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CVF V20

CLIMATE VULNERABILITY OF EAST ASIA

Adaptation in the Region Can Provide Global Benefits

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Climate Vulnerability of East Asia: Adaptation in the Region Can Provide Global Benefits

This derivative regional analysis covers the East Asian region consisting of China, Hong Kong, Japan, Macau, Mongolia, North Korea, South Korea, and Taiwan. While the Climate Vulnerability Monitor 3 (Climate Vulnerable Forum & V20 2022) provides a global overview of climate vulnerability with national-level data, the emphasis of this derivative regional analysis is to provide succinct insights into the regional implications of climate vulnerability and what it means in terms of responses of the countries in the region.

1. Unique Characteristics of East Asia

The East Asia region is unique in Asia and probably in the world on various fronts and these unique characteristics position the region differently with implications in terms of how the climate vulnerability and impacts are understood and addressed in the region.

The region is highly populated, with only seven countries and special administrative regions, East Asia region accounts for 20.8% of the world population (The World Bank 2022). The region is also highly urbanized, probably only next to North America, with 81% of the region's population living in urban areas. It constitutes 24% of the urban population of the world. While much of the region's urbanization rates plateaued over the period, urbanization is still rapidly growing in China at a rate of 2.7%. This has implications in terms of the population density as the region has a population density that is 67 times that of the global population density.

This high urbanization is reflected in terms of the proportion of the population dependent on climate-sensitive sectors for their livelihoods. A small proportion of the region's population

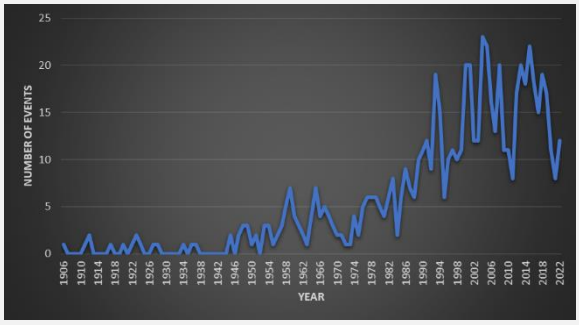

Figure 1. Growing number of hydrometeorological and climatic events in East Asia.

(14.8%) depends on agriculture, forestry and fisheries sectors for their livelihoods contributing to only 4.5% of the regional GDP. Consequently, the region has evolved into one of the biggest net importers of food. In terms of weight, the region imports 10 times the food that it exports.

While the region has been experiencing a growing number of hydrometeorological and climatic events (Figure 1), the high population density in the region also means that the region is disproportionately impacted by these events. Since the 1900s, the region experienced only 11% of the global hydrometeorological and climatic events which killed 10.4 million people (EM-DAT 2022). This constitutes 51.6% of the world's deaths due to hydrometeorological and climatic events. These events have affected the 3.2 billion population constituting 40% of the world affected.

A globally connected region

East Asian countries and special administrative regions play an important role in global trade, economy, and technological development. With 20.8% of the global population, East Asian countries contribute to 25.9% of the global GDP (The World Bank 2022). The region is a powerhouse for technology innovation as 62% of the total global patents come from the region. The region has become the world's

manufacturing superpower as reflected in terms of trade. In 2021, the export of goods and services from the region stood at 5.1 trillion USD constituting nearly 18.2% of global exports. In the same year, the total imports of goods and services stood at 4.3 trillion USD. The socio-cultural diversity and long history of the region make it one of the tourist destinations of the world with 13% of global travellers arriving in the region in 2018. This signifies the strong connection the region has developed with the rest of the world, on social, economic, and technological fronts.

Adaptation in the region as a global public good

The above unique characteristics and especially the social, economic and technological linkages make the region stand out from the rest of Asia with two broad implications. The first implication is that any climate change impacts in the region will not remain within the region but will have spillover impacts beyond the region. The second and foremost important implication is that any adaptation action in the region will benefit not only the region but the entire world. Because of this, investing in adaptation in the region can be considered a global public good. This makes a strong case that the climate change adaptation in the region should not be considered just from the point of view of the national security of the countries in the region but more importantly, it should be understood and addressed from the transboundary perspective as well as the global security perspective. That's why understanding the climate vulnerability of the region as a whole gains significance.

2. Climate Vulnerability of the Region

Providing a detailed description of the climate vulnerability of the East Asia region is beyond the scope of this derivative. Readers are suggested to refer to the Climate Vulnerability Monitor 3 for detailed information on the climate vulnerability described using 32 distinct indicators (Climate Vulnerable Forum & V20 2022).

However, a succinct overview of the vulnerability of the region is discussed here. These results are discussed for SSP3-7.0 (no-policy scenario) and SSP1-2.6 (climate action scenario) scenarios for the time slices of 2020-2040, 2040-2060, and 2080-2100. The difference in impacts between these two scenarios shows the climate action benefit as visualized in the bar charts inserted in the text.

Biophysical vulnerability

For assessing the biophysical vulnerability, CVM3 uses four categories of indicators. These include temperature (mean near-surface air temperature, maximum near-surface air temperature, minimum near-surface air temperature), water (precipitation (rainfall+snowfall) snowfall, surface runoff, discharge, maximum daily discharge, minimum daily discharge, drought index, and extreme precipitation), wind (horizontal wind speed), and agriculture (total soil moisture content, maize yields, first and second season rice yields, soy yields, and spring and winter wheat yields).

Without climate action, the projections indicate that the region will experience an increase in mean minimum (3.35^{O}C by 2090) and maximum (3.43^{O}C by 2090) temperatures with slightly higher warming than the rest of the world. Days will be warmer in the People's Republic of Korea (PRK), South Korea, and Japan and nights will be warmer in PRK and Japan. The magnitude of the increase in mean maximum temperatures is marginally higher than that of the minimum temperatures. Figure 2 presents the difference in temperatures between no climate action and climate action scenarios, indicating the marginal temperature amelioration benefits due to climate actions.

The region will also experience an increase in precipitation. On average, the precipitation will increase by 3.6% and 10.6% by 2050 and 2090 respectively without climate action, with the

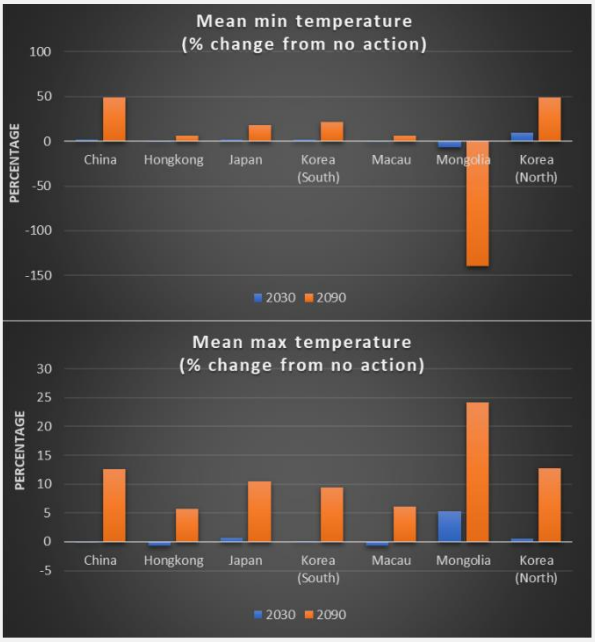

Figure 2. Difference in temperature changes (%) between no climate action and with climate action

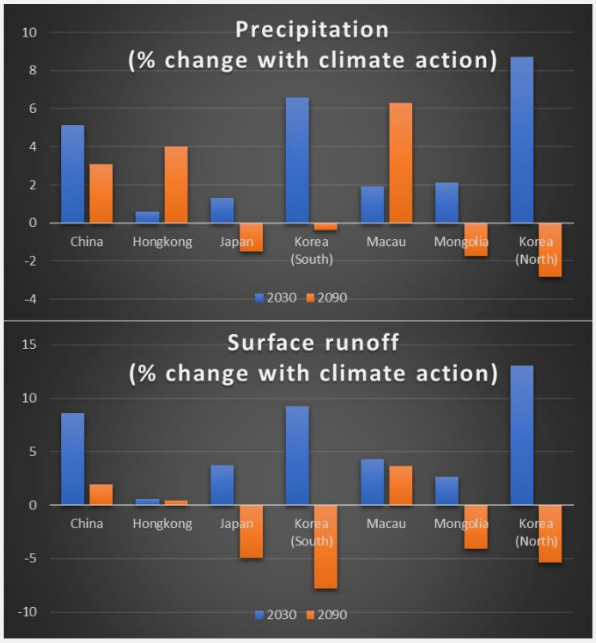

Figure 3. Difference in precipitation and runoff between scenarios

most increase projected in PRK, China, South Korea, and Mongolia. In addition to the increase in the precipitation, the 5-day extreme precipitation events and amount of precipitation received will also increase in the region by 2.1% by 2050 and 8.7% by 2090.

The increase in precipitation and extreme precipitation events is reflected in terms of the change in the surface runoff. Without climate action, the surface runoff in the region will increase by 5% and 17% by 2050 and 2090 respectively, with the most increase in PRK, China, and South Korea. This will have a significant effect on the discharge of rivers with most rivers recording an increase in discharge of 1.8% by 2050 and 10.6% by 2090. The rapid increase in runoff and river discharges can have implications in terms of an increase in droughts due to less opportunity to infiltrate and recharge groundwater and floods as a result of siltation that reduces the river carrying capacity and reservoir capacities. Figure 3 shows the difference between climate inaction and climate action scenarios in terms of precipitation and surface runoff. Climate action will have a significant impact on surface runoff by 2090 with most countries showing increased surface runoff by 2050. By contrast, climate action will have an amelioration effect on river discharge by 2050.

The combined effect of increased temperatures and increased surface runoff could be seen in terms of the region becoming more drought-prone. The drought index, assessed through Standardized Precipitation-Evapotranspiration Index (SPEI), indicated that the drought intensity increases by 15 times by 2090 without any climate action. Over the period, the relative drought conditions of countries will also change in the region (Figure 4). Even with climate action, the drought index is projected to increase 8 times and 10 times by 2050 and 2090 respectively. Climate action will only ameliorate drought conditions by 18% in the region by 2090, with as much as a 36% reduction in Mongolia and a 30% reduction in China by 2090.

The changes in the above biophysical factors will have pronounced but mixed implications for crop production in the region. Among the crops for which projections were obtained, the climate action scenario will see Maize yields decline by 9.4% in the region by 2090 compared with

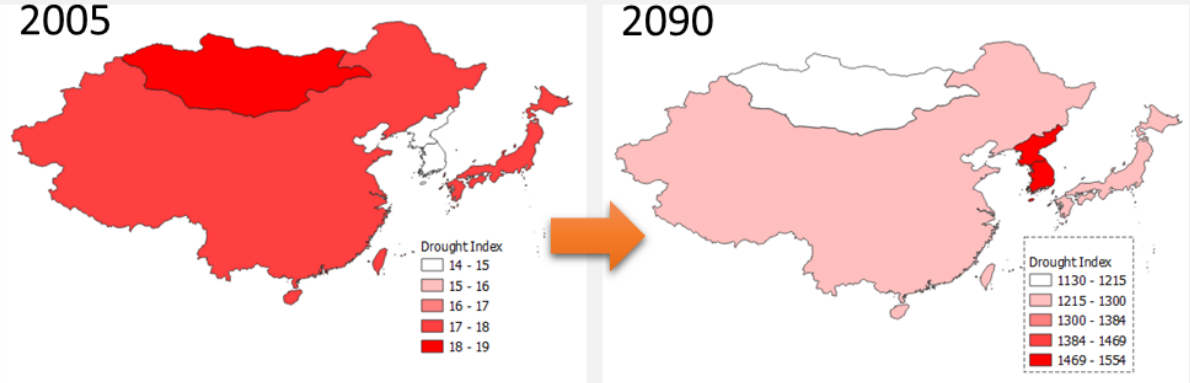

Figure 4. Change in relative drought conditions without climate action

baseline yields in 2005, with the most reduction in China (15%).

On the contrary, climate change will boost rice yields by 2.2% and 4.5% with and without climate action by 2090 respectively. However, the second rice crop growing regions will experience an even higher increase in yields by 4% and 8.8% with and without climate action by 2090. Similar trends were also observed in spring wheat, winter wheat, and soybean yields in the region. Figure 5 shows the difference in rice and wheat yields with climate action. It shows that climate action and crop yields will show a decline in some countries.

Economic vulnerability

The economic vulnerability of the region was assessed by using three indicators of inflation (consumer price index), GDP per capita growth, and interest rates. Though these indicators reflect the macroeconomic condition of the countries and the region in general, they can help understand the implications for household well-being as well. A distinctively negative impact of climate change could be observed in all three macroeconomic indicators. The projections indicated an increase in inflation 4.6 times without climate action in the region, with the most increase in China, Mongolia and Japan by 2090. The difference between no climate action and climate action will increase by 2090 with climate action resulting in a 47% reduction in inflation. The increase in inflation could have implications for the cost of food, with less disposable income to invest in other gainful activities.

A significant increase in interest rates was also projected in the region. Without climate action, interest rates will increase by 3 times by 2090, with the most increase in Mongolia, China and Japan. The increasing inflation and interest rates will harm the GDP growth in the region. On average, the GDP per capita growth of the region can shrink by 1.9% by 2030 and as much as 10% by 2090. Figure 6 shows the % change in GDP per capita and inflation with climate action, showing a favourable effect of climate actions on these parameters until 2090.

In addition, the CVM3 also provides the GDL Vulnerability Index combining various socio-economic indicators (economic growth, poverty,

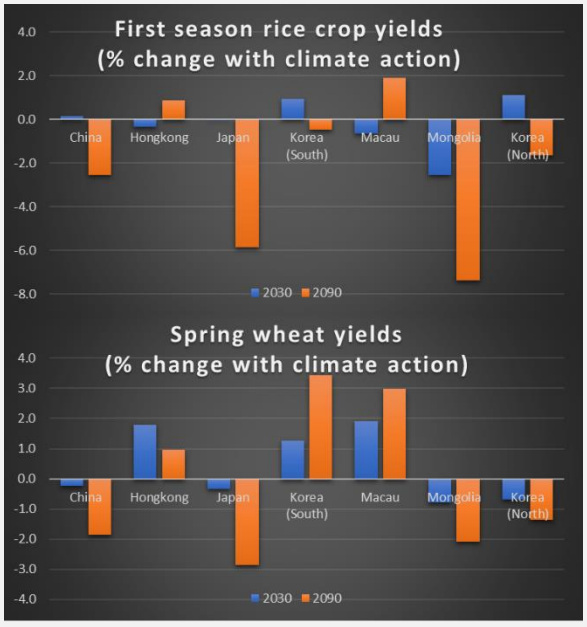

Figure 5. Difference in rice and wheat yeilds with climate action

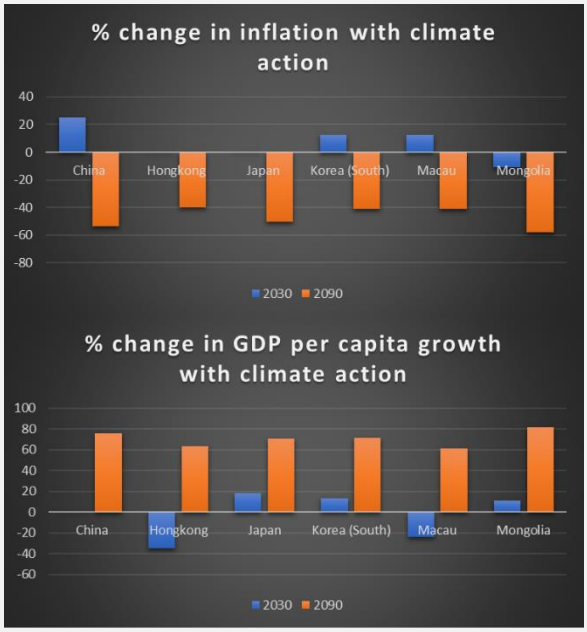

Figure 6. Change in inflation and GDP per capita growth with climate action

education, health, gender inequality, governance, demography and access to basic infrastructure) to provide a unified picture of socioeconomic vulnerability. On the socio-economic front, the GDL vulnerability index has shown a drastic increase in the region without climate action, with the most increase in vulnerability observed in Hongkong followed by Japan by 2090. The index showed a 126% increase by 2090 in the region. With Climate action, the index will increase by 109%, showing a 17% benefit of climate action.

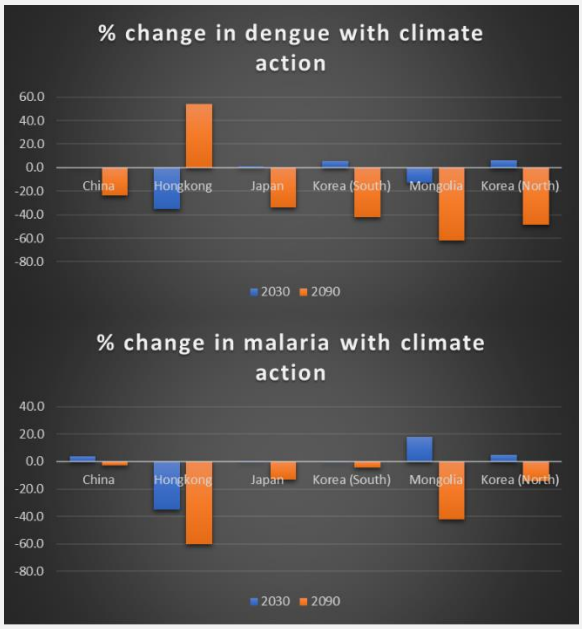

Figure 7. % change in dengue and malaria with climate action

Health vulnerability

In terms of vulnerability in the health sector, the CVM3 considered 10 health indicators consisting of exposure of the vulnerable population to heatwaves, heat and physical activity, loss of labour productivity, heat-related mortality, exposure to wildfire danger, climate suitability for dengue transmission, climate suitability for malaria transmission, environmental suitability for pathogenic Vibrio, heat and crop yield potential, and food insecurity.

Similar to the economic indicators, most human health indicators showed a bleak picture for the East Asia region. The region is likely to experience a 9-fold increase in heatwave exposure by 2090. Consequently, human physical activity will reduce by 58%. An increase in the number of heat days and consequent reduction in human physical activity can be debilitating for human productivity in the region. The labour productivity in the region is projected to decline by 62% by 2030. Without climate action, the region will experience an increase in heat-related mortality by 5.5 times by 2090 with the most increase in mortality in Mongolia. An increase in wildfire risk was also projected in parts of East Asia.

One of the widely feared aspects of climate change is an expansion of vector-borne diseases such as dengue, malaria and vibrio. The region will see an increase in dengue incidence by 49% by 2090. Without climate action, the malaria incidence will increase by 30% by 2090. Despite the climate action, a few parts of the region may continue to see an increase in malaria and dengue incidence during the projection period (Figure 7). Some of the countries in the region have not experienced the level of incidence of vector-borne diseases that they will experience in the future. This will have serious implications for the health sector and public health policies of the region.

The combined effects of the increased socio-economic vulnerability as indicated by the GDL Vulnerability Index, a change in the macro-economic indicators such as inflation could hamper the food security of the region as a whole. Consequently, food insecurity in the region could increase significantly without climate action in countries. This is also one of the areas where climate action could provide maximum benefit. Countries such as Japan and Mongolia could reduce their food insecurity by 5.5 and 4.7 times respectively with climate action by 2090.

3. How do These Findings Affect the Region?

Overall, the climate vulnerability of the region pointed to a negative and bleak picture with serious consequences demanding immediate adaptation actions. Any delay in adaptation could further prolong and exacerbate the climate change impacts affecting our ability to adapt.

The changes in precipitation patterns, surface runoff and discharge characteristics of rivers could mean water scarcity or floods in the region. The projections exemplify the drought hazard in the region with serious drought impacts. Increased surface runoff and discharge could mean greater siltation of water bodies, a decline in reservoir capacity, a reduction in flood mitigation potential, and a decline in hydropower potential. These findings also have stark implications for water resources management in the region. Though this change in the biophysical factors doesn't seem to reflect well in terms of crop yields, most crops for which projections are available indicate an increase in crop yields except for maize whose yields will be affected significantly.

The increase in inflation, reduction in GDP growth rate, and increase in interest rates could significantly affect the ability of governments to create sufficient employment opportunities, and the ability to finance the development and adaptation in the region. Household well-being will be affected as they have to pay more for obtaining the same goods and services and often with wages that do not grow in commensuration with inflation. Private sector investments could also be negatively impacted due to inflation increasing the cost of capital, and increase in input costs. Increasing climate risks in the region can affect investments within the region and outside, as more and more firms may move outside the region in search of safe zones of investment. The observed macroeconomic impacts could have serious implications for the financial markets and stock markets as well.

The increase in infectious diseases could increase the health care costs for the countries. An increase in heat mortality and loss of labour productivity will harm the economy at large and the household's well-being at the micro-level. Already with an ageing population, this could put a further burden on overall national well-being.

A climate shock on the economies in the region could have a cascading effect beyond the region as the region has grown as one of the prominent exporters of goods and services to the rest of the world. From this view, countries beyond the region would also need to keep a watch on the climate change impacts in the region and what it means for their adaptation planning.

Some of the countries in the region will have implications due to never-seen-before impacts such as an increase in drought conditions, an increase in heat-related mortality, and an increase in infectious diseases. These demand special consideration of sectoral capacities in the region including that of the health sector preparedness. Due to the region's linkages with the rest of the world, adaptation in the region can have global benefits and hence should be able to attract significance accordingly.

4. Implications for adaptation in the region

The above-discussed climate vulnerability of the East Asia region brings several implications for

adaptation in the region and beyond. These implications range from the type of adaptation choices to be made to address the vulnerabilities within the region to putting more emphasis on well-coordinated adaptation planning in the region and beyond.

Prioritize nature-based solutions

The negative impacts observed in various biophysical indicators discussed above demand that countries need to focus on nature-based solutions. The region needs to identify hotspots for impacts such as soil erosion and implement appropriate nature-based solutions to arrest the trend.

Nature-based solutions are also important for urban areas where the heat island effect, urban floods and urban water scarcity could manifest seriously. While designing nature-based solutions, planners need to keep in view the increasing demand for multiple competing needs of land in the urban context without further stressing available water resources. Urban planning centring around concepts such as eco-cities, smart cities, and circular ecological spheres (CES) can provide the necessary direction for the burgeoning urban population in the region.

Integrated water resources management is the key

The climate change impacts in the region indicated clear and significant implications for the region's water resources, both surface and sub-surface. China is already the third largest groundwater user in the world. With growing water demand and increasing drought conditions, the water resources in the region can come under even more severe pressure. With transboundary rivers, some the countries like China shares with the rest of the countries in Asia, transboundary water resource management in a cooperative framework takes precedence. There is a need to enhance groundwater potential and stabilize the river flows while reducing the seasonal fluctuations and base flows. Reduced dependency on groundwater use, increasing water use efficiency, reducing water pollution, and implementing adaptation with nature-based solutions need to be considered.

Strengthen the food security policies

Most countries in East Asia are highly dependent on imported food for their food security. Climate change projections indicated a significant increase in food insecurity in the countries in the region. Increasing climate shocks on the exporting countries will further add a burden to the food security of the countries in the region. Even though countries such as Japan may not be able to fully achieve food self-sufficiency, as it may have resource implications such as increased water consumption if it has to produce all the food that it imports, countries need to look at the climate vulnerability of countries from where they import the food to mitigate food price fluctuations and related food insecurity implications. Most East Asian countries have robust farmer protection measures from external market shocks and these measures may continue to play an important role in the future. Strengthening supply chains through supply chain risk assessments, capacity building of stakeholders, emphasizing local production, sustainable lifestyles and nutrition-driven choices, and urban food production are some of the approaches the region needs to consider to address the food insecurity in the region.

Private sector engagement is the strength

Most countries in East Asia are highly industrialized and endowed with a strong private sector presence. The private sector in the region is already playing a major role in climate change mitigation. In addition, it also provides an important opportunity for the governments to increase collaboration with the private sector seeking cutting-edge technological solutions and deployment of adaptation using models such as build-operate-transfer etc. in the region and

beyond. Governments need to reach out to private businesses with proposals that make sense to them to invest. Considering the long-return periods for investments in adaptation, there is a need for the governments to develop appropriate incentives and ensure that the investors in adaptation are equally benefited from the investments.

The private sector in East Asia also needs to enhance its climate change readiness. It can do this through self-regulation, robust investments in de-risking investments in the most vulnerable parts of the world, self-disclosure of risks, and increased allocations to corporate social responsibility to strengthen community-corporate bonding. The private sector can play a significant role in strengthening market solutions such as risk insurance within and beyond the region.

Transboundary adaptation is a reality

As indicated at the beginning of this brief, the East Asia Region is one of the most highly connected regions in the world, socially and economically. This means that climate change within East Asia can have serious implications for the rest of the world and vice versa. This demands that the countries in the region need to consider the transboundary climate change impacts within their adaptation plans and collaborate and coordinate adaptation planning and implementation with other countries in the region and outside the region. Ideas such as regional adaptation planning for sectors such as manufacturing could provide an effective entry point towards a comprehensive regional adaptation plan that can address several transboundary climate risks covering natural resources, food, financial markets etc.

East Asian countries contribute significantly in the form of official development assistance and bilateral development assistance covering a range of development areas for several countries outside the region. China and Japan alone contribute nearly 24 billion USD per annum towards development assistance of various kinds. Countries such as Japan allocate nearly 78% of the bilateral ODA to climate change and related areas.

Through these engagements with vulnerable and developing countries, East Asian countries are already contributing to climate resilience beyond their borders. While these countries are expected to continue to do so, the high exposure of East Asian countries to transboundary risks is likely to govern the way future aid is allocated. With increasing recognition of transboundary climate risks, countries in the region need to protect their investments in vulnerable regions of the world which could contribute to strengthening the adaptation outside the region as well.

5. Conclusions

The East Asia region is projected to experience severe climate change impacts in the future. The projected vulnerabilities provided important directions for the region’s adaptation.

Adaptation is a local issue, it primarily aims to respond to and plan for the local impacts of climate change. However, the unique characteristics of the region and the nature of climate change impacts in the region mean that adaptation in the region can have global implications and hence adaptation in the region can be considered a global public good.

In the context of East Asia, adaptation calls for regional cooperation. Countries in the region have been cooperating on a range of environmental issues through the Tripartite Environment Ministers Meeting (TEMM) initiative and this is the right time for the region to expand the scope to cover adaptation-related issues as well. The cooperation can begin in the areas of climate risk disclosure by the private sector, strengthening the role of the private sector in adaptation, and sharing the knowledge related to urban adaptation to climate change and the application of nature-based solutions in the urban context.

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