THE AD HOC WORKING GROUP ON LONG-TERM COOPERATIVE ACTION UNDER THE CONVENTION

Singapore's Submission on Adaptation

1 This submission on adaptation is made in response to the invitation in AWGLCA/2008/L.5 for Parties to submit ideas and proposals on the elements contained in paragraph 1(c) of the Bali Action Plan.

2 Singapore is firmly committed to understanding the impacts, assessing the vulnerability, and managing the risks associated with climate change. Unless properly managed, these factors can have adverse effects not only within countries but also across national borders. We welcome this opportunity to provide information on key considerations to support the work of the AWG-LCA on adaptation, as well as relevant programmes and activities which have been taken in Singapore. In this connection, the experience of Singapore in adaptation may be relevant to other Parties. Singapore stands ready to exchange experiences and knowledge on adaptation measures with other developing countries, particularly small island developing countries which face similar situations from the effects of climate change.

(I) Principles of Adaptation

3 As highlighted in Articles 4.3, 4.4, 4.5, 4.7, 4.8 and 4.9 of the Convention , developed countries, particularly Annex II countries, have a key role to play in helping developing countries adapt to the adverse effects of climate change, through funding, insurance, and the transfer of technology Such assistance should be expanded and carried out expeditiously. To facilitate access to funding for adaptation by developing countries, information on pledges by developed countries on the financing and technology for adaptation, including the eligibility criteria to access these funds, should be collated and presented in a clear and coherent manner. Funding for adaptation assistance should also be additional to existing ODA commitments.

4 Adaptation measures should include both improvements to the physical infrastructure as well as means to deal with the socio-economic impacts of climate change on the population. Where appropriate adaptation measures should form part of disaster management plans so as to avoid the more pernicious effects of climate change. There will also need to be improved understanding of financial risk management frameworks and mechanisms such as insurance to manage and reduce financial risks.

(II) Vulnerability Assessment in Singapore

5 Singapore is a small densely populated tropical island which is relatively low-lying. The total land area of Singapore is only about 700 sq km, much of which is less than 15m above sea level. With a population of about 4.6 million, Singapore is one of the most densely populated countries in the world.

6 A vulnerability assessment by the National University of Singapore and participated by several IPCC experts has been commissioned and is expected to be completed in 2009. The vulnerability study will cover areas such as temperature rise and sea level rise. It will determine the specific local effects and impacts of climate change on Singapore and would assess what more needs to be done in adaptation.

7 To build up expertise in understanding the impacts, assessing the vulnerability, and managing the risks associated with climate change within the Southeast Asia region, the Earth Observatory of Singapore (EOS) was recently set up to help Singapore and Southeast Asian countries. It will anticipate and adapt creatively to environmental threats including those brought about by climate change.

(III) Adaptation in Singapore

8 Adaptation measures have been progressively put in place over the last several decades. A constant review is made to the existing infrastructure to assess its adequacy in meeting the adverse effects of climate change such as temperature rise. These reviews will help to identify new measures needed and establish national systems to actively monitor and manage these adverse

impacts. Some of the measures Singapore has taken with regard to adaptation are given below.

9 **Flooding**. A rise in sea level will make it more difficult for rainwater to drain into the sea. This will aggravate inland flooding. Since 1991, Singapore has required new land reclamation projects to be built to a level 125 cm above the highest recorded tide level. A deliberate policy to raise the level of low-lying areas in conjunction with redevelopment proposals has also been put in place. This will help Singapore adapt to projected sea level rise made by the IPCC.

10 Furthermore, drainage infrastructure has been constructed to reduce flood-prone areas in Singapore from 3200 ha in the 1970s to 124 ha. With the completion of the Marina Barrage (which will dam the Singapore river thereby creating a freshwater reservoir), the development and improvement of drainage infrastructure (e.g. widening and deepening of drains and canals), as well as other flood alleviation projects, the flood prone areas will be further reduced to 66 ha by 2011. This will reduce the possibility of increased inland flooding due to climate change.

11 **Coastal land loss**. To protect against coastal erosion and land loss, hard wall or stone embankments have been constructed along 70% to 80% of Singapore's coastal area. The government is also looking at adapting to sea level rise through the protection of our foreshore and coastal areas. As necessary, existing revetments will be strengthened and reinforced while natural areas will be protected using different coastal defence systems.

12 **Water Resources**. A rise in sea level can result in saltwater intrusion of Singapore's coastal reservoirs. Plans are in place to raise the gate structures of the dams as necessary.

13 Rising global temperatures can also change rainfall patterns and affect the amount of water stored in reservoirs. The unpredictability in rainfall can cause difficulties in capacity planning of water resources. With

the diversification of Singapore's water resources to include NEWater[1] and desalination, we have increased the resilience of our water supply as these new sources are not dependent on rainfall.

14 **Heat stress**. Warmer temperatures due to both climate change as well as the urban heat island effect can lead to increased energy demand. Higher annual temperatures may also mean more frequent and severe episodes of warm weather, leading to increased occurrences of heat stress and discomfort, particularly among the elderly and the sick.

15 Measures to lower ambient temperature include increasing the amount of greenery in the city and modifying building layout and designs have been taken. Plans have been drawn up to provide greenery island-wide, such as parks and green open spaces, and planting along roads and around developments. About one million trees and more than eight million shrubs have been planted in Singapore over the years of which 62,000 trees were planted in 2006 alone. We have also been promoting rooftop and vertical greenery on our residential and commercial buildings through planning guidelines and incentives. We are in the process of introducing rooftop greenery to multi-storey residential buildings and carparks where feasible.

16 **Public health impact**. Singapore is situated in a region in which vector-borne diseases, particularly dengue, are endemic. Dengue patterns are affected by many factors, including climate. Singapore is studying the link between climate factors such as temperature, humidity and rainfall with dengue cases. Preliminary results indicate that the number of dengue cases in Singapore is correlated to the ambient temperature. To address the spread of dengue in Singapore, we have put in place a comprehensive mosquito surveillance, control and enforcement system, which includes pre-emptive action to suppress the mosquito vector population, dengue-related research and a review of building designs to reduce potential breeding habitats for mosquitoes.

---

[1] NEWater is treated used water that has undergone stringent purification and treatment process using advanced dual-membrane (microfiltration and reverse osmosis) and ultraviolet technologies.

(IV) Singapore's International Efforts

17 Singapore has shared its experience in implementing adaptation measures with other developing countries, particularly those which share the similar physical and geographical features. Since 2000, Singapore has organised training courses in Environment and Urban Development for over 2,000 officials from other developing countries. This has been carried out through the Singapore Cooperation Programme and other technical assistance programmes at the cost of US$4.8 million. Such training courses included courses on urban environmental management, urban and city management, developing and managing a garden city, sewage and wastewater management, pollution control, town planning, sustainable development, environmental management, and 24/7 water supply and distribution management. As a developing country, Singapore will continue to share its experience in adaptation measures with other developing countries and to assist them through such transfer of technological knowledge and capacity-building efforts.

. . . . .