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Report on climate-water policy and actions in Asia

CC WATER

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Acronyms

CARP	Sri Lanka Council for Agriculture Research Policy
CC	Climate change
CCS	Climate Change Secretariat
CCUS	Carbon Capture, Utilization and Storage
CSO	Civil Society Organization
GCF	Green Climate Fund
GHG	Greenhouse gas
INDC	Intended Nationally Determined Contribution
IWRM	Integrated Water Resources Management
LPG	Liquefied petroleum gas
MIPS	Mongolia Integrated Power System
NAP	National Adaptation Plan
NAPCC	National Action Plan on Climate Change
NAPCCI	National Adaptation Plan for Climate Change Impacts
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NPCC	National Program on Climate Change
NRC	National Research Council
NSF	National Science Foundation
R&D	Research and Development
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNCCD	United Nations Convention to Combat Desertification
WWTP	Wastewater Treatment Plant

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CC-Water policy review

This review intends to study of climate change impact of Project participating countries and how countries are anticipating to the situation and combat the diverse negative impacts as taking different activities like developing policies, joining international initiatives/conventions and implementing practical actions in line with national and international strategic policies. Besides of that, the Project aims to prepare generations via developing study programs for high education institutions like starting from overview of present level of climate change study program development activities of participating countries and to learn and discuss together, what need to do and how to improve and how to act for minimizing or eliminating the negative impacts of environmental disasters with more scientific approaches.

There are numbers of studies on regional CC related water management experiences were reviewed and used for the review. Especially the National Adaptation Plan of Sri Lanka, Climate Change Policy of Sri Lanka, China's CC Policy and Actions 2019 Annual Report, National Program on CC and Environmental Performance Review Mongolia, UNECE were much helpful for building up the review. And the CC Water policy review is mainly envisaged CC water impacts and strategic policy, and its actions and responsible/implementing institutions, CC adaptation good practices implemented in participating countries (China, Sri Lanka and Mongolia).

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1 CC impacts in participating countries

It is estimated that up to 3.4 billion out of predicted 5.2 billion populations in Asia could be living in water-stressed areas by 2050[1]. Water will pay an increasingly important and visible role in regional sustainable development in coming years.

It is estimated 60% of grasslands in Asia are already degraded, putting up to 135 million people at risk of distress migration over the next 30 years. By 2050, up to 90% of the coral in South and South-East Asia will also have suffered severe degradation, while up to 3.4 billion people will be living in water-stressed areas[2].

Climate change could have significant impacts on water resources around the world because of the close connections between the climate and hydrological cycle. Rising temperatures will increase evaporation and lead to increases (in some areas decreasing) in precipitation, thoughthere will be regional variations in rainfall. Both droughts and floods may become more frequent in different regions at different times, and dramatic changes in snowfall and snow melt are expected in mountainous areas. Higher temperatures will also affect water quality, possible impacts include increased eutrophication. There is now ample evidence that increased hydrologic variability and change in climate has and will have a significant impact on the water sector through the hydrologic cycle, water availability, water demand, and water allocation at the global, regional, basin, and local levels.

Desertification and Land Degradation (DLD) have vast interconnected causes and consequences in all three dimensions of sustainable development—economic, social, and environmental. It is estimated that 40% of the world's degraded land are in areas of high poverty and approximately 1.5 billion people worldwide depend directly on these degraded lands for their livelihoods. Asia faces a range of DLD challenges due to its vast landmass, geographical and climate variation, and differences in stages and choices of development paths. Countries in the sub region, in particular China and Mongolia, continue to suffer from deforestation, desertification, and loss of biodiversity[3].

1.1 CC impacts in China

China is a country vulnerable to the adverse effects of climate change. In the past century, the fluctuation of regional precipitation in China has increased, especially in Northwest China, the precipitation in Northeast China and North China has decreased, and the coastal disasters such as coastal erosion and salt tide intrusion have increased. Global climate change has had a major impact on China's economic and social development and people's lives. China's glaciers have shrunk by more than 10 percent since the 1950s and have been retreating at an accelerated pace since the 1990s. The frequency of extreme weather and climate events has increased, water shortages in northern China and seasonal droughts in southern China have intensified, floods and other disasters have occurred frequently, landfall typhoons have become more intense and destructive, losses from agricultural disasters have increased, and the safety of major projects and operations has been affected. Northern and western China is facing to droughts problems and more that 400 of China's 669 cities already have water shortage problems. But floods, storms, debris flows, and landslides affect many southern and eastern cities[4].

1 International Institute for Applied Systems Analysis 2016

2 Rsgroup.asia

3 Combat desertification in North-East Asia, NEASPEC working paper

4 J. Liu and X. Deng, "Impacts and mitigationofclimatechange on Chinese cities," Curr. Opin. Environ. Sustain., vol. 3, no. 3, pp. 188–192, 2011.

In China, average precipitation decreased by 1 mm every year from 1950 to 2010, as reflected in ongoing measurements from 156 meteorological stations. Meanwhile, there are significant regional differences in the trends of precipitation: Summer and autumn precipitation has been falling in the drier regions of North China and Northeast China, whereas summer and winter precipitation in the wetter region of southern China has been increasing. Climate change affects agricultural water use and grain production significantly, whereas its impact on human factors (technological progress, policy mechanisms, production inputs, etc. In recent years, more and more attention has been paid to the risks associated with climate change, which will make food production increasingly uncertain. Water availability will be one of the limiting factors for crop production and food security[5].

In the Yangtze River Delta urban agglomeration, the numbers of both precipitation days and heavy precipitation events have shown an obvious increase. In the Pearl River Delta urban agglomeration, an uptrend in the intensity and frequency of precipitation extreme events has been reported the extreme rainfall amount and its contribution to annual rainfall in Hong Kong have increased significantly. In Guangzhou, a study indicated that the number of rainstorm days is highly positively correlated with the number of rainfall days, which has significantly increased in South China[6].

The climate in the arid region of Northwest China has experienced a significant warming trend and increase in humidity over the past 50 years. Research results show that precipitation in the region increased from 1960 to 2010 at a rate of 6.1 mm per decade, while the national average showed a decreasing trend at a rate of 1.6 mm per decade[7].

The expansion of lake area on the Tibetan plateau (TP), is in clear contrast to the shrinking of lake area on the adjacent Mongolian Plateau during 1970s−2013. In China, the number and area of lakes in the TP and Xinjiang had an increasing trend from the 1960s to 2015, while there were decreasing trends in the Inner-Mongolia Plateau and on the Eastern Plain[8].

Climate change accelerated the urbanization and increased water demand, resulting in an additional burden on urban water supplies. Meanwhile, water shortages caused by climate change led to the contradiction between agriculture and industry for water conflicts in relationto urban metabolism China's total water resources were 2746.3 billion m3 in 2018, which was close to the international warning level of 1700 m3 per capita. In addition, resource- intensive industries not only intensify water demand but also wastewater discharge. Accordingly, wastewater reclamation and reuse has been regarded as an effective strategy to relieve water resource pressure. The increasingly severe water pollution problem has imposed higher requirements on urban sewage treatment facilities. In addition, the uneven distribution of water exacerbates the water shortage crisis to some extent. Overall, the parts of the North, Southwest and Northeast and Northwest areas have been regarded as the severe drought zones in China. The main sources of urban water supply are surface water, underground water, rainwater and seawater. The social water cycle is ultimately delivered to the user after treatments such as sewage purification or seawater desalination. In urban metabolic system, water resources are transported to all walks of life through the urban pipe network and then recycled and treated by the sewage treatment system. In 2018, China's total water usage was 601.55 billion m3, with an increase of 69.6 billion m3 compared with the value in 2003. The State Council of

[5] R. li LI and S. Geng, “ImpaactsofClaimate Change on Agriculture and Adaptive Strategies in China,” J. Integr. Agric., vol. 12, no. 8, pp. 1402–1408, 2013.

[6] R. Yu, P. Zhai, and Y. Chen, “Facingclimatechange-related extreme events in megacitiesof China in thecontextof 1.5 °C global warming,” Curr. Opin. Environ. Sustain., vol. 30, pp. 75–81, 2018.

[7] Y. J. Wang and D. H. Qin, “Influenceofclimatechange and human activity on waterresources in arid regionofNorthwest China: An overview,” Adv. Clim. Chang. Res., vol. 8, no. 4, pp. 268–278, 2017.

[8] G. Zhang et al., “Response ofTibetan Plateau lakestoclimatechange: Trends, patterns, and mechanisms,” Earth-Science Rev., vol. 208, no. July, p. 103269, 2020.

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1.1CC impacts in China

China has established "three red lines" for controlling the water usage in view of the water shortage crisis[9].

There are evidences that sea surface temperatures in the China seas increased in the last several decades. Since the 1980s, the Bohai Sea, Yellow Sea, and East China Sea have witnessed significant increase in sea surface temperatures. The projected SLR rate near China is 3.1-11.5 mm per year by 2050, higher than the global SLR rate (3.2-8.0 mm per year). This implies that a total area of (14.3-21.2) 104 per year hm2 might be flooded over the main coastal plain of China, which account for 2.47%-3.66% of the total coastal wetlands. Changes of dominant fishery species driven by multi-decadal climate variability have been reported[10].

By 2050, climate change may lead to per-person reductions of 3.2% in global food availability, 4.0% in fruit and vegetable consumption, and 0.7% in red meat consumption, and these changes would be associated with more than half million climate- related deaths worldwide, which most occur in south and east Asia. Inherently, these food effects also vary with time, places, and people[11].

Comparing 1994–2012 with 1975–1993 in Southwest China, the maize exposure are decreased in the south, maize vulnerability reduces overall, and maize drought prevention and mitigation are gradually enhanced[12].

[9] H. Lv et al., "Waterresourcesynergymanagement in responsetoclimatechange in China: Fromtheperspectiveof urban metabolism," Resour. Conserv. Recycl., vol. 163, no. August, p. 105095, 2020.

[10] N. Z. Jiao et al., "Climate change and anthropogenic impacts on marine ecosystems and countermeasures in China," Adv. Clim. Chang. Res., vol. 6, no. 2, pp. 118–125, 2015.

[11] X. S. Luo et al., "Inclusive development and agriculturaladaptationtoclimatechange," Curr. Opin. Environ. Sustain., vol. 24, pp. 78–83, 2017.

[12] J. Y. Jia et al., "Droughtriskanalysisofmaizeunderclimatechangebased on naturaldisastersystemtheory in Southwest China," ShengtaiXuebao/ Acta Ecol. Sin., vol. 36, no. 5, pp. 340–349, 2016.

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1.2 CC impacts in Mongolia

Mongolia is vulnerable to the impact of climate change, due to its geographical location as a landlocked dry climate country and metrological characteristics, with high fluctuation and extreme temperature, highest summer temperature is +320C, lowest winter temperature is - 450C, and annual precipitation varying from 50 mm in Gobi desert to 400 mm to the northern mountainous area. Globally, Mongolia is one of sixty countries with limited water resources; natural freshwater resource limitation was cited as one of the biggest environmental issues of the country. Mongolia's freshwater supply is projected to be exacerbated due to climate change and increasing water pollution.

Mongolia not only faces with the same problems as developing countries caused by the global climate change, but it also has specific concerns which relate to Mongolia's unique geographical and climatic conditions. For instance, Permafrost covers more than 60 per cent of the territory of Mongolia. Melting of permafrost area caused by global warming will have very adverse effects on agricultural practices, water resources and infrastructure development like bridge and road constructions, buildings, etc. In addition, climate change would seriously affect ecosystem, natural grassland, arable farming, pasture animal husbandry and soil quality. The future climate scenario for Mongolia projects changes such as increased air temperatures, increased precipitation amount in some areas and reduction of water resources and arable land. Potential evapotranspiration increase would be higher than precipitation amount increase. A comparison of the 1992 and 2002 pls. see figure No1. Land degradation, which was taken 10 years apart, reveals that the land surface has changed significantly; desert area has increased and forest area has decreased. Accordingly, water surface decreased by 38% from 1992 to 2002, but in 2006 the water area figures increased. Areas without grass (or barren) increased by 46% from 1992 to 2002. By 2006, this barren area almost tripled, while during the same period forest area decreased by more than 26%[13].

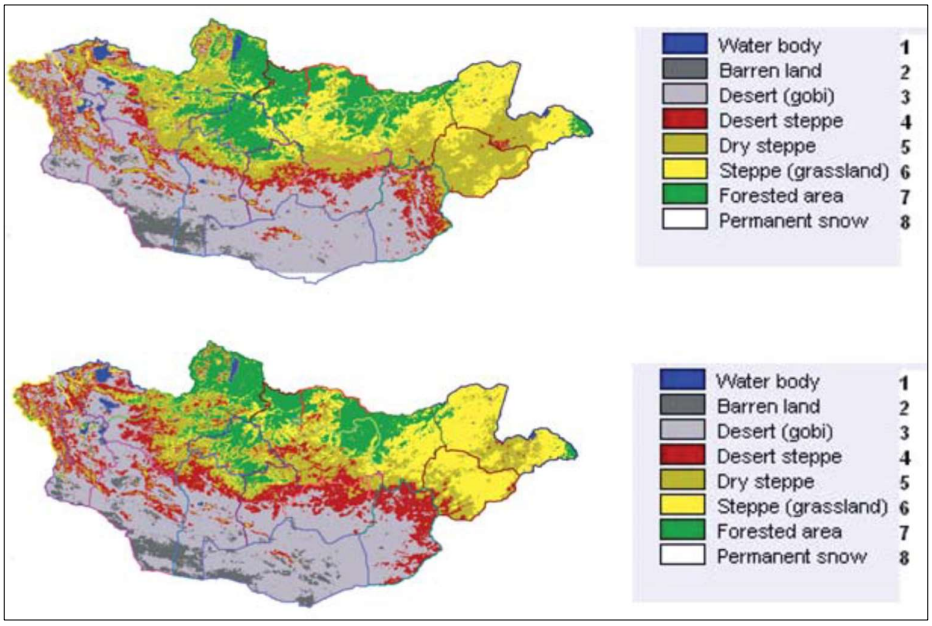

Figure 1: Land degradiationofMongolia

[13] Assessment Report on Climate Change, 2009.

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1CC impacts in participating countries
1.2CC impacts in Mongolia

Climate change assessment conducted nationally in 2009 and 2014 have concluded that fragile ecosystems, the dependency on animal husbandry and rain-fed agriculture, growing population, traditionally nomadic and sparse but with a tendency towards urbanization, make Mongolia particularly vulnerable to climate change. Rural communities dependent on animal husbandry and crop farming are the most exposed to climate change impact, such as melting of permafrost and glaciers, surface water shortages and soil and rangeland degradation; therefore, adaptation to the climate change is particularly relevant for the country. A declining aridity index has been registered, means aridity index has intensified. Scenarios used for Mongolia's 2015 Intended Nationally Determined Contribution (INDC) foresee temperature increases by 2.20C between 2016 and 2035 and decreased precipitation. Climate projections show these tendencies will be aggravated in the medium term and that extreme event such as drought and dzud* will become more frequent and more intense, with severe environmental, social and economic impacts. The 2014 Second Assessment Report on climate change identified as the most vulnerable sectors animal husbandry, arable farming, human health, and natural resources such as water, forests, rangeland and soil.

Table 1: Summary ofthecurrent and futureclimatechangeimpacts in Mongolia[14]

Sector	Current impact	Future impact and risk management
Natural disasters	Frequency of disaster in the last two decades were compared: annually, about 75 disaster phenomena were observed in the previous 10 years and the number has doubled in the last decade; Rapid onset phenomena, such as heavy rain, flash flooding, strong wind, thunderstorm and hail have been more frequent and intense and economic loss due to disasters has doubled; Frequencies of drought and dzud are increasing and the biggest dzud occurred in the winter of 2002-2003 and 2009-2010, when GDP decreased by at least 6 per cent; about 77,8 per cent of the total area has experienced degradation and desertification to certain extent.	Frequency of atmospheric hazardous phenomena will increase by 23-60 per cent from current levels by 2050; Livestock loss due to drought and dzud is expected to increase by 9,4 per cent by 2050, which is about 2,1 per cent more than the average rate of loss from 1981 to 2000; Land degradation and desertification would lead to increased evapotranspiration and decreased rainfall as a result of reverse feedback mechanism.
Water resources, glaciers, permafrost	Surface water regime is changing, lake areas are decreasing, small lakes, springs and even some rivers are drying up; Negative mass balance and shrinkage of glaciers occur and total glacier area has reduced by 27.8 per cent in last 70 years; Ice thickness of rivers draining from glaciers has increased by 40cm and consequently duration of ice cover period has increased by 10-2 days and its water temperature decreased; Duration of ice cover period and ice thickness have decreased by 20 days and by 35 cm respectively in the rest of rivers draining from other than glacier areas; Water temperature has increased by 2^0C; Groundwater table is tending to decrease.	The average water temperature in the period April to October will increase by 3.1-4.2^0C by 2080; River run-off will increase by 8-13mm in 2080, while potential evaporation will increase by several times. The annual glacier melt rate or glacier mass balance will increase by 67 per cent compared with melt rate in the period 1982-2010. Temperature in the ground at depths of 10m and 15m has been increasing in the northern permafrost region.

[14] UNECE Mongolia, Environmental Performance Reviews,2018

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Results of studies show that, in Mongolia accelerating the signs of climate warming, dryness, and desertification and increasing evaporation rates influencing water balance expanding melting of glaciers. Mongolia's water resources are distributed unevenly throughout the country. About 60% of Mongolia's rivers flow to the Russia and China and 40 per cent flowinto lakes in Gobi desert. The flow of rivers is not stable. By statistics, in 2016, of 5585 rivers and streams, 263 were dried out, of 11,420 springs, 774 were dried out and 106 recovered, and of 2,245 lakes and ponds, 346 were dried out and 31 recovered.

There are significant seasonal and regional changes, especially in the Central Asian Internal Drainage Basin. This is a result of the severe winter, which holds down the rivers for half a year and reduces or stops the flow, reduction of precipitation from north to south, and aridity of the Gobi Desert region, where a lot of water is lost because of evaporation and infiltration. Melting of glaciers is highly accelerating last 20 years, and increasing evaporation from river surface of the Tuul river basin is 128, Kharaa river basin is 71, Selenge River basin is 174 mm/year accordantly.

As for the level of precipitation, Mongolia's annual total has dropped by 7 percent - or 16 mm over the past 68 years Table 2. At closer look - by region, the level of precipitation dropped by 8.7-12.5 percent in the central and Gobi regions, and rose by 3.5-9.3 percent in the eastern and western regions. By season, precipitation increased by 5.2-10.7 percent in the fall and winter, and dropped by 9.1-3.0 percent in spring and summer. The annual and summer season drop in precipitation was observed mainly in the central region, eastern side of the western region, the middle of the Gobi region, and the center of the eastern region. Considering that about 70 percent of the total precipitation falls in the warmer season, the significant decrease in precipitation during the warmer season signify an overall decrease of rainfall in Mongolia over time.

Table 2: Changes in precipitation (regional and seasonal) since 1940s in Mongolia.

Classification	Regions	Percentage	Changes
Regional:	Central and Gobi regions	8.7-12.5	Reduced
	Western and easternregions	3.5-9.3	Increased
Seasonal:	Fall and winterseasons	5.2.10.7	Increased
	Spring and summerseasons	9.1-3.0	Reduced
In 68 years:		By 7 percent	Reduced

Besides precipitation, changes occurred in the characteristics of summer time rain events: mild rains have been reduced, while thunderstorms increased from 1980s: the amount of precipitationfrom thunderstorms increased by 20 percent. Changes in the climate have causedchanges in thetotal transpiration, balance in the soil humidity, and land ecosystem, thus leading to transpiration increase of 2-3 mm per annum in Mongolia[15].

[15] Combatting Desertification in North-East Asia, 2012.

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1.3 CC impacts in Sri-Lanka

Sri Lanka is highly vulnerable to the adverse effects of climate change. Consequences of climate change such as temperature rise, rainfall variability and sea level rise are critically affecting almost all economic sectors of the country. Occurrences of natural disasters due to extreme weather conditions such as prolonged droughts, flash floods and landslides deprive lives and livelihoods of people.

There is no significant annual variation in temperature in Sri Lanka, but significant regional variation in temperature could be observed due to altitude. In lowland areas, average annual temperature usually varies around 26.5 – 28.5 °C. Sri Lanka's mean annual rainfall is around 1850 mm (ranging from 900 mm to 5000 mm). There are three major sources of rainfall in the country, namely; monsoonal, convectional and depression.

It has been reported that mean daytime maximum and mean night time minimum air temperatures also have increased. Variability of both summer and winter monsoon rains and rains of convectional origin has increased significantly during recent decades. As a result, both extremes, i.e., water scarcity and excess water have become a recurrent problem faced by crop production in Sri Lanka. Meanwhile, increasing ambient temperature has also resulted in several direct and indirect negative impacts on crop growth.

Sri Lanka is highly vulnerable to impacts of climate change. As a small island in the Indian Ocean, the coastal region of Sri Lanka is susceptible to changes in sea level. The 2004 tsunami has indicated that low-lying plains in the coastal zone will be vulnerable to any future rise in sea level. Important sectors of the economy such as tourism and fisheries could be affected due to impacts of sea level rise (Ahmed and Supachalasai, 2014; ME, 2010 a; Senaratne et al., 2009). Population of the country is dependent on livelihoods connected to agriculture. Studies show that food security of the nation can be adversely affected due to impacts of climate change (De Costa, 2008; De Silva, 2008 and 2013; Marambe et al., 2013, 2015a; Punyawardena, 2007). Besides, a substantial share of Sri Lanka's foreign income is earned through export crops which are highly sensitive to fluctuations of weather (Nissanka et al., 2013; Ranasinghe, 2013; Wijeratne et al., 2007). Emerging evidence from various sources suggest that climate change could alter natural systems connected to water cycle, eco systems and bio-diversity of the country (Eriyagama et al., 2010; Marambe et al., 2012; ME, 2011; Weerahewa et al., 2012). This could lead to the decline of various ecosystem services that are indispensable for the welfare of human population. Impacts of climate change appear to have significant repercussions on health of the citizens and human settlements of the country too (ME, 2010 b and c). Overall, the impacts of climate change are widespread and they are likely to create negative socio-economic outcomes on many sectors in Sri Lanka.

Temperature: Analysis of past data suggests that atmospheric temperature is gradually rising almost everywhere in the country (Chandrapala, 2007a; De Costa, 2008; Eriyagama et al., 2010; Nissanka et al., 2011; Sathischandra et al., 2014). Varied rates of increase in temperature have been reported from different locations and in recent years, the warming trend has become faster (Basnayake, 2007; Chandrapala, 2007a; De Costa, 2008; Sathischandra et al., 2014). Annual mean air temperature anomalies have shown significant increasing trends in all stations during the recent decades (Basnayake, 2007). It has been reported that mean day time maximum and mean night time minimum air temperatures also have increased (Basnayake, 2007; Zubair et al., 2005). Data indicates that increase in night time minimum air temperature contributes more to average increase in annual

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temperature than day time maximum air temperature (Basnayake, 2007).

Precipitation: Unlike in the case of temperature, no clear pattern or trend has been observed in precipitation. Some researchers, comparing the mean annual precipitation of recent and earlier periods, suggest that average rainfall is showing a decreasing trend (Basnayake, 2007; Chandrapala, 2007b; De Costa 2008; Jayatillake et al., 2005). However, there is no consensus on this fact among researchers and opposing trends can be observed in different locations. Punyawardena et al. (2013a) observed that heavy rainfall events have become more frequent in central highlands during the recent period. However, many researchers seem to agree that the variability of rainfall has increased over time, especially in Yala season (Chandrapala 2007b; Eriyagama et al. 2010; Punyawardena et al., 2013b). Moreover, the number of consecutive dry days has increased and the consecutive wet periods have decreased (Premalal, 2009; Ratnayake and Herath, 2005). Studies also indicate that spatial distribution of rainfall appears to be changing although a distinct pattern cannot be recognized yet (Basnayake, 2007; Marambe et al., 2013; Nissanka et al., 2011; Sathischandra et al., 2014). Some studies suggest changes in distribution can even lead to shifting of agro-ecological boundaries (Eriyagama et al., 2010; Mutuwatte and Liyanage, 2013).

Extreme events: The intensity and the frequency of the extreme events such as floods and droughts have increased during recent times (Imbulana et al., 2006; Ratnayake and Herath 2005; Premalal and Punyawardena, 2013; Punyawadena and Premalal, 2013). Areas of high rainfall intensities and the locations of landslides show a strong correlation (Ratnayake and Herath, 2005).

Sea level rise: Sea level rise of 1-3 mm/year is observed in the Asian region and is marginally higher than the global averages (Cruz et al., 2007). An accelerated level of sea level rise has been observed during the period of 1993-2001 (3.1 mm/year) for the Asian region.

Figure 2: ObservedChangesof Climate in Sri Lanka - Some Scientific Evidence

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2 Climate change – Water policy framework

Governments of project participated countries recognize the complexities of climate related water resources challenges and are laying the foundations -knowledge, policy, institutions and infrastructure -for adapting to climate change.

IWRM is accepted in the current water and climate policies of most nations as being the most relevant approach to water management, particularly when growing demand for water is placing the resource base under increasing stress. It is also seen as being well suited to improving water management under climate change because it is designed to address both the "availability" and the "variability" components of the region's challenge[16].

Studies shown that, increasing temperatures is foreseen in every Asian country, resulting with deviation of traditional ecosystem process. It is important that countries have strategies to mitigate climate change by, for example, controlling greenhouse gas emissions and taking possible actions for protecting ecological resources. As mentioned above climate change evidences in Project participating countries show that countries should implement own specific strategic policies to develop resilience and adapt to climate change. It is also all-important accountable implementation of policies with well-educated professionals and sufficient funding of its activities-it's the main aim of the Project implementation.

During the climate change Policy review of Project participating countries, its recognized that countries are already been signed Paris agreement, as Mongolia submitted the INDC in September 2015, Sri Lanka in April 2016, China in June 2015 with intention to contribute to Global efforts to mitigate GHG emissions by implementing the defined policy actions and measures within its own specific approaches in different socio-ecological situations of each country.

Review result shows that, the level of development of strategic policies to prevent and mitigate impact and managing or implementing of adaptive actions are of course very different, and it can be noted that China, Sri Lanka has went ahead from participating countries, particularly, Sri Lanka has been developed concerned policy documentations and China reached a lot with practical achievements, and their experiences/achievements could be a good example for Mongolia and other nations to share with. Sri Lanka has been developed National Climate change Policy of 2012 and the National Climate Change Adaptation Strategy 2011-2016, and in base on such policy documentations the National Adaptation Plan for Climate Change Impacts in Sri Lanka, 2015 to 2025 (NAPCCI) is being developed and in the stage of itsimplementation. For successful implementation of National Climate Change Action Plan and to achieve the NDC targets, the Sri Lanka government has been issued NDA Operational Manual for guiding to all stakeholders in GCF focused activities in Sri Lanka to support effective coordination and ensure transparency in operation.

China has been carrying out preliminary studies and legislative drafting work and issued several important planning and policy documents. For example, the National Measures for Climate Change (2014-2020), the National Strategy to Tackle Climate Change, Measures for the Assessment of the Responsibility for Reduction of CO2 Emissions per Unit GDP, and the National Emission Trading Market Construction Plan Power Sector. The national, local, and enterprise-level greenhouse gas emission statistical accounting system has been initially established[17].

According to the reports and relevant documentation of the China government on climate change, it have been done a lot on actual planned activities for climate change adaptation and reached

[16] South Asia CC risk in water management, IWMI
[17] China: Climate Policies, NDCs and Financial needs

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significant achievements in forestation, water development and energy efficient housing infrastructure, improvement of R&D technological developments.

Mongolia is on the process of development its National Climate Change Adaptation program, and other policy documents such as Green Development Policy 2014, Climate Change program 2011, Combat Desertification program 2010, Sustainable Development Vision-2030, 2016; National Water program 2010 are in implementation.

Actual review information on Policy documentation of each participating countries are followed further.

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2.1 Strategic policies in China

In 2014, China government issued National Program on Climate Change (2014-2020) and National CC Adaptation Strategy 2035 compiled in January 2021.

China's National Climate Change Program (National Development and Reform Commission 2007) has long emphasized the importance of enlarging regional water storage capacity, strengthening its water resources, and improving the management of infrastructure related to water resources.

Establishment and implementation of the China country plan on climate change, the control of greenhouse gas emissions "twelfth five-year" plan and the country to adapt to climate change strategy, accelerate the industrial structure and energy structure adjustment, vigorously promote energy conservation and carbon reduction and ecological construction, and actively promote low carbon pilot demonstration, to strengthen the construction of ability to cope with climate change, and strive to improve the whole society's awareness of climate change, positive progress was made in each work on climate change. In 2013, the unit of gross domestic product (GDP) of carbon dioxide emissions 28.5% lower than in 2005, the proportion of non-fossil energy in primary energy to 9.8%, water and electricity installed capacity, wind power installed capacity, nuclear power construction scale, solar water heater collector area in the world, rural biogas users first, the forest coverage from 18.21% in 2005 to 21.6%. Key areas such as water resources, agriculture and forestry, and disaster prevention and mitigation have become better able to adapt to climate change.

China National Program on climate change (NPCC) evaluates that, climate change oriented activities are in China still relatively weak, the basis of work on relevant laws and regulations, system mechanism, the policy system, the standard is not perfect, the relevant taxation, investment, price, finance and other policy mechanism need further innovation, market mechanisms and statistical accounting need to be strengthened. The NPCC notes, the design of construction, such as climate friendly technologies need to be improved and the R&D development and application ability, talent team construction relative lag, the whole society to address climate change recognition knowledge level and ability need to be improved.

NPCC concentrated on improvement of urban and rural infrastructure for minimizing climate change impacts. NPCC indicated that climate change risk assessment to be carried out for urban expansion and township construction to response to the heat island effect and urban waterlogging. NPCC has included revision and improvement of urban flood control standard which considers the layout of city construction, public facilities, roads, green space, water, functional areas, such as restoration of urban river water system as well as water seepage, storm water resources utilization facilities. The Program plans to strengthen the development of urbanlifeline systems such as power, heat, water supplies including drainage, gas systems and communications, upgrade/improve the technical standards for construction to ensure the smooth and safe operation of facilities under extreme weather and climate conditions.

China's Medium and Long-term Development Plan for Renewable Energy (2007), and the Qinghai's Overall Plan of Solar Utilization (2009–2020), the object of solar energy development on the QTP in 2020 contains: Capacity of solar cooker utilization per rural household is 0.35 units, capacity of solar water heater per rural household is 0.20 m2, capacity of solar greenhouse per rural household is 0.15 m2. Climate change adaptation program in the Qinghai-Tibetan Plateau implemented as solar energy utilization for rural household[18].

[18] Y. Fang and Y. Wei, "Climate changeadaptation on the Qinghai-Tibetan Plateau: The importanceofsolarenergyutilizationfor rural household," Renew. Sustain. Energy Rev., vol. 18, pp. 508–518, 2013.

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The strategic program optimizes and adjusts the previous plans for the operation of large water conservation facilities with improvement of design and construction standards for flood control. The Plan is continue to take comprehensive measures to improve major rivers, and speeding up efforts to harness small and medium-sized rivers with preventive and controlling action on geological disasters caused by mountain floods, construct water conservation facilities more capable for adapting to climate change, and ensuring their safe operation throughout strengthening of the development of hydrological and water resources monitoring networks/facilities.

In terms of policies and regulations, the Ministry of Science and Technology issued China's Carbon Capture, Utilization and Storage (CCUS) Technology Development Roadmap (2019 Edition), which made systematic and orderly deployment of China's CCUS technology development. In terms of technology research and development, China has supported more than 10 CCUS research and development projects and demonstration projects by relying on the national key research and development programs in 2019. In terms of technology application and promotion, by August 2019, dozens of CCUS demonstration projects had been built, which enhanced engineering practice capacity while verifying technological feasibility.

In terms of capacity building, the CCUS special committee was established under the Chinese Society for Environmental Sciences, and multilateral and bilateral cooperation was actively carried out through the China CCUS Industrial Innovation Alliance, striving to build an international cooperation platform for the integration of CCUS industry, education and research.

Under the Water management Policy, China accelerates activities on water shoreline management, water pollution prevention and control, water environment governance, water ecological restoration and law enforcement supervision, promote and improve the hydrological and water resources monitoring system, strengthen dynamic monitoring of surface water and groundwater, and strengthen the analysis, evaluation and prediction of water resources. Actually, accelerated efforts to build a water-conserving society nationwide, and completed the building of a water-conserving society in the first 65 counties (districts) to meet the standards. And carried out major water-saving actions to increase water use in agriculture, increase the efficiency of water use in industry, and reduce water consumption in urban areas.

China is carrying out comprehensive management and protection of water resources nationwide, advance the construction of key water source projects, strengthen supervision and monitoring of drinking water sanitation, and improve the capacity to ensure water supply in both urban and rural areas. China's water resources allocation pattern has been further optimized. By June 2019, the first phase of the middle route of the South-to-North Water Diversion Project had supplied 20.9 billion cubic meters of water to the north, including 1.96 billion cubic meters of ecological water. Water security was further strengthened, the problem of safe drinking water in rural areas was basically solved, and the urban sewage treatment rate increased from 82.3 percent in 2010 to 95.49 percent. Also China actively promotes the reform of water pricing and conservation and rational allocation of water resources.

China strengthens wetland protection and desertification control and carries out wetland restoration and comprehensive management projects, further improve the wetland protection system and strengthen wetland protection. Also plans to carry out actions to restore vegetation in desertification areas, protect species in sandy areas, monitor desertification dynamics, and restore vegetation on degraded lands, and promote comprehensive control of desertification, stony desertification, and soil erosion. As a result of taken efforts the comprehensive treatment of desert is demonstrated, and the technical system of karst ecological restoration is constructed, and a generalizable ecological industry

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model is formed according to local conditions. At the same time, the compilation of the National Master Plan for Major Ecosystem Protection and Restoration Projects was initiated.

Desertification issues are covered under national resource management and conservation laws through the government's promulgation of related legislative acts; examples include the Forest Law Water Law Grassland Law Land Management Law Environment Protection Law. In 1991 the government formulated policies on Desertification control and rational use of sandy deserts to facilitate enforcement of these laws. The Ministry of Forestry auctioned use rights to sandy wasteland and barren hills for farmers to rehabilitate for private gain. Combating Desertification is an essential element of the Chinese Government's national economic andsocial development master plan. The National Desertification Combating Coordinating Group includes representatives from the National Economic Commission Ministry of Forestry Ministry of Water Resources Ministry of Agriculture Chinese Academy of Sciences State Planning Commission Ministry of Finance Ministry of Energy Ministry of Railways and the Poverty Alleviation Office of the State Council. The National Desertification Control Office is located in the Ministry of Forestry in order to coordinate regular programs and activities; coordination points have been created at different levels of local government. The China National Monitoring Centre for Desertification formed within the same ministry provides information on the changing dynamics of desertification and the results of combating measures.

The Chinese government recognizes that scientific and technological skills to combat Desertification are built over generations and for this purpose has established departments of soil and water conservation and desert control in universities colleges and other national academies. Mid-level professional schools have been set up and educational networks improved; enhanced research institutes and experimental stations serve as focal points for case studies pilot projects and technical extension services.

Decertified lands in China are vast and varied. At the planning level China integrates the policy, technical and scientific sectors responsible for land resources and Desertification issues giving due consideration to local conditions. An integrated management approach for decertified land water farmland forests and roads promotes the balanced development of agriculture, forestry animal husbandry and water resources. In arid areas affected by wind erosion green shelterbelts are established water resource management improved and activities to protect vegetation and expand oases encouraged[19].

For strengthen ecological restoration and vegetation protection in coastal areas, and make coastal areas and ecosystems more resilient to climate disasters China implements the Law of the People's Republic of China on Marine Environmental Protection and the State Development of Marine Undertaking. As a result, the multi-dimensional monitoring, forecasting and early warning of Marine disasters such as storm surges, waves, sea ice and coastal erosion have been strengthened, and the frequency of issuing early warning of Marine disasters has been significantly increased. Technical Guidelines for Assessment of Vulnerable Areas under the Impact of Sea Level Rise is been prepared, and vulnerability assessment, impact investigation of sea level change, and monitoring and evaluation of coastal erosion is been carried out in key areas such as coastal provinces and cities. The trend of long-term changes of Marine disasters and environmental factors in China's coastal areas is studied to predict the possible impacts ofclimate change on Marine disasters in the future. Monitoring of sea-gas carbon dioxide exchange fluxes in the sea areas under China's jurisdiction has been carried out, and the source and sink of atmospheric carbon dioxide in different seasons in the sea areas under China's jurisdiction has been preliminarily grasped. Research has been carried out on

[19] http://www.fao.org/3/w7539e/w7539e03.htm

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Marine ecosystem restoration and climate change response, projects have been carried out on mangrove restoration and coastal wetland restoration, and pilot work has been carried out on reforestation and sustainable utilization of abandoned shrimp ponds. And it's planned to strengthen the protection and restoration of Marine ecosystems, carry out the campaign to improve the "Blue Bay" and the comprehensive management of the Bohai Sea, and promote the restoration of the ecological functions of coastal areas, coastlines, islands and waters.

China has successfully responded to a series of major disasters, including Super Typhoon Lekima and the four quake lakes on the Jinsha River and the Brahmaputra River. At the same time, with a focus on strengthening disaster risk monitoring and early warning and assessment system construction, strengthen the risk situation, organize the implementation of disaster risk research and key hidden engineering, strengthen overall coordination, natural disaster prevention and control of key projects to develop the national comprehensive disaster reduction community and managed to create, strengthen basic adapt to climate change and its effects.

China is working on: - strengthen the research on the effects of warming and humidification on ecosystem improvement and water resources utilization in western China and the corresponding measures; - strengthen the forecast of extreme weather and climate events, and the prevention and mitigation measures of high temperature, heat wave, rainstorm, typhoon, forest fire and other disasters, such as; research on sea level rise, storm surges and other disasters in coastal megacities, and develop new long-term plans for comprehensive disaster preparedness.

China is taken measures to strengthen the formulation of climate change-related plans in all areas. The Energy Administration has carried out research on the development strategy of renewable energy in 2035 and 2050 to strengthen the top-level design of the industry development. In 2018, the Ministry of Natural Resources issued the Outline of the Plan for Scientific and Technological Innovation and Development of Natural Resources, which included climate change in its scientific and technological planning for natural resources. The Meteorological Administration has completed the "Planning for the Construction of Meteorological Support Services for the Construction of Ecological Civilization" and issued the relevant division of labor plans. The State Forestry and Grassland Administration have issued the National Plan for Long-term Forestry and Grassland Scientific Research Bases (2018-2035), the National Plan for the Development of Forest Cities (2018-2025) and the National Plan for the Construction of Reserve Forests (2018-2035).

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2.2 Strategic policies in Mongolia

Mongolia has impacts from climate change in terms of temperature and precipitation patterns, putting further pressure on degraded grasslands and poor livestock practices. Increased evaporation from higher temperatures and greater variability in precipitation may cause a decrease in river water levels, higher seasonal variations, and a decline in groundwater levels because of decreased recharge.

The legal framework relevant for implementation of the UNFCCC is composed multiple laws, including the Law on Energy 2001, Law on renewable Energy 2007, Law on Energy efficiency and Law on Air 2015. The main Policy Guidelines & Programs in energy sector related to GHG Mitigation are: Coal Program, Mongolia Integrated Power System (MIPS), Mongolia Sustainable Energy Sector Development Strategy Plan (2002-2010), Mongolia National Renewable Energy Program approved 2005, Liquefied petroleum gas (LPG) Program.

The National Energy Plan being updated, national targets set for saving energy and increasing the share of renewable energy sources mainly from hydro resources with the corresponding GHG reduction goals in CO2 equivalent.

State Policy and program on Disaster Protection, 2011 aims to strengthen the disaster management Protection Capacity system. The document includes the State Policy on Disaster Protection and National Program on Strengthening Disaster Protection Capacity.

In September 2014 approved National Action Program on Climate Change (NAPCC) and other related policies. The NAPCC currently constitutes the main policy framework for implementing the UNFCCC in Mongolia and has three strategic objectives:

- Set a legal environment, structure, institutional and management system responding to climate change issues;
- Ensure environmental sustainability and reduce socio-economic vulnerabilities and risk through strengthening the national climate change adaptive capacity;
- Mitigate GHG emissions and establish a low-carbon economy through the introduction of environmentally friendly technologies and improvement in energy effectiveness and efficiency.

The NAPCC includes measures on both mitigation and adaptation in key sectors of the Mongolian economy. The first implementation phase took place between 2011 and 2016. According to the plan, in the first phase legal and institutional framework would be set up and capacity building would be strengthened. In the second phase (2017-2021), adaptation and mitigation activities would be undertaken. An Assessment has been conducted for the firstimplementation phase. Measures taken under this phase include: the climate change response action plan being implemented at aimag (province) level and several aimags having local action plans on climate change; development and approval of the National Action Plan for Disaster Risk Reduction; 2015 amendments to the Law on Energy and Law on Renewable Energy; development of the Ecosystem-based Adaptation Action Plan for Disaster Risk Reduction in the River Basins; activities aimed at enhancing reforestation and forest rehabilitation; conducting a forest inventory; and preparation of Mongolia's Second Assessment Report on Climate Change.

As of mid-2017, the second phase implementation plan is being prepared and consideration is being given to how to align with the most recent developments, namely the 2015 INDC.

Nationally Determined Contribution (NDC)

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Mongolia submitted its Intended Nationally Determined Contribution (INDC) on 24 September 2015, and one year later it became first Nationally Determined Contribution (NDC), both include a mitigation commitment and an adaptation component. Its elaboration was coordinated by the Special Envoy for CC, with the support of the CC Project Implementing Unit of the then Nature Conservation Fund under the Ministry of Environment, Green Development and Tourism, with financial and technical support from GEF, UNDP and GIZ.

According to NDC, by 2030, Mongolia intends to contribute to global efforts to mitigate GHG emission by implementing the policies and measures described in energy, industry, agriculture and transport sectors, and contingent upon the continuation of international support to complement domestic efforts. The NDC also indicates Mongolia's interest in pursuing additional mitigation actions in energy, transport, agriculture, waste, industry and forestry sectors. The cumulative impact of the measures identified is estimated to result in annual reduction in emissions of approximately 7,300t CO2eq in 2030, corresponding to a 14 per cent reduction compared with a business-as-usual scenario.

Considering the relevance of adaptation to CC for Mongolia, the NDC also comprise an adaptation component. It establishes as a vision increasing adaptive capacity to overcome negative impacts of CC and to strengthen resilience of the ecosystem and socioeconomic sectors. Adaptation target are identified as well as funding, capacity and technologies needed.

According to the NDC estimation, the implementation of the foreseen adaptation policies in the agriculture, forestry and water resources sector would increase the capacity of carbon sink of natural ecosystem to absorb almost half of the emission from the energy sector in Mongolia Table 3.

Mongolia is on track with the work on implementation and monitoring of the 2030 Agenda for Sustainable Development and it's Sustainable Development Goals (SDGs). The Government has designed the 2016 Mongolia Sustainable Development Vision 2030 (SDV) as a framework policy document for implementation of SDGs with achievement indicators. The SDV places an emphasis in IWRM and includes a number of water related targets, -to ensure that, by 2030, 90 per cent of the population is supplied with safe drinking water and 60 per cent of the population uses improved sanitation and hygiene facilities.

The Government of Mongolia has made significant progress in improving its legal and institutional framework for integrated water resource management (IWRM) and the environmental protection of river basins. In 2010, Mongolia was divided into 29 river basins. By introducing the concepts of river basin organizations (RBOs), 7 which consists of river basin councils (RBCs) and river basin authorities (RBAs), paved the way for decentralization and community involvement in water governance. The Water Law of 2012 serves as an umbrella law for water management and based on IWRM approach. The law also addresses water monitoring and research, protection zones, water use permitting, the management of water infrastructure and measures to protect water resources in times of drought from desertification and desiccation. The law defines self-monitoring requirement: all water users must have equipment installed to measure water use. The 1995 Law on Water and Mineral Water use Fees has been consolidated with laws on the use of natural resources as the 2012 Law on Fees for Use of Natural Resources.

The law on Use of water Supply and Sewerage System in Urban and Settlement Areas regulates the ownership and utilization of water facilities required to supply urban users with drinking water and to treat and dispose of their wastewater. This law assigns the task of development the legislation and policy on urban water supply and sewerage disposal to the Ministry of Construction and Urban Development.

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The key specific water focused policy document is the National Water Program include; protection of Mongolia's water resources and conservation of their purity and natural replenishment; establishment of a comprehensive network for the monitoring of water resources and adaptation of new management and information management technologies; creation of the condition necessary for an accumulation of water resources, provision of drinking water meeting health standards, and improvement of the agricultural and industrial water supply; improvement of the use and management of water resources, development of the legislative and institutional environment so as to coordinate the multiple requirements for the use of water; capacity building; and fostering civil participation and the provision of the public with information on the protection and use of water resources using advanced technologies. The program highlighted the importance of institutional development and capacity buildingand stipulated the establishment of new agencies-the water basin councils and the State-owned enterprise now called Mongol Us (Mongolian Water). Key achievements in implementation of the first stage of the program include establishment of the legal framework for the introduction of IWRM in the period 2009-2013, rehabilitation/improvement of 169 springs in period 2012-2016 and establishment of new monitoring points in the period 2014-2016.

While implementation of National Program on Safe Drinking Water Supply, 2008, new WWTPs were built in several aimags and hydrological research was done to increase the population coverage with safe drinking water.

The 2012 Khatan Tull National program and Action Plan, 2012, aims to protect and sustainability manage the Tuul River basin, which covers a total area of about 50'000km2 extending over seven districts of Ulaanbaatar and 37 soums of five aimags. The River is the main source of water supply for UB, is nearly polluted by insufficiently treated and untreated sewage. The program is implemented in two stages within 2012-2020 and includes measures to improve water quality and protect the river source, small rivers and streams flowing into the Tuul River. The Action program includes activities on water supply, environmental protection, water quality monitoring, wastewater treatment technology upgrade, and reuse of treated wastewater. All WWTPs in Ulaanbaatar along the Tuul River are to undergo technological innovation. The program provides for discontinuation of exploitation of sand and gravel from Tuul River and technical and biological rehabilitation.

Green development is a clear policy objective, enshrined in the key national visionary document, the 2016 Mongolia Sustainable Development Vision 2030, as well as in the specific green-economy-oriented 2014 Green Development Policy.

The Government Action program for the period 2016-2020 prioritizes support to the introduction of wastewater recycling technology; recycling wastewater pit the grey water standards, enabling it to be used for the technological purposes of sewerage system or watering green areas; accelerating the step-by-step renovation work of the central wastewater treatment plant; and ground water for industrial technology needs.

Since 1985, Mongolia has developed an extensive legal framework on environmental protection. The environmental legislation is largely consistent and coherent. However, implementation of environmental legislation is often delayed. Furthermore, enforcement of environmental laws and environment-related provisions in sectoral legislation often represents a serious challenge. In recent years, the Government made efforts to integrate environmental requirements into the legal and policy framework on mining. The current documents related to mining focus on establishing a favorable investment environment for the mining sector. Mining companies are obliged to build up financial resources to ensure adequaterehabilitation/reclamation of mining sites after their closure.

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The adaptation of environmental management system has progressed lately, but so far very few companies have been certified in accordance with MNS ISO 14001.

The role of economic instruments in creating effective incentives for changes in the behavior of polluters remained modest. The tax rates applied to the four components of the air pollution tax are too low for achieving this. The water pollution tax has been awaiting the adoption of secondary legislation required for its implementation.

Water pollution charges are based on the Law on Water. There are two tariffs direct and indirect use of water; 1) fees for direct use of water charged for commercial use like mining, agriculture, industries which are itself abstracted water via own deep wells; 2) fees for indirect use-as a service fee to the Water Authority. The 2011 Law on Use of Water Supply and Sewerage System in Urban and Settlement Areas establish the general legal framework for water supply and sewerage tariffs. Tariffs for water supply and sewerage services have been established for all cities and amiga by the Water Services Regulatory Commission since 2012.

In 2012 Law on Water pollution fees approved, but secondary legislation for the implementation of this instrument has not yet been adopted.

The strategy identified six priority areas of development of Mongolia, of which the Priority Area 5 says that “to create a sustainable environment for development by promoting capacities and measures on adaptation to climate change, halting imbalances in the country’s ecosystems and protecting them”. In the Strategic objective 6 titled “Promote capacity to adapt to climate change and desertification, to reduce their negative impacts” of this priority area, the climate change adaptation activities and measures were identified.

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Table 3: Adaptation target and needsunderthe NDC

Sector	Adaptation goals	Adaptation targets	Capacity needs	Technology needs
Water resources	To maintain the availability of water resources through protection of run-off formation zones and their native ecosystem in river basins.	30 per cent of the territory will be protected as national SPAs by 2030 and the sustainable financial mechanism will be introduced.	To implement integrated water resource management systems; To coordinate multi-stakeholder relations through improved legal and policy measures and efficient management; To strengthen human resource capacity to deal with technical issues.	To implement ecosystem-based technologies; To support ecosystem services through hydrological monitoring, construction of water diversion canals to drying lakes located in flood plains and re-forestation actions.
	To construct reservoirs for glacier melt water harvesting; To regulate river streams and flow.	To create water reservoirs at rivers and outlets of lakes, and to construct multipurpose systems of water usage.	To enhance hydrological monitoring and research for river flow regulation; To construct water reservoirs and water diversion facilities to transfer water resource to dry regions.	
	To introduce water saving and water treatment technologies.	To find solution for sustainable water supply of Ulaanbaatar city and industries and mining in the Gobi region, and subsequently implement.	To conduct a study and introduce sustainable water supply with closed systems preventing evaporation loss.	To introduce new technologies for water saving and treatment

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2.3 Strategic policies in Sri-Lanka

Sri Lanka, a country highly vulnerable to adverse effects of climate change and very lower greenhouse gas, presents the NDCs to strengthen the global efforts of both mitigation and adaptation. In response to challenges posed by climate change, Sri Lanka has taken several positive steps by introducing national policies, strategies and actions in order to address climate change induced impacts, amongst which are the National Climate Change Policy of Sri Lanka, National Climate Change Adaptation Strategy for Sri Lanka in 2010, the Climate Change Vulnerability Profiles; Water, Health, Agriculture and Fisheries, Urban Development, Human Settlements and Economic Infrastructure in 2010, the Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation and Mitigation in 2014, the National Action Plan for Haritha Lanka Program in 2009 and Urban Transport Master Plan 2032 based on the National Transport Policy in 2009.

Further, National Adaptation Plan (NAP) for Climate Change Impacts in Sri Lanka has been developed, Nationally Appropriate Mitigation Action (NAMA) on Energy Generation and End Use Sectors is being implemented, and the NAMA on Transportation is being prepared. In addition to the aforementioned, the Long-Term Electricity Generation Expansion Plan 2015-2032 and the National Solid Waste Management Strategy 2000, the Corporate Plan 2014-2018 by the Central Environmental Authority and various legal amendments made by government entities related to environment are being implemented. In addition, Forestry Sector Master Plan 1995-2020, National REDD+Strategy are two important initiatives towards enhancing the forest cover in the country[20].

Among these, the most important action document is the National Adaptation Plan for Climate Change of Sri Lanka 2016 to 2025, 2016 (NAP) which is aiming to implement the National Climate Change Adaptation Strategy for Sri Lanka 2011-2016 prepared in 2010 and the National Climate Change Policy (NCCP) adopted in 2012 for adaptation of climate change adverse effects.

The NAP covers adaptation needs at two levels, namely; adaptation needs of key vulnerable sectors and cross-cutting national needs of adaptation. Nine vulnerable sectors were identified in the consultative process, i.e. food security, water, coastal sector, health, human settlements, bio-diversity, tourism and recreation, export development and industry- energy-transportation. The NAP proposes an institutional and coordination mechanism along with implementationand resource mobilization strategies for the successful implementation of the NAP based on a realistic timeframe.

Sri Lanka signed the Paris Climate Agreement in April 2016 and submitted Sri Lanka's INDCs covering national commitments to both mitigation and adaptation. The adaptation commitments in INDCs are largely based on the adaptation options and actions identified in the NAP process and this plan is fully consistent with Sri Lanka's commitments towards global efforts on adaptation13.
Sri Lanka's INDCs are covered the sectors of; human health, food security (agriculture, livestock and fisheries), water, irrigation, coastal and marine, biodiversity, urban city planning & human settlements, and tourism & recreation.

NDCs of Sri Lanka were prepared based on the Readiness Plan for the Implementation of the Intended Nationally Determined Contributions (INDCs) 2017-2019. Mainly five sectors have been identified under mitigation for reducing greenhouse gas emissions. These are sectors of energy (electricity generation), transport, industry, forests and waste. Possible emission reduction actions have been identified in each sector, which are to be implemented during the period of 2020 to 2030. NDCs for Mitigation intends to reduce the GHG emissions against BAU scenario by 20% in the energy sector (4% unconditionally and 16% conditionally) and by 10% in other sectors (transport, industry, forests and waste) by 3% unconditionally and 7% conditionally by 2030.

[20] NDCs of Sri Lanka

Sri Lanka's NDCs comprise of following four areas;

Mitigation - Reducing the GHG emissions against the Business-As-Usual (BAU) scenarios in the sectors of energy (electricity generation), transportation, industry, waste and forestry. The key contributors to GHG are Carbon Dioxide (CO2), Methane (CH4) and Nitrous Oxide (N2O).

Adaptation - Building resilience in most vulnerable communities, sectors and areas to adverse effects of climate change. Adaptation will focus on human health, food security (agriculture, livestock and fisheries), water and irrigation, coastal and marine, biodiversity, urban infrastructure and human settlement, tourism and recreation. Adaptation initiatives that derive mitigation co-benefits will be prioritized.

Loss and Damage - In order to address issues related to losses and damages resulting from extreme weather events, a local mechanism will be developed in accordance with the Warsaw International Mechanism for Loss and Damage.

Means of Implementation- External support for Finance, Technology Development and Transfer, and Capacity Building for the above sectors are considered in the implementation process of the NDCs of Sri Lanka.

National Climate Change Policy of 2012 (NCCP): The Policy articulates the broad national policy statements which will guide decisions taken at national and sub-national levels against the threat of climate change. It presents twenty five policy statements to cover a number of relevant areas of climate change in Sri Lanka including: vulnerability, adaptation, mitigation, sustainable consumption and production, knowledge management and general statements concerning institutional coordination, research and development, technology transfer, legal and regulatory framework, market and non-market based mechanisms and resource mobilization.

The NCCP is defined national vision, and the NCCAS: 2011-2016 identified strategic priorities of adaptation process.

National Climate Change Adaptation Strategy (2011-16), (NCCAS): The Strategy identifies strategic priorities required to be addressed when facing the threat of global climate change. Its scope covers five strategic thrusts, 25 thematic areas of action and 91 priority adaptation measures. Hence, it goes beyond identification of strategic priorities and suggests a broad selection of interventions to address these strategic priorities without specific plan of actions to implement them or to monitor the progress.

National Adaptation Plan: In relation to the Policy and Strategy, the role and function of NAP is designed with a set of implementable actions to overcome anticipated threats due to impacts of climate change. While the interventions of NAP are guided by broad principles lay down by the Policy and Strategic priorities but it is not restricted by their scopes. Interventions identified in the NAP are focused actions with specific timelines, responsible stakeholders, implementation strategies and key performance indicators for monitoring and reviewing mechanisms compared with the broad interventions suggested by the Strategy[21].

The NAP is essentially contributing to number of SDGs and the specific goals addressed by the relevant adaptation options and actions were described in the plan too.

[21] National Adaption Plan of Sri Lanka

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The NAP includes the organizational structure of line ministries and line agencies of the Government of Sri Lanka. However, its target beneficiaries are not the government agencies, but the vulnerable sections of the society to climate change impacts.

Methodology of Planning was guided by the broad framework proposed by UNFCCC guidelines on NAP process.

Stakeholder consultations helped to identify projections on five major types of changes in atmosphere and oceanic systems that could create impacts on vulnerable sectors. They are:

- Increased atmospheric concentration of greenhouse gases
- Rising atmospheric temperature
- Changing pattern of precipitation
- Increased incidence and severity of rainfall
- Sea level rise

The NAP consists of action plans for nine vulnerable sectors and a set of interventions proposed to fulfill cross-cutting national needs of adaptation. Among the key components covered in the NAP are: specific actions/interventions with time lines to fulfill sectoral and cross-cutting adaptation needs; an implementation strategy for selected interventions; institutional mechanisms for coordination of actions of stakeholders; key performance indicators (KPI) for each action; system for monitoring and evaluation KPIs.

The major goals of the plan are to:

- Raise the adaptive capacity of individuals, communities and the society to cope with
- impacts of climate change effectively;
- Reduce the vulnerability to climate risks by enhancing the resilience of communitiesand ecosystems,and;
- Capture any opportunities that arise due to changes for maximum gain for the societyand people.

And the plan intends to reach these broader goals through achieving the following objectives.

1. To increase the resilience of economic sectors and natural systems against the emergingand projected impacts of climate change by adopting appropriate coping strategies andsystem improvements
2. To minimize the risk of damage caused by short-, medium- and long-term impacts associated with projected changes in climatic parameters through timely adaptive measures
3. Toexpand the current knowledge on observed and projected changes of climate and associated physical vulnerabilities and socio-economic impacts through scientific research
4. To build the capacity of communities, economic sectors and ecosystems to adjust more readily to unfolding changes of climate through supportive investments on adaptive actions and increased awareness
5. To improve the existing systems of disaster risk management to minimize the vulnerabilities and increase the risk preparedness for extreme events
6. To increase the preparedness to face the threats of climate change through establishment of advanced monitoring and surveillance systems, timely weather and climate forecasting systems and effective communication channels for information dissemination
7. To increase the skills and knowledge on successful practices of adaptation through well designed education, training and awareness programs

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Time horizon of the plan is ten years extending from 2016 to 2025. This period is divided into three stages for periodic revision of the plan (foundation building stage 2016-2019; development stage 2020-2022; goal achieving stage 2023-2025).

The plan has described Summary of Plan-Priority Actions, we can take as an example the WaterResources Plan as below:

Table 4: Plan-Priority Actions

Sector	Priority actions
Water resources	• Develop and implement watershed management plans for critical watershed areas • Increase the efficiency of use and reduce losses of irrigation water • Assess the current practices of water management for climate resilience and identify ways to improve them • Identify and map areas vulnerable to droughts and flood hazards and prepare disaster risk management plans • Design rational intra-basin and trans-basin strategies to harness periodic surpluses of water in storage facilities
Coastal and marine sector	• Implement a continuous program for monitoring shore line changes • Develop shore shoreline management plans including M&E programs • Study impacts of sea level rise on costal habitats over short-, medium and long-term horizons • Identify, declare, collect information and prepare maps on vulnerable areas to extreme events and inundation • Conduct awareness programs on sea level rise and extreme events to coastal communities to empower them for facing the risks of climate change

The NAP identified other *water resources related actions* as tourism and recreation and *agricultural* - new cultivars/clones tolerant to heat, drought and flood and resistant to diseaseand pest attacks; sustainable cropping systems; develop research institutes capacity for conducting R&D on CC impacts on export agriculture crops; industry, energy, transportation-minimize the fluctuation hydropower generation potential trough improvements in system management, diversify the energy mix with increased share of renewable energy; and other essential *cross cutting needs for adaptation* as undertake a review of relevant macro and sectoral policies, ordinances, acts, statutes and procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka; develop policy recommendations necessary for addressing vulnerability to climate change impacts in all development /management projects; restructure and strengthen the CC Secretariat as the National Focal Point (NFP) for implementation of NAP; develop an inventory of international climate donors, funding schemes, training providers, training programs, research agencies/consortiums and events (conferences, seminars etc.) for the benefit of local stakeholders of adaptation; create a National Adaptation Fund with the collaboration of the Ministry of Finance to support the implementation of NAP actions and supportive programs; establish a national network of research agencies and universities that are carrying out research on climate adaptation for promoting coordinated research and information dissemination; develop a coordinated multi-disciplinary small research grant program on thematic areas relating to climate change adaptation to be facilitated by the National Focal Point and managed by the national research support agencies (e.g. NSF, NRC, CARP); establish a

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common repository of scientific and awareness materials on climate change adaptation; conduct training programs for government officers, CSO members, and private sector employees on climate change adaptation; establish a national research program on climate modeling for long-term climate projections.

The NAP developed sectoral adaptation plans which contain adaptation actions/interventions proposed to fulfill adaptation needs of nine identified sectors with high level of vulnerability to CC impacts. The actions have been chosen to fulfill adaptation needs on a logical criteria based on projections, vulnerabilities and impacts on respective sectors. Advantages of Action plan was provided the adaptation needs and details on actions, responsible agencies and key performance indicators. Here we can overview the water resource related actions as well.

Water Resources

Availability, supply, distribution, use and conservation of water resources are directly dependent on climate conditions. The water resources sector in Sri Lanka has to cater to the domestic, agricultural and industrial needs of water. Besides fulfilling human needs, the survival of all ecosystems also relies heavily on the availability of water. Relationship between water and ecosystems is a complex one. Hence, in addition to fulfilling human needs, managers of water resources have to be mindful about ecosystems also. Only a limited segment of households in the country have access to safe drinking water.

Sri Lanka has invested heavily on agricultural water supply and a significant share of the country's power generation capacity also is dependent on water resources. A growing number of industrial facilities also create demand for water resources and this has led to high level of extraction of groundwater as well as increased pollution of water resources. Overall, water is an important sector that has implications for all major economic sectors and human activities that need special attention in adaptation climate change.

Other National Policies and Plans

In addition to the Policy and the Strategy on climate change, the environment sector has a number of other national policies, strategies and action plans. Some of these policies have recognized climate change as a key environmental challenge faced by the country. Even though their coverage of the subject is not comprehensive and focused as in the current plan, they propose certain strategies, actions, projects for overcoming threats posed by climate change impacts on respective areas of interest.

National Action Plan for Haritha Lanka Programme: The Haritha Lanka Programme has identified climate change as the third mission and selected certain strategies/actions relating to both mitigation and adaptation (NCSD, 2009). While the climate change mission in Haritha Lanka has given more weight to strategies/actions targeting mitigation (i.e. reducing GHG emissions), it has adaptation actions in areas of infrastructure vulnerability, land use zoning, rain water harvesting, increase of vectors and food security.

Sri Lanka Comprehensive Disaster Management Programme 2014-2018 (SLCDMP): The SLCDMP is a policy document, which has a close connection to the National Adaptation Plan (NAP). It identifies

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climate change as a disaster and proposes actions to overcome its' consequences. In addition, other major types of disasters identified by the SLCDMP such as floods, droughts, landslides, high winds/cyclones are also closely associated with extreme weather events. While proposing adaptation actions for extreme events in all sectors, the disaster risk management has been identified separately as a cross–cutting need of adaptation so that all disaster related actions can be coordinated closely with the existing disaster management agencies such as the Ministry of Disaster Management and the Disaster Management Centre.

National Action Programme for Combating the Land Degradation of Sri Lanka (NAPCLD):

The NAP-CLD has recognized climate change as a factor that can intensify the degradation of land resources in future (Ministry of Environment and Natural Resources, 2014). It highlighted issues such as soil erosion and landslides in up- and mid-country wet zone (upper watershed) areas as critical issues together with actions to overcome them. These actions can complement the climate change adaptation. Therefore, certain actions in the NAP-CLD and NAP can be jointly implemented through proper coordination.

Coastal Zone Management Plan (CZMP): The CZMP has also recognized climate change as a factor that can intensify the degradation of coastal resources in future. Its main concerns include coastal erosion, coastal pollution and degradation of coastal habitats.

The NAP identifies impacts of climate change on the coastal sector and proposes adaptation measures to overcome them. Hence, overlapping areas of the CZMP and NAP are complementary and better results can be achieved through proper coordination.

National Physical Plan 2011-2030 (NPP): The NPP has identified global warming as a concern that can affect physical development activities of the country. In addition, it covers some aspects of disaster risk management too. However, the major focus of the NPP is development of physical infrastructure facilities and no attention was given to climate adaptation. However, its proposal to conserve central and coastal regions as environmentally sensitive (fragile) areas, complements achieving the objectives of the NAP to a certain degree.

Sri Lanka Water Development Report 2010 (SLWDP): The SLWDP has identified climate change as a major driver of change in the water resources sector. However, information in the report suggests that there is no current policy, plan or program in the water sector that specifically cover climate change adaptation. Hence, proposed actions of the NAP would be highly beneficial for addressing adaptation needs in the water sector.

Draft National Agriculture Policy: The presently available draft framework of the National Agriculture Policy for public comments identified 'Assuring food security' and 'Ensuring environment sustainability' as two major pillars of the policy in making. It recognized 'Natural resource management & climate change adaptation' as a key strategic/intervention area that cover soil conservation, water management, agriculture climate forecast and disaster risk reduction. However, the policy is still at the preliminary stage of preparation and the NAP has a comprehensive portfolio of actions under food security and water resources sectors that can complement the objectives of the National Agriculture Policy.

All these sectors have been covered in the NAP. In addition, it also covers adaptation needs of export agriculture sector along with industry/transport/energy sectors which comprises main mitigation sectors in Sri Lanka's INDCs. Moreover, nearly all sectoral INDCs have been captured under different adaptation options and adaptive actions proposed to address respective sectoral needs of adaptation. The submission on INDCs acknowledges the NAP, all technical work of which had been

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completed by the time of submission (April 2016) and identifies it as a source document for identifying key sectors and sectoral INDCs. Hence, the connectivity between the NAP and Sri Lanka's INDCs is straightforward and there is high level of consistency between the two. In fact, even though official submission of INDCs came first, they are directly based on and guided by the NAP. This implies that implementation of the NAP will complement fulfilling Sri Lanka's global commitments on climate change and vice versa.

There are following key policies, strategies and actions on Water and Climate Change in Sri Lanka:

- National Drinking Water Policy
- National Rural Water Supply and Sanitation Policy 2001
- National Disaster Management Policy 2010
- National Environmental Policy and Strategies 2003
- National Wetland Policy and Strategy 2006
- National Policy on Protection and Conservation of Water Sources
- National Climate Change Strategy and Action Plan,2011-2016
- National Climate Change Policy, 2012
- Water Resources Board Act 1999
- Irrigation Amendment Act 1994
- Disaster Management Act 2005
- National Agriculture Policy 2007
- Agrarian Development Act 2000
- Mahaweli Authority Act 1979
- National Environmental Amendment Act 1988
- Irrigation Amendment Act 1994
- Technology needs Assessment for Climate Change 2007
- Capacity assessment and Action Plan Developing Capacity for Compliance with Global Convention on Biodiversity, Climate Change and Land degradation 2007
- Public Perception on Climate Change in Sri Lanka 2010
- Sector Vulnerability Profiles, 2010
- Climate Change Vulnerability Data Book, 2010
- Country vulnerability Assessment (Agriculture),2013
- Sri Lanka Comprehensive Disaster Management Program 2014-2018
- National Adaptation Plan, 2016-2025

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2.4 Conclusion remarks

Asia is highly vulnerable to water-related extreme events: droughts, desertification, floods, landslides and siltation are major threats.

Drought

Countries mostly affected by droughts are located in semiarid and arid areas like north China, Gobi desert in Mongolia. Sri Lanka is also subject to droughts with most occurring during the inter-monsoonal months from January to March and August to September. The 2015/16 drought in Sri Lanka resulted in severe water, food and energy shortages and severe impacts on livelihoods in the dry zone. Most drought problems are related to the availability of food, safe drinking water. Droughts not only affect surface water availability but also the recharge of aquifers which are currently depleted by unsustainable pumping rates. With growing population and food demand, large irrigation areas can become rapidly water-stressed.

Resent study results show that, about 90 percent of Mongolian territory affected by desertification and land degradation. In 2015, around 76.8 per cent of the total territory was degraded to some degree, with 29.8 per cent moderately degraded and 25 per cent degraded severely and very severely degraded.

Desertification in North China Climate change, human activities and other factors are accelerating the desertification process along this vast 5 000 km-long arid stretch in northern China. The annual of expansion of land desertification increased from 1 600 km2 in the 1970s to 2 100 km2 during the 1980s.

Ecological degradation and restricted economic development in the affected areas are severe. In the wield-impacted sandy area of northern China the annual number of days of wind greater than force eight is 30 to 100, with sandstorms occurring in some areas. On the Loess Plateau the average erosion model records between 5 000 to 8 000 t/km2/yr with 20 000 t/km2/yr as maximum. The annual quantity of silt flowing into the Yellow River now totals 1.6 billion tons (t) which raises the river bed in the lower reaches by ten centimetres (cm) each year. Desertification threatens two million hectare (ha) of farmland and 4.93 million ha of pasture land. Estimated direct economic losses from low and unstable productivity in agriculture, forestry and animal husbandry total 4.5 billion RMB yuan. China's most underdeveloped counties are located in decertified areas.

The major causes of land desertification in China are climate change and human economic activities. Climate variation and desertification are contributing factors to the phenomena of global climate change. Since the 1970s China's semi-arid and dry sub-humid zones simultaneously experienced increases in temperature and decreases in precipitation. Given current industrial energy usage, China is projected to lose 959 000 km2 in the humid areas and gain 843 000 km2 in arid and semi-arid areas by 2030. Sandstorms demonstrate the harmful and destructive impact of climate change. In May 1993 a sandstorm attacked over ten counties in four provinces including Xinjiang and Gansu. Soil loss due to wind erosion was ten to 15 cm, and sand loss, 20 to 150 cm for a total economic damage of 560 million RMB yuan17.

Floods

Asia experiences large scale riverine floods and coastal floods as well as more localized floods such as flash floods and glacial lake outburst floods (GLOFs). Due to their size and sediment loads, the largest rivers of Asia are difficult to manage and regularly cause flooding. Riverine floods lead to significant indirect losses including the degradation of agricultural land which subsequently diminishes agricultural productivity, impacting rural development and income opportunities, as well as the

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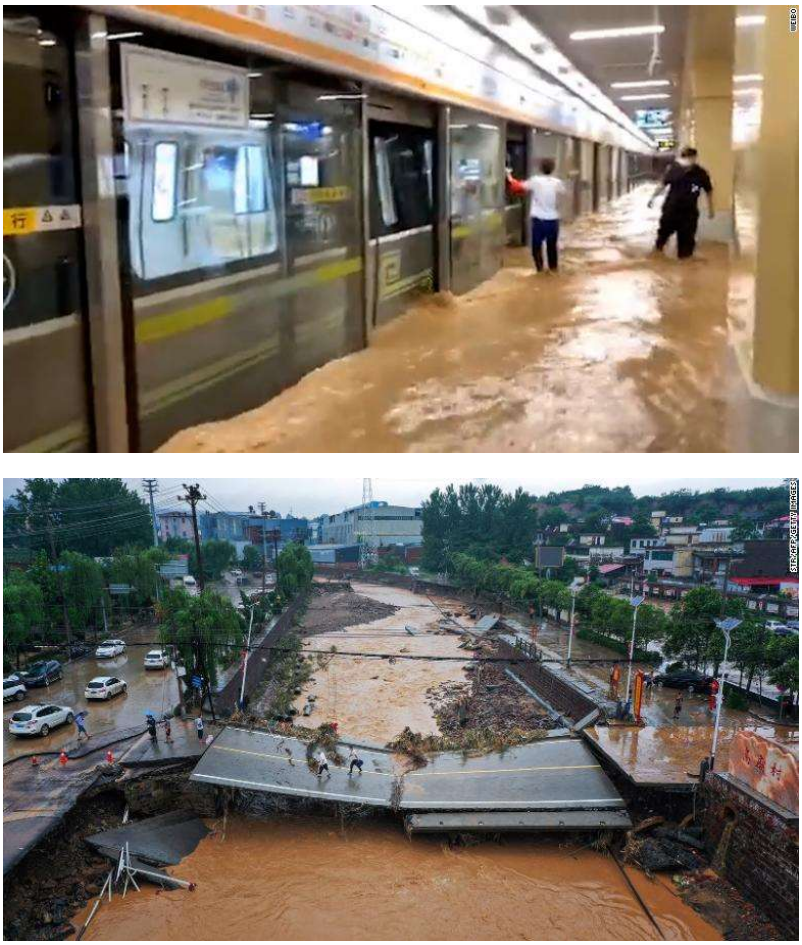
contamination of surface and groundwater, either with salt intrusion or pollutant dissemination. Riverine floods also damage water infrastructure including hydropower dams and irrigation schemes. This last decade saw the highest number of reported flood disasters with the greatest spatial coverage on record.

It reported that due natural disaster as floods hail, etc., damage has significantly increased during the past 30 years and caused human death and economic losses in Mongolia.

The flooding in China hit smaller cities and villages as well, with rivers swelling beyond warning levels and numerous reservoirs overflowing, affecting hundreds of thousands of people, frequently noted state-run media last years. The severity of the flooding was captured by numerous videos shared on Chinese social media, which showed people and cars swept away in surging torrents.



- Zhengzhou,the provincial capital of 12 million people, is one of the worst-hit areas, with 12 killed after being trapped for hours on a flooded subway line. Many smaller cities and villages have also been badly ravaged.
- More than 500 people were rescued from the subway while 12 were found dead and 5 were injured.
- A damaged bridge following heavy rains which caused severe flooding in Gongyi in China's central Henan province on July 21

Figure 3: Flooding in China July 21, 2021

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A car sitting in flood waters as waves caused by Typhoon In-Fa surge over a barrier along the coast in the Shandong provincial city of Qingdao in eastern China on July 25, 2021. Photo: AFP

Figure 4: Flooding in China, Shandong province

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Sea level rise combined with more intense and frequent cyclones will induce destructive coastal flooding. The most vulnerable areas to coastal flooding will be the low-lying and densely populated areas and costal aquifers are at risk. Floods and mudslides in Sri Lanka, for example, claimed nearly 150 lives, left 77,000 people homeless and destroyed 1500 homes.

Water dependent ecosystems will also be affected by climate change, although these impacts have not been properly assessed. For example, increasing crop water demand because of rising temperatures is likely to further reduce river flows and groundwater levels.

As we can see that countries have developing own policy and actions to minimize adverse effects on CC and adaption policy actions. However, this important development challenge will require greater policy coherence and integration across many economic sectors and administrative jurisdictions. They will also require investments in water supply and demand side management options, investments in flood management and drought resilience, and capacity to manage the region's water resources challenges.

Distance review has made only on the information provided by University representatives of Project partnering country which definitely limit to access relevant policy documentation and timing.

Main elements of water resources management strategy:

- Developing reliable supplies for meeting growing domestic, industrial, and agriculture water demand, and energy uses;
- Promoting sustainable use of water resources, protecting water quality, and managing watersheds, aquifers, lakes and wetlands;
- Systematic planning, development and management to address the systemic risks emerging of water-related disasters-droughts, floods, sedimentation;
- Promoting collaborative management of shared waters across administrative units, river basins and aquifers, states and provinces, and nations;
- Integrating water policies and actions with those outside the water sector (environment, land use, energy).

There could be raised following general points for successful implementation:

- Performance of the national water management and climate change policy should be evaluated through a sound monitoring and reporting system at all executive levels;
- Strengthen legal and regulatory mechanisms to take effective measures to meet climate change challenges by integrating legal requirements in to the respective sectors;
- Ensure sustainable financial mechanisms to support implementation of the national climate change policy;
- Develop mechanisms to establish, enhance, and improve skilled human resources throughout each country;
- Develop the new curriculum on CC-Water related issues of Partnering Universities and share existing experiences;
- Foster good governance practices at all levels to improve mutual understanding and trust among stakeholders to ensure accountability of implementing of the policy;
- The capacity for evaluating policy choices and water resources development options based on analyses of water and climate data needs to be strengthened in central agencies as well as in local and community organization.

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3 Experiences on adaptation and mitigation actions

3.1 China

China Future Ocean Alliance (CFO) is a national, neutral and independent scientific association, which provides an international, open forum for marine researchers and end-users to share their knowledge and experience. China Blue Carbon Plan which will potentially be a guide for the future directions in marine carbon sinks research in China. A non-profit alliance, the Pan-China Ocean Carbon Alliance (COCA) was established in September, 2013, with members from 21 domestic Chinese institutions including universities affiliated to the Ministry of Education of China, research institutes affiliated to Chinese Academy of Sciences, institutes/centers affiliated to the State Ocean Administration, as well as enterprises including China National Offshore Oil Corporation (CNOOC)[22].

Hydroelectric projects such as the South-to-North Water Diversion Project are planned to help optimize the allocation of water resources, to control floods in major rivers, and to alleviate drought in the north.

Shanghai and Baoding were chosen for pilot studies regarding the implementation of low carbon cities in China.

In response to climate change, China has also been launching a series of programs to boost ultra-supercritical (USC) R&D during the past several decades, and it currently possesses the world's largest number of USC units. By the end of 2016, ninety-four 1000MW USC units have put into operation in China[23].

Since 2018, the Chinese government has taken a series of measures to adjust the industrial structure, conserve energy and improve energy efficiency, optimize the energy mix, control greenhouse gas emissions from non-energy activities, increase carbon sink, strengthen the coordinated control of greenhouse gases and air pollutants, and promote low-carbon pilot projects and local actions. These measures have achieved positive results.

***Preliminary calculations show that China's carbon intensity dropped by 4.0% in 2018, a cumulative decline of 45.8% compared with 2005*.**

(China's Climate Change Policy and Actions 2019 Annual Report)

The Ministry of Industry and Information Technology has promoted energy conservation in industry, reduced greenhouse gas emissions, selected and released 728 items of advanced and applicable industrial energy-saving technologies and equipment, and accelerated the spread and application of highly efficient and energy-saving technologies and equipment. Preliminary calculations show that China's energy consumption per unit of GDP fell by 3.1% year on year in 2018, and energy efficiency continued to improve.

The newly-built buildings in cities and towns in cold and cold regions will be fully energy-

[22] N. Z. Jiao et al., "Climate change and anthropogenic impacts on marine ecosystems and countermeasures in China," Adv. Clim. Chang. Res., vol. 6, no. 2, pp. 118–125, 2015.

[23] H. Fan, Z. Zhang, J. Dong, and W. Xu, "China's R&D of advanced ultra-supercritical coal-fired power generation for addressing climate change," Therm. Sci. Eng. Prog., vol. 5, no. June 2017, pp. 364–371, 2018.

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efficient by 65%.
The State Administration of Housing and Urban-Rural Development issued the first batch of 12 green product evaluation criteria list and certification catalog, jointly with the Ministry of Housing and Urban-Rural Development, the Ministry of Industry and Information Technology issued the "Guide Opinions on Promoting Green Building Materials Product Standards, Certification and Identification", taking the lead in promoting green product certification in the field of building materials.

The Government of China will effectively promote clean heating in northern China. The Ministry of Housing and Urban-Rural Development, together with the Energy Administration, and four other departments organized a mid-term assessment of clean heating in northern China to guide local governments in promoting clean heating in accordance with local conditions. National Development and Reform Commission, bureau of energy, Ministry of Finance and other ministries are issued the clean the northern region winter heating planning (2017-2021), is proposed to clean the heating rate of 50%, in 2019, northern region instead of loose coal (including inefficient small boiler coal 74 million tons, to 2021 north clean heating rate of 70%, instead of loose coal (including inefficient small boiler coal) 150 million tons.

A three-year campaign to improve the quality and efficiency of urban sewage treatment was launched, and by the end of 2018, a total of cities and counties across the country had built sewage treatment facilities. There are 4,332 plants with a sewage treatment capacity of 195 million cubic meters per day.

China planned to increase forest carbon sinks by speeding up the implementation of the national forestation planning outline (2016-2020), for the printing of the forestry in 2018 to address climate change the key work division of line and plan, issued by the national afforestation committee, the state bureau of forestry and grassland in promoting action opinion for large-scale afforestation, innovation to promote national compulsory tree planting activities, further promote the "Internet + national compulsory tree planting" pilot, pilot area have been expanded to 10 provinces such as Shanxi. And China will continue to carry out a new round of key ecological restoration projects, such as returning farmland to forests and grasslands, controlling the sources of sandstorms in Beijing and Tianjin, comprehensively controlling stony desertification, building a shelterbelt system in the three northern regions, and building a shelterbelt system in the Yangtze and Pearl River basins and coastal areas.

In 2018, China planted 7.267 million hectares of trees and cultivated 8.667 million hectares of forest. The national forest coverage rate reached 22.96 percent, and the forest stock volume reached 17.56 billion cubic meters. China plans fully protect natural forests and grasslands, develop public welfare forests and complete the development of natural forests by cultivating 1.753 million hectares.

In 2018, the comprehensive vegetation coverage of grasslands across the country reached 55.7 percent, an increase of 0.4 percentage points over 2017. To strengthen the protection of desert vegetation, the State formulated the Measures for the Supervision and Administration of the Construction of Railways, Roadways and Other Construction Activities within the Area of the National Protected Areas Closed off on decertified Land, and strengthened the construction of the protected areas closed off on decertified Land. In 2018, 200 million yuan was spent on the construction of protected areas on desertification land, six new protected areas were added and protected areas on desertification land reached 1.663,800 hectares in total, and 16 national desert parks were approved

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through evaluation. The Ministry of Ecology and Environment, the Ministry of Natural Resources and other departments jointly launched the "Green Shield 2018" special campaign for supervision and inspection of national nature reserves, and the Forestry and Grassland Administration carried out large-scale inspections of protected nature areas across the country.

3.2 Mongolia

Mongolia has done a comprehensive and thorough strategic planning and needs assessment on climate change, which is a direct benefit of being a party to the 1992 UNFCCC. The country today has time series of up to 25 years of climate relevant data, though some challenges persist in terms of data availability and GHG inventory.

Being a party to the 1994 United Nations Convention to Combat Desertification in those countries experiencing Serious Drought and Desertification, Mongolia implements its National Action Program to Combat Desertification 2010-2020 aligned with 10 years Strategy of UNCCD.

Options for reduction of GHG emissions are mainly focused on clean coal technology, energy saving through energy efficiency measures and promotion of renewable energy sources. Energy sector identified a number of mitigation options: For the energy supply sector, to increase renewable options such as hydropower plants, wind farms and PV and solar heating; to improve the efficiency of heating boilers and convert steam boilers into small capacity thermal power plants; to improve household stoves and furnaces; to improve coal quality by coal beneficiation and effective mining technology and to improve power plants efficiency, For the energy demand sector, develop district heating and building environment; improve lighting efficiency; improve industry housekeeping and implement motor efficiency improvements and introduce energy efficient technologies such as dry-processing for cement industry, etc.

The Government established the priorities for water management in 1998, amended in 2010 National Water Program. Much attention is paid to revising and extending the legislative and regulatory frameworks. Achievements include the prohibition of mineral exploration and exploitation in no-off source areas, introduced in 2009, and placing 44.5 per cent of the total area of river sources under national protection by 2016.

National Water program has targeted to build traditional water collection pond in rural areas for watering livestock, and yearly reporting informs that hundreds of water ponds created by local residents.

The integrated water resources management (IWRM) approach is a priority direction or reforming the water management system. Practical implementation of IWRM is to ensure implementation of IWRM plans and advance opportunities for public participation in water management. Training and professional development of employees of the water basin authorities are the most important, to enable them to implement assigned tasks and be better positioned for advancing implementation of Target 6 of the 2030 agenda for Sustainable Development.

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Greening subsidy system

Mongolia provides tax incentives-exemptions from income tax, for entities that invest in equipment that is environmentally friendly and improves the efficiency of natural resources use (equipment for water saving, energy saving, electric motors, wind turbine kits, solar power generation kits and hydropower plant equipment). In 2014, total tax exemption worth US$1,3 million were granted to 22 enterprises.

Since the beginning of 2017, moreover, a special zero night tariff applicable from 9p.m.to 6a.m.is available for residents of get district with metered electricity consumption. This subsidy is offered during winter (November-March) and is designated to create incentives for using electric heating rather than polluting coal fired stoves. The scheme applied to 146,000 household, and the total value of the subsidy is estimated at US$2 million.

3.3 Sri-Lanka

The Ministry of Environment, with the initiatives taken by the CCS, has already published two National Communications of Climate Change in 2001 and 2011, which reviewed the existing situation. The Ministry has completed the Technology Needs Assessment (TNA) for adaptation and mitigation which identified priority technologies for five adaptation sectors and three mitigation sectors.

Among the actions take, the ministry in-charge (Ministry of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries & Aquatic Resources Development, Sri Lanka) has undertaken a major project from 2014 for improving climate resilience with World Bank funding (US$ 152 million) is the prominent. The project is mainly focused to establish a process that would built a more climatic resilient economy since current understanding of multispectral impacts of climate and flood & drought modeling and scenario analysis are not adequate at present. In addition, project supports to implement urgent climate mitigation investments required to ensure the short-term integrity of flood control and irrigation infrastructure, transport network and critical education facilities at risk.

The study covers technical capacity building on climate studies, development of river basin investment plans, Increase climate resilience of Infrastructure, Development of Infrastructure to resist against climate changes and Contingent emergency responses.

Good practices in Sri Lanka

Storage based small scale irrigation systems scattered in the low rainfall regions. Increasing water productivity – farmers' awareness about optimum use of water. Education and attitude towards water saving by every person. Technology solution for CC resilient systems, adaptations.

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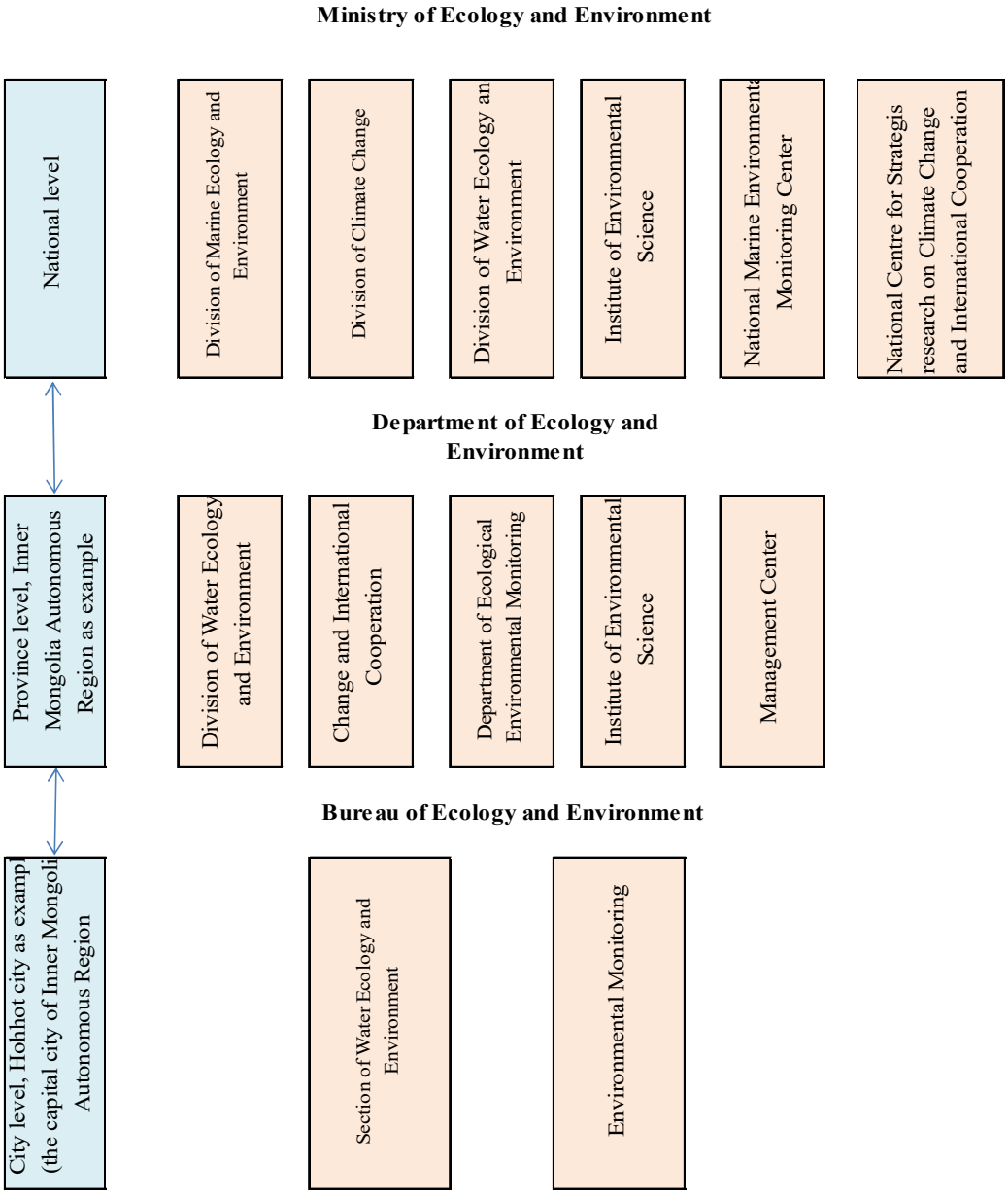
4 Institutions

4.1 China

The institutions related to water and CC from national level, province level to city level is described in below diagram.



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4.2 Mongolia

As the energy sector is the main source of GHG Emissions and energy problems are becoming increasingly complex and will require inter sectoral coordination for comprehensive implementation of GHG mitigation policies. Responsibilities for policymaking and implementation of energy related issues are belonging to Ministry of Energy. And the leading organization in GHG mitigation policies and the water resources management is the Ministry of Environment and Tourism (MET). It is important to make clear and effective coordination between the ministries and responsible organizations to formulate GHG Mitigation policies and implement GHG Mitigation projects.

Ministry of Environment and Tourism

The main governmental organization on CC Water is the Ministry of Environment and Tourism, formed in 1987, is responsible for all major environmental media and issues-air, water, forests, soil, desertification, nature conservation, biodiversity, and protected area. In 2020, Water Agency established as an independent governmental implementation agency under direct supervision of the Ministry, responsible for implementation of water policies on rational water use, and protection, restoration its resources. The National Agency for Meteorology and Environmental Monitoring (NAMEM), is the governmental implementing agency, responsible for hydrological, meteorological and environmental monitoring and for hydrological and meteorological forecasting. Its functions include early warning to prevent the impacts of natural disasters, especially on human health and livestock. Under structure NAMEM operates Information and Research Institute of Meteorology, Hydrology and Environment that runs the Environmental Information Centre EIC). In each aimag, NAMEM has a Department of Meteorology, Hydrology and Environmental Monitoring. NAMEM has 22 laboratories, of which 21 are in aimags and a Central Laboratory of Environmental Monitoring in UB.

Water Basin Administrations. Mongolia has 29 water basins covered by 21 water basin Administrations with 208 staff in total. The chairperson of water basin administrations is appointed by the Minister of Environment and Tourism. The functions of water basin administrations are to develop a water basin management plan and coordinate its implementation, carry out a water inventory at basin level, set up water supply and wastewater removal points in the basin area, maintain a sub-database of water basin information, provide information to the public and propose the establishment of a water basin council.

The Government has established the interdisciplinary and inter-sectoral *National Climate Committee* (NCC) led by the Minister for Environment and Tourism to coordinate and guide of national activities and measures aimed to adapt to climate change and to mitigate GHG emissions. High level officials such as Deputy Ministers, State Secretaries and Director-Generals of the main Departments of all related ministries, agencies and other key officials are members of the NCC. The NCC approves the country's climate policies and programs, evaluates projects and contributes to the guidance to these activities. In order to carry out day to day activities related to implementations of responsibilities and commitments under the UNFCCC and NCC, and to manage the nationwide activities, and to bring into actions/integration of climate change related problems in various sectors.

Sectorial Ministries

Ministry of Energy-The Ministry is in charge of development and implementation of policies and legislations on energy, including power generation, grid development, district heating and thermal power plants, renewable energy and clean cola technologies.

Ministry of Construction and Urban Development-The main responsibilities of the Ministry include development and implementation of policy and legislation on the construction sector, urban

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development, land use management, the building industry and materials, housing and public utilities-water supply and sewerage systems. Water Service Regulatory Commission, has main duties are to define water and wastewater service tariffs and to issue special licenses to legal entities for water supply and sewerage management.

Ministry Of Food and Agriculture and Light Industry (MFALI)-The Ministry is responsible for the development and implementation of policy and legislation on animal husbandry, crop cultivation, food safety, light industry and SMEs, including watering pasture land. The Ministry has responsibility for the implementation of measures and projects to mitigate GHGs emissions from the industrial sector, and for measures to adapt to climate change in arable farming, animal husbandry.

Ministry of Health- The ministry of health manages the consolidated policy on population health, including hygiene, sanitation and safety of food production.

Ministry of Mining and Heavy Industry -The Ministry has mission is to promote transparent and responsible mining, develops policy on rehabilitation of mining sites and artisanal mining are part of the Ministry's responsibilities.

General Agency for Specialized Inspection- An independent agency is bringing together various inspections. The scope of work of legislation on water, forest, flora fauna, soil, air and other issues covered by 26 environmental laws.

4.3 Sri-Lanka

Develop and strengthen an inter-institutional coordinating, collaborating and monitoring mechanism for effective implementation of the activities related to climate change at national, provincial, district and divisional levels under the National Focal Point in Sri Lanka to the United Nations Climate Change Multilateral Agreements.

Recognizing this responsibility, the Government of Sri Lanka has launched a national initiative to face the threat of climate change (Jayathunga and Kumari, 2013; Marambe et al., 2015b). The Climate Change Secretariat (CCS) of the Ministry of Mahaweli Development and Environment (MMDE) plays the leadership role for implementation of Climate Change adaptation activities.

The Climate Change Secretariat has established two expert advisory committees comprised of sector experts to provide advisory guidance on adaptation and mitigation related issues to CCS and the NDA. The National Expert Committee on Climate Change Adaptation (NECCCA) and National Expert Committee on Climate Change Mitigation (NECCCM) are the two committees comprising experts from government, academic, private and nongovernment sectors. These committees meet at least once a quarter and discuss relevant matters on priority basis.

And CCS has established its position as the key national agency with specialized mandate for addressing national issues on climate change. This is a positive feature which strengthens the process for developing and implementing the NAP in Sri Lanka.

A general overview of the Governance mechanism of Sri Lanka and relevant institutional mechanism for climate change is given below.

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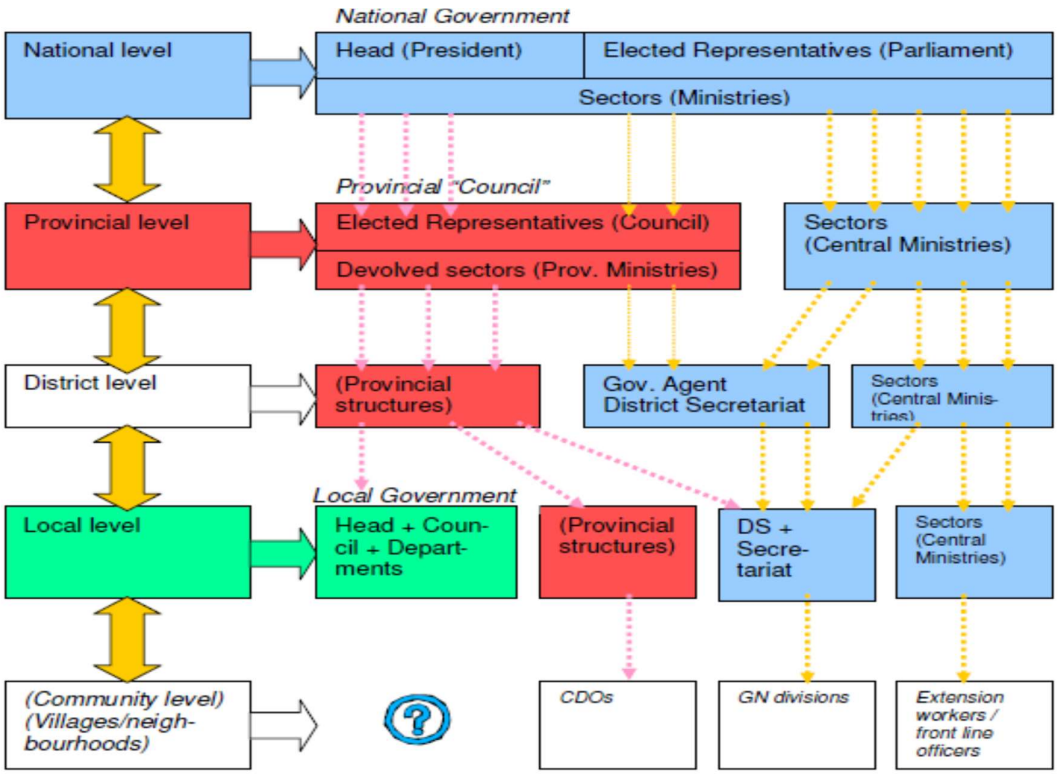

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5 Needs for curriculum development on CC-Water issues

The project aim is to support and strengthen the water related higher educational competences and skills with modern/new innovative methodologies and sharing best practices and experiences on climate change achievements within the partnering countries.

Understanding of present level of water related high education experiences of partnering Universities on climate change impacts and its mitigation approaches, there was a question asked on whether climate change and water issues are included in the Curriculum/ any Training program of partnering universities or not. The answers were included below:

Not yet included in current curriculum of the water and environmental engineering postgraduate program in Sri Lanka. There are several postgraduate programs in other faculties (e.g. Agriculture) where the CC effects are taught at varying degrees/emphasis.

In NUM, Mongolia, there are no more particular courses in the water and environmental engineering programs, except 3 credit hours on Climate Change adaptation in the Hydrology Master program.

There is no official CC related theme/subject in teaching curricula within the MUST, Mongolia educational program, but because of actual climate phenomenon which changes of precipitation and river flow regime, taken some examples during lectures.

The Law on High Education Mongolia states that universities and college's education activities should be organized by approved teaching program and the teaching program and planning should be discussed by Academic Council and to be approved by University President. It means, the universities in Mongolia itself can decide its own teaching program/curricular under general requirement defined by Ministry of the Education.

In Mongolia, the process of integration of education for sustainable development (ESD) into curricula has intensified in recent years, since ESD was integrated into the curricula of general secondary education. Numerous activities are implemented as part of informal and non-formal education on the environmental and sustainable development, including climate change issues and its impacts/risks and adaptation strategies. The biggest challenge is the provision of necessary financial resources from the state budget in order to ensure the training of teachers and build capacity on ESD of relevant governmental officers.

However,China's high education program doesn't include yet the Climate Change adaptation, but the plan to integrate and promote education on climate change into the national education system. Report shows that, climate change knowledge has been introduced into schools and classrooms, and scientific knowledge on climate change has been popularized. It is planned to strengthen training in addressing climate change and improve the awareness and working capacity of government officials, business managers, media practitioners and other professionals in addressing climate change[24].

[24] China's Climate Change Policy and Actions 2019 Annual Report

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6 Conclusion remarks

This is a great opportunity to unifying universities to start together to strive with global warming and Climate Change negative impacts facing for a globe.

A. Capacity building

At present it is needed a considerable amount of capacity building and institutional strengthening. Education program could include numbers of issues to support socio-economic sector to overcome adverse effects and adaptation activities:

a. Research and technology to ensure the socio-economic development that could successfully deal with various environmental problems;
b. Technology and information transfer at all levels (international, local);
c. Management measures by coordinating information of research, inventory and monitoring
d. Adaptation strategic policy developments to be addressed all socio-economic sectors
e. Financial fund raising for CC adaptation activities
f. Intensify the education and activities to enhance awareness for decision makers, technical experts, stakeholders, the general public, students and even school children
g. Development of new regulations for energy efficiency standards;
h. Allocate sufficient financial assistance and develop systematic evaluation approach for achieved results;
i. Effective organization of public awareness is essential.

Since there is not a single sector out of climate change impact, and intersectional or sectional surveys should be done in the future. There is a much demand to prepare qualified specialists in each sector, who can understand, evaluate adequately climate change as a systematic issue. To expand and intensify the studies on climate change and climate change monitoring, it is necessary to take certain actions on preparation, training and specializing young researchers by getting them involved in local, international and occupational trainings and seminars, after the degree studies. Public awareness!!!

B. Organizational and structural issues

Among the susceptible and vulnerable sectors to climate change, there are still obscurity, misjudgment and lack of practice and full awareness of the danger of actual and anticipated risks of climate change. There is a contradiction between ministries and government agencies due to the lack of interagency operational coherence and human resource, and germination and uncertainty of their responsibilities for adaptation of climate change lead to the loss and reduction of management efficiency. Implementation of adaptation measurements requires cooperative and regulatory activities by various groups. Decision making and implementation responsibilities regarding to climate change are allocated to only government agencies such as the ministries of agriculture, environment, power energy or municipal administrations and it results in the overall efficiency of these actions. Climate change issues are not only the concerns of one sector or institution; it needs integration and collaboration and definite assessment of responsibility and duty line. It is compulsory to fund and maintain the activities with high efficiency, to formulate the present and future measurements of adaptation, to monitor outcomes and benefits, to improve coherence of government agencies and institutions actions while implementing planned actions.

C. Funding

Successful implementation of strategic policies and CC adaptation measurements is dependent on the reliable source of funding. Furthermore, the gap between planning and realization process of the

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policy, for instance expensive means to implement adaptation measurements would be greater burdens on the realization process.

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Appendix

Adaptation options on water management in NAP, Sri-Lanka

Adaptation Options	Actions	Responsible agencies	Key performance indicators
Improvement of watershed management	• Identify and map critical watersheds • Develop and implement watershed management plans for critical upper watersheds - Declare critical catchments as reserves - Incorporate water safety plans • Increase the canopy cover in catchment areas of - Irrigation reservoirs - Water supply reservoirs - Hydropower reservoirs • Promote conservation farming methods in reservoir catchments • Launch participatory cascade management programs in selected village tank catchments • Incorporate climate impact assessment for the future water resources development plans	ID MASL DAD CEB NWSDB WRB PCs	• Number of watershed plans developed • % of canopy cover increased in the catchment areas of irrigation and water supply reservoirs • Number of conservation framing methods adopted • Amount of money allocated/spent on promotion of conservation farming methods • Number of workshops carried out in promotion • Number of villages covered by the participatory cascade management programs • Amount of money allocated/spent on participatory cascade management programs
Capacity development of storage facilities	• Assess the current facilities and storage options in connection to future projections of climate change • Evaluate future options for enhancement of storage facilitates including groundwater • Develop a road map and investment plan for efficient utilization of existing and future storage options • Assess, regularize and preserve ground water resources at local level water resources for effective utilization	ID MASL DAD AFoU NWSDB WRB IWMI	• Number of current facilities and storage options assessed • An assessment report is finalized and made available on the current facilities and storage options • Number of options evaluated • A road map and an investment plan is developed.
Initiating research studies to assess	• Assess short-, medium- and long-term impacts of climate change on water resources management in the country • Screen current practices of water management for climate	ID; MASL DAD; DM IWMI;	• An assessment report completed and published • Number of screened water management practices for climate change resilience

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climate impacts		resilience and identify ways to improve them • Explore climate resilient indigenous practices of water management and identify ways to integrate them into modern practices	AFoU/SFoU NSF; NRC CARP	• Number of indigenous practices of water management identified and integrated
Strengthen the monitoring of CC impacts (change pattern of variability)		• Initiate a long-term monitoring program on essential bio-physical parameters of climate change on water resources • National monitoring program	**CEA**; DM; ID; MASL; DAD; IWMI; NWSDB	• Monitoring program is installed and functioning
Promote efficient practices of water management and use		• Promote efficient domestic water use practices: - Domestic rain-water harvesting systems (e.g. ferro-cement tanks; roof top) - Domestic water treatment facilities • Increase the efficiency of use and reduce losses of irrigation water - Re-use of drainage (waste) water - Water saving irrigation applications: micro irrigation, drip irrigation - Efficient use of groundwater: Production wells , boreholes - Rainwater harvesting: *Pathaha* • Improve maintenance of existing reservoirs - Improve the water conveyance efficiency - Rehabilitation of village tanks to design capacity • Promote wastewater recycling for industrial and aquaculture water uses	ID MASL DAD IWMI NWSDB DOA	• Number of awareness campaigns launched to promote efficient domestic water use practices • Money allocated/spent on promoting efficient domestic water use practices • Number of awareness campaigns on promoting means of reducing wastage and losses in irrigation • Money allocated/spent on promoting means of reducing wastage and losses in irrigation • Money allocated/spent on improving the maintenance of existing reservoirs • Number of village tanks rehabilitated Number of village tanks with improved conveyance efficiency
Ensure the safety of water management facilities and minimize disturbance	A. Strengthening the monitoring of climate change impacts (extreme events)	• Assess the capacity of existing hydro-meteorological information facilities • Implement necessary capacity improvement measures (Focus: facilities in water management agencies)	**DM** ID; MASL DAD NWSDB DOA	• Number of assessments completed out of existing hydro-meteorological information facilities • An assessment report is completed and published • Number of initiatives implemented
	B. Establishment of an	• Improve the existing system for timely issuing short term weather forecasts		• A system is developed • Money allocated/spent on strengthening the systems

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s to supply due to extreme weather events	efficient climate information and communication system	• Strengthen the early warning systems • Develop network based communication systems (Focus: mobile phones and internet) • Assess the traditional knowledge of weather forecasting and integrate them for better forecasts of water availability.		of short-term weather forecasts A mobile phone based communication is in place • Money allocated/spent on developing the mobile phone based communication system • An assessment study is completed and report published on traditional knowledge of weather forecasting • Number of training programs/workshops conducted on integrating traditional knowledge of weather forecasting in to existing one
	C. Improvement of disaster risk preparedness and management	• Identify, map and collect information on areas most vulnerable to flood , drought and land slide hazards • Develop disaster risk management plans for vulnerable areas • Establish necessary facilities for improvement of drainage in susceptible areas • Develop dam safety plans and promote use of safety measures and equipment	**DMC** **NBRO** ID MASL DAD NWSDB DM	• Number of areas identified and completed with data collection • Number of areas completed with finalized flood risk management plans • Number of areas with established facilities for improvement of drainage • Number of dam safety plans developed
	D. Capacity development of storage facilities	• Design rational strategies to harness excess water in storage facilities (Focus: Intra-basin and trans-basin approaches)	**ID; MASL** **DAD;** AFoU NWSDB; DM	• Number of strategies designed to harness the excess water in storage facilities. • Number of workshops/training programmes on designing strategies to harness the excess water in storage facilities
Minimize the impacts of sea level rise on water supply and management in coastal zone	A. Strengthening the monitoring of climate change impacts (sea level rise)	• Monitor salinity levels regularly	**NARA** **CC&CRMD**	• Money allocated/spent on developing the monitoring system • Regular (quarterly) monitoring reports prepared and presented
	B. Improve saltwater intrusion protection	• Identify vulnerable areas for saltwater intrusion and develop maps • Strengthen the salinity exclusion structures to control sea water intrusions	**CC&CRMD** ID DAD NWSDB	• Number of vulnerable areas identified and plans developed • Number of salinity exclusion structures rehabilitated /repaired/newly built

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	measures in coastal areas and wetlands	• Design and construct salinity barriers to protect fresh water resources and agricultural lands • Establish desalinization facilities in effected/vulnerable areas	DA NARA NAQDA	• Amount of money allocated/spent on rehabilitating /repairing the salinity exclusion structures • Number of salinity barriers designed • Number of desalination facilities established

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