CAMBODIA 2040

ECONOMIC DEVELOPMENT

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Chapter 8 | Environment and Climate Change

Mr. OUNG Ty Keithya

If we can work towards a positive outlook for climate change adaptation and mitigation in Cambodia, what would it look like?

Ms. Sothy is a middle-aged woman from a farming household based in a rural village of Kampong Cham province. Her family is practicing crop diversification for their farmland. Primarily the family grows rice, utilizing a drought-resistant seed, as their main source of income. In addition to rice, they also use plots on their farmland to grow other crops such as tomatoes, pumpkins, mangoes, and cassavas. During April, whilst her village is going through a long dry season with very little rainwater, Sothy waters her farm through the irrigated pipelines. The water supply available for this process is being pumped from a communal village water storage. This irrigation and storage system was installed and supported by district authorities, alongside the farming committee in her province. To power her farm, Sothy uses a biodigester in which she inputs waste from farm, both animal manure and farm waste. In return, the biodigester provides her with biogas for clean cooking, and organic fertilizer for better crops and healthier soil. Most households in her village also use this type of clean energy because it is affordable.

In the afternoon, Sothy attends a community meeting as she is an active member of the farming committee in her province. The committee organizes bi-weekly meetings and trainings to help educate farmers about the issue of climate change, in addition to training them in up-to-date agricultural and

adaptive techniques. Through these community meetings, trainings and practices, Sothy's family and many of her neighbors have been well-informed about Climate Change and have strong adaptive capabilities in terms of agriculture, water and food security.

Later in the evening after the meeting, Sothy prepares her schedule for tomorrow as she has to participate in a community forest program with her neighbors to help preserve the forest near her village. In exchange for their efforts towards preserving forest land, Sothy and her family receives quarterly remuneration towards household bills. The family is able to save some of that money to buy and install solar panels.

I. Environment and Climate Change: The Ideal Scenario

When forming ideal scenarios for Cambodia regarding climate change, it must be pointed out that the kingdom is one of the most vulnerable countries in the world to the impacts of climate change despite it being among the developing nations that contribute the least to emissions of global greenhouse gases (GHG). According to USAID, Cambodia's total GHG emissions in 2013 were 51.67 million metric tons of carbon dioxide equivalent (MtCO2e), a mere 0.11% of the global total (USAID, 2017). The kingdom, however, ranked 13th in the Global Climate Risk Index from 1995-2015, and eighth in the World Risk Index 2016. In 2014, Standard and Poor's ranked Cambodia's economy as the most vulnerable in the world to the effects of climate change (NCSD, 2017).

However, if changes to the global climate are minimal (see "Global Factors" in "Section 2: Scenario Space and Key Factors), the impacts on vulnerable countries like Cambodia can also be expected to be less severe. In this regard, positive outlooks in 2040 for Cambodia in terms of climate change adaptation can certainly be imagined. The following are key factors in reaching the ideal scenario for Cambodia regarding climate change in 2040.

Program and Policy

By 2040, an effective, comprehensive, and fully functioning Cambodia Climate Change Strategic Plan (CCCSP)[24] will have been put in place by the Royal Government of Cambodia (RGC). The CCCSP 2014-2023 will have been updated and thoroughly reinforced and re-mandated to match the country's development pace, directions, and priorities, and will have gone hand in hand with its efforts to meet its Sustainable Development Goals (SDGs). The RGC will have taken full ownership of the CCCSP, with support from local and international partners. The program will be fully in force, with supporting policies and regulations from the relevant ministries and departments in place. With regards to adaptation programs, the National Adaptation Program of Action (NAPA) will have been tailored to fit all development situations and adaptation needs for each of the 24 provinces and Phnom Penh. Implementation will have been decentralized, with the local authorities at all sub-national levels—district, commune, and village—effectively carrying out adaptation programs for their communities and people.

Community and Agriculture

By 2040, communities in all provinces and the capital will be resilient to the impacts of climate change. They will have a broad knowledge of climate issues and will be well-apprised of adaptation methods. Farming communities especially will be well versed on using drought-resistant crops. Communities will be adequately irrigated and have water storage systems in place in anticipation of severe dry seasons and droughts. With effective irrigation systems and drought-resistant agricultural techniques, communities' adaptive capability will have increased, with them more resistant to water vulnerability and food security issues. Additionally, each province will have a weather-forecasting center in place to predict local weather conditions and impending natural

[24] Cambodia Climate Change Strategic Plan (CCCSP) is the first-ever strategic plan produced by the Royal Government of Cambodia to mainstream climate change policies into National Strategic Development Plan (NSDP) to have a national response to climate change adaptation from all relevant ministries and government institutions.

disasters such as floods and powerful storms. Communication systems between the provincial and local authorities will be well connected to ensure communities have effective early warning systems in place.

Land Management and Forestry

By 2040, the RGC will have effectively and sustainably developed its land management master plan. The relevant ministries will have worked together effectively to have found a sustainable balance in land use management, classifying land for development and land for conservation. The management of economic land concessions (ELCs) will have been substantially improved through necessary amendments to the Land Law. Potential investors will have been thoroughly scrutinized and audited to ensure a legitimate and sustainable business plan was in place before being granted an ELC. Existing ELCs will have been rigorously reviewed before being allowed to resume activities. Under the new law, the ELC period will have been reduced, and if developers are not abiding by the law, their status will be revoked and permanently canceled. The RGC will have identified feasible measures for sustainable land use management dedicated to effective forest conservation. Cambodia will also be participating in international and regional carbon trading schemes. The RGC will have fully developed and implemented its national Reducing Emission from Deforestation and Forest Degradation (REDD+) programs, sharing the benefits sustainably with deserving beneficiaries and communities.

Awareness and Behavior

By 2040, the majority of the Cambodian population will be well informed on climate change issues. Public awareness of the issue will have gradually translated into positive behavioral changes, with most people now concerned with reducing their carbon footprint. With infrastructure having been improved and public transport made widely available, an increase in the use of public and mass transport systems over personal vehicles can be expected. With increasing economic growth, middle and upper-income families will have likely adopted greener energy solutions in household use, installing solar panels in their homes, for example. With public awareness resulting in a focus on reducing the carbon footprint per capita, more environmentally friendly lifestyles can be

expected, if not from the majority of the population then at least from the middle and upper-income bracket that can afford to do so.

Business and Industry

By 2040, Cambodia will have in place sustainable trends in manufacturing and the private sector. "Green" business models will have emerged that will have set the new norms for companies and start-ups. Producers will prioritize raw materials from sustainable sources as resources become increasingly scarce. Production processes will be structured to minimize environmental impacts, waste outputs and carbon footprints. Most manufacturers and producers will have switched to sustainable energy sources, especially renewable energy from solar, hydro, biomass and wind sources. Such business models will be encouraged by the government, with the support of the public. The government will incentivize businesses and industries to put in place sustainability plans and environmentally friendly practices, with Cambodian consumers putting greater value on products and services from sustainable sources. Sustainable business will become the new norm for the private sector in Cambodia.

With these ideal scenarios in place, Cambodia can look to having a net zero carbon footprint and being a carbon-neutral country by 2040. While this may seem a bold target, the Cambodian government at all levels and people from all income brackets and societal statuses could work together to lay out a 20-year nationwide master plan for the kingdom to not only adapt to climate change, but also reduce its carbon footprint and become carbon neutral by 2040.

II. Scenario Space and Key Factors for Environment and Climate Change

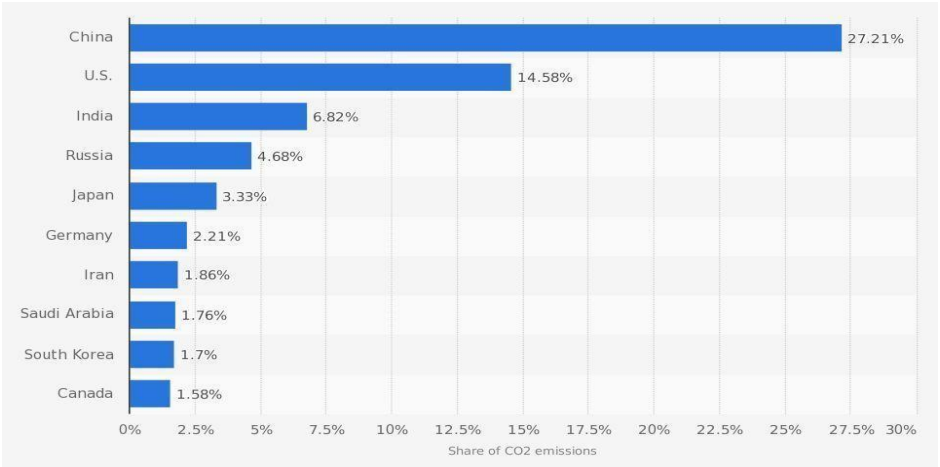
Before moving toward the proposed roadmap, with policies and interventions put in place to progress the kingdom toward the ideal 2040 scenario as outlined in Section 1, the key factors influencing the Cambodian context regarding climate change should be outlined. In addition to the key factors outlined in Section 1, Section 2 includes global factors that could have policy implications for the government.

Global Factors

In creating a climate change vision for Cambodia in 2040, global climate change trends cannot be omitted from the discussion, as they impact the national situation in both the short and long term. Cambodia can therefore only have an optimistic outlook with regard to climate change if the global effort moves in a positive direction.

Let's imagine that international efforts have by 2040 been able to keep the global temperature rise to well below 2°C above pre-industrial levels, with efforts taken to limit the increase even further to 1.5°C as committed to in the Paris Climate Agreement of 2016. This will have meant that all of the 194 signatories have adhered to the targets set in their Intended Nationally Determined Contributions (INDCs).[25] Most importantly, the major GHG emitters, China, the United States, India, Russia, and Japan (Germanwatch, 2017), will have consistently remained committed to reducing their GHG emissions.

Figure 1: Largest producers of territorial fossil fuel CO2 emissions worldwide in 2017, based on their share of global CO2 emissions.



Source: Germanwatch, (2017)

[25] INDCs: refers to the nationally determined contributions which each country sets their own targets to contribute to climate change mitigation effort. INDCs is one of the key tools to achieving 195 signatories to a climate agreement for the first time.

China will have had to have remained fully committed to reducing its carbon footprint. This might not be as unlikely as previously thought, with the Chinese government ratifying the Paris Agreement and actively promoting and heavily investing in renewable energy such as hydro, wind and solar power (Engels, 2018 & Hsu, 2018). However, the Chinese Ministry of Environment will need to double its reduction efforts as pressure mounts internally from the pollution problems plaguing China's major cities. China needs to start taking real action, not only for the globe, but for the well-being of its own citizens.

China taking a leadership role in climate change mitigation efforts will hopefully compel the United States to take strong action. One major factor that could allow for this is the 2020 presidential elections, which could see a new president in the White House representing a new administration that strongly supports climate change mitigation. Most importantly, a new administration could see the US rejoin, sign, and ratify the Paris Agreement, and lay out nationwide strategic plans to transform a heavily fossil fuel-reliant economy into one based on renewable energy.

Notwithstanding action from the two heaviest GHG polluters, China and the United States, which currently account for around 41% of total global GHG emissions, other countries such as India, Russia, and Japan will need to take steps to tackle climate change.

Japan is already working on a long-term strategy to decarbonize and has set the ambitious net zero emissions target of 2050 (Hurst, 2019). With millions of its people highly vulnerable to climate change, India is on the front line regarding the effects of climate change, with violent heatwaves killing thousands, especially in low-income communities (Awasthi, 2018). India is therefore also working hard nationally to tackle climate change. With the creation of additional carbon sinks of forests and tree cover, India could reach its Paris Agreement commitment ahead of its 2030 deadline (Sethi, 2018). Russia, despite being one of the signatories of the Paris Agreement, has yet to formally ratify the framework. However, there had been some recent positive signs that Russia was closer to ratifying the agreement by the end of 2019 (Ayres, 2019), possibly to fill

the climate change leadership void left by the US after its withdrawal from the Paris Agreement.

Aside from these major emitters, there is also a need for united and global responses from all nations to significantly reduce CO2 emissions to keep the global temperature well below 2.0°C above pre-industrial levels.

With the aforementioned commitments and actions taken by the major GHG polluters, a huge reduction in global emissions can be expected by 2040. According to Intergovernmental Panel for Climate Change (IPCC) scientists, if the global temperature remains at 1.5°C above pre-industrial levels rather than 2.0°C, many climate change disasters (IPCC, 2018) could be avoided. In the long term, if the global temperature were to remain at this level for decades, it could be possible for the damaged environment to regenerate.

Ice sheets in the Arctic, Antarctica and Greenland could reform and sea levels remain stable, with islands and low-lying areas avoiding devastating flooding. Ocean warming and acidification could slow, and vulnerable marine ecosystems such as coral reefs could begin to revive; desertification could slow and forest cover regrow. Ecosystems could find a healthier balance, with plants and species again thriving in their habitats. As for humankind, future generations would be able to enjoy a beautiful and non-hostile planet.

National Factors

With regard to national factors and contexts, this section will outline the situation regarding key factors: (i) Program and Policy; (ii) Community and Agriculture; (ii) Land Management; (iv) Awareness and Behavior; and (v) Business, which will provide an overview of the climate change issues Cambodia is currently facing.

Programs and Policy

There are two main ongoing policies proposed and being implemented by the RGC in response to climate change issues. The CCCSP and Cambodia's INDCs represent the most prominent action plans and documents outlining key national efforts in climate change adaptation and mitigation.

Cambodia Climate Change Strategic Plan: The RGC has made impressive progress since 2013 in mainstreaming climate change policies through establishing the first CCCSP 2014-2023 (NCCC, 2013). It represents significant progress as "the CCCSP is a significant step toward embedding climate change into the National Strategic Development Plan (NSDP) 2014-2018 and sectoral development plans of all relevant ministries," said Prime Minister Hun Sen in 2013 (NCCC, 2013).

The integration of the CCCSP into the NSDP and sectoral planning aims to mainstream climate change policies into national and sub-national planning. At the ministerial level, up to 2016, three ministries, the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Water Resources and Meteorology (MOWRAM), and the Ministry of Public Works and Transport MPWT), successfully incorporated climate change into their planning and budget processes (NCSD, 2017).

The CCCSP lays out eight strategic objectives:

1. Promote climate resilience through improving food, water, and energy security;
2. Reduce sectoral, regional, and gender vulnerability to climate change impacts, and minimize risks to health;
3. Ensure the climate resilience of critical ecosystems (the Tonle Sap, the Mekong River, coastal ecosystems, and highlands, etc.), biodiversity, protected areas and cultural heritage sites;
4. Promote low-carbon planning and technologies to support sustainable development;
5. Improve capacities, knowledge and awareness for climate change responses;
6. Promote adaptive social protection and participatory approaches in reducing losses and damage due to climate change;
7. Strengthen institutions and coordination frameworks for national climate change responses; and
8. Strengthen collaboration and active participation in regional and global climate change processes.

Cambodia's Intended Nationally Determined Contribution: The RGC has also outlined climate change policies as part of its commitment to the global GHG mitigation effort by submitting its INDCs as required by the Paris Agreement. Cambodia's INDCs are divided into two main parts: adaptation and mitigation.

Adaptation: The document proposes priority action for adaptation planning, which mainly includes:

- Promoting and improving the adaptive capacity of communities, especially through community-based adaptation action, and restoring natural ecological systems to respond to climate change;
- Implementing management measures for protected areas to adapt to climate change;
- Strengthening early warning systems and climate information dissemination;
- Developing and rehabilitating flood protection dykes for agricultural and urban development;
- Increasing the use of mobile and permanent pumping stations in response to mini-droughts, and promoting groundwater research in response to drought and climate risk;
- Promoting aquaculture production systems and practices that are adaptive to climate change;
- Repairing and renovating existing road infrastructure, and ensuring effective operation and maintenance, taking into account climate change impacts;
- Strengthening technical and institutional capacities in conducting climate change impact assessments and climate change projections, and including climate change in sectoral and sub-sectoral development plans.

Mitigation: According to its submitted INDCs, "Cambodia proposes GHG mitigation contributions for the period of 2020-2030 conditional on the availability of support from the international community […]."

In the proposal, "Cambodia sets out two major actions:

i. **Energy, Manufacturing, Transport, and Other Sectors:** A proposed reduction of 3,100 GgCO2eq compared to baseline emissions of 11,600 GgCO2eq by 2030; and

ii. **Land Use, Land Use Change, and Forestry (LULUCF):** Voluntary and conditional actions to achieve the target of increasing forest cover to 60% of national land area by 2030, which is expected to reduce 7,897 GgCO2 by 2030 compared to projected sequestration of 18,492 GgCO2 in 2016" (RGC, 2015).

Community and Agriculture

The agriculture, forestry, and fisheries sectors are highly dependent on climate and accounted for 26% of Cambodian GDP in 2012 (World Bank, 2015). These sectors also represent the livelihoods of the majority of the rural population (79% of the total population). According to a 2014 climate vulnerability assessment[26] on Cambodian communities conducted by the Mekong River Commision (MRC), 17.2% (279 communes) of Cambodia's communes were highly vulnerable, while 31.5% (512 communes) were quite vulnerable to multiple climate change hazards (MRC, 2014).

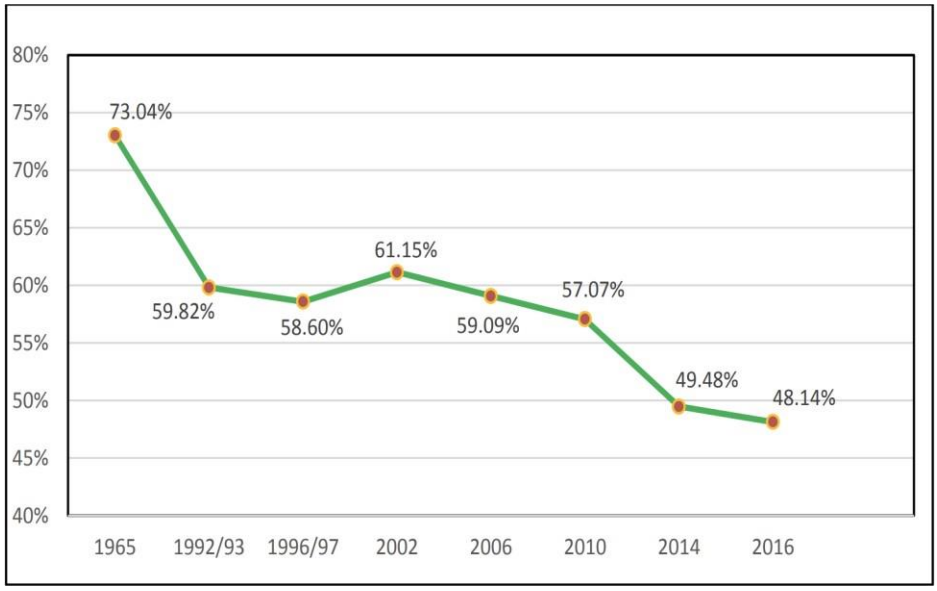
Extreme weather events are also being intensified by climate change, damaging the agricultural sector as losses in production were mainly due to flooding (around 62%) and drought (around 36%) based on data from the past 20 years (NCSD, 2017). These natural hazards are predicted to become more frequent, and the poor are likely to be the hardest hit. Poor physical infrastructure and irrigation systems, combined with weak health care systems, poverty, and high rates of illiteracy, will leave the underprivileged the most vulnerable to climate change (NCSD, 2017).

[26] The vulnerability assessment determines vulnerability through three components: (i) Exposure: the nature and degree to which a system is exposed to significant climatic variations; (ii) Sensitivity: the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli; and (iii) Adaptive Capability: dynamic and influenced by economic and natural resources, social networks, entitlements, institutions and governance, human resources, and technology.

Land Management and Forestry

The kingdom has carried out eight national forest cover assessments. According to the assessments conducted by Cambodia's Ministry of Environment (MoE) from 1965-2016 (see Figure 2), forest cover has declined by around 25%, with the 2016 forest cover at 48% compared with the 73% recorded in the first assessment in 1965. Causes for the decline include civil war, population increase, and land being used for agriculture, among others (MoE, 2018).

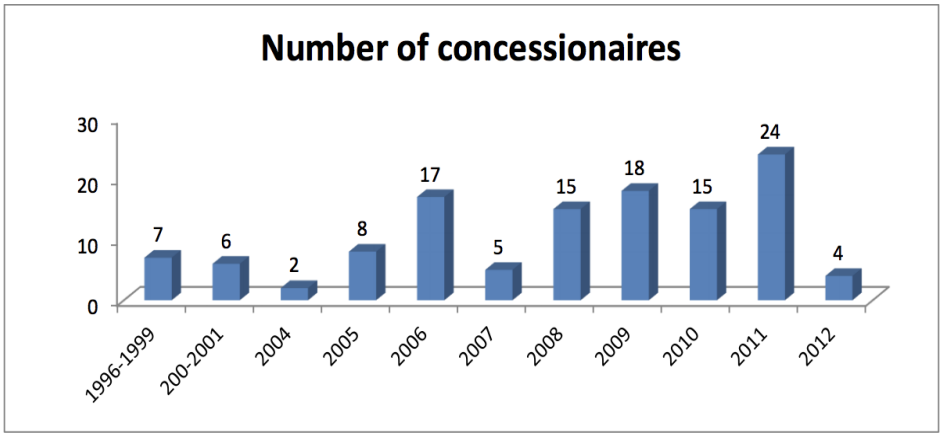
Figure 2: Forest Cover Statistics from 1965-2016



Source: MoE, 2018

Discussions on land use and forestry in Cambodia cannot exclude ELCs, as they accounted for 14% of land use (Harfenist, 2015). ELCs were formalized in 2001 as a "long-term lease that allows a concessionaire to clear land in order to develop industrial-scale agriculture, and can be granted for various activities including large-scale plantations, raising animals, and building factories to process agricultural products," according to Sub-decree No. 146 on Economic Land Concessions (2005). According to data from the Ministry of Agriculture, Forestry, and Fisheries (MAFF) (see Figure 3), 121 companies had received ELCs, with a total area of 1,204,750 hectares.

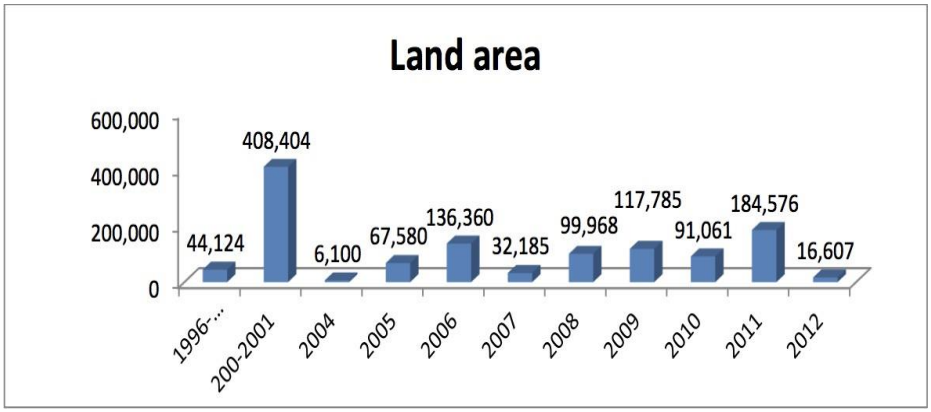
Figure 3: Number of Concessionaires Granted ELCs, 1996-2012



Source: MAFF, 2014

The data (Figure 3) indicates that the granting of ECLs peaked in 2011, with 24 companies receiving ELCs with a total land area of 184,576 hectares (Figure 4). However, the majority of ELCs were granted between 2000 and 2001, totalling 408,404 hectares (Figure 4).

Figure 4: Total Granted Land Area (in hectares)



Source: MAFF, 2014

However, in May 2012, the RGC issued Directive 001 on "Measures to strengthen and enhance the effectiveness of management of economic land concessions

(ELCs)", announcing a moratorium on the granting of new ELCs and a review of existing ones. Directive 001 resulted in a dramatic drop in the number of ELCs granted, with none issued in 2013. More than 330,000 hectares of land have been seized from ELCs to be redistributed to people in the form of social land concessions (SLCs) (ADHOC, 2014). However, the report suggested the directive also reflected a "lack of engagement in a long-term commitment to the suspension of ELCs, allowing the granting of ELCs to be resumed at any time" (ADHOC, 2014).

Awareness and Behavior

The MoE conducted two "Knowledge, Attitude, and Practices" (KAP) studies—KAP1 in 2011 and KAP2 in 2016—to gain understanding on public perceptions of climate change in Cambodia. The methodology of the nationwide studies included (i) quantitative surveys of 2,401 respondents in KAP1 and 1,000 in KAP2 across 25 provinces; and (ii) qualitative interviews; as well as 67 in-depth key informant interviews for KAP2 (MoE, 2016).

The key results include:

- "The majority of respondents considered their own and family members' health to be the most critical issue as related to climate change impacts;
- "The term 'climate change' has become slightly better known since KAP1, while 'global warming', 'greenhouse gas' and 'ozone layer' are still not well understood because of their technical complexity and problematic translation into Khmer and local minority languages" (MoE, 2016);
- An increasing number of respondents were aware that their daily activities could contribute to climate change. The activities referred to were strongly connected to agricultural production and firewood collection;
- The majority of the respondents clearly remained uncertain as to how to adapt to climate change in a cost-effective manner;
- Television, radio and word of mouth remained the key sources of information, playing vital roles in communicating details on climate change to people regardless of their socio-demographic background;

- "The press and the media only covered climate-related information when natural disasters or extreme weather events were to strike and related meetings and workshops to take place, and then only if they were funded to do so" (MoE, 2016);
- The main obstacles to the mainstreaming of climate change included a lack of financial, technical, and human resources, as well as limited local institutional capacity.

Business and Industry

Business, industry, and energy are the main sectors in a country's development. They represent the majority of manufacturing jobs and production outputs, with products and services that contribute largely to a country's GDP. They are not only the backbone of social and economic development, but also a main driver of poverty reduction for many developing nations. However, these sectors are also responsible for most of the pollution put into the atmosphere and waste into the environment. Starting from the first step of resource extraction to the final product, the whole production cycle produces harmful by-products and waste (either solid or liquid), and emits greenhouse gases and other pollutants.

According to economic analyses and research, textile and garment manufacturing and rice processing accounted for half of the industrial sector in 2007 (MIME, 2007). The textile and garment industries still represent the largest proportion of the manufacturing sector, which accounted for 31% of the Cambodian economy in 2016 (ADB, 2018).

In 2013, the MIME developed a sectoral "Climate Change Strategic Plan for Manufacturing Industry and Energy" for the implementation of "green industry initiatives" to promote energy efficiency in industry and improve environmental standards. The assessment report on these initiatives is yet to have been released by the ministry.

III: Policy Initiatives to Achieve the Ideal Scenario

The roadmap toward the ideal 2040 scenario for Cambodia regarding climate change requires nationwide collaboration between all levels of government, the public and communities from all societal levels, civil society groups, scientists

and academia, business owners, and producers and consumers. The roadmap focuses largely on Cambodia's mission to adapt to climate change (adaptation) as one of the countries most vulnerable to its effects. The kingdom also needs to look into key potential industries and areas in which to mitigate the problem by reducing GHG emissions (mitigation).

It is necessary to point out that this roadmap does not necessarily look to completely reform and renew the existing CCCSP; however, it will aim to close institutional, policy and implementation loopholes in the current plan and bridge these gaps with certain restructuring and feasibility measures. The roadmap will be divided into two parts: (i). Adaptation Reinforcement; and (ii) Mitigation Plan and Low-Carbon Development. While these are two separate missions, there are certain linkages between the two, especially with regard to resources, including the funding, technology, and human capital required to implement plans effectively.

Adaptation Reinforcement

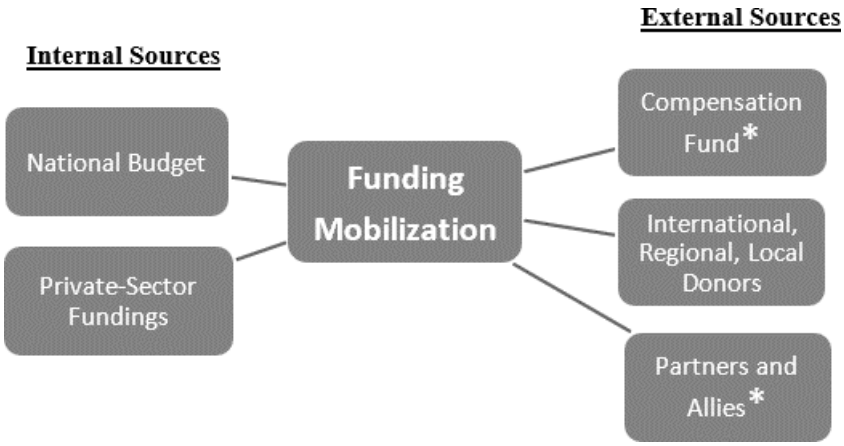
Despite comprehensive national and sub-national institutionalization and coordination, the implementation of adaptation programs and policies still encounters numerous challenges (NCSD, 2017). Thus, the roadmap aims to provide practical measures for the RGC to take to reinforce Cambodia's current adaptation programs and policy implementations for 2020 to 2040. There are four key areas in the current national strategic adaptation plan that will require increased attention and reinforcement: financing, sub-national implementations, data and science, and technology.

Financing

Adequate and sustainable funding is imperative to ensure the effective sustainability of the program. According to the MoE, financial capacity is one of the major limitations to its national adaptation program, the National Adaptation Program of Action (NAPA) (MoE, 2006). The RGC therefore needs to establish strategies and mechanisms for funding mobilization. According to the 2017 report "National Adaptation Plan Process in Cambodia" by the MoE's National Council for Sustainable Development (NCSD), there are two main

sources of funding for all national climate-related programs in Cambodia: (i) internal sources from national budget and private-sector funding; and (ii) external sources from international and bilateral donors.

Figure 5: Funding Mobilization for National Strategic Adaptation Plan



Source: National Council for Sustainable Development, 2017

*Proposed mechanism by this paper

According to the 2015 Climate Public Expenditures Reviews, one internal source of funding for climate change projects was the National Budget, with an increase from $21.7 million in 2009 to $52.7 million in 2014. Another was the private sector. It was estimated that around $185 million was invested by the private sector in climate change-related projects (NCSD, 2016). Despite the increases in funding from the National Budget and the private sector, the financing gap remains an issue for climate change projects in Cambodia. The kingdom was until 2018 around $400 million short of funding for its climate change priority projects (NCSD, 2017). The roadmap will focus on external funding sources and propose three potential mechanisms the RGC can utilize for the National Strategic Adaptation Plan.

External Sources of Funding for Climate Change Projects: Compensation Fund: Cambodia needs to form a strong coalition with other Non-Annex 1

countries.[27] This means joining with other most climate change vulnerable countries to propose to the United Nations Framework Convention on Climate Change Convention (UNFCCC) the formation of a Compensation Fund. This refers to mandatory annual funding that developed countries, particularly major GHG polluters, are required to pay to compensate the most vulnerable countries for their climate change adaptation efforts. The Cambodian government should work closely with other vulnerable nations to form a lobbying committee, either regionally or internationally, to enforce this funding proposal at the UNFCCC, especially in preparation for the Conference of the Parties (COP26) meeting in 2020.

Lobby Group: In order to successfully pitch for a Compensation Fund at international conferences, the National Climate Change Committee (NCCC) must ensure the Cambodian delegation to attend the COP conferences is comprised of skilled and highly effective negotiators. The delegation should be made up of people who can best represent Cambodia's national interests and, most importantly, who can galvanize support from fellow Non-Annex 1 Parties and lobby other COP participants in successfully establishing the Compensation Fund.

International Organizations and NGOs: Cambodia receives most of its climate change funding from international organizations or development partners such as the Asian Development Bank (ADB), the International Fund for Agricultural Development (IFAD), the World Bank, the Swedish International Development Cooperation Agency (SIDA), the European Union (EU), and UN agencies such as

[27] **Non-Annex 1 parties:** Refers mostly to developing countries. Certain groups of developing countries are recognized by the UNFCCC as being especially vulnerable to the adverse impacts of climate change, including countries with low-lying coastal areas and those prone to desertification and drought. The Convention emphasizes activities that promise to answer the special needs and concerns of these vulnerable countries, such as investment, insurance, and technology transfer.

the World Food Programme, World Health Organization (WHO), and United Nations Development Programme (UNDP) (Table 3).

They are the main financial contributors to Cambodia's climate change adaptation efforts. While the kingdom must maintain the financial commitments from these organizations, it should also request more attention to the environment and agriculture. As shown in Table 1 below, only a small proportion of NGO and development partner finance went to the agricultural and environmental sectors.

Table 1: NGO and DP (Development Partners) Support by Sectors in 2014-2017

Sector Names	2014			2015			2016			2017		
	NGO Own Fund	DP Fund	Total	NGO Own Fund	DP Fund	Total	NGO Own Fund	DP Fund	Total	NGO Own Fund	DP Fund	Total
Health	79.0	29.0	108.0	78.1	30.7	108.9	73.6	38.4	112.0	75.4	35.8	111.1
Education	54.8	8.5	63.3	47.5	10.7	58.2	59.6	8.8	68.4	52.1	7.8	60.0
Community Welfare	47.7	11.7	59.4	64.5	8.1	72.6	60.5	8.6	69.1	42.3	4.4	46.7
Rural Development	15.1	18.0	33.1	24.4	13.6	38.0	25.6	13.4	39.0	21.5	10.4	32.0
HIV/AIDS	11.6	10.4	21.9	5.6	9.7	15.3	5.5	9.9	15.4	6.1	13.8	19.9
Governance	2.9	6.3	9.3	2.2	7.2	9.4	3.3	9.1	12.4	1.7	11.2	12.9
Agriculture	7.4	7.5	14.9	7.0	7.5	14.5	12.6	6.8	19.5	8.9	3.5	12.4
Environment	6.0	6.8	12.8	4.1	9.1	13.3	6.4	9.2	15.5	1.5	2.9	4.4
Others	6.3	6.8	13.2	4.2	5.2	9.4	3.3	4.5	7.8	1.7	4.9	6.6
Total	**230.7**	**105.1**	**335.8**	**237.7**	**101.9**	**339.6**	**250.3**	**108.7**	**359.0**	**211.3**	**94.6**	**305.9**

Source: CDC, 2018

Partners and Allies: Partners and allies here refer to a "country" as an entity and the relationship and bond Cambodia has developed bilaterally. These bilateral relationships can be seen through aid and development. Each year, Cambodia receives hundreds of millions of dollars in grant aid from strategic partners such as China and Japan (see Table 2). However, none of these bilateral donors has substantially mainstreamed its development assistance to climate change. For instance, China has used only eight percent of its entire official development assistance (ODA) to Cambodia on Climate Change, while Japan has used only 14% (see Table 3).

Cambodia should request more grant aid or loans from its strategic partners toward climate change projects. Setting annual quotas such as 30-40% of total annual development aid toward climate change would greatly increase funding for climate change adaptation projects. While infrastructure projects are clearly

important and have received the most funding (CDC, 2018), investing in sustainability and climate-resilience is prudent and forward-looking with regards to ensuring Cambodia is resilient to natural disasters such as flooding.

Table 2: Official Development Assistance (ODA) Disbursement by Bilateral Donors 2008 – 2018 (in USD Million)

Development Partners	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 (Est.)	2018 (Proj.)
Australia	49.1	47.8	63.4	78.2	79.5	59.3	64.9	55.9	51.9	56.3	41.3
Canada	11.5	16.7	12.8	18.5	20.5	11.8	5.7	3.8	3.0	1.6	0.7
China	95.4	114.7	154.1	332.0	460.7	436.6	347.8	339.4	265.3	223.5	251.4
Japan	126.4	134.0	140.0	114.4	172.3	130.8	111.4	110.4	119.7	126.4	168.0
New Zealand	2.8	2.3	5.2	4.4	3.8	3.2	6.0	4.9	4.0	5.3	5.5
Republic of Korea	33.0	15.8	35.2	45.3	46.2	50.1	80.3	61.7	31.9	51.2	24.6
Switzerland	3.9	3.0	3.1	4.5	4.3	7.8	11.8	13.0	15.8	13.8	10.0
United States of America	55.7	56.9	63.3	64.4	85.0	93.5	91.6	101.0	71.1	76.0	35.7
Sub-Total: Other	**377.6**	**391.3**	**477.2**	**661.8**	**872.3**	**793.1**	**719.6**	**690.0**	**562.6**	**554.2**	**537.2**

Source: CDC, 2018

Table 3: Development Partners Mainstreaming of Climate Change in 2016-2017 (in millions of dollars)

Development Partners	2016 (Total)	2017				Total ODA Disbursement by Donors	Climate Change as % of Total Disbursement
		Minor	Moderate	Significant	Total		
WFP	16.4	-	14.1	3.3	17.3	17.3	100%
WHO	9.5	1.5	-	8.0	9.5	9.5	100%
World Bank	13.1	0.5	30.3	1.0	31.8	39.7	80%
IFAD	15.5	-	4.9	6.8	11.7	14.7	80%
UNDP	3.4	-	0.5	5.3	5.8	7.4	78%
ADB	49.2	38.1	59.9	8.1	106.1	146.0	73%
UN Women	0.7	0.3	-	-	0.3	0.5	66%
UNIDO	0.5	-	-	1.2	1.2	2.1	55%
Australia	13.3	12.0	18.9	-	30.9	56.3	55%
FAO	0.1	-	1.5	1.0	2.6	4.8	54%
Germany	9.8	4.8	4.8	0.3	9.9	36.5	27%
Czech Republic	0.3	0.1	0.2	-	0.3	1.2	23%
Canada	0.2	0.3	-	-	0.3	1.6	21%
USA	9.9	1.3	9.5	1.7	12.5	76.0	16%
Republic of Korea	5.1	7.5	-	-	7.5	51.2	15%
Japan	12.7	18.1	-	-	18.1	126.4	14%
Sweden	5.1	2.9	-	-	2.9	20.3	14%
EU/EC	8.8	0.4	6.9	0.5	7.8	59.8	13%
Switzerland	1.7	1.6	-	-	1.6	13.8	12%
France	4.9	0.9	9.0	-	9.9	103.3	10%
China	92.3	18.1	-	-	18.1	223.5	8%
Others	-	-	-	-	-	111.4	0%
Total (Exclude Pipeline Projects)	**272.5**	**108.4**	**160.5**	**37.1**	**306.1**	**1334.7**	**23%**

Source: CDC, 2018

Program and Policy Reinforcement

Within the CCCSP, national adaptation programs and policies are mainly implemented through the NAPA. As a least developed country and among the nations most vulnerable to the impacts of climate change, Cambodia is required by the UNFCCC to develop its national NAPA to establish policies and action plans on adaptation (MoE, 2006). Since its implementation in 2006, NAPA has greatly contributed to Cambodia's adaptation efforts, particularly through the promotion of resilient water management and agricultural practices in rural areas (UNDP, 2014). However, the NAPA programs still encounter challenges with technical and coordination loopholes, especially at the sub-national level (NSCD, 2017). This section aims to provide key feedback on the programs and planning processes that would enhance adaptation efforts between 2020 and 2040.

Program Localization: Adaptation programs must be localized to fit with the development situations and priorities in each community. Institutionalizing and coordinating adaptation measures has been designed with a top-down approach through the development of the CCCSP; however, each adaptation program should be designed and developed through a bottom-up approach. Policy-makers must work closely with communities to identify their vulnerabilities and environment to effectively draft adaptation measures to suit their specific concerns and needs (see the "Policy, Knowledge and Information Synergy" section to understand more). Ideally, each province should identify its most vulnerable communities, design specific adaptation methods, and assign the appropriate bodies to execute and oversee the implementation process.

Program Decentralization: To implement adaptation programs effectively, the local government working directly with vulnerable communities needs to have adequate authority and possess a sense of ownership of the program to effectively implement the adaptation measures. Moreover, the decentralization of adaptation programs to sub-national authorities would also mean setting up strong institutional frameworks on the ground and enforcing coordination between national and local government. In other words, all sub-national level authorities—provincial, district, commune, and village—must be aware of the

adaptation program for their community and of their coordination and implementation tasks and responsibilities.

Capacity Building at the Sub-national and Community Level: Decentralized adaptation initiatives will not be effective if sub-national administrators are incompetent and lack technical knowledge and expertise regarding adaptation policies. Thus, building the capacity of sub-national administrations should be carried out simultaneously with the program being decentralized. Officials at the sub-national level are the ones who work closely and connect with community leaders and members on the ground. It is therefore important to train these officials as the programs also aim to improve the adaptive capacity and knowledge of the communities. In addition to funding, adaptive knowledge and skills training are vital resources that need to be distributed to the grassroots and administrations on the ground. In addition to existing capacity training programs, the NCCC should allocate funding to provide opportunities to local and sub-national administrators and community leaders to attend conferences and workshops with adaptation experts to enhance their social and technical knowledge and skills regarding adaptive methodologies and program management.

Policy, Knowledge and Information Synergy: Knowledge and information synergy is a useful tool in guiding policy cycle, specifically regarding the relationship between the three key groups involved in planning and implementing adaptation programs. The following are the definitions and roles of these three key groups:

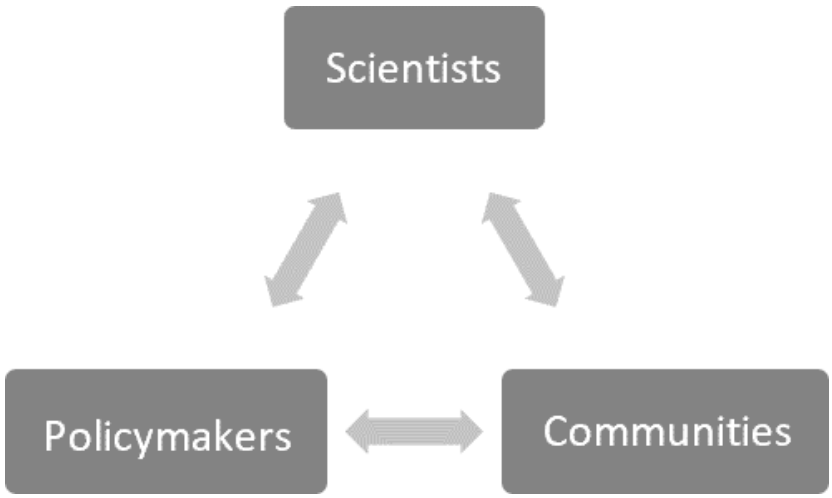
1. **Scientists:** Refers to the scientists, researchers and engineers whose specialized knowledge and skills are crucial in providing up-to-date knowledge, information, and discoveries regarding, for example, climate science, weather variation, hydrology, and water resource management.
2. **Policymakers:** The groups of officials and administrators whose main responsibility is to utilize the scientific knowledge and information supplied by scientists to draft into the policies, regulations, and programs for the adaptation methods to be implemented by communities.

3. **Communities:** The leaders and members of communities who are the direct beneficiaries of adaptation programs and the groups most vulnerable to the impacts of climate change. The role of the community is to provide their on-the-ground adaptation experiences, concerns, and feedback to policymakers and scientists.

In this relationship, the scientists provide the technical knowledge and information to the policy-makers, who use it to form policies and programs to be implemented by the communities. After a certain time, the communities must be given a platform for feedback on whether the policies and programs meet the actual situation on the ground. With this feedback from the communities, policymakers can adapt the programs and policies accordingly to fit each specific community.

Through monitoring and evaluation (M&E) systems and participatory processes, the synergy between the three groups will, through the sharing of knowledge and a healthy feedback loop, ensure that the adaptation programs and their implementation is well suited to the situation and needs of each community.

Figure 6: Policies, Knowledge, and Information Synergy



The Utilization of Technology and Science

This section outlines how the roadmap aims to reinforce the use of technology and science in adaptation policy and program planning to modernize national adaptation efforts as a whole. In order to imagine and create a more positive outlook for Cambodia regarding climate change by 2040, policymakers need to treat technology and science as crucial resources, and update existing adaptation programs with all the technological resources available locally, regionally, and internationally.

Data-driven Policy and Technical Capability: Policy decisions and program planning for climate change should be driven by data and localized to fit the specific concerns of each community. In order to promote scientific thinking into decision-making, the NCSD needs to develop a climate change technical team (CCTT). When dealing with complex scientific information, interpreting meteorological data, or assessing the vulnerability and adaptive capacity of a community's water resources, hydrogeological systems and soil structures, it is imperative that the CCTT is comprised of highly trained scientists, engineers, and researchers. CCTT officials should be capable in accurately studying, gathering, and interpreting necessary technical and scientific information for policy use. Improving the scientific knowledge and technical skills of CCTT members will come through capacity building measures. There should be frequent platforms for sharing knowledge, where the Cambodian CCTT can work closely with technical experts from neighboring countries and international and regional organizations, learning from the different successes of each NAPA program.

Technology as Alternatives to Funding: In the section on adaptation planning, the roadmap proposes different measures for financial mobilization. However, as an alternative to financial assistance and grant aid, Cambodia should regard technology as crucial in improving community resilience and adaptive capacity to the impacts of climate change. Cambodia should propose and be open to material or in-kind assistance in the form of the sharing of technology and equipment useful for adaptation efforts. Examples of material assistance include pumping stations using solar energy to power irrigation system to farms and homes, sprinklers and drip irrigation used on farms, the construction of

communal water reservoirs, and drought-resistant crops during the dry season and periods of drought. In addition to physical or in-kind assistance, technological or technical assistance can come in the form of research and development and training sessions. With this type of assistance, donor assistance is not limited to just funding or financial aid. This would allow resource flows and important opportunities for technological advancement in farming practices and supplying water, which would also greatly assist adaptation efforts.

Modernizing Agriculture, Water Supply, and Disaster Management: The following techniques and technologies are not new to the adaptation discussion. However, Cambodian rural communities remain vulnerable to climate change impacts mainly due to a lack of sufficient physical infrastructure in place for water management and a lack of agricultural training. National and sub-national authorities must continue to work closely with implementation partners, stakeholders, and community leaders to set these activities and infrastructural development as priorities for program implementation.

Agriculture

In most vulnerable communities, agricultural techniques remain conventional and non-adaptive to a changing climate. National authorities need to work with sub-national officials and community leaders to establish farming communities that can share information on adaptive agricultural techniques and technology. The following are some agricultural technologies that could help farmers adapt to climate change.

Crop diversification: This method allows farmers to have multiple harvesting seasons. Farmers should be given practical information on developing their farmland to be able to yield multiple harvests.

Drought-resistant crops: These do not need a lot of water and can survive droughts. Farming communities should be provided with the seeds of drought resistant crops and practical know-how on their cultivation.

Rainwater harvesting: Rainwater collected and stored in rooftop tanks can be utilized for farming. Material assistance such as providing homes with

rooftop water tanks and piping systems would help farming families store rainwater for agricultural purposes.

Water supply and resource management: There is a need for each community to have integrated water management systems in place for the efficient use and management of the resource. Each community, particularly those identified as vulnerable, must be equipped with adequate irrigation systems.

Irrigation and integrated water resource management: *Authorities* and experts should study each community's hydrology and soil structure, establishing the layout for an integrated water resource management system and designing irrigation to meet the community's layout and physical structure.

Technologies for water pumps: In addition to well-equipped irrigation systems for communities, authorities also need to ensure there is electricity for the movement of water. Solar and wind pumps are among the popular and growing technologies that can be energy options to support irrigation systems. Solar pumps use solar power to pump water to farms or homes, while wind pumps use energy from wind to do so.

Disaster Management

The National Committee for Disaster Management (NCDM) and sub-national authorities need to establish weather centers in each province stationed with meteorology and climate experts. Technical assistance from implementing partners and international organizations should be utilized to put in place a system for the analysis and storage of data.

Climate information

Provincial technical teams will need to have the technical capacity to gather and store information on climate and accurately interpret the data. This information would help in establishing accurate early-warning systems for impending disasters and predict precipitation levels, crucial information for farmers.

Early-warning systems

Provincial, district, and commune authorities will need to set up effective communication systems, whereby warnings for impending natural disasters can be quickly issued to communities.

Flood protection dykes

Physical infrastructure such as flood protection dykes should also be constructed to protect irrigation and water storage systems from flooding.

Investing in Adaptation: The Role of Business and Technology: In addition to government adaptation programs and initiatives, there is a huge role for business to play in helping communities adapt to the effects of climate change through technology and research and development. The role of business and investment in climate change adaptation is usually overlooked. However, this could be a potential area for a win-win strategy for both the private sector and communities.

Currently, companies such as ATEC are providing heating solutions such as digesters that produce biogas from the decomposition of manure, and there are others helping communities transfer water with solar-powered pumping stations. Such companies deserve more attention as they are the businesses of the future, those providing solutions to communities' issues while creating jobs.

The role of the government in encouraging such investment is through providing more incentives, such as tax exemptions and tax credits. The government could also assist the businesses currently providing such services and products to communities through subsidies. For instance, with the NAPA, a UNDP- monitored program, having found that communities using biogas digesters are more resilient to electricity and water scarcity, the government should look into providing subsidies for businesses that provide homes with such technology.

Mitigation Plan and Low-Carbon Development

In this section, the road map will identify pivotal strategies associated with key industries to help Cambodia to lower emissions to achieve its INDCs by 2030. Moreover, this "Mitigation Plan and Low-Carbon Development" section also

aims to be a foundation for government policies to transform the country structurally and systematically, not only to reduce its carbon footprint but also to gradually turn Cambodia into an environmentally friendly nation that pollutes less.

Promoting Energy Efficiency, GHG Inventories, and Environmental Standards

Cambodian industry is highly energy inefficient, with consumption per unit of output more than twice as high as many nations in the region and other developing countries (MIME, 2013). Three sectors, construction, transport, and industry have been identified as priority areas by the Cambodian Ministry of Industry, Mines, and Energy (MIME) in cooperation with the EU under the National Policy, Strategy, Action Plan on Energy Efficiency Program (ADB, 2018). In addition to this existing initiative, strengthening energy efficiency and energy savings, tracking GHG inventories, and enforcing environmental standards can contribute hugely to GHG emission reductions to meet Cambodia's INDCs.

- **Construction sector:** Energy efficiency building codes for new buildings, particularly office and commercial spaces and shopping malls, should be established. A GHG inventory inspection scheme to keep on track of buildings' GHG emissions should be developed, while emissions reduction should be encouraged through incentives and awarding "role models for green building". Construction permits should be expanded to meet environmental as well as construction standards, with studies to be carried out on introducing Leadership in Energy and Environmental Design (LEED) green building certification.
- **Transport sector:** Inspections on vehicle energy performance should be enforced, while biofuels should be promoted and fuel-efficient hybrid vehicles and zero-emission technologies incentivized. Public transport should be promoted through cost reductions for passengers and subsidies for investors.
- **Industry sector:** Audits on energy efficiency should be brought in, with the providing of accredited energy audits enforced. GHG inventories and production cycle tracking should be implemented and the use of

renewable energies promoted, with environmental impact assessments on new manufacturing firms enhanced.

Expanding the potentials of Renewable Energy: Hydropower, Solar, and Biomass in National Electricity Generation and Energy sector

Cambodia has great potential in its renewable energy industries. According to the 2018 "Tracking SDG:7 The Energy Progress Report", renewable energy accounted for 65% of Cambodia's total energy consumption in 2015. This comprised 46% from traditional biomass such as wood, charcoal, and dung, 15% from modern biomass such as biogas produced from human and animal waste, and three percent from hydropower (ADB, 2018). With regards to electricity generation, hydropower represented 52% of total national electricity capacity. However, the kingdom still struggles with issues such as electricity access and shortages, and a dependence on imported oil (ODC, 2015). The government should therefore grasp the opportunity to improve energy diversification through expanding renewable energy industries.

Energy Diversification and Expansion of Renewable Energy Industries: Despite heavy investment in hydropower, particularly from China, Cambodia should look into other renewable energy sources to expand its potential, and create markets and economic opportunities. Biomass, carbon-neutral or low-carbon energy, is one of the main renewable sources of energy in Cambodia. Biomass accounted for more than 40% of residential fuel use for cooking and heating (ODC, 2015). With regard to solar, there are national programs such as the Rural Electrification Fund and numerous private investment projects that use solar power for both home use and electricity generation (ODC, 2015). The government should look to expand the markets for these renewable energy sources by not only supporting large projects and investment, but also by incentivizing and providing the necessary facilities for small local businesses looking to use renewable sources to provide energy solutions for remote communities.

Improving Electricity Access Through Renewable Energy: The government should tackle the issue of electricity access and shortages by connecting

renewable energy sources to the electrical grid. The government should provide incentives to encourage investors in solar power to provide low-cost solar solutions for electricity generation, especially in rural and remote areas. Despite 52% of large hydropower plants being connected to the national grid for total electricity consumption, there is great potential in connecting small and medium-sized off-grid hydropower plants to increase generation for communities with limited electricity access.

Enhancing Forest Programs and ELC Legal Framework and Enforcement for LULUCF sectors

According to a 2016 national assessment of land use, forest cover accounted for only 48.14% of Cambodia's total land area (this figure included plantations of rubber, palm oil, and other perennial crops), while the REDD+ program's assessment was of only 45.05% forest cover (excluding plantations) (MoE, 2018). Either figure is far from achieving 60% forest cover of total land area by 2030. Cambodia has one of the fastest rates of forest loss in the world, increasing by 14.4% between 2001 and 2014 (Hansen, 2017). There are two feasible courses of action to be outlined to regain national forest cover and increase Cambodia's carbon sink (forest) for emissions reduction to meet the kingdoms INDCs.

Enhancing the National Forest Program and REDD+ Program: The relevant authorities should collaborate with forest experts and implementation partners on classifying land as development land or protected land for forest conservation, with forest areas reclassified into protected areas, protected forest, community forest, forest concessions, and production forest. Moreover, the RGC should work with relevant ministries to enhance the implementation of REDD+ program by moving from the readiness phase to the program implementation phase. This can be done through setting up improved REDD+ technical teams and putting in place the necessary monitoring, reporting, and verifying (MRV) systems to apply for available funding to move forward to the implementation stage.

Enhancing ELCs Legal Framework and Enforcement: Land use and forest conservation issues in Cambodia cannot be resolved without discussing the legal enforcement of ELCs. According to a report by Forest Trends using NASA

satellite imagery, ELCs in 2013 accounted for 14% of Cambodia's land area, an almost four-fold increase compared with 2004 data (Harfenist, 2015). The relevant ministries need to therefore review the existing laws and regulations on ELC management. The revision should focus on the reassessment of existing ELCs to see whether the businesses and land have been sustainably managed. The enforcement of forest governance must also be heavily inspected, assessed, and improved to reduce corruption and the possible collusion between officials and illegal loggers. The issuing of new ELCs should also be restricted until they have been proven sustainable after environmental impact assessments and other relevant studies have been thoroughly carried out.

Advancing Green Industry and Businesses

There is a huge potential for green industries to stimulate the Cambodian economy through production and development while taking environmental and social considerations into account. Such enterprises can not only contribute to economic growth through market and employment creation, but also to climate change mitigation and emissions reduction through sustainable business models. There are two ways to promote green industries in Cambodia: (i) by greening existing industries; and (ii) by creating new green industries and businesses.

Greening Existing Industries: The relevant authorities should form inspection teams comprised of energy experts, environmental impact analysts, chemical experts, and those involved in relevant fields to conduct quarterly or annual inspections of existing businesses focusing on:

- **Production efficiency:** Optimizing the production and use of natural resources and raw materials;
- **Environmental performance:** Improving waste management and minimization, and enhancing pollution controls in production and buildings.
- **Risk minimization**: Controlling and managing chemicals and hazardous waste, as well as implementing other social safeguards and employee protections.

Creating New Green Industries and Businesses: With limited green industries in the Cambodian market, there is great potential for prospective investors. New green industries and businesses can also provide answers to existing social and environmental issues such as plastic waste, sustainable packaging, recycling, and so on. "Green" businesses and industries not only refers to those with environmental objectives, but also those with environmentally friendly production processes and sustainable waste disposal system. These are businesses that adhere to the environmental standards mentioned in the previous section "Greening Existing Industries". The government can play a huge role in promoting such business models by providing incentives and advantages such as loans, tax credits, or subsidies for potential investors.

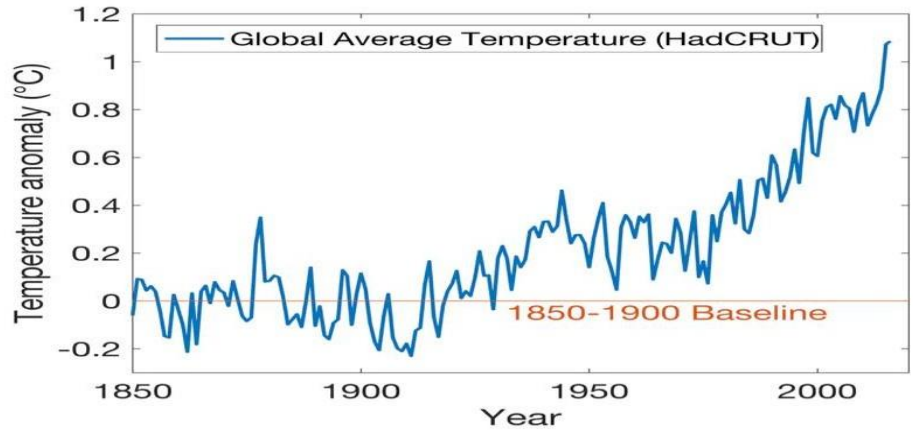
IV. Environment and Climate Change Under the Baseline Scenario: Business as Usual in 2040

The "Baseline" section will provide an overview of the future regarding climate change in the scenario of "Business as Usual", whereby all nation states, particularly the major polluters, have not taken drastic measures to reduce global GHG emissions. This section also offers predictions on the possible impacts, vulnerabilities, and sensitivities in Cambodia in scenarios in which the Cambodian government has failed to implement suggested policies and action plans, with the country operating in a business-as-usual manner.

Global Business as Usual Scenarios

According to the IPCC's 2018 "Global Warming of 1.5°C" summary report for policymakers, it is estimated that human activities have already caused a 1.0°C raising of the global average temperature above pre-industrial levels. At the current rate of warming, this likely to reach the 1.5°C mark between 2030 and 2052.

Figure 7: Global Average Temperatures from 1850 to 2018



Global temperatures are on the rise and are about 1°C above late 19th century levels. Author provided

The report also projects that the global average temperature could reach 1.5°C above pre-industrial levels if GHG emissions continue at the current rate, resulting in trillions of dollars in damage, with inundated coastlines, intensifying droughts, and increasing fatalities from heat waves and extreme weather events (Davenport, 2018; McEvoy, 2018)). "The United States along with Bangladesh, China, Egypt, India, Indonesia, Japan, the Philippines, and Vietnam are home to 50 million people who will be exposed to the effects of increased coastal flooding," the report states.

The IPCC report mainly compares the impacts between 1.5°C and 2°C global warming above pre-industrial levels. It states that a 1.5°C rise in the global average temperature above pre-industrial levels is a hugely important threshold for climate impacts. An increase of half a degree Celsius (between 1.5°C and 2°C) could result in irreversible ice sheet loss and a consequent rise in sea levels. Although the report says it is unlikely that the global temperature could reach the 2°C threshold before 2040, reaching the 1.5°C limit by 2040 would only make the journey toward the irreversible impacts of climate change at 2°C that much faster.

According to the IPCC report, the catastrophic impacts between a half-degree difference in temperature (between 1.5°C and 2°C) include:

- **Sea level rise:** Sea levels are expected to rise 10cm higher this century under 2°C of warming than 1.5°C, exposing an extra 10 million people to coastal flooding and saltwater getting into farmland and supplies of drinking water;
- **Biodiversity loss:** Out of 105,000 species studied, the rate of loss doubles between 1.5°C and 2°C warming to 16% for plants and eight percent for vertebrates, tripling to 18% for insects.
- **Thawing permafrost:** An estimated 1.5-2.5 million more square kilometers of permafrost will thaw this century with 2°C warming compared to 1.5°C;
- **Ocean acidification damaging coral reefs:** Marine ecosystems will be hit by ocean acidification and warming, with 2°C virtually wiping out coral reefs, compared to a 70-90% decline at 1.5°C;
- **Agriculture and fisheries:** For farming and fishing communities especially in the Arctic, drylands, islands, and the poorest nations, limiting global warming to 1.5°C reduces the number of people susceptible to poverty and climate-related risks by up to several hundred million by 2050. The quantity and quality of staple crops suffers under 2°C warming compared to 1.5C, as does livestock, which would be disastrous for food availability in many parts of the world.

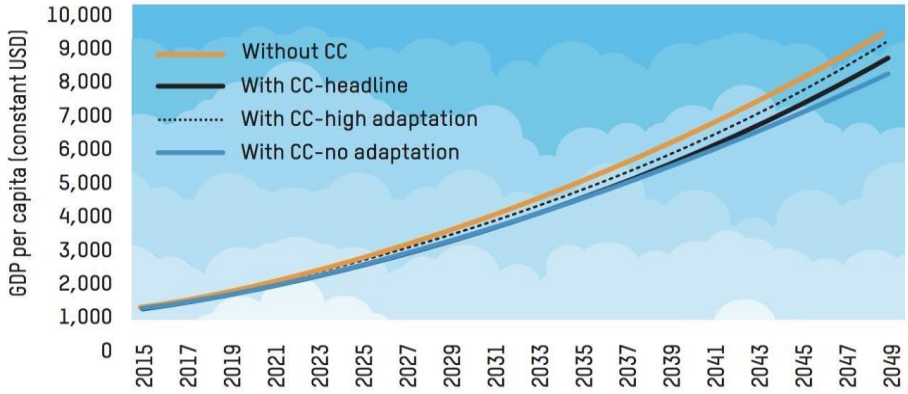
Cambodia's Business as Usual Scenario

In the scenario in which global GHG emissions continue to rise at the current rate, the impacts of climate change would also be worsened for most vulnerable nations like Cambodia. The kingdom's vulnerabilities to climate change would be further exacerbated if adaptation policies and action plans were not implemented effectively to increase Cambodian people's adaptive capabilities and resilience.

The Cambodian Ministry of Economy and Finance (MEF) and the National Council for Sustainable Development (NCSD) released the "Modelling of Climate Change Impacts on Growth" report in April 2018 that used a Climate Economic Growth Impact Model (CEGIM) to project possible impacts on the Cambodian economy (DCC, 2018).

The report's major findings were that without climate change, the CEGIM projected that real GDP would grow at an average of 6.9% per year from 2017 to 2050, with Cambodia achieving upper middle-income country status by 2035. However, with climate change, GDP growth would be reduced to 6.6% in 2020, 2.5% in 2030, and 9.8% in 2050 (see Figure 6)

Figure 8: Impact of Climate Change on Economic Growth

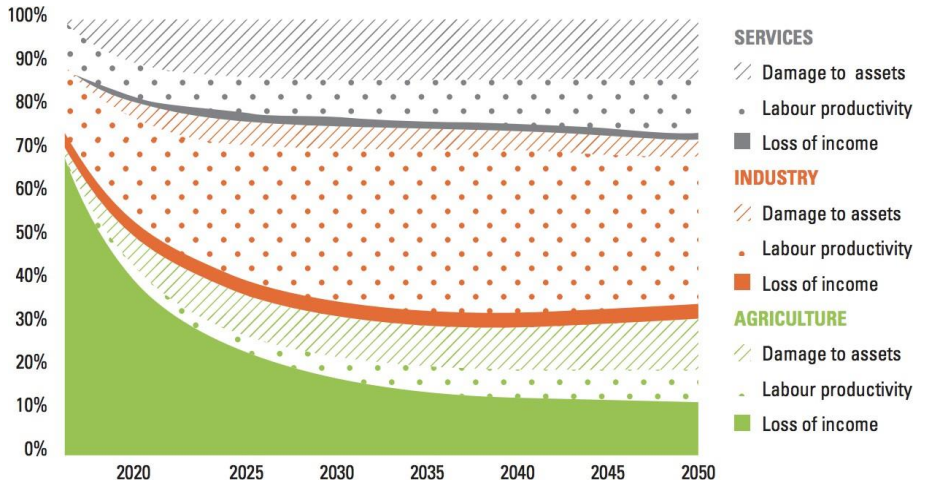


Source: MEF & NCSD, 2018

Note: CC-headline refers to the current rate of adaptation

The report (MEF & NCSD, 2018) categorizes losses and damage resulting from the impacts of climate change on the economy in different sectors into three types: damage to assets, reduced labor productivity, and loss of income (saee Figure 6). According to Figure 8, by 2050 reduced labor productivity would account for 57% of all losses and damage. Industry, especially manufacturing and construction, would be among the sectors impacted hardest by reduced labor productivity. Loss of income represents 17% of all losses and damage, and is mostly concentrated in the agricultural sector. Damage to assets accounts for 26%, but is slightly higher in the service sector due to a projected damage to roads.

Figure 9: Economic Impacts of Climate Change by Sector and Type of Impact (% drop in absolute GDP 2050)



Source: MEF & NCSD, 2018

However, the report concludes that with the current levels of spending and the efforts being made on adaptation, Cambodia could avoid one-third of climate change impacts (33%) by 2050. And if adaptation policies and efforts are further strengthened and effectively mainstreamed into sectoral action plans, two-thirds of impacts (66%) could be avoided by 2050.

References

UNFCCC. (2018, Oct 22). The Paris Agreement. Retrieved from https://unfccc.int/process-and-meetings/the-paris-agreement/d2hhdC1pcy

Engels, A. (2018). Understanding how China is championing climate change mitigation. Palgrave Communications, 4(101). doi: 10.1057/s41599-018-0150-4

TED. (2018, Sep 19). How China is (and isn't) fighting pollution and climate change | Angel Hsu [Video file]. Retrieved from https://www.youtube.com/watch?v=VlHiEN1zTKI

BBC. (2018, Oct 25). Why India needs to worry about climate change. [Press release]. Retrieved from https://www.bbc.com/news/world-asia-india-45949323

Sethi, N. (2018, Nov 12). India Set to Achieve 2 of 3 Paris Agreement Goals: Draft Government Report. The Wire. Retrieved from https://thewire.in/environment/india-paris-climate-agreement-targets

Observer Research Foundation. (n.d.). India's low carbon transition. Retrieved from https://www.oecd.org/environment/cc/g20-climate/collapsecontents/ORF-India-low-carbon-transition.pdf

Hurst, D. (2019, April 16). Does Japan's New Climate Change Strategy Go Far Enough? The Diplomat. Retrieved from https://thediplomat.com/2019/04/does-japans-new-climate-change-strategy-go-far-enough/

Environmental Defense Fund. (n.d.). India: Development while fighting climate change. Retrieved from https://www.edf.org/climate/india-development-while-fighting-climate-change

Climate Links. (2017, April). Greenhouse Gas Emissions Factsheet: Cambodia. Retrieved from https://www.climatelinks.org/resources/greenhouse-gas-emissions-factsheet-cambodia

Ayres, S. (2019, Feb 16). Russia looking to ratify Paris climate agreement as U.S. continues withdrawal. Los Angeles Times. Retrieved from https://www.latimes.com/world/europe/la-fg-russia-climate-change-20190216-story.html

National Council for Sustainable Development. (2016, July). Promoting Private Sector Contribution to the Climate Change Response in Cambodia. Version 6 Final. Department of Climate Change. Ministry of Environment

Cambodian Rehabilitation and Development Board Council for the Development of Cambodia. (2018, Jan). Development Cooperation and Partnership Report. Retrieved from http://www.cdc-crdb.gov.kh/cdc/dcpr_images/docs/english.pdf

Royal Government of Cambodia. (2015). Cambodia's Intended Nationally Determined Contribution. Retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Cambodia%20First/Cambodia%27s%20INDC%20to%20the%20UNFCCC.pdf

UN-REDD. (2016, March). Cambodia Forest Cover 2016. Retrieved from https://redd.unfccc.int/uploads/54_3_cambodia_forest_cover_resource_2016_english.pdf

Earth Observatory NASA. (n.d.). Cambodia's Forests Are Disappearing. Retrieved from https://earthobservatory.nasa.gov/images/89413/cambodias-forests-are-disappearing

Asia Development Bank. (2018, Dec). Cambodia Energy Sector Assessment, Strategy and Road Map. Retrieved from https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf

Ministry of Mines and Energy of Cambodia. (2013). Climate Change Strategic Plan for Manufacturing Industry and Energy. Retrieved from: http://www.camclimate.org.kh/en/documents-and-media/library/category/117-sectoral-ccsp.html?download=528:sectoral-ccsp-for-manufacturing-industry-and-energy.

Ministry of Mines and Energy of Cambodia. (2016, Sep). Cambodia National Energy Statistics 2016. Retrieved from http://www.eria.org/RPR_FY2015_08.pdf

Open Development Cambodia. (2015, March 3). Energy. Retrieved from https://opendevelopmentcambodia.net/topics/energy/#ref-64091-8

Intergovernmental Panel on Climate Change. (2018). Global Warming of 1.5°C: Summary For Policymakers. Retrieved from https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Hoegh-Guldberg, O., Jacob,D., Taylor, M., Bindi, M., Brown, S., Camilloni, I., Diedhiou, A., Djalante, R., Ebi, K. L., Engelbrecht, F., Guiot, J., Hijioka, Y., Mehrotra, S., Payne, A., Seneviratne, S.I., Thomas, A., Warren, R., and Zhou, G. (2018). Impacts of 1.5oC Global Warming on Natural and Human Systems. Intergovernmental Panel on Climate Change. Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf

Davenport, C. (2018, Oct 7). Major Climate Report Describes a Strong Risk of Crisis as Early as 2040.

The New York Times. Retrieved from https://www.nytimes.com/2018/10/07/climate/ipcc-climate-report-2040.html

Darby, M. & Stefanini, S. (2018, Oct 8). 37 things you need to know about 1.5C global warming. Climate Home News. Retrieved from https://www.climatechangenews.com/2018/10/08/37-things-need-know-1-5c-global-warming/

McEvoy, J. (2018, Oct 10). Humans could face severe climate change consequences by 2040, warns UN report. USC Annenberg Media. Retrieved from http://www.uscannenbergmedia.com/2018/10/10/humans-could-face-severe-climate-change-consequences-by-2040-warns-un-report/

Department of Climate Change. (n.d.). Report on the Modelling of Climate Change Impacts on Growth is Launched. Retrieved from http://www.camclimate.org.kh/en/policies/ncsd-news/445-report-on-the-modelling-of-climate-change-impacts-on-growth-is-launched.html

Ministry of Economy and Finance & National Council for Sustainable Development. (2018, May). Addressing Climate Change Impacts on Economic Growth in Cambodia. Retrieved from: http://www.camclimate.org.kh/en/documents-and-media/library/category/39-financing.html?download=912:full-report-on-cc-impacts-on-economic-growth-in-cambodia_may-2018_en

National Climate Change Committee. (2013) Cambodia Climate Change Strategic Plan 2014 – 2023. Ministry of Environment. Retrieved from: http://www.camclimate.org.kh/en/policies/nccc-news/197-cccsp-2014-2023-kh-en-final.html

NCSD. (2017, May). National Adaptation Plan Process in Cambodia. General Secretariat of National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh.

Ministry of Environment Cambodia. (2006). National Adaptation Program of Action to Climate Change (NAPA). Phnom Penh.

ADHOC. (2014). Land Situation in Cambodia. Retrieved from: https://data.opendevelopmentmekong.net/dataset/3c557e19-527d-406a-97cc-8b06940bdd90/resource/646574be-25e7-45dd-9219-aa53af7defe7/download/adhoclandreport2013.pdf

Parliamentary Institute of Cambodia. (2015). Community Land Registration and Economic Land Concessions in Mondulkiri Province. Retrieved

from:
https://www.pic.org.kh/images/2015Research/20160421_Community%20Land%20Registration%20and%20Economic%20Land%20Concessions%20in%20Mondulkiri%20Province_EN.pdf

Ministry of Environment. (2016). A Second Study on Understanding Public Perception of Climate Change in Cambodia. Knowledge, Attitude and Practices. Retrieved from:http://portal.gms-eoc.org/uploads/resources/1112/attachment/Understanding%20Public%20Perceptions%20to%20Climate%20Change%20in%20Cambodia.pdf

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