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Review of the implementation of the 2030 Agenda for Sustainable Development in Asia and the Pacific: disaster risk reduction

Subregional and regional approaches for disaster resilience

Note by the secretariat

Summary

As climate uncertainties grow, Asia and the Pacific faces an increasingly complex disaster riskscape. In the *Asia-Pacific Disaster Report 2019: The Disaster Riskscape across Asia-Pacific – Pathways for Resilience, Inclusion and Empowerment*, the Economic and Social Commission for Asia and the Pacific provided a comprehensive overview of the regional riskscape, identifying the region's main hotspots and options for action. Based on the findings, the present document contains highlights of the changing geography of disasters together with the associated multi-hazard risk hotspots at the subregional level, namely, South-East Asia, South and South-West Asia, the Pacific small island developing States, North and Central Asia, and North and East Asia. For each subregion, the document provides specific solution-oriented resilience-building approaches. In this regard, the document contains information about the opportunities to build resilience provided by subregional and regional cooperation and a discussion of the secretariat's responses under the aegis of the Asia-Pacific Disaster Resilience Network.

The Commission may wish to review the present document and provide guidance for the future work of the secretariat.

I. Introduction

1. The 2030 Agenda for Sustainable Development provides a blueprint for development, including ending poverty, fighting inequalities and tackling climate change. Disaster resilience is a common thread that cuts across many of the 17 Sustainable Development Goals, and it is increasingly clear that if disaster risks are ignored, progress towards the Goals will be undermined.

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2.   Over the past two decades, Asia and the Pacific has borne the brunt of the world's natural disasters. Whole communities have seen their homes and livelihoods shattered or washed away. While considerable progress has been made in decreasing fatalities from disasters due to better disaster management and prevention and increased early warning capacity, economic losses and the number of people affected by disasters continue to increase at a considerable pace.[1] A better understanding of the current and future areas of risk hotspots is crucial to enable effective disaster risk reduction and resilience measures. This is especially so for countries reaching a point at which disaster risk, fuelled by climate change, exceeds their current capacity to respond.

3.   Based on the findings from the *Asia Pacific Disaster Report 2019: The Disaster Riskscape across Asia-Pacific – Pathways for Resilience, Inclusion and Empowerment* and the five associated subregional reports,[2] the information contained in the present document expands on and captures the subregional specificities of risk hotspots, exposure and vulnerability to disasters and climate change. It contains recommendations for specific solution-oriented approaches, including those provided by regional and subregional cooperation mechanisms to help to mitigate and respond to increasing risk. The present document also contains highlights of the secretariat's responses for building resilience in the region, under the aegis of the Asia-Pacific Disaster Resilience Network.

II.   A region at risk: the disaster riskscape and multi-hazard hotspots

4.   The *Asia-Pacific Disaster Report 2019*, for the first time, captures a comprehensive picture of the complexity and the changing geography of disaster risk in the region with the addition of slow-onset disasters. Adding slow-onset disasters to previous loss estimates has quadrupled the average annualized loss estimates, from $148 billion to $675 billion, amounting to approximately 2.4 per cent of the gross domestic product (GDP) for the region. As shown in Figure I, drought and other slow-onset disasters account for 60 percent of the total losses. In all subregions expect for the Pacific, drought and slow-onset disasters account for the largest portion of the annualized losses.

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[1]   Centre for Research on the Epidemiology of Disasters, EM-DAT: The International Disaster Database. Available at www.emdat.be (accessed on 30 May 2019).

[2]   *The Disaster Riskscape across South-East Asia: Key Takeaways for Stakeholders*; *The Disaster Riskscape across South and South-West Asia: Key Takeaways for Stakeholders*; *The Disaster Riskscape across the Pacific Small Island Developing States: Key Takeaways for Stakeholders*; *The Disaster Riskscape across North and Central Asia: Key Takeaways for Stakeholders*; and *The Disaster Riskscape across East and North-East Asia: Key Takeaways for Stakeholders*.

Figure I
Asia-Pacific riskscape, average annual losses equalling $675 billion
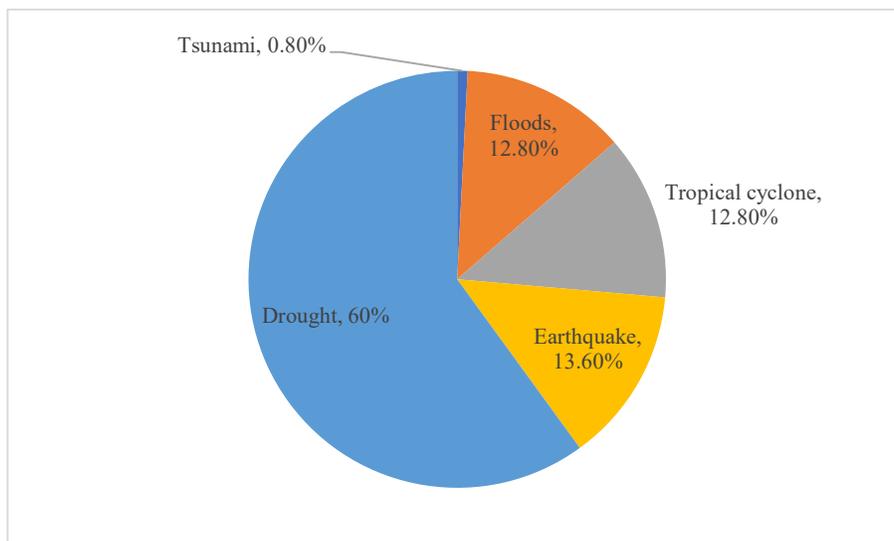

5. Based on the average annual loss estimates of previous years, the five countries at greatest risk from disaster losses, in order, were Japan, China, Republic of Korea, India, and the Philippines. With the addition of slow-onset disasters, the riskscape order changes to China, followed by Japan, India, Indonesia and the Republic of Korea (figure II).

Figure II
Riskscape in numbers, average annual loss
(Billions of United States dollars)
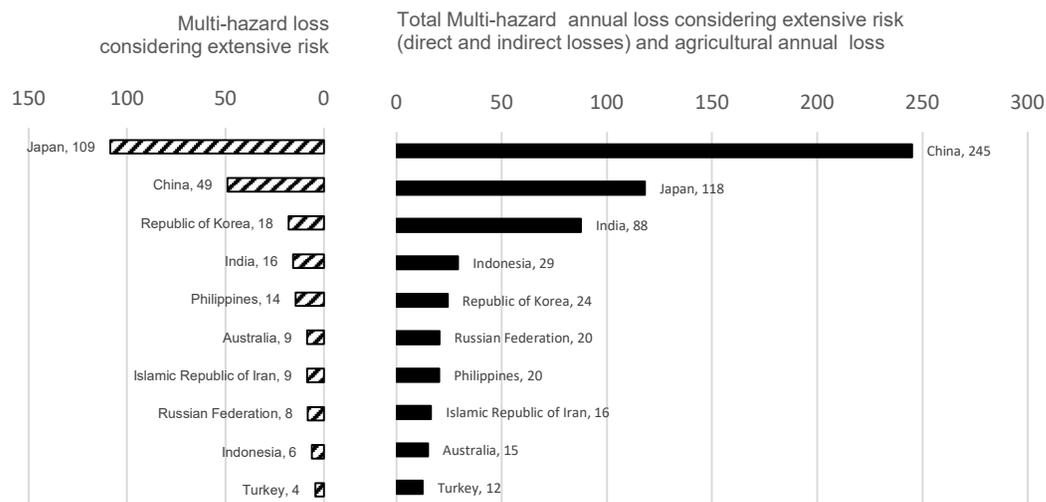
6.   Moreover, the ratio of the new total multi-hazard average annual loss by a country's population and GDP shows that Pacific small island developing States, such as Palau, Tonga and Vanuatu, are in the extreme range for populations and economies at risk. A person living in the Pacific is three to five times more at risk than a person in South-East and South Asia. Figure III shows that most of the least developed countries in South and South-East Asia, such as Bangladesh, Bhutan, Cambodia and Nepal, among others, have relatively large numbers of at-risk populations and economies, while Australia, Japan and the Republic of Korea record the highest average annual losses per capita.

Figure III
Distribution of average annual loss per capita and as a percentage of gross domestic product
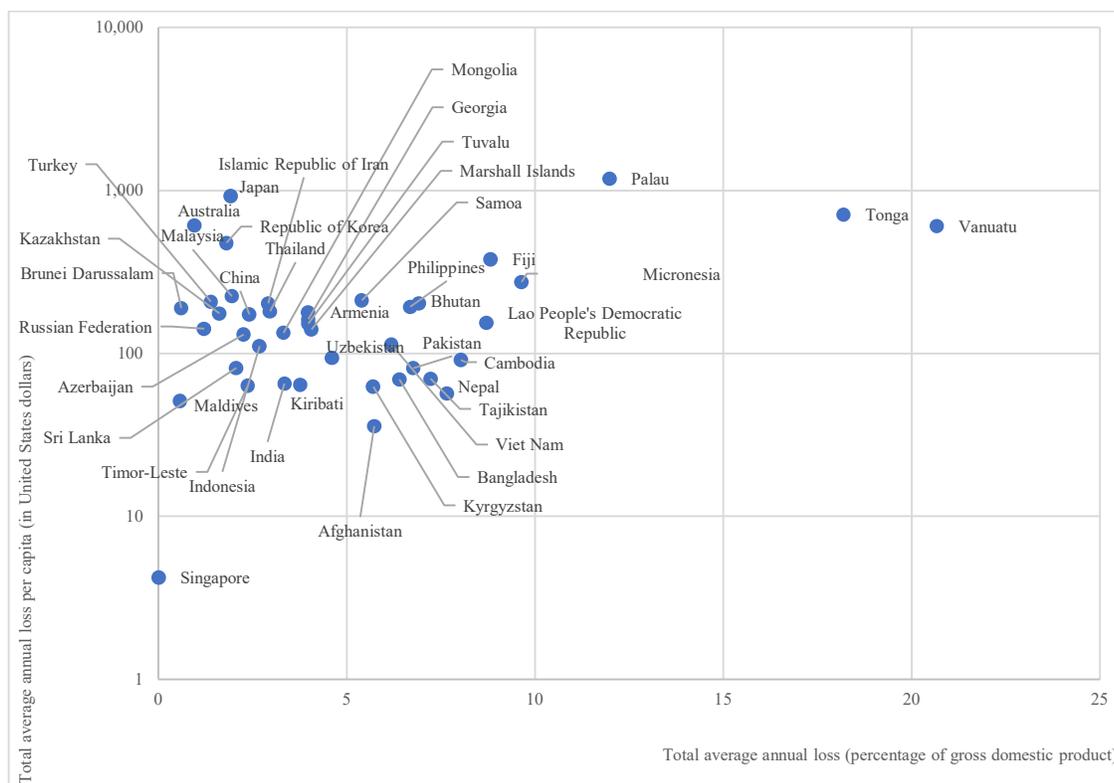
7.   In large part, the increasing loss estimates and new complexities from slow-onset disasters have been attributed to climate change and its associated weather patterns. Referred to as a super wicked problem[3] for scientists and policymakers alike, uncertainties from climate change are creating extraordinary challenges for preparedness within the region. Japan is one of the countries in the world most prepared for disasters, and yet it struggled when record-breaking

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[3]   Kelly Levin and others, "Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change", *Policy Sciences*, vol. 45, No. 2 (June 2012), pp. 123–152. The authors characterize a super wicked problem as comprising four key features: time is running out; those who cause the problem also seek to provide a solution; the central authority needed to address it is weak or non-existent; and, partly as a result, policy responses discount the future irrationally. These four features combine to create a policymaking tragedy, where traditional analytical techniques are ill equipped to identify solutions, even when it is recognized that actions must take place soon to avoid catastrophic future impacts.

rainfalls hit the country in July 2018. Not only was there significant economic damage to prefectures in western Japan, the events killed more than 300 people.

8. While the region has been successful in reducing disaster related mortality rates, it is emphasized in the *Asia Pacific Disaster Report 2019* that fatalities are still occurring on a regular basis. Since 1970, natural disasters in Asia and the Pacific have killed 2 million people – 59 per cent of the global death toll. Earthquakes and tsunamis are the major cause of fatalities in the region. As demonstrated in Japan, increasing climate change uncertainties will continue to add to the death toll.

9. The economic and social implications of these disasters are manifesting themselves in the widening inequalities in income and opportunities; this is the case in some subregions more than others. Evidence in the *Asia Pacific Disaster Report 2019* demonstrates that a one percentage point increase in exposure to climate-related hazards in the region increases malnutrition among children under 5 years of age by 0.19 of a percentage point, decreases education rates by 0.26 of a percentage point, increases under-5 mortality rates by 0.3 of a percentage point and increases the Gini coefficient for inequality by 0.24 of a percentage point.

10. Drawing from these trends, the region's complex and diverse risks are clustered around four hotspots. The table shows the geolocation of the hotspots in various subregions based on an assessment of multi-hazard exposure with regard to population, economy and critical infrastructure, such as energy power plants, transport infrastructure – roads, airports and ports – and information and communication technology (ICT) infrastructure. Among some hotspots, fragile environments converge with critical socioeconomic vulnerabilities, thus making it much more likely that disasters will transmit poverty, marginalization and disempowerment across generations.

Locating disaster risk hotspots

Hotspot 1: Transboundary river basins		Hotspot 2: Ring of Fire	
Flood and drought prone areas: South and South-East Asia		Earthquake, landslide and tsunami, typhoon tracks: North and North-East Asia, South-East Asia	
Population exposure	Very high (mostly poor)	Population exposure	High (mostly poor)
Economic stock exposure	High	Economic stock exposure	Very high
Infrastructure, energy	Low	Infrastructure, energy	Very high
Infrastructure, transport	Moderate	Infrastructure, transport	High
Infrastructure, ICT	Low	Infrastructure, ICT	Moderate
Hotspot 3: Pacific small island developing States		Hotspot 4: Sand and dust storm risk corridors	
Tropical cyclone, El Niño, earthquake and landslide		Sand and dust storms, drought and floods: South Asia, South-West and Central Asia	
Population exposure	Very high (mostly poor)	Population exposure	High (mostly poor)
Economic stock exposure	High	Economic stock exposure	High
Infrastructure, energy	High	Infrastructure, energy	Moderate
Infrastructure, transport	Moderate	Infrastructure, transport	Moderate
Infrastructure, ICT	Low	Infrastructure, ICT	Low

Note: Very high=Approximately more than 75 per cent are exposed to hazards; High=Approximately 51–75 per cent are exposed to hazards; Moderate=Approximately 25–50 per cent are exposed to hazards; Low=Approximately less than 25 per cent are exposed to hazards

Abbreviation: ICT, information communication and technology

Source: Economic and Social Commission for Asia and the Pacific (ESCAP), calculations based on data from the United Nations Office for Disaster Risk Reduction, *Global Assessment Report on Disaster Risk Reduction 2015: Making Development Sustainable – The Future of Disaster Risk Management* (Geneva, 2015); United Nations Environment Programme and United Nations Office for Disaster Risk Reduction, Global Risk Data Platform, available at https://preview.grid.unep.ch/ (accessed on 1 March 2019); Asia-Pacific Information Superhighway, available at https://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/about; ESCAP, "Total primary energy supply per capita", Asia-Pacific Energy Portal, available at https://asiapacificenergy.org/ (accessed on 15 September 2018); unpublished ESCAP transportation data (accessed September 2018); Daniel R. Muhs and others, " Identifying sources of aeolian mineral dust: present and past", in *Mineral Dust: A Key Player in the Earth System*, J.B. Stuut and P. Knippertz, eds. (Springer, Dordrecht).

III.   Subregional specificities: the riskscape across the subregions

11.   The hotspots analysis shows that each subregion in Asia and the Pacific is exposed and vulnerable to a different set of risks, therefore, the disaster riskscape varies from subregion to subregion. South-East and South and South-West Asia fall within hotspots where there is a rapid convergence of disasters and critical socioeconomic vulnerabilities. In the Pacific, climate vulnerabilities that intensify occurrences of floods and cyclones are rapidly increasing economic losses and population vulnerability. East and North-East Asia as well as North and Central Asia are within the hotspot of exposed infrastructure. The present document provides information on each subregion with its specific riskscape and concurrent impacts on economies and populations in further detail.

(a)   Riskscape of South-East Asia: flood, drought, tropical cyclone and the Pacific Ring of Fire hotspots

12.   In South-East Asia, the new annualized loss estimates are $86.5 billion, constituting a higher percentage of its GDP than for the whole Asia-Pacific region. Much of this increase is due to agricultural drought losses which, at $51 billion, contribute to 60 per cent of the total annualized losses.

13.   The subregion has one of the highest proportions of subregional average annual loss to subregional GDP. The losses amount to more than 3 per cent of the subregional GDP. Within South-East Asia, there is also a great deal of variability in the extent of the losses compared to country GDP. Cambodia, the Lao People's Democratic Republic, Myanmar and Viet Nam have an average annual loss to GDP ratio of 7.1 per cent compared to 2.8 per cent for the other countries in the subregion.

14.   Additionally, the impacts of agricultural drought are higher within South-East Asian countries than across the Asia-Pacific region in general, constituting approximately 1.8 per cent of the subregional GDP. The dominance of agricultural drought is consistent across all countries for which data are available. The agricultural losses are highest in Indonesia, which, at $23.3 billion, constitute 80 per cent of the annualized losses.

15.   As climate change exacerbates the intensity and frequency of agricultural drought, significant impacts not only on economies, but on human development as well are expected. Across the subregion, there is a high correlation between drought exposure and human development, as 104 million people, or 34 per cent of the employed population, rely on agricultural livelihoods. In the Lao People's Democratic Republic's, for example, 72 per cent of the population relies on agriculture as its primary employment. Thus, no South-East Asian country can afford to ignore agricultural drought.

16.   Post-disaster analysis in the past decade within the subregion reveals that significant economic losses and damages were sustained to social sectors such as education, health, housing, social protection, and water and sanitation, and to livelihood sectors such as agriculture, livestock and fisheries, and tourism. Just 11 major disasters during the past 10 years resulted in $5.4 billion losses to social sectors and $6.8 billion losses to livelihood sectors. Ultimately, this will perpetuate inequalities in incomes and opportunities, disempowering at-risk communities and leaving them susceptible to generational poverty and more vulnerable to future disasters.

17.   The secretariat's computable general equilibrium modelling shows that this may manifest as higher poverty rates among nine countries in the subregion. In 2016, approximately 30 million people were living in extreme poverty. Sustained economic growth in the region until 2030 is projected to reduce this number to 5 million people. However, when unmitigated disaster risk is included, these projections for 2030 increase to 13 million people living in extreme poverty. For example, within Myanmar, the number of people living in extreme poverty was 1.3 million in 2016, and with economic growth this is projected to fall to 470,000 people by 2030. However, with unmitigated disaster risk included, the number doubles to 940,000 people.

(b)   **Riskscape of South and South-West Asia: flood, drought and sand and dust storm corridor hotspots**

18.   Among the five ESCAP subregions, South and South-West Asia has the second highest annualized losses from disasters, an estimated $153 billion. As a percentage of subregional GDP, this amounts to 3 per cent, which is the same as the percentage for South-East Asia. All countries in the subregion, except Maldives, Sri Lanka and Turkey, have annualized average losses that are a higher percentage of GDP than the 2.4 per cent figure for annual average loss as a proportion of GDP for the Asia-Pacific region as a whole. These recurring losses represent an ongoing erosion of development assets and reduce the potential to invest the dividends of economic growth into human development.

19.   While 44 per cent of economic stocks are at risk from seismic-related hazards in the subregion, slow-onset disasters are responsible for the extremely high economic losses across the subregion. They account for 89 per cent of the subregional annualized disaster losses, which are particularly large among countries with big agricultural sectors and rural populations, such as Afghanistan, Bangladesh, India, Nepal and Pakistan.

20.   An emerging risk in the region is from sand and dust storms and desertification. In 2018, sand and dust storms in the Islamic Republic of Iran and neighbouring countries made fragile semi-arid and arid areas environmentally vulnerable. Storms swept over the eastern parts of the Islamic Republic of Iran, south-western Afghanistan and north-western Pakistan, impacting a wide geographical area and resulting in the loss of hundreds of lives. The annual average loss metric has yet to account for this developing climate disaster and therefore this is a relatively conservative estimate of the future losses in this subregion.

21.   Of all the ESCAP subregions, South and South-West Asia is where overlaps between disaster and socioeconomic risks and vulnerability are at their most complex. The region is characterized by high population exposure of mostly poor people and their livelihoods. The subregion contains one of the most extensive and complex transboundary river basins: the Ganges-Brahmaputra-Meghna river basin. As the world's largest river basin, which is shared by four South Asian countries, namely, Bangladesh, Bhutan, India and Nepal, the basin shapes social and cultural lives of approximately 630 million people, almost 70 per cent of whom are in rural areas, accounting for the largest concentration of poverty in the world.

22.   In this subregion more than any other, records of major disasters show that social sectors suffer impacts that perpetuate inequality of opportunity. Almost 43 per cent and 38 per cent of disaster impacts were on the social and livelihood and productive sectors, respectively. Further analysis of these impacts show that poverty, inequalities and disaster risk reinforce each other greatly in the subregion. For example, 77.6 per cent of the population in Bangladesh live

in high multi-hazard risk areas, and poor households with agricultural employment are 1.9 times more likely to live in high multi-hazard risk areas. In Pakistan, the poor are 1.3 times more likely to live in high multi-hazard risk areas and in Afghanistan that number is 1.15.

23.   Computable general equilibrium modelling used to project the impact of disaster shocks on income inequality and poverty shows that with unmitigated disaster shocks, poverty and inequality reduction in the subregion might not be achieved by 2030. The analysis shows that in Bangladesh, the current poverty rate is 15 per cent. Without disaster shocks, the rate will decrease to approximately 7 per cent in 2030. However, with continued and unmitigated disaster shocks, the poverty rate will increase to approximately 10 per cent, which, while lower than the current rate, is still higher than it would have been had the shocks been mitigated. Unmitigated and repeated disasters will continue to keep people in or push them back into poverty.

24.   Disasters also have had a significant impact on the health, education and nutrition of communities in the subregion. For example, in 2017, in Afghanistan, a drought that caused scarcities of water and food exacerbated already high malnutrition rates among children and pregnant and lactating women. Women living in high multi-hazard risk areas have less access to prenatal and medical care; in Nepal, for example, women living in risk-prone areas are 17 per cent less likely to have access to prenatal and medical care.

(c)   **Riskscape of Pacific small island developing States: a hotspot of cyclone tracks along the Pacific Ring of Fire**

25.   The Pacific small island developing States subregion is the only one where tropical cyclones take precedence over drought in contributing to annualized disaster losses. As shown in figure IV, almost 50 per cent of the $1 billion in average annual losses in this region emanate from tropical cyclones. The extensive exposure to both tropical cyclones and earthquakes poses a serious threat to infrastructure, including the ports, airports, roads and power plants that many countries in the subregion rely on for trade and power generation. Power plants that generate 50 per cent of the total power in the subregion are exposed to earthquakes, and plants that generate 84 per cent of the total power are exposed to tropical cyclones.

Figure IV
Subregional riskscape for Pacific small island developing States, average annual losses equalling $1.075 billion
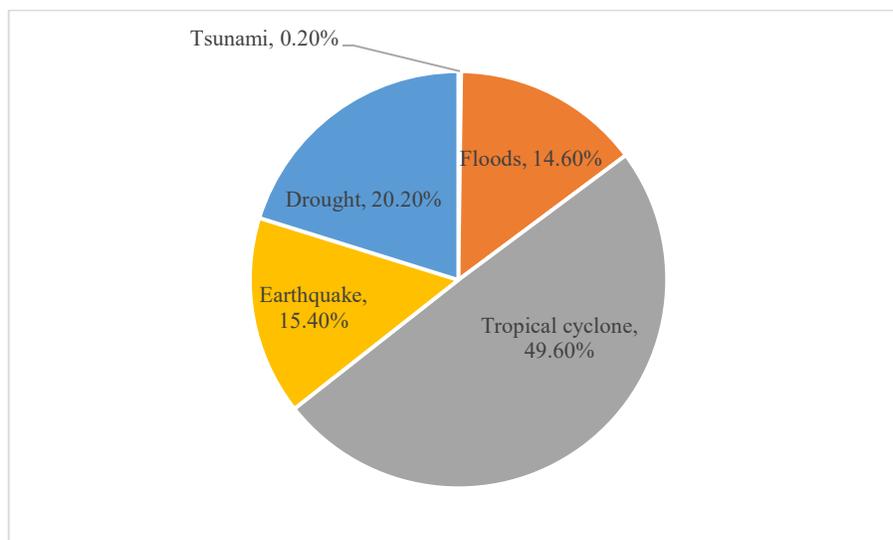
26.   The subregion also records extremely high annualized losses per capita compared to other subregions. The average Pacific small island developing State has an average annual loss per capita that is at least three times higher than the average for South-West Asia, South and South-East Asia, and North and Central Asia. In fact, Palau has the highest average annual loss per capita for the entire Asia-Pacific region.

27.   Additionally, despite the declining value added to GDP, agriculture continues to be an essential source of livelihood across the Pacific small island developing States. It contributes to more than 30 per cent of total exports in Fiji, Papua New Guinea and Solomon Islands and to more than 60 per cent in Samoa, Tonga and Vanuatu. Considering the lack of data to estimate annualized losses for Papua New Guinea and Solomon Islands, which are both extremely prone to drought, the current losses remain a conservative estimate for the subregion.

28.   Among the five subregions, the Pacific small island developing States are also the most affected and impacted by climate change. In this region, an increase in global temperature of 1.5°C is expected to severely increase extreme temperatures, inter-annual sea level inundations and tropical cyclone frequency and intensity. As the climate warms, the parallel changes in El Niño and La Niña events will increase the frequency of floods, droughts and coastal flooding, threaten freshwater availability, increase coral bleaching and limit the protection provided by coral reefs.[4] In support of these findings, studies are already showing increasing trends in intense cyclone frequencies in the Pacific in recent years.[5]

29.   This intensity was demonstrated by the category 5 Tropical Cyclone Gita in February 2018 and the 2015–2016 El Niño event. Tropical Cyclone Gita affected approximately 80,000 people in Tonga, or 80 per cent of its population, and caused damages of $164.1 million, equivalent to 37.8 per cent of the country's GDP.[6] The 2015–2016 El Niño, combined the increasing intensity and frequency of tropical cyclones with worsening droughts and affected the water sector, reduced nutrition and education rates, and resulted in a loss of livelihood for much of the subregion.[7]

30.   Records of the major disasters in the Pacific small island developing States demonstrate that the social sectors (education, health, housing and culture) have sustained the most losses and damages. Evidence suggests that these disruptions disproportionately impact the poorest and most vulnerable groups, perpetuating inequalities of opportunity. Following the category 5 Tropical Cyclone Winston in 2016, school attendance of older boys declined so that they could assist with rebuilding homes and re-establishing livelihoods, and the attendance of girls declined so that they could help with domestic activities. Furthermore, as women were more likely to engage in reproductive and informal economy work in the home, their incomes were more disrupted than those of men who were more likely to work outside the home. Women who were head of household, widowed heads of households, the elderly, people living with disabilities and single women also struggled to rebuild their homes due to a lack of the resources.

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[4]   Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C* (Geneva, 2018).

[5]   Nam-Young Kang and James B. Elsner, "Climate mechanisms for stronger typhoons in a warmer world", *Journal of Climate*, vol. 29, No. 3 (1 February 2016), pp. 1051–1057.

[6]   Tonga, *Post Disaster Rapid Assessment: Tropical Cyclone Gita* (Nuku'alofa, 2018).

[7]   United Nations Development Programme and others, *Enhancing Resilience to Extreme Climate Events: Lessons from the 2015–2016 El Niño Event in Asia and the Pacific* (2017).

(d) **Riskscape of North and Central Asia: drought, flood and seismic risk hotspots**

31.   The subregional average annual losses of North and Central Asia capture the uneven geographical distribution of losses in the subregion; 87 per cent of the subregion's total multi-hazard losses are concentrated in three countries, namely, Kazakhstan, the Russian Federation and Uzbekistan. The Russian Federation alone accounts for 67 per cent of subregional multi-hazard average annual losses. On average, countries in North and Central Asia are losing 4 per cent of their GDP, creating at-risk populations and economies.

32.   Economic stock, a key driver for growth and development in these countries, also faces significant exposure. In Kazakhstan, for example, 73 per cent of the energy infrastructure, 56 per cent of the communication infrastructure, and 57 per cent of the transport infrastructure is at high risk from future losses from multiple hazards. In Kyrgyzstan, annualized disaster losses currently represent almost 3.9 per cent of the gross fixed capital formation.

33.   In addition, agricultural drought accounts for 61 per cent of the total annualized losses and close to 1 per cent of the subregional GDP, the highest among all disasters. Due to changing climate, the economic damages from water scarcity and, on the opposite end, river flooding are both projected to increase; projections from the Intergovernmental Panel on Climate Change show that economic damages from river flooding, for example, will increase by 223 per cent in the Russian Federation and by 190 per cent in Kazakhstan.[8]

34.   Contrary to the rest of the subregions, North and Central Asia is the only subregion that shows an upward trend in disaster fatalities since the 1990s. This may be a result of the changing geography of disasters, where rising impacts are from climate-related disasters rather than the more traditional seismic-related disasters. As these risks are also increasingly unpredictable, it is necessary to upgrade early warning systems to keep up with the complexity of the hazards in the subregion.

35.   The escalation of these hazards has further impacted the well-being of populations. For example, the post-disaster analysis for the 2015 Georgia floods demonstrate that 25 per cent of the losses were in social sectors. The impacts of disasters remain greater for poorer communities and poorer populations, which are often the most exposed to disasters; they do not have the means to protect their assets and to avoid living in areas hit by disasters. Tajikistan, for example, has the highest discrepancy between the wealthy and the poor in the Asia-Pacific region with regard to people living in high disaster risk areas. The World Bank notes that despite the country's sustained economic growth in the past few years, and its notable achievements, poverty and low standards of living remain a pressing problem;[9] poorer populations, which have higher odds of residing in high disaster risk areas, can continuously lose wealth and assets, which pushes them deeper into poverty.

36.   Computable general equilibrium models projecting impacts of disaster shocks on income inequality demonstrate that on average, without disaster shocks, countries in North and Central Asia will have 0.6 per cent lower Gini coefficients. However, that number is halved with unmitigated disaster shocks with a 0.3 per cent decrease.

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[8]   Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C.*

[9]   World Bank, *South Asia Water Initiative: Annual Report from the World Bank to Trust Fund Donors – July 2014–June 2015* (Washington, D.C., 2015).

(e)   **Riskscape of East and North-East Asia: a hotspot along the Pacific Ring of Fire, converging with cyclone tracks and emerging sand and dust storms**

37.   Of the five ESCAP subregions, countries of East and North-East Asia bear the highest brunt of economic losses from disasters. Losses are approximately $409 billion, accounting for 60 per cent of the region's total annual average loss and representing 2.11 per cent of the subregional GDP. As expected, the highest losses are concentrated in higher-income countries, notably Japan, with a 40 per cent share, and China, with an 18 per cent share in the subregion's total average annual losses. When the data on economic losses are disaggregated, Mongolia is the most affected by slow-onset drought, followed by China and the Russian Federation, while typhoons and floods are the greatest cause of annualized losses in Japan and in the Republic of Korea. Japan also has the highest average annual loss for earthquakes and tsunamis due to its geographical location in the Ring of Fire.

38.   The subregion's location on the Ring of Fire is characterized by a very high exposure of economic stock and energy infrastructure to risk. The seismic fault lines threaten communication infrastructure, particularly in technologically advanced countries, such as China, Japan and the Republic of Korea. In the subregion, 16.7 per cent of ICT infrastructure is exposed to earthquakes. Many coal, oil and hydropower generation plants, especially in Japan, are also exposed to earthquakes and tsunamis. Of the total 1,437 coal, oil and hydropower energy resources, 46.4 per cent of the energy infrastructure and 34.7 per cent of the total capacity of power plants are exposed to earthquakes. These countries also depend on submarine fibre-optic cables that are vulnerable to typhoons. Access to functioning road networks, airports and ports are essential for evacuations and the distribution of supplies, especially in the emergency phases of a disaster. Energy failures in the subregion can have cascading impacts on health services and communications, affecting swaths of the subregion's population.

39.   Moreover, sand and dust storms are quickly emerging as an environmental concern. Originating principally in the arid areas of Inner Mongolia in China and in the Gobi Desert in Mongolia (as well as increasingly from north-eastern China), windborne dust particles are carried eastward to affect not only China but also the Korean Peninsula and Japan.

40.   While the countries in the subregion have a considerably higher human development index, slow-onset droughts have caused significant losses in agricultural production, depleted fresh water supplies, and increased inflation and poverty. In the Democratic People's Republic of Korea for example, fatalities and economic losses are on the rise from floods and droughts. Agricultural livelihoods especially need to be protected to maintain the high levels of development and growth that the subregion has enjoyed.

IV.   Accelerators for a resilient future: adopting risk-informed investments and technological innovations

41.   These highlighted subregional specificities of disaster risks and impacts need to be translated into policies and actions to protect economies and peoples. To overcome the current silos of disaster risk reduction initiatives and prevent disasters from reducing development gains, Governments should prioritize risk-informed development policies and investments in critical sectors. Governments can also play a valuable role in capitalizing on the extensive developments in technology and innovations by integrating disaster risk and early warning information across all timescales into decision-making systems that promote inclusion and empowerment.

A.   Adopt risk-informed investments

42.   To date, the region has invested less than the global average in key resilience-building sectors and needs to catch up. In the *Asia Pacific Disaster Report 2019*, the secretariat notes that the additional investments required to meet the global average in three critical sectors per year are lower than the annualized losses for all subregions.

43.   Those sectors are education, social protection and critical infrastructure. Investments in these crucial areas can ensure that Governments strengthen disaster resilience for the poorest and most vulnerable groups. At the same time, Governments should reach out in a coherent matter to the same groups through investments in traditional entry points for disaster risk reduction, such as agriculture, livelihoods and land-use planning. The subregions offer several examples of successful initiatives and interventions that can be scaled up to benefit the Asia-Pacific region as a whole.

44.   In the education sector, the Philippines, in South-East Asia, has established a dedicated disaster risk reduction and management office. Its staff work in the central, regional and divisional offices of the department, ensuring that disaster risk reduction is part of its annual planning and budgeting. Within East and North-East Asia, the benefits of disaster preparedness in schools were demonstrated by Japan during the great east Japan earthquake of 2011. Dubbed the Kamaishi miracle, 2,900 schoolchildren in the city of Kamaishi, were protected by earthquake-resistant buildings and then evacuated to higher ground due to the introduction of disaster risk management education programmes which built on a local tradition of *tendenko*, meaning to evacuate without first searching for relatives or friends.

45.   However, to fully utilize the benefits of disaster resilient investments in education, interventions must be inclusive. Children with disabilities are particularly vulnerable as their needs may be ignored in many disaster risk reduction policies. They may be less able to take advantage of early warning systems, evacuations, shelter facilities and relief distributions because of medical conditions and physical and social structures. School-based disaster preparedness also misses children with low attendance rates or who are excluded from schools altogether due to economic circumstances. This includes children in informal urban settlements who live and/or work on the streets as well as working children. Expanding access to education for these children can ensure that school-based risk reduction can deliver for them.

46.   As with the education sector, the social protection sector should also look to be adaptive, by integrating climate, disaster risk and socioeconomic information. In South-East Asia, for example, following Typhoon Haiyan, the Government of the Philippines expanded the existing national conditional cash transfer programme to protect people from falling into poverty as a result of asset losses. In the Pacific, post Cyclone Winston, the Government of Fiji delivered recovery assistance using existing social safety net programmes for the first time.[10] The approach facilitated rapid delivery, and the payments were utilized to repair houses, neighbourhood infrastructures and agricultural lands. In East and North-East Asia, the Government of Mongolia has an innovative index-based insurance scheme for *dzud*, where droughts and pasture shortages lead to mass livestock deaths. By establishing an index that is automatically activated by changes in weather parameters, the cost of providing insurance can be lowered. Lower costs to insurers can help build a profitable and sustainable business model that provides affordable insurance.

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[10]   Aisha Mansur, Jesse Doyle and Oleksiy Ivaschenko, *Cash Transfers for Disaster Response: Lessons from Tropical Cyclone Winston* (Canberra, Australian National University, 2018).

47.   Lastly, disaster resilient investments in critical infrastructure such as hospitals, transport, communications and energy are essential to social and economic functioning, especially for the most vulnerable communities, during and after disasters. In East and North-East Asian, Japan has led the Group of 20 Action Agenda on Adaptation and Resilient Infrastructure. Likewise, the Ministry of Trade, Industry and Energy of the Republic of Korea has been implementing a support program to evaluate the vulnerability levels of various industrial sectors to climate change and to help those sectors to establish adaptation measures.[11] Within South and South-West Asia, the recent launch of the Coalition for Disaster-Resilient Infrastructure led by the Government of India aims to develop resilient infrastructure. The coalition will enable a measurable reduction in infrastructure losses by promoting emerging technologies, risk identification and estimation, and recovery and reconstruction.[12]

B.   Capitalize on new technologies, innovations and big data ecosystems to integrate disaster risk and early warning information into decision-making and adaptation processes

48.   The Global Commission on Adaptation found that building early warning capacities and resilience is cost effective. Globally, investing $1.8 trillion in strengthening early warning systems, making new infrastructure resilient, improving dryland agriculture crop production, protecting mangroves, and making water resources management more resilient could generate $7.1 trillion in total net benefits in the next 10 years. Of these, the highest benefit cost ratio, 10:1, is for strengthening early warning systems, followed by building resilient infrastructure, at 5:1.[13] The accrual of these benefits can be accelerated by capitalizing on emerging technologies and innovations.

49.   Governments in the region are already taking advantage of these developments. Countries on the World Meteorological Organization (WMO)/ESCAP Panel on Tropical Cyclones, for example, are using advancements in meteorological satellite technology, computer science, big data and related mathematical modelling of tropical cyclones to improve forecasts in various time scales and give longer lead times for evacuation.[14] For example, ESCAP, through the WMO/ESCAP Panel on Tropical Cyclones, shared data and risk advisories in preparation for Cyclone Fani, one of the severest cyclones to hit the Bay of Bengal in the past two decades. The almost pinpoint accuracy of the early warnings by the national meteorological organizations led to not only one of the biggest human evacuations in the history in India and Bangladesh – a record of more than 2 million – but also an evacuation at the right time, neither too early nor too late. The result is that the death toll was contained to 42 people as compared with 15,000 people just two decades ago.[15]

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[11]   Organization for Economic Cooperation and Development, *Resilient infrastructure for a changing climate: Input document for the G20 Climate Sustainability Working Group* (Argentina, 2018).

[12]   Delia Paul, "India launches global coalition for disaster-resilient infrastructure", International Institute for Sustainable Development, SDG Knowledge Hub, 3 October 2019.

[13]   Global Commission on Adaption, *Adapt Now: A Global Call for Leadership on Climate Resilience* (n.p., 2019).

[14]   World Meteorological Organization, Tropical Cyclone Programme, "Projects and future plans". Available at https://www.wmo.int/pages/prog/www/tcp/Projects.html (accessed on 6 February 2020).

[15]   Red Cross Red Crescent Climate Centre, "UN praises 'almost pinpoint accuracy' of forecast-based warnings, with clean-up underway in India and Bangladesh from Cyclone Fani", 6 May 2019. Available at www.climatecentre.org/news/1139/un-praises-a-almost-pinpoint-accuracya-of-forecast-based-warnings-with-clean-up-underway-in-india-and-bangladesh-from-cyclone-fani.

50.   Among South-East Asia countries, the successful response to the Sulawesi earthquake in Indonesia used satellite and remote sensing imagery to provide a rapid assessment of the damage-affected areas, including sector-based preliminary economic loss estimates. Based on an open loss modelling approach, the assessment included data from social media for results calibration and novel inundation extent and ground deformation. Within 10 to 14 days of the disaster, stakeholders could access loss estimates and the spatial distribution of damage. The rapid assessment was used to programme support for recovery and reconstruction with funding of up to $1 billion for the disaster-affected areas of Lombok and Sulawesi.[16]

51.   In the Pacific, the post-disaster needs assessment of Tropical Cyclone Gita in Tonga was carried out using drones. They had the advantage over satellites of producing higher-resolution imagery which was important for small- area damage estimation.[17] Drones also captured images of damaged buildings and infrastructure and land cover and enabled rapid mapping, which accelerated the process of reconstruction and recovery.

52.   Within South and South-West Asia, in India, challenges with regard to leakages and delays in wage payment under the public workfare programme of the Mahatma Gandhi National Rural Employment Guarantee Act are being addressed through direct payments using a biometric-enabled national identity number called Aadhar. The use of Aadhar-linked digital identity bank accounts to pay for a variety of subsidy and social protection schemes, including for disasters, saves an estimated $11 billion per year.

53.   Among East and North-East Asian countries, the China Meteorological Administration is using big data for gridded, smart and impact-based typhoon forecasting, which has improved timing in evacuation exercises. Impact-based forecasting that enables risk-informed, spatial land-use planning also protects exposed economic assets. As a result, there has been a significant decrease in casualties, even for super typhoons and a reduction in disaster losses as a proportion of GDP.[18]

54.   Despite these successes, a lack of baseline data disaggregated by gender, age and disabilities, particularly for the hardest to reach and most vulnerable peoples, currently presents a significant challenge to up scaling implementation of such policies. This is exacerbated by errors in traditional statistical sampling, which means that vulnerable people may not be accounted for within census records. Advances in geo-statistical interpolation techniques can address these issues.[19] These new approaches have been found to reduce the problem of undercounting in the urban slums of Hanoi, as well as in Kathmandu and Dhaka, in South Asia.

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[16] Deepti Samant Raja, "Bridging the disability divide through digital technologies – background paper for the World Development Report 2016: Digital Dividends" (Washington, D.C., World Bank, 2016).

[17] Marit Virma, "The role of UAVs in Cyclone Gita response and recovery in Tonga", Malmö University blog, 19 October 2018.

[18] ESCAP/WMO Typhoon Committee, "Annual report 2018 of the Advisory Working Group", document WRD/TC.51/10.2. Available at www.typhooncommittee.org/51st/docs/item%2010/10.2%20AWG%20REPORT%202 018.pdf.

[19] These techniques can integrate disaggregated geospatial data into gridded population areas taken from satellite imagery to determine the circumstances of people living within defined areas.

55.   Using big data and related technologies is not easy. Typically, big data is high volume, high velocity, with high variety, integrating many diverse data sources. This requires dense infrastructure networks. It is also unstructured and imprecise with a lot of big noise that needs to be filtered out, requiring new forms of computer processing and analytics to enhance decision-making, the discovery of insights and process optimization. The discussion on how to capture the full benefits of big data and emerging technologies is in its nascent stage and sharing of experiences and lessons learned through subregional and regional cooperation will prove timely and essential as a body of regional experience emerges.

V.   Opportunities to accelerate adoption of resilience measures through subregional and regional cooperation

56.   Asia and the Pacific has some of the world's most extensive transboundary disaster hotspots. With climate change these are likely to expand still further, creating deep uncertainties. The secretariat has long engaged with the region in addressing these transboundary issues at subregional and regional levels.

57.   In 2019, the secretariat was requested to prioritize regional platforms for multi-hazard early warning systems for floods and droughts under the Asia-Pacific Disaster Resilience Network. Further, the secretariat was asked to customize the implementation of the Network and address the subregional specificities of the risk hotspots. The Network capitalizes on its partnerships to promote the latest scientific innovations, to work at subregional levels.

(a)   Subregional cooperation: South and South-West Asia

58.   In this subregion, ESCAP, following the modality of the ESCAP/WMO Typhoon Committee and WMO/ESCAP Panel on Tropical Cyclones, supports the Regional Integrated Multi-hazard Early Warning System for Africa and Asia to ensure that multi-hazard risk information and early warning services are integrated fully with the broader resilience targets of the 2030 Agenda. Three recent developments in this area are worth highlighting.

59.   First, the South Asia Hydromet Forum, held in Kathmandu in November 2019,[20] emerged as an initiative of the World Bank, WMO, South Asian countries, and technical organizations such as the Regional Integrated Multi-hazard Early Warning System for Africa and Asia, the Met Office of the United Kingdom of Great Britain and Northern Ireland, and the European Centre for Medium-Range Weather Forecasts. The initiative aims to operationalize multi-hazard approaches to manage floods, droughts, heat waves and slow-onset disasters in the risk hotspots of the subregion. The South Asia Hydromet Forum, with the Regional Integrated Multi-hazard Early Warning System for Africa and Asia as the regional technical capacity development hub of the initiative, has been tasked with delivering innovative climate and weather services for disaster resilience. The Commission was recognized for its early work on impact-based forecasting across critical economic sectors and will support the Regional Integrated Multi-hazard Early Warning System for Africa and Asia in order to elevate these services to high-level policymakers beyond the community of meteorologists and hydrologist.

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[20]   The South Asia Hydromet Forum is a platform for regional exchange, collaboration and fostering innovation for increasing the coverage, quality and access to hydromet services and ensuring their sustainability in the region

60.   Second, during the third South Asia Forum on the Sustainable Development Goals' session on disaster risk reduction, held in Dhaka in December 2019, members and associate members requested the Commission to facilitate the integration of climate and disaster risks into development planning processes. Underscoring that risk-informed development cannot be achieved without using the newest climate-related innovations, technologies and forecasts, they asked the Commission to develop a strategy wherein the South Asia Hydromet Forum could substantially contribute to future South Asia forums on sustainable development.

61.   Third, the inter-governmental Council of the Regional Integrated Multi-hazard Early Warning System for Africa and Asia, at its meeting in Bangkok from 20 to 22 January 2020, endorsed the partnership of ESCAP and WMO to support the Regional Integrated Multi-hazard Early Warning System in delivering the South Asia Hydromet Forum's work programmes. It also endorsed the recommendation of the planning and finance ministers present at the third South Asia Forum on the Sustainable Development Goals on building institutional linkages between the South Asia Hydromet Forum and the South Asia forums on sustainable development and on creating a collective plan of action to implement disaster and climate resilience measures in development planning.

(b)   Subregional cooperation: South-East Asia

62.   In South-East Asia, the release of the ESCAP-Association of Southeast Asian Nations (ASEAN) joint study, entitled *Ready for the Dry Years: Building Resilience to Drought in South-East Asia – With a Focus on Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam: 2020 Update*, as well as several multi-stakeholder policy dialogues in Cambodia, the Lao People's Democratic Republic, Myanmar and Viet Nam have propelled high-level discussions on drought resilience. The ASEAN Committee on Disaster Management, with support from the ESCAP and ASEAN secretariats, will consider a draft declaration and is developing a region-wide strategy for building resilience to drought.[21]

63.   The subregion is also leading cooperation efforts to share technological developments and capacity. Under the Commission's Regional Cooperative Mechanism for Drought Monitoring and Early Warning, the Governments of China and Thailand are supporting the Governments of Cambodia, the Lao People's Democratic Republic, Myanmar and Viet Nam in advancing a tailored, cloud-based crop-monitoring system that integrates geospatial information into crop and drought monitoring systems for agriculture.[22] The ASEAN and ESCAP secretariats are also embarking on building a common information-sharing platform that will serve as a point of entry for the storage, access, retrieval and analysis of geospatial data and information for urban areas which can be used for disaster risk management. In that workplan several urban and peri-urban areas will be identified wherein the integration of geospatial information with hazards and sectoral data will provide opportunities to better manage and prepare for disasters.

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[21]   Viet Nam News, "ASEAN to take immediate steps to combat drought in SE Asia", 11 December 2019.

[22]   *Ready for the Dry Years: Building Resilience to Drought in South-East Asia – With a Focus on Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam: 2020 Update* (United Nations publications, Sales No. E.19.II.F.7).

64.   Further, the launch of the second phase of the ASEAN Disaster Risk Finance and Insurance Programme is an important step forward in strengthening the financial resilience of the people in the subregion. Collective thinking on financial diversification and differentiated fiscal solutions is needed to improve risk management and break the link between poverty, disasters and inequality, and the secretariat stands ready to share expertise on the subject.

(c)   Subregional cooperation: North and Central Asia and East and North-East Asia

65.   The secretariat has been supporting member States in North and Central Asia in their efforts to share information and build policy and technical capacity to address the challenges related to the root causes of sand and dust storms, namely desertification and land degradation. The Regional Cooperative Mechanism for Drought Monitoring and Early Warning supports North and Central Asian and East and North-East Asian countries, namely, Kazakhstan, Kyrgyzstan, Mongolia and Uzbekistan, to expand their capacity to more effectively utilize space applications for drought, desertification and land degradation.

66.   Building on the successful experience of developing a drought monitoring tool and programme for Mongolia, ESCAP is now facilitating work with the Chinese Academy of Sciences and the National Remote Sensing Centre of Mongolia to develop and tailor seasonal forecast models to better prepare people for possible *dzud* conditions, so that they can stock up on additional food or be better informed about where to take their livestock.

67.   Under a Development Account project on addressing the transboundary dimensions of the 2030 Agenda through regional economic cooperation and integration in Asia and the Pacific, ESCAP is further addressing the challenges of infrastructure resilience. The project is supporting the subregion in efforts to protect its current and future infrastructure from disaster impacts using novel methodologies for multi-hazard disaster risk assessment.

(d)   Subregional cooperation: the Pacific small island developing States

68.   Under the United Nations Resident Coordinator Office in Samoa, ESCAP, with the United Nations Development Programme, the United the Nations Educational, Scientific and Cultural Organization, the International Labour Organization and the United Nations Children's Fund, is implementing a project on social protection in the Pacific subregion where climate risks need to be taken into account when designing social protection systems and financing.

(e)   Regional cooperation

69.   While subregional cooperation is beneficial, regional cooperation enables all Governments to learn from the successful examples in the region and overcome their limitations in capacity development and access to emerging technologies.

70.   Already, technology-rich countries like China, India and Thailand are supporting on-the-job exchanges and training courses to build developing countries' capacity in the use of space applications for risk reduction. Spacefaring countries have also actively supported disaster-struck member States by providing timely satellite-derived remote sensing data and imagery for damage assessment and response.

71.   In recent years, regional efforts have intensified in geospatial information management. The Commission leads the secretariat of the Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific. The Committee promotes the concepts of open data, communities and sources, as well as spatial data infrastructure to address local and global development challenges and support the implementation of the 2030 Agenda and the Sustainable Development Goals.

72.   The secretariat's Asia-Pacific Disaster Resilience Network is a continuation of its efforts to strengthen regional resilience. With an emphasis on partnerships, innovations and a hazard cluster approach, the Network comprises interrelated streams which (a) support development of multi-hazard early warning system platforms with priority given to floods and droughts; (b) build regional capacity for data, statistics and information management; and (c) enhance regional knowledge for policy and decision support systems using the next generation of analytical tools.

73.   In response to requests from member States to initiate subregional- specific approaches under the Network with consideration given to the different disaster riskscapes, the secretariat has dedicated significant resources to developing publications, resources and technical materials to support subregional capacity development cooperation activities.[23] Its analytical research on impact forecasting for slow-onset disasters, including drought,[24] sand and dust storms,[25] heat waves and extreme events, including floods, cyclones and earthquakes,[26] is generating awareness of multi-hazard approaches for the next generation of early warning systems. The upcoming editions of the ASEAN-ESCAP drought study *Ready for the Dry Years* will deepen the subregion's focus on adaptation and resilience issues that promote an integrated framework of environment, climate change and disaster risk. The secretariat's work on building resilient infrastructure has included exploring the feasibility of combining grey and green infrastructures for water-related disasters and promoting novel methodologies to assess infrastructure losses; this work will be used to increase the region's knowledge capital to enable resilience and adaptation in this key sector.[27]

VI.   Role of the Commission in supporting the future resilience of the region

74.   With the aim of ensuring resilience in all sectors and societies of Asia and the Pacific, ESCAP provides support on resilience issues in intergovernmental processes, research and capacity-building. The work of ESCAP to deepen regional cooperation in disaster resilience benefits from the intergovernmental structure of the Commission, including the Asia-Pacific Forum on Sustainable Development and the Committee on Disaster Risk Reduction.

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[23] See ESCAP/75/12.

[24] *Ready for the Dry Years: Building Resilience to Drought in South-East Asia.*

[25] ESCAP, *Sand and Dust Storms in Asia and the Pacific: Opportunities for Regional Cooperation and Action* (ST/ESCAP/2837)

[26] ESCAP, Regional Integrated Multi-hazard Early Warning System for Africa and Asia and United Nations Development Programme, "2018/19 El Niño Asia-Pacific impact outlook for March to April 2019", 1 March 2019. Available at: www.unescap.org/sites/default/files/El%20Nino%20Advisory_Feb2019.pdf.

[27] ESCAP, *Risk Informed Infrastructure Planning: Central Asia Pilot in Kazakhstan and Kyrgyz Republic* (Bangkok, 2020).

75.   The Commission will continue to respond to cross-cutting challenges across the region and subregions. Noting that key challenges remain in harnessing the benefits of geospatial tools and digital connectivity to reduce disaster risks,[28] ESCAP is increasing efforts to combine traditional statistics with Earth observation data and geospatial information, align data and information with user needs, and lower the gaps in the digital divide, a prerequisite to putting geospatial information and big Earth data analytics into use for disaster resilience.

76.   Under the Asia-Pacific Disaster Resilience Network, the secretariat will support members and associate members in scaling up these initiatives as well as in building subregional and regional cooperation to mainstream the initiatives into planning and development processes.

77.   To take forward the work of the Asia-Pacific Disaster Resilience Network, the Commission may also wish to provide guidance on priority areas and to propose partnerships to accelerate actions on the proposed areas.

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[28]   See ESCAP/75/12.