Development

	▪ Environmental – impacts on ecosystems such as loss of biodiversity, water scarcity, and land degradation; ▪ Impacts on human systems – socio-economic effects (e.g. loss of life and livelihood, food insecurity), and infrastructural consequences.
Climate hazard	Any climate-related physical event (e.g. cyclone), trend (e.g. increasing temperatures in dry season) or impact (e.g. flood, sea level rise), which has the potential to cause loss of, and damage to, people, physical assets, provision of services, and ecosystems. Hazards (as well as climate change impacts) can be divided into slow onset (like drought and insect infestations), and rapid onset (like floods) events.
Climate variability	The variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate, attributed either to natural internal processes within the climate system, or to variations in natural or anthropogenic variables. In other words, climate variability refers to the annual fluctuation of the climate, above or below the long-term average.
Climate risk	The probability of experiencing negative impacts of climate change.
Ecosystem	A system of living organisms, their environment (e.g. land, water) and the interactions within and between them.
Ecosystem services	Ecosystems provide people with numerous benefits called ecosystem services, which could be categorized as follows: ▪ Provisioning services are all products obtained from ecosystems such as food, fresh water and raw materials. For instance, people depend on lakes and rivers for water and fish, while forests are vital source of wood and food for many communities. Nature also provides people with traditional and commercial medicinal plants/raw materials (e.g. *'Thanaka'* in Myanmar). ▪ Regulating services are related to the ability of ecosystems to regulate natural processes such as water, air and soil quality control, erosion prevention and moderation of extreme events. For example, trees in urban areas provide shade in hot days and improve the air quality, while mangroves can protect communities from hazards by reducing wind speed, flooding and coastal erosion. Forests remove carbon dioxide, prevent soil erosion and landslides, and reduce the flow of water during floods. Wetlands can filter waste water (e.g. human and animal waste) and absorb floodwaters. ▪ Cultural services refer to non-material benefits such as using the nature for tourism, ecotourism and sports, and cultural and spiritual activities. ▪ Supporting services are those benefits related to natural processes that support and maintain all other services (e.g. soil formation, providing nutrition and habitat for species).
Gender	Socially ascribed roles, responsibilities, rights and opportunities associated with being a man or a woman, and the social relations between women and men. These are dynamic, change over time and are context-specific. Gender

	roles in society shape the gender division of labour, which is the allocation of the tasks and responsibilities of women and men at home, at work and in society. For example, often a division is made between: (a) productive tasks (e.g. agriculture, fisheries/aquaculture, self-employment, workers in enterprises); (b) reproductive tasks such as child care and household tasks; and (c) community tasks[3].
Mitigation of climate change	Human interventions aimed at reducing greenhouse gas emissions and/or enhancing the capacity of 'sinks' for GHGs, for the ultimate purpose of stabilising their concentration in the atmosphere; aims to reduce global exposure to the effects of climate change. Mitigation encompasses a wide range of activities, from reducing deforestation while also planting trees, to switching to renewable energy sources and climate-smart agricultural practices. It is important to highlight that while through mitigation we can limit the global warming, the temperatures will continue to rise.
Resilience	Resilience, in the context of climate change, is the ability of a system to: (i) absorb stress and cope with climate change and hazards, including maintaining its basic structure, functions and adaptive capacity, and (ii) recover, adapt and transform in ways that improve its sustainability, leaving it better prepared for future climate change impacts. In this context, climate-resilient development of townships of Myanmar suggests development that ensures townships' ability to cope with current climate and its impact and to adapt to future climate change, by preserving development gains and minimising damages.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes. This notion is used to describe socio-economic, physical and environmental factors, which determine the sensitivity/susceptibility of a country, town, community or individual to the impact of climate change (e.g. change in seasonal patterns) and/or hazard (e.g. flood). For example, socio-economic factors of vulnerability are poverty, low level of awareness on climate change, and dependence on climate-sensitive agricultural production. Land degradation and unsustainable natural resources management are environmental factors of vulnerability. Physical vulnerability relates to the state of infrastructure and human settlements.
Weather	A condition of the atmosphere at a certain time and location described by meteorological variables such as temperature, precipitation, wind, humidity, atmospheric pressure, cloudiness.

[3] UN Women (2014). UN Women Master Class Training Manual: Rights Based Approach to Gender and Climate Change: the situation in Bangladesh. UN Women Bangladesh. Available at: http://asiapacific.unwomen.org/en/digital-library/publications/2015/04/un-women-master-class-training-manual

II. Climate change in Myanmar

1. How is the Earth's climate changing?

Warming of the Earth's climate system is evident from the observed increases in the average global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Weather events of all kinds are getting more extreme. In arid areas, droughts and wildfires intensify. Number of cold days and nights decreases, while winter temperatures and precipitation become more extreme. Cities experience more frequent and extreme heat waves.

Temperatures will continue to rise in future. Most scientists agree on the "threshold" of a 2°C increase in global average temperature on the pre-industrial levels, above which humans and nature will not be able to cope with the negative effects of climate change. Myanmar is already experiencing significant losses due to climate change, and without adaptation, country's future development will be impeded.

2. What you should know about climate change in Myanmar?

Present climate in Myanmar[4]

There are eight major physiographic regions in Myanmar: the Ayeyarwady Delta, Central Dry Zone, Northern Hilly Region, Rakhine Coastal Region, Eastern Hilly Region, Southern Coastal Region, Yangon Deltaic Region, and Southern Interior Region. These regions form three main agroecological zones: i) Central Dry Zone; ii) Coastal Zone; and iii) Hilly Zone (Figure 1). The latter are used to describe climate variability and change at the sub-national level.

The country's climate is tropical to subtropical monsoon with three seasons: (i) hot, dry inter-monsoonal (mid-February to mid-May); (ii) rainy southwest monsoon (mid-May to late October); and (iii) cool, relatively dry northeast monsoon (late October to mid-February). Annual climate patterns, as well as seasonal temperatures and precipitation vary across the country, as summarized below.

[4] Summarized from: (i) Ministry of Natural Resources and Environmental Conservation (2012). Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change; (ii) Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

- *Coastal Zone.* The Yangon Deltaic Region has the highest mean annual temperature. The regions in the Coastal Zone receive the highest mean annual rainfall (2,500 – 5,500 mm) and are prone to flooding. Furthermore, the west coast experiences frequent tropical storms and cyclones during October-December and April-May periods.

- *Central Dry Zone.* Mean annual rainfall is the lowest in the Central Dry Zone (500-1000 mm per year) that is prone to extreme heat events and drought. Temperatures in this zone could reach 40-43°C during the hot dry season.

- *Hilly Zone.* The Northern Hilly Region has the lowest mean and maximum annual temperatures. The Eastern and Northern Hilly areas receive the lowest wet season precipitation, and both regions are exposed to heat waves, droughts and floods, as well as landslides.

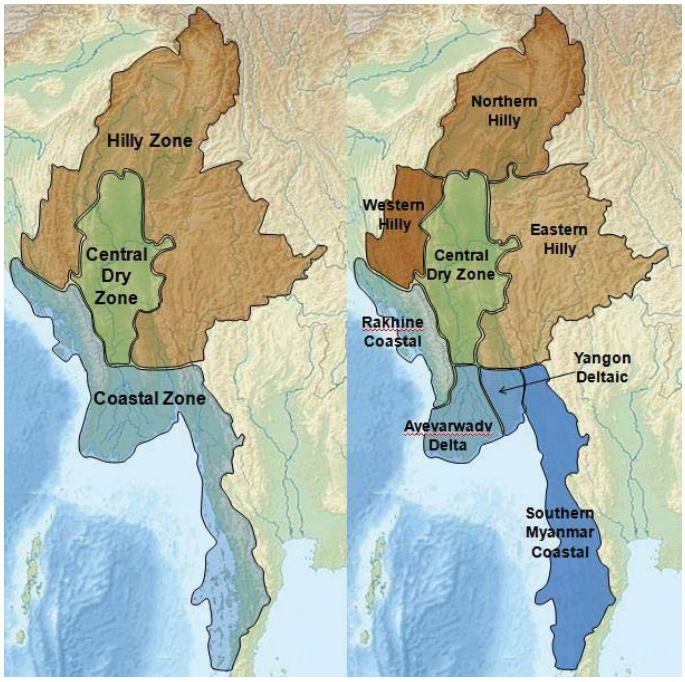

Figure 1 Agroecological zones in Myanmar (left) and physiographic regions (right)[5]

Observed climate changes

According to recent estimations based upon data from 19 weather stations across Myanmar, average temperatures and precipitation have increased as described in detail below[6].

Temperatures. From 1981 to 2010 the national average daily temperatures increased at a rate of about 0.25°C per decade. In addition, the daily maximum temperatures rose by 0.4°C per

[5] Source: Ministry of Natural Resources and Environmental Conservation (2012). Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change.

[6] Summarized from: Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

decade over the same period. Inland territories have experienced more rapid temperatures increase in comparison to coastal areas (Figure 2).

Precipitation. Over the period 1981-2010 the total annual rainfall in coastal and inland regions increased by 4.5 per cent (157 mm) and 2.5 per cent (35 mm) per decade, respectively (Figure 3). Importantly, the Coastal Zone territories have experienced 17 per cent (85 mm) rise per decade in seasonal rainfall during the dry season (November-May).

Figure 2 Trends in daily average (top row) and daily maximum (bottom row) average temperatures, 1981-2010[7]

Climate extremes/hazards. Myanmar has faced an increase in heat-related hazards since 1980s[8]. The most recent severe droughts occurred in 2010. Extreme high temperatures and heat

[7] Source: Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

[8] Ministry of Natural Resources and Environmental Conservation (2012). Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change.

waves affect mostly the Central Dry Zone. In addition, exposed to droughts are mainly the Eastern and Northern Hilly Regions, and the Central Dry areas.

Late onset and early withdrawal of the monsoon has been observed. Rainfall patterns have become more variable and unpredictable in terms of intensity and seasonality, e.g. shorter rainfall seasons combined with heavy rains. This has considerably increased the risk of flash and river flooding, and landslides. Catchment areas of major rivers in the Hilly regions and the Central Dry Zone, as well as the coastal areas are particularly exposed to floods caused by intense rainfall.

Storm surges and cyclones affect mostly the Rakhine Coastal State, Ayeyarwady Delta and Mon State. Over the last two decades the county experienced more intense and frequent cyclones than before. For example, Nargis (May 2008) and Giri (2010) were the most devastating cyclones in the recent history of Myanmar.

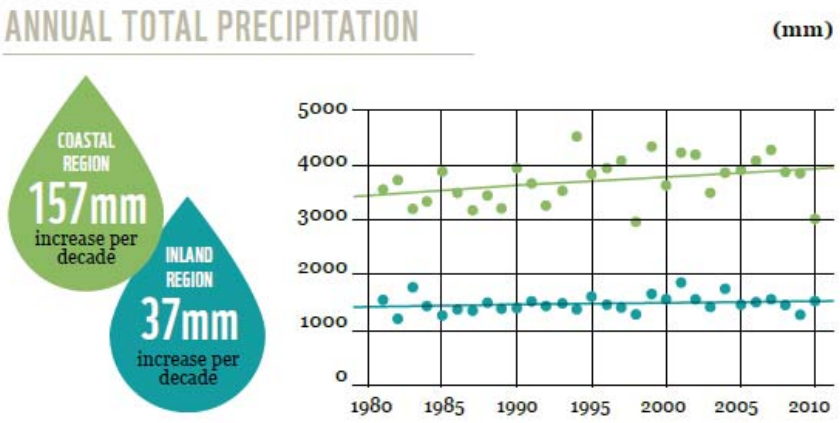

Figure 3 Trends in total annual precipitation, 1981-2010[9]

Future climate[10]

Temperatures and heat extremes. In future, the average annual and daily maximum temperatures in Myanmar are projected to rise. Regions will face more often extreme hot days

[9] Source: Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

[10] Summarized from: (i) Ministry of Natural Resources and Environmental Conservation (2012). Myanmar's National Adaptation Programme of Action (NAPA) to Climate Change.; (ii) Ministry of Natural Resources and Environmental Conservation (2017) Myanmar Climate Change Strategy and Action Plan (MCCSAP) 2016–2030. Nay Pyi Taw, Myanmar: The Republic of the Union of Myanmar.; (iii) Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

and heat waves (with temperatures above 38°C). Consequently, there is an increasing risk of forest and urban fires, especially in the Central Dry Zone.

Inland areas are expected to warm at a higher rate than coastal territories. The Eastern and Northern Hilly Regions are likely to experience the highest increase in temperatures in the country. Projections suggest that the national annual average temperatures could rise by 0.7-1.1°C during the period 2011-2040 and by 1.3-2.7°C from 2041 to 2070 (in comparison with the values for the 1980-2005 base period).

Precipitation and hydrological hazards. Predicting future rainfall patterns is difficult. Nevertheless, projections point out that in future Myanmar will experience more intense rainfall (relative to the 1980-2005 base period) particularly during the wet season. This in turn could exacerbate wet season flooding in some regions. Furthermore, seasonal rainfall patterns could become more erratic (e.g. periods of heavy rainfall followed by long-lasting dry spells).

Sea level rise and coastal hazards. By 2059 sea level in Myanmar may rise 41cm above the levels recorded between 2000 and 2004. By 2089 this rise could amount to 83 cm. Therefore, the country's low-lying coastal areas, such as the Ayeyarwady Delta, are at an increasing risk of frequent and severe coastal flooding (inundation) and storm surges from intense storms. Global climate change projections indicate that tropical cyclones will become stronger than they are today.

3. What are the impacts of climate change in Myanmar?

Impacts of climate change on ecosystems

Agricultural land, soils and crops

Climate change will exacerbate soil erosion process in some areas. For instance, strong winds can remove the surface layer of dry soils, and heavy rains/floods can increase waterlogging and washing away of top soil and nutrients. Intense rainfall and floods increase the risk of landslides in the Hilly Zone. Degradation of agricultural land due to landslides has already been observed in this zone.

Rising sea levels could lead to a loss of agricultural land and/or land productivity. In future, parts of inhabited and productive coastal areas could become permanently inundated, while others could be affected by intrusion of salt water into groundwater systems, soil salinization and coastal erosion processes. For example, stakeholder consultation revealed that every two years in the Ayeyarwady Delta around two million hectares of land are flooded and more than three million hectares are moderately inundated.

Increasing temperatures and change in soil moisture could have negative impacts on strategic crops such as rice and wheat yields, and could increase the risk of significant losses due to plant pests and diseases. Furthermore, droughts will increase the demand for irrigation that could put water and land resources under growing pressure.

Inland water resources

Climate change will affect the hydrological cycle in many regions across the country. Intense rains increase the risk of river floods and flash floods, which could result in contamination of water resources. Intense floods coupled with prolonged drought periods will alter river flow and consequently the recharge of groundwater resources. Freshwater biodiversity could also be affected by the expected change in climate conditions. For example, during prolonged dry and hot periods, Inle Lake is becoming shallower, whereas negative impacts have already been observed not only on lake's biodiversity and ecosystems, but also on local tourism.

Marine and coastal ecosystems

Sea level rise could lead to salinization of land and water (groundwater and surface) resources in low-lying coastal areas and the Ayeyarwady Delta Region. Myanmar can also experience a loss in marine biodiversity caused by a change in the seawater chemical composition (oceanic warming and acidification), which is one of the major impacts of climate change. For example, coral reefs are vital habitat for fish and shellfish. However, increasing seawater temperatures affect the corals and hence alter the living environment of numerous marine species. Furthermore, coastal erosion, sea level rise and more intense and frequent tropical storms will likely lead to deterioration of mangrove ecosystems in some areas.

Forests and mountain ecosystems

Forests cover about 45 per cent of the country's territory. However, climate change is likely to affect the distribution, composition and health of forests in Myanmar. Droughts and high temperatures will increase the risk of forest fires, particularly on the Central Dry Zone and the northern regions. The Central Dry Zone may experience desertification and loss of tree/plant species. Forests may suffer increasing incidences of plan pests and diseases, while hilly areas will likely face a growing number of landslides.

Long-term consequences of climate change on ecosystems in Myanmar:

- Reduced agricultural productivity in the long-term;
- Increasing human pressure on water, land and forest resources, e.g. for agriculture and energy production;
- Lower productivity of ecosystems, resulting in e.g. decline of yield in agriculture and fisheries, or water for drinking;
- Desertification (caused by, for instance, intense rains following lengthier dry periods, which increases run-off rate and soil erosion; deforestation and heat stress);
- Loss of tree and plant species, and in turn reduced carbon storage and sequestration capacity of the country.

Socio-economic impacts of climate change

Agriculture and food security

Increasing temperatures and erratic rainfall, combined with frequent occurrence of droughts and floods, will result in a *loss of agricultural productivity*, including short-term crop failures and livestock losses, and long-term production declines. Climate change and hazards have also high impact on fisheries. Cyclones and tropical storms along the country's coastline, and floods along major rivers, often lead to loss of fishing boats and assets, and damages to infrastructure. After such disasters, affected fishermen lose their income for weeks.

Industries and businesses

Food and agriculture processing industries could be affected by the impacts of climate change on crops and livestock production, as well as on fisheries. For example, an increase in prices of agricultural input/raw materials due to climate changes could lead to an increase in prices of processed products and make industrial production less competitive. In a long term, this could result in increased unemployment in the sector and impede the economic development. Small-scale household production (e.g. textile) could be affected by seasonal floods and other hazards. In addition, climate change will likely affect the health of employees and, hence, their productivity.

Employment and migration

The impacts of climate change on agriculture and industrial production could limit the demand for employees in these sectors. As well, connectivity between settlements in many parts of the country could be impacted by hazards such as permanent or temporary inundation of coastal areas, or damages to road infrastructure, which in turn would reduce the access of people to work opportunities.

The projected rapid urbanization will increase the risks posed by climate change in cities/towns. High migration flows often lead to establishment of informal settlements located in the most hazardous zones of towns and cities. The socio-economic vulnerability of people residing in such settlements could be further deepened by the adverse effects of climate change such as poverty and limited access to basic services. The long-term social consequences of climate change include further migration to urban centres, displaced population from coastal areas, and increased poverty. In addition, conflicts over land and diminishing water resources could emerge.

Human health

Climate change and hazards pose significant risk to human health. Potential impacts of future climate include increase of vector-borne diseases and heat-related illnesses, injuries and malnutrition, among others. Furthermore, many communities will experience decreased access to safe water due to droughts or salinization of freshwater resources, which will increase dehydration risks and further exacerbate diarrheal diseases. In urban areas, population will be exposed to heat waves, decreased access to water and nutrition, increasing pollution levels.

Vulnerable groups

Some social groups such as poor people, women, children and elderly, as well as disabled and ill members of the society, are more at risk of climate change and hazards than others. Therefore, policymakers should be aware of the specific needs and vulnerabilities of such high-risk groups. Poor people, pregnant women, children, elderly and sick people face bigger climate change risk to health and life.

Children will be affected by the impacts of climate change in many other ways. Climate change will affect income of poor households, especially in rural areas. This will limit the ability of families to cover school costs and provide their children with nutritious and healthy food. Furthermore, extreme heat, floods and storms are already affecting the access of children to education and threatening their health.

Women in Myanmar are at a higher risk than men. Climate change could exacerbate existing inequalities such as inequality in access to land and other natural resources (threatened by climate change), or income inequality (access to jobs and payment rates). Furthermore, climate change aggravates the burdens of unpaid care work, such as fetching water or wood, or taking care for the sick. For example, climate change increases health risks, which would affect family and community well-being, and hence burden women with additional unpaid care work. In addition, for many women, loss of safe housing and living environment caused by disaster or sea level rise could bring serious insecurity issues such as violence, sickness, or malnutrition. As well, women often rely on ecosystems to generate additional income and secure food for family. However, climate change will likely reduce agrobiodiversity including traditional medicine plants, and hence will affect women's livelihood. Secondary impacts of climate change on women and girls include reduced number of girls enrolled in schools and less opportunity for women to engage in income-generating activities.

Impacts of climate change on infrastructure and human settlements

Many urban areas could suffer significant loss and damage of assets, houses and urban infrastructure as result of climate hazards (e.g. from floods or coastal hazards). Coastal towns such as Bogalay (Ayeyarwady Region) may need to be relocated or redesigned because of sea level rise. Permanent inundation in coastal areas could force displacement of whole communities. Growing water and energy demand will surpass the available resources in future.

Climate change will affect the production and distribution of electric power. Heatwaves and increasing number of hot days will increase the energy demand, while prolonged droughts and change in river flows due to erratic rainfall will likely affect hydropower energy supply (potential energy price increases), which currently represents 75 per cent of country's electricity consumption. Intense rains and increasing number of flood events could trigger large-scale erosion processes, leading to siltation and sedimentation of waterways and dams. This could result in reduced water storage capacity of dams, structural damages, and increased maintenance and operational costs. As well, storms, floods and other rapid-onset hazards could potentially damage energy infrastructure (e.g. dams, electricity grid, gas pipelines, solar panels of households, etc.).

Furthermore, impacts on transport infrastructure and connectivity such as damages to road infrastructure, and disruption of river transportation services, will be inevitable. Manufacturing and industrial facilities can also be destroyed or damaged by hazardous events. Water and irrigation infrastructure can be damaged, while in many places there will be water scarcity under increasing demand due to population growth, urbanization and economic development.

4. The need of local level action in response to climate change

The effects of climate change are experienced locally. Severity of impacts varies from region to region, from town to town, from community to community, depending on geo-physical and environmental characteristics, and socio-economic specifics. Therefore, local adaptation response is needed. It ensures proper consideration of: (i) local vulnerabilities (environmental, social, economic); and (ii) needs, capacities and resources of communities including local knowledge, skills and practices.

The Myanmar Climate Change Strategy and Action Plan 2016-2030 identifies six sectors most vulnerable to climate change, and lays out a strategy for mainstreaming CCA into sectoral policies. Sectoral strategic objectives are as follows:

- **Climate-smart agriculture, fisheries and livestock for food security**

Sectoral outcome: Achieve climate-resilient productivity and climate-smart responses in the agriculture, fisheries and livestock sectors to support food security and livelihood strategies while also promoting resource-efficient and low-carbon practices.

- **Sustainable management of natural resources for healthy ecosystem**

Sectoral outcome: Natural resource management that enhances the resilience of biodiversity and ecosystem services that support social and economic development and deliver carbon sequestration.

- **Resilient and low-carbon energy, transport and industrial systems for sustainable growth**

Sectoral outcome: Climate-resilient and low-carbon energy, transport and industrial systems that support inclusive and sustainable development and economic growth.

- **Resilient, inclusive and sustainable cities and towns where people can live and thrive**

Sectoral outcome: All township and city dwellers, including the most vulnerable, are safe from increased risks of rapid- and slow-onset natural disasters and live in sustainable, inclusive, low-carbon, climate-resilient towns.

- **Climate risk management for people's health and well-being**

Sectoral outcome: Communities and economic sectors have the capacity to respond to and recover from climate-induced disasters, risks and health impacts and build a healthy society.

- **Education, science and technology for a resilient society**

Sectoral outcome: Strengthen education, awareness and technological systems that foster a climate-responsive society and human capital to design and implement climate-resilient and low-carbon development solutions for inclusive and sustainable development.

III. Developing local climate resilience action plans

1. Understanding the planning process

Building local level resilience to climate change and hazards necessitates a long-term strategic planning, which involves conducting a vulnerability assessment, development of a Local Climate Resilience Action Plan based upon the vulnerability assessment results, and implementation and monitoring of activities (Figure 4).

Figure 4 Phases of local climate resilience action planning

What is a vulnerability assessment?

Before identifying appropriate CCA actions, local administrators should understand the local vulnerabilities including the most vulnerable economic sectors, social groups and communities. This can be achieved through a vulnerability assessment, which is a process of identifying, measuring (quantifying) and analysing vulnerability to climate change and hazards. The purpose of conducting local vulnerability assessments is to inform local, regional and national authorities (and international development organizations/donors) on:

- Underlying causes/factors of vulnerability including ecological, socio-economic and infrastructure.
- The most vulnerable locations, sectors and social groups at current time.
- Potential consequences of climate change in a short-, medium-, and long-term.
- Those sectors that require, immediate, mid-term and long-term action for building local level resilience.

To learn more, refer to: ECD, MCCA (forthcoming, 2017). "Climate Change Vulnerability Assessment Manual: Methodological Framework for Townships of Myanmar".

What is a Local Climate Resilience Action Plan?

A Local Climate Resilience Action Plan is a policy document that outlines key climate change issues, strategic adaptation objectives, and specific actions to be implemented in a short-term (one to two years), medium-term (three to five years), and long-term (six plus years). Overall, such plans aim to

direct national and local governments, development partners, as well as the private sector, civil society and individuals to invest in a climate-resilient and low-carbon development pathway to secure inclusive and sustainable development[11].

Objectives:

- To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience[12];
- To facilitate the integration of CCA and DRR in a coherent manner into township development planning processes and strategies, within all relevant sectors and at different levels.

Key principles:

Local climate resilience action plans should be strategic and inclusive, and follow a participatory, gender-sensitive and integrated approach to planning and implementation.

- *Strategic planning*

  Setting optimal short-, medium- and long-term goals, objectives and specific actions, given the capacities and resources available.

- *Participatory CCA planning process*

  Ensuring that relevant stakeholders take part in the planning process would allow for developing adaptation objectives built upon robust understanding of the needs, capacities and values of local communities and different social groups.

- *Gender-sensitive approach to climate resilience planning and implementation ('Do no harm')*

  Gender-sensitive policy, program, administrative and financial activities, and organizational procedures should:

  - differentiate between the capacities, needs and priorities of women and men;
  - ensure that the views and ideas of both women and men are taken seriously;
  - consider the implications of decisions for women and men;
  - take actions to address inequalities or imbalance between women and men.

  … so that both men and women can equally benefit.

- *Integrated approach to implementation*

  Local climate resilience action plans are integrated into exiting township plans (including budgets), strategies and processes, through mainstreaming CCA (and DRR) measures into multiple sectors.

[11] Ministry of Natural Resources and Environmental Conservation (2017) Myanmar Climate Change Strategy and Action Plan (MCCSAP) 2016–2030. Nay Pyi Taw, Myanmar: The Republic of the Union of Myanmar.

[12] Least Developed Countries Expert Group, 2012. National Adaptation Plans. Technical guidelines for the national adaptation plan process. Bonn: UNFCCC secretariat. Bonn, Germany. December 2012. Available at <http://unfccc.int/NAP>.

How to prepare local climate resilience action plans based upon vulnerability assessment results?

Through series of consultative meetings with a wide range of stakeholders and/or separate consultations with vulnerable communities, township officials can undertake strategic planning exercises to prepare local climate resilience action plan. Key steps of the planning process and suggested methods are discussed in the next section.

How to identify relevant stakeholders?

Engaging relevant stakeholders is critical for a successful CCA planning process. Therefore, the planning team should develop a list of potential stakeholders (Table 1).

Table 1 List of potential stakeholders[13]

Guiding question	Potential stakeholders
Who should be included because of relevant government position?	National, regional and township government officials from multiple sectors who has expertise and decision-making power
Who should be included because of their control over relevant resources?	International organizations (governmental and non-governmental) and local non-governmental organizations can provide expertise and financial support
Who can support the implementation of the CCA action plan?	The private sector such as local businesses and industries Financial institutions Local media Research institutions and academia
Who can represent the needs of the most vulnerable, and contribute to the successful implementation of the CCA action plan?	Representatives of civil society organizations such as local labour and women's organizations/groups, organizations of persons with disabilities, local youth groups, farmers' associations, others Community leaders and individuals who can represent the interests of the most vulnerable communities and groups (e.g. residents of a settlement located in a flood-prone area, fishermen and farmers, small-scale producers, etc.)

2. Local climate resilience planning: key steps and methodological guidance

The process of developing local climate resilience actions has three main steps (Figure 5) discussed in detail below.

[13] Modified from: UN-Habitat (2014). Planning for Climate Change: A Strategic, Values-Based Approach for Urban Planners – Toolkit.

Figure 5 Local climate resilience strategic planning: key steps

STEP 1 Defining key issues in township based upon vulnerability assessment results and a SWOT analysis

This step entails presenting a summary of key findings *in the form of issues*, i.e. concerns, problems and challenges that people in the township face, as well as opportunities they may have. The identified issues could be grouped into three categories: ecosystem, socio-economic and infrastructure, as shown in the example below.

Example: Key issues identified for Labutta Township

Ecosystem issues:

- Deforestation of mangroves increases exposure to storm surges and erosion
- Seawater infiltration increases salinization of water impacting nutrient cycling in soil
- Shorter monsoon season and higher temperatures resulting in water shortage for agriculture and drinking

Socio-economic issues:

- Stronger storms, winds and unusually heavy rainfall destroys crops and cause frequent floods
- Shorter monsoon season and higher temperatures decrease crop production and increase livestock death
- Seawater infiltration increases salinization of soil and water resulting in lower rice crop yield
- Depletion of mangrove and over fishing has resulted in decline in fishery livelihood for coastal communities.

Infrastructure issues:

- Stronger storms, winds and unusually heavy rainfall affects people's mobility and access to cyclone shelters and basic services
- Shorter monsoon season and higher temperatures give less time to collect rain water and increase evaporation
- Deforestation of mangroves for firewood and housing material increases exposure to storm surges and erosion.

In addition, a SWOT[14] analysis of each component of vulnerability (ecosystem, socio-economic and infrastructure) could inform adaptation planning on opportunities and limitations for action.

- *Strengths* relate to features of the township of interest that could be used to achieve adaptation objectives such as presence of/access to natural resources, and capacities (human, financial, technical).
- *Weaknesses* point to township characteristics that could limit CCA such as lack of technical knowledge and financing, poverty, inadequate infrastructure and environmental deterioration.
- *Opportunities* relate to environmental, socio-economic and infrastructure specifics of townships that create a ground for new developments such as potential for introduction of renewable energy, potential for creating jobs in the industry sector, or potential for forest restoration and conservation.
- *Threats* are those factors that pose barriers to/or can undermine climate-resilient development such as change in land tenure system, large infrastructure investment risks, expansion of industries that harm the environment (e.g. coal production, logging).

STEP 2 Converting key issues into strategic objectives and specific actions

How to convert an issue into an objective?

Converting an issue into objectives relate to expressing how you would like to address (manage, minimize or mitigate) the issue. This is done by combining an action verb that describes a direction of preference (e.g. "increase", "reduce", "maximize"), with a description of the subject (e.g. "reduce risk of coastal storm surges", "improve soil quality" or "reduce farmer's dependency on rice production")[15].

Considering the identified key issues, as well as the SWOT analysis findings, township officials should set clear strategic and specific objectives, and concrete actions. This would provide direction and focus for decision-making, help people create a vision for the future and identify actions to achieve it, and support monitoring and evaluation of CCA action plans. Below is described how to do that.

- Convert the identified key issues, now grouped in categories, into **3 strategic objectives** (which will correspond to **strategic outcomes of local climate resilience action plans**).

- Set **specific objectives** under each strategic outcome by taking key issues and converting them into 2-3 specific objectives (which will correspond to the **expected results of a local climate resilience action plan**).

Example: Strategic and specific objectives identified for Labutta Township

[14] SWOT refers to an analysis of strengths, weaknesses, opportunities and threats.

[15] UN-Habitat (2014). Planning for Climate Change: A Strategic, Values-Based Approach for Urban Planners – Toolkit.

Strategic objective 1: Maintain and enhance healthy ecosystem to support living standards
Specific objectives:

- Protect and extend Forestry coverage to reinstate 1980 levels
- Protect natural resources to support agriculture and fishery;
- Mitigate the salinization phenomenon through adaptive crops and regulating eco-system services;

Strategic objective 2: Enhance socio-economic conditions by diversifying production
Specific objectives:

- Learning new skills to increase employment opportunities in other sectors;
- Maintaining agriculture productivity through capacity-buildings, loans, cooperatives;
- Investing in new industries, such as manufacturing, small enterprise.

Strategic objective 3: Ensuring people of Labutta have access to resilient infrastructure to protect people and support development
Specific objectives:

- Increase coverage and dissemination of hazard-resistant infrastructure and preparedness;
- Increase safety of household, through public and private climate resilient architecture and planning, including through household level water harvesting capacities;
- Ensure connectivity is protected and enhanced, through resilient transport services.

Outcome	Expected Result	Activities	Type
To protect and enhance environment so that it can continue supporting and improving the living standards of people in Laputta	ER1 Forestry coverage is restored (to 1980 levels), enhanced and protected so to continue providing services as protection from hazard, eco-system for biodiversity (fishery), construction materials, soil regulation	Protecting existing mangrove/forestry areas by enforcing laws and regulations on protected forestry areas	
		Protecting existing mangrove/forestry areas by creating community awareness on the need to mantain forestry	
		Enhancing and restoring mangrove/forestry coverage in areas exposed to natural hazards and in areas with soil	
		Enhancing access to renewable energy sources as cookstoves, Solar Power to reduce weight on mangrove	
		Implementing Community Forestry (Integrated Management and Livelihoods) to provide for construction,	
	ER2 Natural resources and in particular the soil and the sea/river biodiversity are protected and enhanced so to continue supporting agriculture, fishery and people	Enhancing knoweldge and capacities for Sustainable Soil Management (sustainable organic fertilizer, rotational	
		Testing integrated soil management techniques to mantain soil productivity/fertility, including in salt	
		Raising awareness on sustainable fishery and illegal chemical fishery	
		Enhancing and restoring mangroves to (re)create eco-systems for fishery	
	ER3 The salinization process effects are mitigated by means of adaptive crops, regulating services (mangroves), and infrastracture	Protecting paddy fields/fields from salinization by construcing small community embankements	
		Protecting fields by constructing constructing large embankements	
		Protecting fields by constructing dykes systems structing dykes	
		Testing crops resistant to salt to mantain and increase agricultural productivity	
		Enhancing forestry and mangroves to control salinization	
		Changing to livestock	
		Training in agriculture adaptive techniques	

Figure 6 Example of strategic outcome, expected results and actions identified for Labutta Township

- Propose concrete **actions** to achieve the specific objectives. These actions should be linked to each specific objective. In case actions from the long list remain not categorised, discuss whether objectives are still relevant and if further objectives are required. Eliminate options that are not feasible or realistic given the capacity of the selected township of interest. At the end of this step, a short-list of options should be identified/agreed upon. In addition, to guide policymakers on the types of action, each group of adaptation options (ecosystems, infrastructure and connectivity, socio-economic systems) could be further categorized into type of activity: management, investment, capacity-building/awareness, research/analysis (and indicated by using different colours as shown in Figure 6).

STEP 3 Prioritizing actions

Criteria to assess and prioritize actions include:

- **Cost:** Key question: Can this township/community afford this option, and will it bring enough benefits relative to the cost of implementing it?
- **Feasibility:** Key question: Is the technology readily available and will the design, implementation and operation of the action be possible and within the capacity of communities and local government?
- **Community acceptability:** Key question: Would local people accept this action and have ownership of it?
- **Adaptation effectiveness:** Key question: How well would this action work in building resilience to climate change (relative to other options)?
- **Benefit anyway (no regret):** Key question: Would it bring other development benefits (e.g. raising income, improving education, delivering more services)?
- **Speed:** Key question: Can the action be implemented in a short-term? Will it take long to bring adaptation benefits?

Result	Action	Category	Cost	Feasibility	Community acceptance	Adaptation effectiveness	Benefit anyway (no regret)	Speed	Score	Strategy
All people in Labutta are protected to natural hazards	Participatory planning (Disaster Preparadness, Disaster Sen		5	5	5	5	5	5	30	100
	Disaster drills in schools		5	5	5	5	5	5	30	100
	Improve radio access and broadcast		5	5	5	5	5	5	30	100
	Flood maps at village tract/urban ward level		5	5	5	5	5	5	30	100
	Early warning system		5	5	5	5	5	5	30	100
	Hospitals and health post safety/security plans		5	5	5	5	5	5	30	100
	Emergency preparedness		4	5	5	5	5	5	29	100
	Sand Banks for protection in coastal areas		3	4	5	5	5	4	26	50
	Local material shelter		2	5	5	5	5	3	25	75
	Other small infrastructure resilient to hazards		2	3	5	5	5	3	23	75
	Evacuation routes		2	3	5	5	5	3	23	75
	Flood and erosion control plans		2	3	5	5	5	2	22	50
	Building cyclone shelters than can also be used as schools/community centres (local materials, double-use etc.)		1	2	5	5	5	1	19	75

Figure 7 Prioritized adaptation options for Labutta Township under Strategic Outcome 3 Infrastructure[16]

Suggested method

- Develop a table, which contains the identified Strategic Outcomes, Expected Results and Actions in the previous steps (short list of adaptation options).
- Discuss with stakeholders/community members and assess each action against the above criteria. Assign score to each action under each criterion (e.g. 1 – the lowest, and 5- the highest score). Higher score suggests higher priority. For instance, construction of cyclone shelter could have score 1, which indicates high cost that township may not be able to afford (Figure 7).
- Compute the total score for each action and rank all options.
- Review the results and ensure their accuracy.
- Discuss the strategic value of each option against the total score and make final selection of priority actions. For example, building cyclone shelter could have lower score due to the high cost of intervention. Nevertheless, it could be of strategic importance for community's resilience and hence prioritized (Figure 7).
- Verify if the prioritized actions address the most vulnerable sectors, locations and groups (women, children, other marginalized groups), identified through the vulnerability assessment.
- Develop a final list of CCA actions based upon the prioritization exercise.

[16] Source: Fee, L.; Gibert, M.; Bartlett R.; Capizzi, P., Horton, R., Lesk, C.(forthcoming, 2017 (a)). Climate Change Vulnerability Assessment of Labutta Township, Ayeyawady Region, Myanmar, 2016-2050, UN-Habitat Myanmar.

3. Integrating disaster risk into CCA at a local level

- Strengthen collaboration between diverse stakeholders working on disaster risk reduction (DRR) and CCA at a local level. Engage them in the planning, implementation and monitoring process. Define clear roles, institutional arrangements and finance strategy for the implementation of local resilience action plans by engaging DRR authorities.
- When developing local resilience action plans, take into consideration implementation priorities of existing local DRM/DRR plans. Find synergies (e.g. objectives and specific actions targeting climate-related disasters), and ensure that: (i) objectives of DRM plans and local resilience action plans are not contradicting; (ii) specific actions are coherent and aim at achieving common goal. Remember, when a township has a DRM/DRR plan, this makes it less vulnerable (because this suggests higher capacity of the township to face disasters), and hence supports the resilience-building efforts. Therefore, developing disaster risk management/reduction plans could be viewed as a specific action under local resilience plans. This in turn opens more opportunities for funding DRR activities listed in climate resilience plans.
- Raise awareness of DRR authorities on the need of integrating changing disaster risk and uncertainties into DRR/DRM planning. For instance, promote the use of climate change data in disaster risk assessments, and strengthen the collaboration between DRR and CCA authorities (including hydro-meteorological institutions) for knowledge and information sharing.

4. Structure and content of a Local Climate Resilience Action Plan

Once the priority actions have been identified, township officials can develop climate resilience plan (Table 2). Based upon vulnerability assessment results and strategic planning exercise, the plan should also be linked to a selected scenario for 2050 (e.g. business as usual, low investment or high investment)[17].

Table 2 Suggested structure and content of a Local Climate Resilience Action Plan

Section	Content
Executive summary	Brief overview of purpose, objectives and key issues
1. Introduction	The introductory chapter could set the background, purpose and objectives, as well as key principles. Brief outline of the strategic planning process could also be highlighted, including who was involved and how. Description of key agencies responsible for developing the plan could be added.
2. Township vulnerability profile	Summary of vulnerability assessment results and scenarios for 2050
3. Strategic vision	Overview of agreed Strategic Outcomes, Expected Results and Adaptation Actions. This section should make link to the selected scenario.

[17] Refer to: ECD, MCCA (forthcoming, 2017). Climate Change Vulnerability Assessment Manual: Methodological Framework for Townships of Myanmar.

4. Action plan	The information in this chapter could be presented in the form of a table, which contains Strategic Outcomes, Expected Results, Adaptation Actions with Annual Targets, and respective Strategic Indicators for measuring results.
5. Implementation and monitoring	Overview of institutional arrangements for implementation and monitoring Description of the mechanism for monitoring, reviewing and updating the plan Finance strategy (i.e. how CCA activities will be financed) Communication and public awareness strategy (i.e. how activities and results will be communicated to the wider public and stakeholders)
Annexes	Any relevant information such as glossary of terms, list of implementing agencies, or the vulnerability assessment report

IV. From adaptation planning to implementation

Building resilience to climate change and hazards requires comprehensive policy response and actions. Identified ecosystem, socio-economic and infrastructure strategic outcomes and specific actions can build resilience only if they are seen and implemented as a whole set of necessary measures. This means that diversifying local economy without rehabilitating infrastructure and protecting nature cannot make communities less vulnerable to climate change.

Vulnerability of townships, communities and individuals is changing over time. Therefore, planned adaptation actions should be revised and updated at least every five years (including re-examining vulnerability assessment studies).

Engaging communities in implementation of CCA activities (and in maintenance of new or upgraded infrastructure) could: (i) reduce the cost of intervention); (ii) increase the sense of ownership of communities; and (iii) strengthen their knowledge and skills on how to cope and adapt to changing conditions.

Financing adaptation is often challenging. However, there are many low-cost solutions, particularly for community-based adaptation that should be explored when planning and implementing adaptation measures. Some examples: use of traditional knowledge, and those practices and local materials suitable to build resilience of communities; raising awareness of communities on the importance of forests and supporting them to implement tree-planting small projects.

In addition, townships could consider the following financing options:

- International climate finance mechanisms and development donors: in collaboration with national government and international partners, local governments can benefit from the Adaptation Fund, the Global Environment Facility, the Green Climate Fund, and the Warsaw

International Mechanism for Loss and Damage associated with Climate Change Impacts; or seek financing from various bilateral and multilateral donors.

- National and local budgets: setting annual budget allocations for planned adaptation.
- Attracting direct investments in township resilience projects such as new green industries, which could reduce dependency on agriculture while creating jobs; or renewable energy projects that could limit deforestation practices.
- Promoting public-private partnerships in various sectors such as communications, insurance, transportation.
- Community level opportunities such as community savings groups and locally managed funds; and improved access to small credit and microfinance for community adaptation plans and hazard risk transfer.

ANNEX Long list of local climate change adaptation options

A.1 Agriculture Sector (including crops, fisheries and livestock sub-sectors) and Food Security

	Proposed adaptation measures	Area of action/ type of activity
Crop production	Improved soil management: · Promoting conservation tillage techniques (e.g. no-tillage and use of residue to preserve soil moisture and prevent soil erosion). This technique might not be suitable for all types of crops. · Applying integrated nutrient management (balanced and optimal use of organic and mineral nutrients). This technique requires prior soil and plant analysis to determine nutrient deficiencies. · Introducing inter-cropping and crop-rotation techniques (e.g. in fields used for cash crops) · Promoting organic farming · Windbreak trees prevent from soil erosion and offer additional benefits (e.g. shade and fodder for cattle)	ecosystems/ management (and research)
	Improved crop management and production: · Promoting crop diversification (i.e. adding new/alternative crops to agricultural production) · Introducing new crop varieties resistant to environmental stress (e.g. flood-, drought-, heat- and salt-tolerant varieties; varieties with a shorter growing cycle) and improving the access of farmers to seeds. · Ecological pest management through integrated crop, soil and pest management · Improved storage of seeds and grain · Developing local risk maps for agriculture to support adaptation planning	socio-economic/ management (and research)
Water management	Climate-resilient infrastructure: · Introduction of sprinkler and drip irrigation (for dry areas, drip irrigation is considered more suitable than sprinkler), focusing also on small-scale community-managed irrigation schemes · Rainwater harvesting (particularly suitable technology for areas where surface and groundwater resources are scarce) · Improved irrigation canal and drainage systems (e.g. building dykes could help to drain away excess water and allow farmers more control over water levels in their	infrastructure/ investment

	fields)	
	Improved water-use management at the farm level through: · Establishing water user groups/committees · Introducing alternate wetting and drying irrigation for rice (periodic drying and re-flooding of a rice field), which saves water and reduces greenhouse gas emissions while maintaining yields. · Trainings on water management and maintenance of water infrastructure	infrastructure/ management and capacity-building
Livestock	· Selective breeding of animal species · Planning for animal feed and pastures when rehabilitating degraded crop land · Planning climate resilient water supply for livestock (water requirements, access points, etc.) · Supporting farmers to build safe shelter for animals and storage of animal feed (disaster preparedness)	socio-economic/ management
Fisheries	· Investing in community-scale aquaculture and building community capacity (e.g. provide training, support the formation of aquafarm management committee, support the selection of species that thrive in local conditions) · Improve the access of fishermen to microfinance/loans (e.g. for buying fishing nets, boats)	socio-economic/ investment
	· Raising awareness on sustainable fishing, as well as on illegal and chemical fishery (e.g. through workshops, fliers, signs and radio broadcasts) · Develop fishing calendars and enforce laws/regulations	ecosystems/ management and capacity-building
Farming systems and household food security	Diversifying farming systems by promoting: · Mixed farming (integrated crop and livestock farming system) · Agroforestry practices (mixed farming of trees, non-tree crops and/or animals) · Integrated farming by combining fishing, crops production, forestry and/or livestock (e.g. combining rice and fish farming) · Household gardening to increase food security and diversify income	socio-economic/ management
Capacity-building	Improved capacities of townships and farmers to sustain agricultural production: · Building technical capacities of townships for testing innovative, climate-resilient agricultural techniques and crop varieties · Training of farmers on various climate-resilient practices, as well as on quality seed storage/preservation · Training of farmers on how to develop seasonal crop calendars for changing hydro-meteorological patterns · Promoting mechanized production by developing finance schemes for farmers and providing training on maintenance and operation · Increasing the access of farmers to climate risk information (e.g. seasonal forecast), and raising climate change awareness of communities	socio-economic/ capacity-building

	· Forming cooperatives at the community level in agriculture, livestock and fisheries sub-sectors for improved access of producers to markets and sustained natural resources utilization (e.g. by providing trainings and establishing clear rules/regulations)	
Finance and insurance	· Improving access of small producers to finance and insurance · Investing in agriculture-related processing industries to create jobs and diversify local economy (based upon prior value-chain analysis)	socio-economic/ investment (and research)
Disaster risk reduction	· Undertaking measures against floods and saltwater intrusion by engaging communities in implementation of activities, as well as providing trainings on maintenance. Those include building sandbanks or embankments, and planting mangroves (in coastal areas), among others.	infrastructure/ investment and management
	· Increasing food storage and stockpiling capacities of communities · Conduct capacity-building activities for establishment of community-run climate monitoring and disaster early warning system (e.g. for slow-onset disasters such as droughts, and rapid-onset disasters such as floods)	socio-economic/ capacity-building

A.2 Environment, ecosystems and tourism

	Proposed adaptation measures	Area of action/ type of activity
Marine and coastal ecosystems	Conservation and restoration of mangroves, which provide protection against climate hazards, as well as breeding and feeding grounds for fish and other aquatic species: ▪ Adopt community-based approach to restoration, management and protection of mangrove forests. ▪ Raise awareness of local communities to prevent over-extraction, and promote sustainable forest use. ▪ Work with cooperatives for conservation.	ecosystems/ management and capacity-building
	Strengthen policy and regulatory measures for protection of marine ecosystems: ▪ Increase patrols and enforce laws/regulations to prevent cutting of mangroves, and illegal activities such as chemical and electric shock fishing, as well as overharvesting of fish stocks. ▪ Expand protected zones along the coast, and strengthen land tenure regulations to prevent land seizing from foreign and domestic developers.	ecosystems/ capacity-building
Inland water resources	Promote health of rivers: ▪ Enhance riverbank vegetation (e.g. trees plantation): reduces riverbank erosion, controls run-off, and protects communities against upstream flow regime variation, flash floods, sea level rise and storm surge. ▪ Restore ecosystem balance in lakes (e.g. Inle Lake) through conservation initiatives, control of pollution from agriculture, and awareness-raising of local communities.	ecosystems/ management and capacity-building
	Promote health of wetlands, which are important habitats for biodiversity and provide water purification and groundwater recharge services: ▪ Control nutrient and fertilizer pollution from agricultural areas located upstream of the wetland by encouraging use of organic fertilizers. ▪ Enforce laws and regulations, and fence wetlands to prevent land encroachment and agricultural use during dry season.	ecosystems/ management and capacity-building
	Sustain quality and recharge of groundwater: ▪ Conduct research on groundwater aquifers. ▪ Enhance forestry and vegetation cover to induce groundwater recharge. ▪ Introduce artificial recharging projects in over-exploited areas. ▪ Improve groundwater use efficiency.	ecosystems/ research and management
	Manage watersheds for water quality and quantity control: ▪ Introduce integrated water resources management, i.e. managing water, land and related resources usually at a	ecosystems/ management

	river basin scale. Such approach promotes the coordinated development and management of water and other resources to maximize the economic and social benefits without compromising the sustainability of vital ecosystems. · Implement small-scale watershed management projects, which aim at reducing risks (e.g. improved storm water run-off from agricultural and urban areas) and enhancing health of ecosystems (such as to reduce pollution from various human activities, and to prevent deforestation and soil erosion). · Implement reforestation projects and/or reduce upstream deforestation: This has a myriad of benefits, including preventing flash floods downstream by reducing storm water run-off from upstream areas, preventing landslides, replenishing groundwater supplies, and preventing erosion. · Enhance forestry and mangroves downstream: This slows sea level rise and buffers storm surge, in turn preventing saline intrusion to ground- and surface water sources.	
Forests and mountain (hilly) regions	Protect and enhance forests: · Promote community-based forestry. · Increase electrification rate/provide alternative sources of energy such as solar power cook stoves, to reduce reliance on firewood and charcoal for energy generation. · Adopt practices on sustainable management and conservation of forests, e.g. through REDD+ (Reducing Emissions from Deforestation and Degradation) projects. · Enforce strict laws and regulations against illegal commercial logging, and conversion of forests to agricultural land, and unsustainable practices such as 'slash and burn'. · Promote community-based wildfire management, e.g. establishing and training ranger groups. Reduce the erosion and landslide risk in unstable hillsides: various mitigation actions could be implemented such as shrubs/trees plantation, construction of drainage systems, and sustainable use of land for agriculture.	ecosystems/ management and capacity-building
Drylands	· Enhance local level capacities to prevent occurrence of wildfires resulting from heat waves and droughts. · Establish community-based wildfire management (e.g. ranger groups) · Enhance forestry: in dry areas, this can provide a myriad of benefits including preventing soil erosion and retaining nutrients in soil, provide canopy cover, recharge groundwater, prevent flash floods and excessive sedimentation downstream.	ecosystems / management
Tourism	· Promote community-based ecotourism, which is "a form of ecotourism where the local community has substantial control over, and involvement in, its development and	ecosystems / management and research

	management, and a major proportion of the benefits remain within the community."[18] · Employ tourism as a tool to enhance management of protected areas, and alleviate environmental pressures from unsustainable forms of commercial agriculture. · Conduct destination specific vulnerability assessments and adaptation strategies, and integration climate change knowledge into destination plans.	
Environmental monitoring for improved resilience	· Improve monitoring of key environmental indicators at the local level such as climate parameters, soil properties, erosion and sedimentation, water quality, vegetation cover, health of forests. Specific actions could be focused on strengthening technical and human capacities of townships (e.g. delivering computers and creating monitoring database, trainings, etc.). · Engage academia in developing environmental monitoring systems and conducting policy-oriented research.	ecosystems/ capacity-building and research

[18] The International Ecotourism Society (2006) Community-Based Ecotourism in Asia Pacific: Best Practice Stories and Resources

A.3 Energy, transport and industry sectors

	Proposed adaptation measures	Area of action/ type of activity
Energy	Introduce new energy sources at the township level: ▪ Provide solar panels on the village level to generate and distribute electricity to households. ▪ Construct new/renovate existing mini-scale hydropower dams: This is particularly well-suited for hilly and remote areas with abundant water resources, where the expansion of an electricity grid across the rugged terrain to distribute to a scattered population poses a challenge. This action can be implemented by communities. ▪ Where resources are available, introduce large energy infrastructure such as hydropower, wind and tidal energy. This involves studying suitable locations, considering environmental and social impacts, and installing facilities, infrastructure and a distribution system.	infrastructure / management
	Introduce diverse energy sources at the community/household level: ▪ Introduce renewable energy to communities: for example, community kitchens, cook stoves and solar panels can improve access to energy in rural communities, and at the same time help to reduce greenhouse gas emissions by preventing deforestation for firewood. ▪ Conduct a willingness to pay survey that could help communities gain a sense of ownership ▪ Training should be provided so that the communities can adequately maintain and repair facilities.	infrastructure/ management and capacity-building
Transport	Take a community-driven approach to upgrade road transportation and infrastructure: improving road and bridge infrastructure will improve access to markets and services for people in isolated communities, making them less vulnerable during and after extreme weather events. ▪ Construct/restore bridges, renovate roads and footpaths. ▪ Construct and renovate culverts and course ways. ▪ Restore drainage systems to clear away culverts and sites of stagnant water from floods.	infrastructure/ management and research
	Improve river transportation: With heavy rainfall and sea level rise hindering connectivity, improved water transport will enable people in rural areas to trade and access services more effectively, thus reducing their vulnerability. ▪ Improve boat transport, including boat conditions and river routes. ▪ Plant riverbank vegetation to reduce the impacts of upstream flow regime variation, sea level rise and storm surge.	infrastructure/ management
	Introduce public transportation, to improve people's access to	infrastructure/

	markets and services: ▪ Buses and mini-buses are affordable and easily implementable options which also create jobs. ▪ Where there is need and resources are available, light rails might also be considered.	management
	Adopt planning practices, including transportation planning: ▪ Adopt integrated spatial strategic planning: a coordinated effort to involve or integrate transport in the planning process, especially land-use planning, to reduce the costs of transportation. ▪ For medium to large cities: develop a comprehensive urban transport plan. This can address, for example, strengthening road maintenance and improvement, public transport development and traffic management, in the short-, medium- and long-term. ▪ Conduct risk assessments for high risk regions (e.g. sea level rise or landslide risk assessment).	infrastructure, socio-economic/ management
Industries	Build capacity of large-/medium scale enterprises: ▪ Awareness-raising in the private sector: companies should be informed on the climatic threats (e.g. implications of climate change for agricultural products and raw materials). ▪ Encourage business planning with early climate change adaptive planning and investment (which will attract partnerships with foreign companies that do have a strategic long-term outlook). ▪ Create enabling environment for investments in climate-/disaster-resilient and energy efficient production.	socio-economic/ capacity-building and investment
	Encourage and build capacity of Small and Medium Enterprises: ▪ Form microfinance organizations to provide loans for small medium enterprises: This would enable people to be less reliant on agriculture and increase their income in other sectors. ▪ Provide/improve access to loans and necessary skills (training). ▪ Provide capacity development to microfinance clients, institutions, regulators, investors and private banks.	socio-economic/ capacity-building and investment

A.4 Human Settlements and the Built Environment

	Proposed adaptation measures	Area of action/ type of activity
Housing	Build resilience: · Adopt disaster resilient design and building techniques: Provided adequate training on construction and maintenance, residents can build their homes themselves using local materials, and traditional building methods that are adapted and resilient to climate change impacts. · Use legislation to promote sustainable construction or other measures for the adoption of energy efficient and disaster resilient technologies (e.g. adopt the Myanmar National Building Code in building construction).	infrastructure/ management and capacity-building
	· Conduct study on willingness to pay for retrofitting: informs decision makers on how much people are willing and able to pay to upgrade their houses. This helps to plan for additional support needed for at-risk communities.	infrastructure/ research
Infrastructure and basic services	Improve water infrastructure and services: · Improve Water Capture and Storage: This involves: (i) conducting a study on water availability in different locations to determine design interventions (e.g. upgrading ponds or building new facilities such as gravity flow piped water system, wells with overhead tank in order to provide piped water with meter to households, spring source with catchment), (ii) working with communities to install the new facilities, and (iii) training local people on maintenance. · Strategic Water Networking: This activity involves planning and designing water management systems through community consultations with the objective to improve distribution efficiency and ensure that people have access to water when they need it. · Conjunctive use of surface water and groundwater: reliance on a single source for freshwater increases people's vulnerability to climate hazards such as flooding and droughts. · Conduct Water Safety Planning to strengthen communities' capacities and capabilities for cost-effective management and maintenance of their water supply resources.	infrastructure/ management
	Improve sanitation facilities : · Construct school sanitation with toilets and hand washing facilities. Build water storage facilities for schools in drought-prone regions. · Construct and upgrade household latrines.	infrastructure/ management
	Improve waste management: as with sanitation, this will reduce human health risks in the face of extreme weather	infrastructure/ management

	events such as flooding and droughts. · Adopt integrated waste management and spatial planning. Select location not prone to hazards. Small-scale, regional landfill sites are less costly to construct and operate, and incur less transportation costs than large-scale landfills. · Use the informal sector for waste collection: Employing informal waste pickers creates jobs, saves municipalities money and protects the environment. · Introduce composting: an inexpensive process that can deal with as much as half of urban waste.	
	Adopt sustainable practices: · Introduce Green Infrastructure: An urban environment designed with green infrastructure to reduce urban heat island effects is better positioned to manage current and future climate variability and change. · Implement Sustainable Urban Drainage Systems: this is a cost-effective natural approach to managing drainage. Main benefits include preventing water pollution, recharging groundwater to help prevent drought, and reducing the risk of flooding, among others. The different techniques include green roofs; filter strips and drains; permeable surfaces and swales; infiltration devices and basins and ponds. · Conduct a willingness to pay survey to inform decision makers on how much people are willing and able to pay to upgrade their basic services such as water and sanitation. This helps to plan what additional support is needed for at-risk communities. · Extend the reach of services to ensure that the poorest and remote communities are included. · Improve management of infrastructure through awareness- raising and capacity-building activities. For instance, communities could be trained on maintenance of community infrastructure. This is essential because future climate and urban population growth will create pressure on urban infrastructure.	infrastructure, ecosystems/ management and research
City and town planning	· Conduct local adaptation planning: develop hazard risk maps (e.g. landslide, sea level rise and flood risk assessments), conduct vulnerability analysis and prepare short- and long-term local adaptation plans. · Adopt climate-sensitive land-use planning which systemically considers locations, siting, and orientation of public buildings and settlements, and introduces mechanisms to integrate additional features resulting from changes in climate to plan for new infrastructure. · For coastal settlements: adopt coastal zone management that adequately prepares for sea level rise. · Adopt cross-sectoral planning and decision-making: the impacts of climate change cut across all urban sectors, and hence coordinated actions will reduce overlap or counteracting interventions and increase efficiency.	all categories/ capacity-building

Disaster risk reduction in urban areas	Implement the Myanmar National Building Code, which regulates structural integrity for disaster resilience.	infrastructure/ management
	Implement capacity-building activities: · Conduct disaster management course trainings for township officials. · Prepare a Township Disaster Management Plan. · Raise disaster risk awareness among communities.	socio-economic/ capacity-building
	Construct and upgrade hard infrastructure: · Small infrastructure to protect from hazards (cyclones, floods, heatwaves): select most vulnerable areas for construction, and work with local designers to ensure that houses can withstand floods, strong cyclones, etc. Involve local communities in constructing the houses, and train local people on maintenance. · Build cyclone shelters than can also be used as schools/community centres: identify locations that lack both schools and cyclone shelters, and design a disaster resilient structure. Work with communities themselves to undertake construction, and to develop a local level plan to design escape routes.	infrastructure/ management
	Adopt ecosystem-based measures: communities can play a leading role in the design and implementation of these measures, and be trained to maintain the outcome. · Build bamboo river embankments, and other natural infrastructure: This can protect communities, fields and other assets from excess water, including salt water, as well as from flooding and erosion. · Mangrove conservation and rehabilitation: in coastal areas mangrove forests serve as a natural buffer protecting communities from strong winds and storm surge, and preventing erosion of the coast. · Sandbanks can be built and protected, especially together with mangroves, to protect coastal communities and agriculture from inundation. Ensure that work is done in conjunction with mangrove restoration. · In mountainous areas, enhancing forestry can help prevent landslides during heavy rain events, and prevent flash floods downstream.	infrastructure, ecosystems/ management

A.5 DRR, Health and Social Inclusion

	Proposed adaptation measures	Area of action/ type of activity
Health	Improve access to health services, sanitation and hygiene, as well as information and knowledge on health risks related to climate change: ▪ Increase awareness of climate change and health: This will enable people to undertake actions by themselves that prevent injury and disease as result of climate hazards. Awareness-raising can be achieved through community-level workshops, schools and radio broadcasts, distribution of brochures, among others. ▪ Provide decentralized health care services: Decentralized rural health care facilities could be established to ensure that all people have adequate access to healthcare, especially in rural areas where people are exposed to various climate hazards. For instance, provide mobile clinic services which have the capacity to treat diseases such as malaria, and train volunteers. ▪ Adopt interventions centred on "Behaviour Change Communication" by implementing "Participatory Hygiene and Sanitation Transformation", where communities themselves become responsible for promoting awareness and practice-improved hygiene behaviour. Construct and upgrade water and sanitation infrastructure: ▪ Improve drainage infrastructure to prevent water- and vector-borne diseases resulting from flooding. ▪ Plant trees to provide canopy cover and reduce heat-related ailments. ▪ Upgrade water infrastructure and services to prevent dehydration and water-borne diseases resulting from reduced water availability, or contaminated water supplies due to climate hazards such as flooding or droughts. ▪ Ensure adequate waste management to reduce the risk of air-, water- and vector-borne diseases.	socio-economic/ capacity-building and management
Disaster preparedness, early warning, response, recovery and reconstruction	▪ Improve housing construction to protect from floods and cyclones: Incorporating disaster risk reduction principles into housing construction will benefit people in flood and cyclone prone areas who experience frequent damage resulting from these hazards. This will reduce the risk of injury and death in extreme weather events. ▪ Develop early warning systems and evacuation routes: These will enable people to escape sudden, rapid-onset hazards such as cyclones and storm surges. ▪ Improve radio access and broadcasts: This help people to be aware of climate change and impending severe events.	socio-economic/ capacity-building and management

	Broadcast quality should also be improved to include relevant information. · Develop Flood and Erosion Control Plans: These would give the township the required knowledge to propose flood and erosion prevention and control measures to national government and external donors. · Mobilize local volunteer groups to support disaster preparedness, early warning and early response activities, and provide necessary trainings. · Promote establishment of community-run early warning systems. · Adopt community-based projects for post-disaster reconstruction and rehabilitation of homes and community infrastructure, applying "Build Back Better" principles. Provide trainings to affected communities on how to build safe houses after disaster using local materials.	
Social protection and inclusion	Diversify livelihoods to reduce people's vulnerability: households relying solely on primary economic sectors such as agriculture and fisheries risk losing their livelihoods due to extreme weather events. · Provide more access to primary and secondary education. · Provide vocational and skills training and apprenticeships, such as such as carpentry or computer skills. Target vulnerable groups such as people with disabilities and women heads of households. · Establish microcredit cooperatives and savings groups.	socio-economic/ capacity-building and investment
	Strengthen socio-economic safety nets: · Introduce job guarantee schemes: This will provide employment for people affected by disaster when other work may not be available. Involves identifying at risk population, finding labour sources and sponsoring their daily wages. · Provide access to agricultural land for people who lost their land due to climate hazards such as sea level rise and erosion.	socio-economic/ capacity-building
	Involve children in decision-making and advocacy: · Children learn why climate change is occurring, the risks they face in their communities, and the actions they can take to become resilient. · Encourage involvement of youth: Children and youth can get involved and take the lead in devising community action plans, as well as finding innovative solutions for adaptation. · Leverage social media as a tool for communicating messages to youth about climate change that lead to increased awareness.	socio-economic/ capacity-building

A.6 Education and public awareness

	Proposed adaptation measures	Area of action/ type of activity
Public awareness	Disseminate knowledge and information regarding climate change and its impacts to the public through various channels: · Conduct radio and television broadcasts with relevant information, and manage social media sites (Facebook, Twitter etc.) to reach a broad target audience in disseminating relevant knowledge and information. · Conduct trainings and workshops on CCA targeting communities and civil society groups. · Work with volunteers to reach communities and vulnerable groups, and build their capacities through trainings. · Organize youth forums to discuss issues related to climate change. · Create appealing brochures, games, short videos and materials that share climate change messages. Engage communities and representatives of vulnerable groups in developing awareness-raising materials such as women, people with disabilities and children. · Raise awareness among children: work with teachers, school administrators and local departments of education to teach lessons about climate change in the classroom. · Use school and community events to raise awareness. For example, include climate change among the topics of open day events organized by local schools. · Engage (local) media such as newspapers to reflect various climate change events and activities organized in townships to raise awareness. · Integrate climate change into school curriculum. For example, organize planting trees in schools to raise awareness of children.	socio-economic/ capacity-building
Climate-resilient and safe schools	· Plan for future climate risks when selecting sites for new school buildings (e.g. sea level rise projections; flood/landslide risk; connectivity under future climate). · Conduct risk assessments of local schools and undertake actions to make school buildings safe. · Build schools that have a double-use, e.g. as cyclone/heat-wave shelters or community centres, employing disaster-resilient design. · Build water storage facilities for schools in drought-prone regions. · Train teachers and school children on safety measures during disasters and climate extremes. · Integrate climate change into school curriculum. For example, organize planting trees by children to raise their	infrastructure/ management and capacity-building

	awareness. ▪ Improve access to information technology and communication devices such as radio, television, mobile phone, computer and internet to provide solutions to the frequent disruption of education due to extreme weather events.	

A.7 Mainstreaming gender into CCA and DRR

Proposed adaptation measures	Area of action/ type of activity
Economic empowerment of women: · Acknowledge women's contribution in the agriculture and fishing sector. · Provide support and training to women so that they can gain new skills such as business development. · Ensure equal access to credit and loans; give special attention to female-headed households. · Develop policies that support decent work and entrepreneurship for women.	socio-economic/ capacity-building and investment
Promote women's participation and leadership: · Promote women's participation and leadership in natural resources management (e.g. water and forest). · Promote women's participation and leadership in CCA in mixed groups. Raise awareness of communities on the importance of engaging women in CCA as they play a major role in the use of natural resources, securing food and income for family and contributing to community's development. · Ensure active participation of women at all stages of local adaptation planning, including vulnerability assessment, local action planning activities, implementation) and monitoring and assurance of sustainability. · Develop and distribute awareness-raising brochures to communities, which explain the relationship between gender roles and CCA planning and implementation.	socio-economic/ awareness-raising
Strengthen the capacities of women through knowledge building: · Strengthen disaster preparedness and response capacity of women, and improve their access to disaster prevention, preparedness and early warning information at the local level, targeting the most vulnerable women through trainings and awareness-raising activities. · Develop and distribute gender-focused information materials and infographics (capturing CCA and DRR activities.), by engaging women in this process.	socio-economic/ capacity-building and awareness-raising
Reduce women's unpaid workload through improved access to basic services (water, energy, sanitation)	socio-economic/ management and investment
Introduce policies/measures that enable women to have improved access/control over productive resources such as land, seeds, irrigation, credits.	socio-economic/ management
Raise awareness on the gendered dimension of CCA and ensure capacity to implement gender-specific activities. Undertake outreach activities to ensure that different stakeholders understand the gender dynamics of climate change	socio-economic/ capacity-building and awareness-raising

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