UTM UNIVERSITI TEKNOLOGI MALAYSIA

IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 6(2)/2019, 23-37

Climate Change Policy Evaluation and Its Impact on Island Nations: Case Of Singapore And Sri Lanka

Osada Vishvajith Peiris
Department of Town & Country Planning, Faculty of Architecture, University of Moratuwa, Katubedda, Sri Lanka.
Email: vishvajithp@uom.lk

ABSTRACT

Climate Change (CC) is universally recognized as a major global threat due to its nature of impacts. Island nations are known to be the most vulnerable to CC impacts where many countries have initiated mitigation and adaptation actions through sector-based policy measures. Singapore and Sri Lanka are two Asian island nations with CC induced threats. Two countries are different in terms of economic development, but similar developing countries in the CC agenda. In this context, both the countries have initiated mitigation and adaptation actions through policy measures. This study compares the key climate driven performance indicators with historical data to evaluate the performance of climate change policy of each country. Generally, policy evaluation has been conducted by adopting scientific and non-scientific tools, but it is seldom see that the relation of climate driven indicators along with CC policy. Also the policy research was mostly based on European case studies and Asian island nations were not easy to find in this context. The comparison of two countries in terms of CC policy is to determine the key vulnerable sectors where intervention is necessary for island nations. Mitigation policies are evaluated in Singapore and Sri Lanka using GHG emission pathways under twelve (12) indicators and adaptation policies are measured under the national expenditure of key sectors of the economy under seven (07) indicators. The analysis further elaborated by comparing both countries with key economic sectors that has positive and negative influence on CC impacts. Finally, the analysis outcome is used for lessons to learn from each other in improving the CC policy of Singapore and Sri Lanka. As every country has a unique set of strategies to minimize contributions to CC impacts, unique features that are common to both countries are chosen as variables for the comparison. Policy recommendations are provided to implement solid action plan for post 2020. The study expects to assist island countries to strengthen the CC policy as a national priority to manage unforeseen impacts posed by CC phenomena.

Article History

Received : *21 January 2019*
Received in revised form : *24 March 2019*
Accepted : *17 April 2019*
Published Online : *30 April 2019*

Keywords:

Climate Change, Island Nations, Policy Evaluation, Mitigation, Adaptation.

Corresponding Author Contact:

vishvajithp@uom.lk

DOI: 10.11113/ijbes.v6.n2.345

1. Introduction

Climate change (CC) refers to the fluctuations in average global atmospheric conditions such as precipitation pattern, temperature, and extreme weather events. Scientists are aware that anthropogenic causes create most such changes since 20th century. Many researchers found that climate change pose greater threat to island nations, specifically due to sea level rise. Such scenarios make climate change a mainstream issue for many countries. However, there is no specific framework for governments to mandate consistent and coherent policy on climate change. Yet the policy decisions play a key role in formulating climate change resilient countries. CC policy making is a challenging task. Challenges include uncertainty of the impacts, long time frames, clash with long-term socio economic policy objectives, and trans-boundary nature of the

issues. This study attempts to evaluate the performance of CC policy within a stipulated time period from the date of policy implementation.

Globally, CC policies are formulated by countries aiming at reducing the anthropogenic causes of CC through increased greenhouse gas (GHG) emissions to the atmosphere and to reduce vulnerability to CC impacts. Even though countries have crafted well defined CC policies, the threat of CC is significantly increasing everyday. Even though uncertainty and major GHG emitting countries get the blame, the evaluation of level of achievement of CC policies are seldom questioned by the people and research community. Even in most cases, CC policies are evaluated by scientific methods (such as emission levels) and non-scientific methods (stakeholder consultation) which has proven to be not effective in most cases. This research has been identified that mitigation policies must have direct relationship with reducing GHG emissions while adaptation policies must have direct relationship with reducing the vulnerability to CC induced impacts. With this assumption, it is identified that successful mitigation policy means reduction of GHG emissions while successful adaptation policy will reduce the vulnerability of the economy. Governments allocate funds for the sectors that are mostly affected by CC impacts. CC adaptation involves in improving the resilience by strengthening the vulnerable sectors of the country. This study considered on GHG emissions as a proxy to determine the CC mitigation of the country where GDP contribution of key vulnerable sectors of the economy as a proxy to determine the CC adaptation actions. Although the contribution to CC by individual countries may be small but this study tries to develop a framework to assess each country's level of preparedness to CC by evaluating the CC policy outcomes through mitigation and adaptation proxies.

Singapore and Sri Lanka are two islands in Asia with different levels of development, yet facing similar challenges of sea level rise and other impacts of climate change. Both countries have ratified Kyoto protocol and focused on different aspects of response to CC vulnerability. Performance, drawbacks, and limitations of CC policies have been critically evaluated using relevant indicators. Key themes of climate policy evaluation have been identified under economic, social, technological, and environmental aspects and thereby compared Singapore and Sri Lanka with the existing achievements and trends of climate policy responses. GHG emission pathways determine CC mitigation and adaptation actions are determined by the expenditure as a percentage of GDP of key vulnerable economic sectors. The lessons learnt from climate change response perspectives lead countries to move into more focused targets in terms of adaptation and mitigation.

This study focused on climate policy analysis in terms of emission levels, and national expenditure factors of the country along with the scientific and economic indicators relating them into CC policy implementation. The study is based on empirical data available for Singapore and Sri Lanka from international sources such as World Development Indicators (WDI), International Energy Agency (IEA), and United Nations (UN). Study boundary under consideration is within the geographic area of each country, whereas country's impact on nearby regions or the external impacts (emission trading schemes and fuel use for international transportation) on country's CC vulnerability has not been considered. In addition, selection of climate change indicators is based on the selected criterion related to the context of Singapore and Sri Lanka.

CC mitigation and adaptation actions within the country form the basis for evaluation. National level performance indicators support the analysis while the climate change actions are obtained for the period from 1990 to 2020. The level of success or failure is determined by the performance of each country under the given period of time with respect to prevailing climate change response targets.

Methodology adopted for the study is indicated in Figure 1.

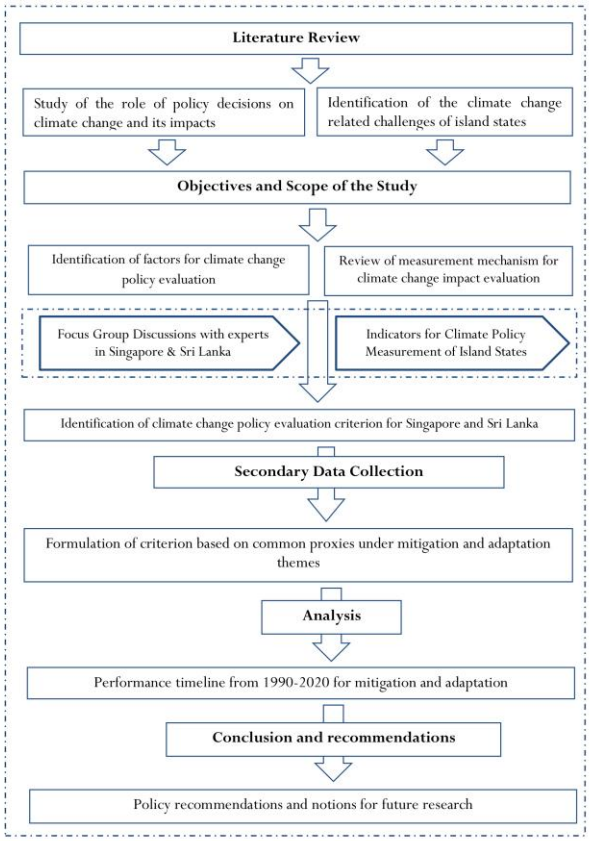

Figure 1 Methodology of the Study (Compiled by Author)

2. Data, Materials and Methods

Accurate risk assessment and estimation of potential losses and their economic impacts to the society are vital information for decision makers to regulate and circulate the limited funds on actions. These funds are misused if decision makers are unaware of real impacts due to complexity of CC challenges. Benchmarking of CC policy actions is difficult as CC challenges have uncertainty in nature. Therefore, performance indicators are used to interpret the behavior of CC impacts, mitigation,

and adaptation actions over the period of time. Periodical assessment helps to evaluate CC policy performance and needed policy reforms for future CC preparedness.

Indicators play a vital role in determining impacts of CC and suitable indicators are necessary to manage policy implementation effectively. UNFCCC encouraged countries to report on CO2 emissions as a key indicator of CC contribution. However, CO2 emissions alone cannot provide the effects of economic policy decisions that reflect on climate policy agenda. Thus, many additional indicators are required to measure the actual performance of the policy in the face of CC. Decision makers have tried forecasting the future costs and benefits of economic activities to compare with the costs of CC mitigation and adaptation. The pricing of non-market effects and calculating costs of socio-economic impacts involve assumptions and series of controversial price effects. The ambiguity of such calculation may overcome by selecting multi scale indicators together with comparing time series data. Use of wide range of indicators benefits the country in different areas.

CC policy measurement indicators are twofold as scientific and economic types. Scientific indicators base on evidences that assess risk and vulnerability of the country under consideration, and these indicators generally measure the probability of experiencing extreme weather events, and natural hazards that are beyond human control. Subsequently, 'tipping points' are identified and benchmarked to understand the growth of such extreme events before determining targets. Economic indicators generally express the pathway movement of economy as a whole for climate resilient development. This involves direct political processes and public interests in general through top-down and/or bottom-up approach. Potential economic losses from anticipated scientific evidences are important facts for decision makers to create CC adaptation and mitigation decisions.

A comprehensive set of indicators would be critical for the decisions with accurate and quantifiable projections. World Bank (2009) identified the mitigation instruments used to measure the response through city level performance indicators. The key sectors of mitigation actions are energy supply, transport, buildings, industry, and waste. Adaptation measures can take different forms such as, vulnerability and risk assessment, anthropogenic causes of CC, and elements at risk. UN-HABITAT (2008) identified a set of criteria for cities to adapt and thereby creating a portfolio for potential projects. Adaptations are expected to establish a framework for policy level measures through appropriate indicators. The key sectors identified are water, infrastructure and settlements, human health, urban transport, and energy.

Various criteria assist climate policy evaluation in different context. It is important to use a rationale criterion for evaluating the climate policy within the scope of island nations. In terms of global CC negotiations, island nations such as Maldives, Pacific Islands, Singapore, and Sri Lanka are categorized under 'developing countries' because of the vulnerability and resource limitations. CC policy is critical to develop nations in order to manage unforeseen effects of CC. Singapore and Sri Lanka has different development status in the economy, but retains similarities in the challenges faced. Finding correct information in expected spatial level is challenging when the geographical scale of a country increases. With reference to various criteria used by different experts in the field and spatial parameters suitable for the selected case studies, following themes are identified as parameters for climate change policy evaluation. Table 1 shows a summary of adaptation and mitigation themes with international sources used to identify universal indicator themes.

Table 1 Data Sourcing of Evaluation Themes

	Type of Theme	Source of Indicators
Adaptation		
1.	**Consumption Pattern and Food Security**	WDI (World Bank), FAO, UNFCCC, UNEP, ISIC
2.	**Resource Management and Bio Diversity Conservation**	WDI (World Bank), IUCN, WWF, FAO
3.	**Human Settlement and Land Use Planning**	UN-HABITAT, WDI (World Bank), UNFCCC, ADB, APEC, ILO
4.	**Disaster Management**	UN-HABITAT, WDI (World Bank), UNISDR, IMF, ADB
Mitigation		
5.	**Energy Consumption**	IEA, WDI (World Bank), DOS (Singapore), DCS (Sri Lanka), CEIC
6.	**Infrastructure Development and Transport Management**	IEA, WDI (World Bank), LTI (Singapore), CEIC, APEC
7.	**Industrial Development**	IEA, WDI (World Bank), CEIC, UNIDO, WTO
8.	**Research and Development**	WDI (World Bank), ADB
9.	**Institutional Set-up and Governance**	CPIA (World Bank), APEC, ADB, WGI

3. Case Studies

Categorization of climate change policies of the countries based on the income level is an ineffective method of evaluation. However, development status matters on the sector-based policy reactions. Economic growth strategies of countries provide the key aspects considered by formulating climate policies with respect to development level. Therefore, considering Singapore and Sri Lanka provide the opportunity to evaluate how each country responds to common challenges of CC through mitigation and adaptation policies.

3.1 Singapore

Singapore is one of the smallest countries in the world with an approximate land area of 714 square kilometers. As a low-lying

urbanized island state, Singapore face extreme challenges of CC change, and its impacts.

Singapore is recognized as a developing country since the adoption of Kyoto Protocol (1997) under UNFCCC, and had no specific obligations to reduce GHG emissions. With increasing attention by the public at large and vulnerability of the island nation to adverse impacts of CC, Singapore government initiated key steps on making the climate change policy in 2005. Vulnerability assessments were conducted in 2005 and 2007 through 1st and 2nd 'National Study on Climate Change.' As a result, Singapore government released the 'National Climate Change Strategy' in 2008. Another key milestone of the CC policy of Singapore is the establishment of National Climate Change Secretariat (NCCS) in 2010 under the Prime Minister's office, with the intention of developing policies and strategies to cooperate with CC and related issues. NCCS consist of various governmental organizations, NGOs, business leaders, academic professionals, and the community groups. Objectives of NCCS are:

- Facilitate efforts to mitigate carbon emissions in all sectors
- Help Singapore adapt to the effects of climate change
- Harness economic and green growth opportunities arising from climate change
- Encourage public awareness and action on climate change

The approach of late Prime Minister Lee Kuan Yew of creating "City in a Garden," was extended to the climate resilient livability through National Climate Change Strategy (NCCSt). NCCSt (2012) pledged that Singapore has initiated policies to reduce CO2 emission by 7% - 11% by 2020 business-as-usual (BAU) levels in 2009. This is a significant improvement compared with the strategy paper released in 2008, which did not mention on emission reductions. This is a challenging task by comparing the available resource base and economic base. Singapore has identified key strategy for the mitigation as energy efficiency. The actions on this are already initiated among businesses and households. Government has already identified required fiscal tools, capacity building, and legislative tools to move forward. Sustainable Singapore Blueprint (SSB) (2015) is an important initiative taken by Singapore government to tackle CC impacts through sustainable use of energy, waste, water, public spaces, and commuting modes. Community involvement for achieving targets set by SSB is vital in mitigation and adaptation options.

3.2 Sri Lanka

Sri Lanka is an island state, with an approximate total land area of 65,525 km2 in the Indian Ocean. Although Sri Lanka's contribution to global warming is comparatively low, the country is highly vulnerable to its impacts. A concentration of 70% population and 80% of economic infrastructure are located in coastal cities of Sri Lanka. Further, "the coastal zone accounts for 43% of the nation's GDP, so impacts on coastal settlements translate into substantial impacts on the nation's economy". In this context, National Climate Change Secretariat (CCS) was established in 2010 under the Ministry of Environment (MOE), and key focal point of CC related actions in Sri Lanka under UNFCCC and Kyoto Protocol.

National Advisory Committee on Climate Change (NACCC) is established under CCS for multi stakeholder involvement for integrated decision-making. CCS has formulated National Climate Change Adaptation Strategy of Sri Lanka (NCCASSL) to respond to CC induced challenges in Sri Lanka for 5 years starting from 2011. NCCASSL identified key thrust areas for the CC adaptation and direction of investment to address the challenges posed by it.

- Mainstream the climate change adaptation into national planning and development
- Creation of climate resilient and healthy human settlements
- Minimization of climate change impacts on food security
- Improve climate resilience of key economic drivers
- Safeguard natural resources and bio diversity from climate change impacts

Under the above strategic thrust areas, key thematic areas of action and priority adaptation measures are identified. National Climate Change Policy (NCCP) has conducted disaster management and health impact assessment under vulnerability assessment of the
country. Hence, the national adaptation and mitigation policy statements are identified under the following themes as in Table 2.

Table 2 Adaptation and mitigation policies under NCCP-Sri Lanka (Source: Climate Change Secretariat – Sri Lanka)

No.	Adaptation Policy Themes	Mitigation Policy Themes
1	Food Production and Food Security	Energy Sector
2	Conservation of Water Resources and Bio Diversity	Transportation Sector
3	Human Settlement and Land Use Planning	Industrial Sector
4	Infrastructure Design and Development	Waste Management
5	Coastal Resources Management	Agriculture and Livestock

To support above mentioned policy themes, supportive policies such as knowledge management, research and development, technology transfer, resource mobilization and other market and non-market mechanisms are identified. In spite of policymaking, it is highly doubtful of the enforcement. As a country with comparatively high level of vulnerability, the NCCP has covered every aspect at large but the complexity remains on the implementation of broad policies. Compromising other national development policies and people at high risk zones are not visibly prioritized in the document.

CC policy and strategy of Singapore and Sri Lanka initiated around 2008 – 2010 period. Singapore established NCCS and Sri Lanka established CCS in 2010. Establishment of CC policy of two countries in the same period is useful to compare the performance in terms of its objectives. Key milestones related to the Climate Change Policy of each country has been compared in Table 3 to understand the actions of each country within the past decade.

Table 3 Local Level Milestones of Climate Change Policy in Sri Lanka and Singapore

Sri Lanka	Year	Singapore
Vulnerability Assessment 1	2000/01	
	2004/05	Vulnerability Assessment 1
	2006/07	Vulnerability Assessment 2
	2008/09	National Climate Change Policy
Climate Change Secretariat, National Climate Change Policy, NCC Strategy 2011-2016	2010/11	Climate Change Secretariat
Vulnerability Assessment 2	2012/13	NCC Strategy 2011-2016
Adaptation based action plan	2014/15	Mitigation based action plan

4. Analysis

4.1 Selection of Indicators

IPCC use scientific indicators (GHG Emission, Ocean and Surface Temperature Rise and etc.) for predicting vulnerability and magnitude of CC impacts. However, there are additional socio-economic and political indicators required to measure the overall performance of policies and to guide decision makers on required amendments. It is important to select indicators with appropriate validity and practicality to avoid misleading policy directives (Bartelmus, 2015). Out of the assessed indicators, the critical indicators have been refined based on the following areas of concern:

- Relevance of indicator in terms of objectives of the study
- Possibility of obtaining common base for evaluation through data sources and country specific measures
- Ability of each indicator to provide guidance for policy decisions

Accordingly, the list of indicators selected for the evaluation is elaborated in Table 4.

Table 4 Selected Indicators for the Evaluation of Climate Change Policy (Source: Compiled by Author)

Adaptation and Mitigation Theme	Performance Indicator(s)
Consumption Pattern and Food Security	• Imports of goods and Services (Percentage of GDP) • Agricultural value addition (Percentage of GDP)
Resource Management and Bio Diversity Conservation	• Forest area (Percentage of total land area) • Total natural resources rents (Percentage of GDP)
Disaster Management	• Population living in areas where elevation is below 5 meters (Percentage of total population) • Health expenditure, total (Percentage of GDP)
Energy Consumption	• Fossil fuel energy consumption (Percentage of total) • Energy use (per kg of oil equivalent per capita)
Infrastructure Development and Transport Management	• No. vehicles per 1km road area • GHG emissions from transport sector (Percentage of total fuel combustion)
Industrial Development	• Industrial value addition (Percentage of GDP) • CO_2 emissions from manufacturing industries and construction (Percentage of total fuel combustion)
Research and Development	• Research and development expenditure (Percentage of GDP) • Literacy rate, adult (Percentage of people ages 15 and above) • Internet users per 100 population

Analysis of CC policy of Singapore and Sri Lanka is listed under mitigation and adaptation themes to separately demonstrate the performance of each country. No weightage is assigned for adaptation and mitigation themes because both themes are

considered equally important for the success of CC policy implementation. The physical dimensions of indicators are as follows:

- GHG emission pathways of different sectors (Mitigation of climate change impacts through GHG reduction).
- GDP share of different segments of the economy (Adaptation to climate change impacts through reduction of expenditure on key segments of economy).

Generally, emission pathways help to measure CC response of a country. Additional analysis used here is the GDP share of economic sectors as a proxy for adaptation. Data has been collected from 1990 to 2014 and projected the trend towards 2020. The intention of the analysis up to 2020 is to highlight the required actions for post 2020 climate action agenda of each country. The projections from 2015 to 2020 are useful to determine the policy direction and setting up short-term CC response plans for both the island nations.

4.2 Assumptions

As CC policy is evaluated using physical measures, the indicators require guidance to prevent misleading outcomes. Therefore, assumptions are required for the proxies to display CC evaluation objectively. Based on the objective of the study, following assumptions and facts are considered:

- Use of GHG emissions as the determining factor for climate change mitigation
- Use of annual expenditure (GDP Share) of key segments as the determining factor for climate change adaptation
- Projection of emissions and government expenditure based on past results
- Consideration of selected proxies as the key driver of climate change policy failure or success
- Existing barriers for policy implementation and policy driven tools are considered static during the considered time scale
- Political and economic decisions affecting climate change policies are considered stable during the study period

4.3 Selective Indicators for Mitigation Actions

GHG emission pathways are derived ranging from 1990 to 2020, to understand the policy involvement in mitigating climate change impacts. List of indicators selected for the analysis is provided in Table 5.

Table 5 Selected Indicators to evaluate the Climate Change Mitigation (Source: World Bank – World Development Indicators)

No.	Mitigation Indicator	Emissions Description (Source)
1	CO_2 emissions from gaseous fuel consumption (kt)	From use of natural gas as an energy source (WDI)
2	CO_2 emissions from liquid fuel consumption (kt)	From use of petroleum-derived fuels as an energy source (WDI)
3	CO_2 emissions from solid fuel consumption (kt)	From use of coal as an energy source (WDI)
4	Other GHG emissions-HFC, PFC and SF_6 (kt - CO_2 equivalent)	By-product emissions of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (WDI)
5	HFC gas emissions (kt - CO_2 equivalent)	As a replacement for CFC, used mainly in refrigeration and semiconductor manufacturing
6	Methane emissions (kt of CO_2 equivalent)	From production, handling, transmission, and combustion of fossil fuels and biofuels (WDI)
7	Nitrous oxide emissions (kt - CO_2 equivalent)	From energy processes are emissions produced by the combustion of fossil fuels and biofuels
8	CO_2 emissions from residential buildings and commercial and public services (kt)	From fuel combustion in households (corresponds to IPCC Source/Sink Category 1A 4b)
9	CO_2 emissions from electricity and heat production, total (kt)	From main activity producer electricity generation, combined heat, power generation, and heat plants (IEA)
10	CO_2 emissions from manufacturing industries and construction (kt)	From combustion of fuels in industry (IPCC Source/Sink Category 1 A 2)
11	CO_2 emissions from other sectors, excluding residential buildings, and commercial and public services (kt)	From commercial/institutional activities, residential, agriculture/forestry, fishing and other emissions not specified elsewhere in the IPCC Source/Sink Categories 1 A 4 and 1 A 5
12	CO_2 emissions from transport (kt)	From the combustion of fuel for all transport activity, regardless of the sector, except for international marine bunkers and international aviation (WDI)

4.4 Selective Indicators for Adaptation Actions

Key expenditure facts identified under the adaptation themes, which demonstrate the possible vulnerability of country is considered for analysis. Similar to mitigation data analysis, the collected data set ranges from 1990 to 2020 including projections of GDP share of each segment. The adaptation indicators are listed in Table 6.

Table 6 Selected indicators to evaluate Climate Change Adaptation (Source: World Bank – World Development Indicators

No.	Adaptation Indicator	GDP Share Description (Source)
1	Imports of Goods and Services (Percentage of GDP)	The value of all goods and other market services received from the rest of the world (WDI)
2	Total natural resources rents (Percentage of GDP)	The sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents (MDG)
3	Health expenditure, total (Percentage of GDP)	The sum of public and private health expenditure (WDI)
4	Research and development expenditure (Percentage of GDP) on CC	Current and capital expenditures (both public and private) on basic research, applied research, and experimental development (WDI)
5	Industry, value added (Percentage of GDP)	Comprises value added in mining, manufacturing, construction, electricity, water, and gas (WDI)
6	Agriculture, value added (Percentage of GDP)	Includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production (WDI)
7	Central government debt, total (Percentage of GDP)	Includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans (WDI)

The analysis is based on 12 mitigation indicators and 7 adaptation indicators within which climate policy performance is expected to demonstrate via results. The composite graphs for mitigation and adaptation are illustrated separately. It is noted that data is analyzed for both countries based on Business-As-Usual (BAU) scenario. Year 2010 is highlighted in each graph to indicate the CC policy implementation of each country.

4.5 Results & Discussion

4.5.1 Climate Change Mitigation Analysis

Singapore depicts undulated emission levels with significant peaks and drops in 1995, 1997, 2003, and 2007. Singapore held the upper hand in Asian Financial Crisis in 1997 where investments flew from region into the country (Lye, 2008). In addition, private consumption expenditure shares of GDP declined drastically by 2006, creating economic growth volatile. Positive trade balance outweighs the negative impacts of capital and financial balances from 2006 onwards. This reveals the synergy between economic profile and GHG emissions of Singapore. However, a steady increase of emissions is visible from 2007 onwards and the projections show rapid growth of total emissions by 2020. This is visible in the GHG emissions graph depicted in Figure 2.

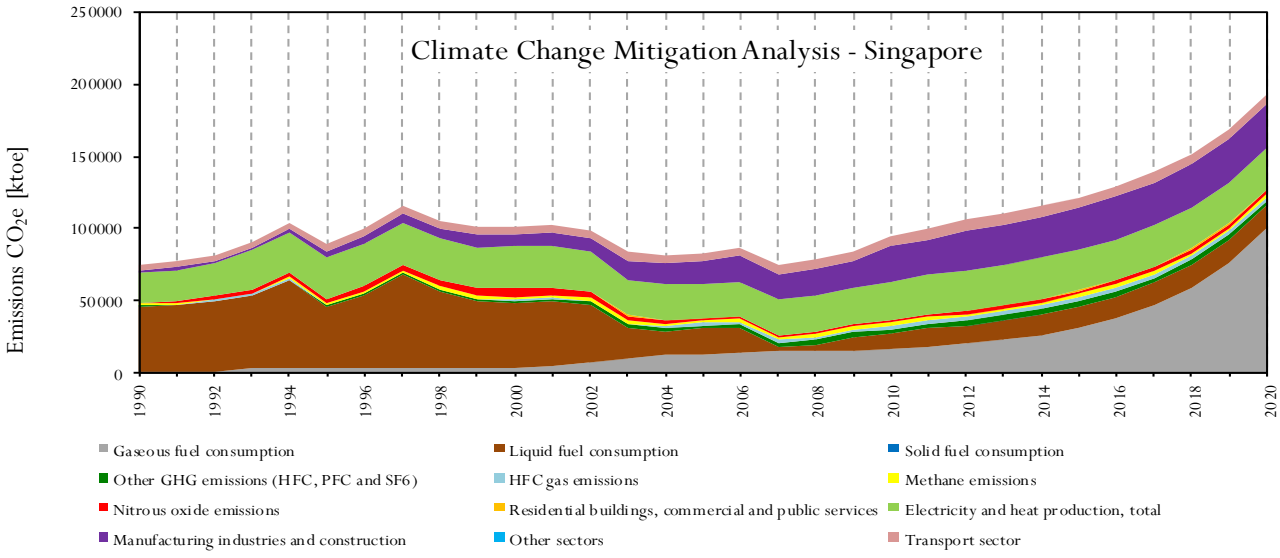

Figure 2 Climate Change Mitigation Analysis Graph of Singapore

Another significant feature of Singapore is the reduction of oil-based GHG emissions. This reflects the government policy initiation to transfer from fossil oil into natural gas in energy sector from 2006 onwards. Yet, the trend of natural gas-based CO2 emissions is increasing. The next significant emission areas

are the manufacturing industries sector and electricity generation. These segments directly link with economy of Singapore so the climate policy has to be integrated with economic policy to address the issue of GHG emissions. CC policy and strategy focused on energy efficiency and clean tech industries to reduce the emission trends.

Sri Lanka has no significant fluctuation as with Singapore. According to Figure 3, steady fluctuations are evident throughout the timeline. However, the increasing emission trend continues 2011 onwards. With the post-war development in Sri Lanka, government has initiated major infrastructure development projects including airports, harbors, coal power plants, and highways, which contribute to the steady increase of emissions. Emission pathway of Sri Lanka indicates that highest GHG emissions are from methane and fossil oil consumption and it reveals that Sri Lanka economy is heavily dependent on fossil fuel imports in energy and industrial sector.

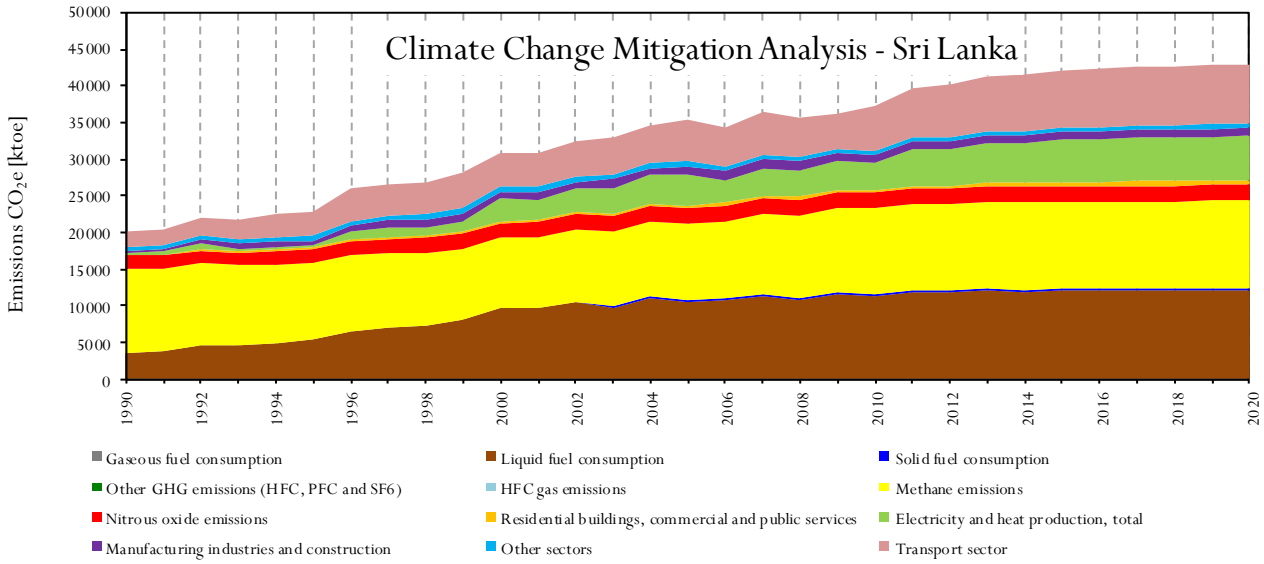

Figure 3 Climate Change Mitigation Analysis Graph of Sri Lanka

Furthermore, transport sector and electricity generation highly contribute to GHG emissions. The negative impacts of fossil fuel-based power plants and subsidized fossil fuel-based vehicle imports are evident in Figure 3. It is necessary for the government to prioritize mitigation actions of climate change towards key highlighted sectors of energy, industry, and transport sectors.

In comparison, estimations reveal that Singapore may have approximately four times higher emissions than Sri Lanka by 2020 (192,891 kt vs. 42,984 kt) in absolute terms. Consumerism is a reason for Singapore's exponential growth of emissions, which is a result of growth of per capita income (Shove, 2010). Emissions from economic sectors contribute to most of this in Singapore and comparatively, lower emissions from Sri Lanka are due to slow progress development. Hydropower generation, decentralization of industries, and population distribution strategies of Sri Lanka could be the directions Sri Lanka should follow to respond to CC impacts.

With the limited land space, mitigation options are the obvious priority for Singapore. It is about reducing individual emissions, which matters for the both countries in order to avoid any failures in CC policy. It reveals that the trend of total emissions has not affected by CC policy implementation from 2010 onwards, but follows the economic strategies. This shows that CC policy is a dependent variable of economic policy of both countries. Mitigation actions have to be in line with changing socio-economic strategies in Singapore and in Sri Lanka.

4.5.2 Climate Change Adaptation Analysis

Adaptation trends of both countries are associated with expenditure on several impactful sectors of the economy. Thus, the analysis demonstrates adaptive capacity of two countries the vulnerability to impacts. Graph reads as the divergent trend of total natural resource rents, R&D expenditure, value added industries, and agricultural share of GDP determines strong CC adaptive capacity of country. Increasing government debt, imports, and health expenditure show the risk and vulnerability of specific sector, and thereby the CC policy. This trend is clearly visible in Figure 4.

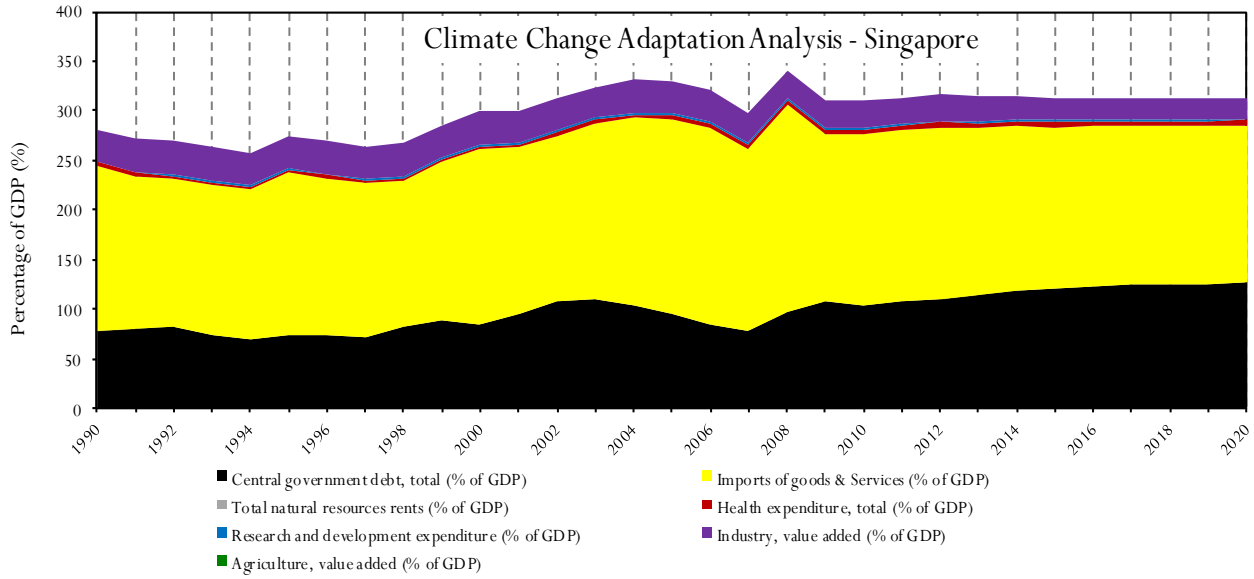

Figure 4 Climate Change Adaptation Analysis Graph of Singapore

Imports of goods and services also contribute to GHG emissions. Potential of adapting behavioural changes could reverse the risks associated with CC policy, especially in food imports. Food security is one globally accepted area of CC adaptation with the potential to be utilized with latest technology in Singapore. Instant surge of Figure 4 in 2008, which is a result of the Global Financial Crisis, affected import-based trade activities.

Adaptation trends of both countries are associated with expenditure on several impactful sectors of the economy. Thus, the analysis demonstrates adaptive capacity of two countries the vulnerability to impacts. Graph reads as the divergent trend of total natural resource rents, R&D expenditure, value added industries, and agricultural share of GDP determines strong CC adaptive capacity of country. Increasing government debt, imports, and health expenditure show the risk and vulnerability of specific sector, and thereby the CC policy.

Imports of goods and services also contribute to GHG emissions. Potential of adapting behavioural changes could reverse the risks associated with CC policy, especially in food imports. Food security is one globally accepted area of CC adaptation with the potential to be utilized with latest technology in Singapore. Instant surge of Figure 4 in 2008, which is a result of the Global Financial Crisis, affected import-based trade activities.

Figure 5 reveals that Sri Lanka has an overall decreasing trend of adaptive indicators. Upon implement of CC policy in 2010, Sri Lanka had a steady contribution to GDP in sectors such as industrial value addition (33% average), central government debts (81% average), and agricultural value addition (11% average). Most significant feature was the reduction of imports by 7% after CC policy implementation. Qualitative analysis indicates that important changes are happening in agricultural and industrial value addition of Sri Lanka and food security through agricultural research and development is addressed by CC policy of Sri Lanka (Climate Change Secretariat, 2010). In addition, mainstreaming of CC actions into local level planning is a positive move by Sri Lanka to improve adaptive capacity to CC impacts.

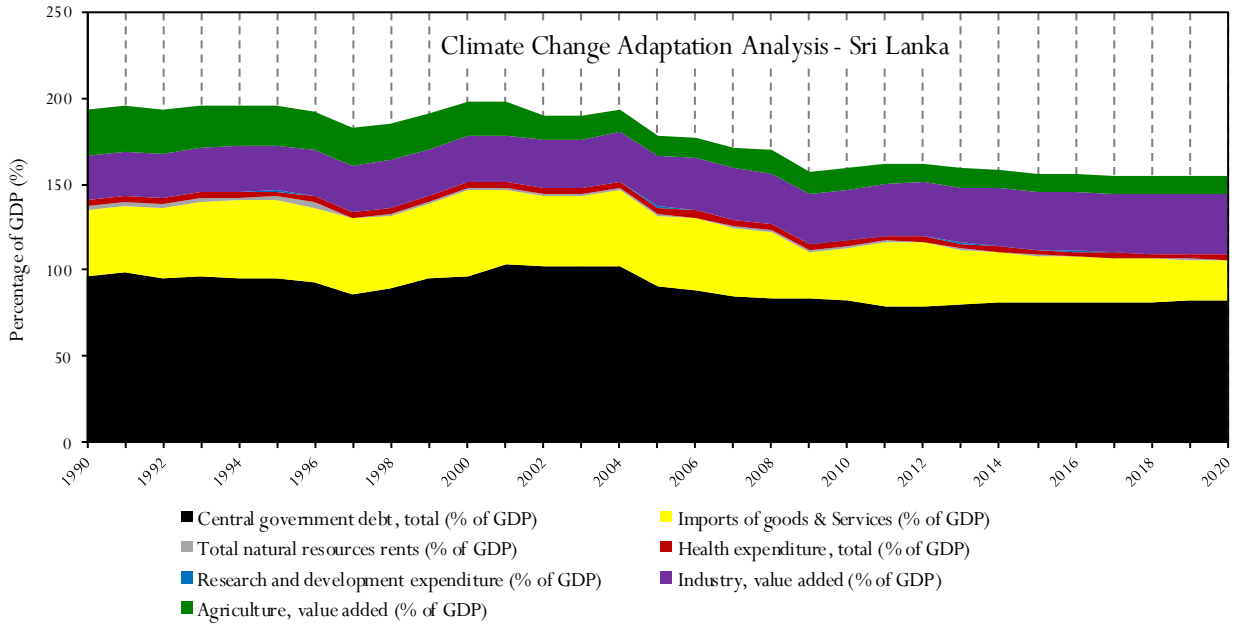

Figure 5 Climate Change Adaptation Analysis Graph of Sri Lanka

Use of expenditure as GDP contribution has its own merits and demerits. It is difficult to compare indicators – as it is possible for mitigation analysis – because proxies hold different stands in the overall economy. There is no benchmarking for contribution to GDP as it can vary in short terms with government policy changes. Unlike mitigation graph, adaptation graph has to use with individual sectors to review CC policy of each country. Nevertheless, sector-based GDP contribution provides information on short-term strategies, which can be related to CC policy, in order to achieve its success.

Island nations are aware on possible impacts of climate change and the need of strong CC policies and actions. By evaluating the Singapore and Sri Lankan context, CC has been a priority topic in the decision-making process since 2005. Main problem with climate policy analysis is the difficulty in setting benchmarks to the expected goals and objectives of controlling emissions. Each country must use the best possible targets unless otherwise any global convention would not be successful in finding common consensus. Singapore and Sri Lanka must use unique trade-off between development goals and
CC responsibility to reduce the emissions and thereby improve resilience to the CC impacts.

5. Conclusion

Traditional scientific indicators cannot necessarily measure the CC policy due to socio-economic and political decision making defining the CC policy of both island nations. Under such situation, it is difficult to perceive an instant change in political and social perceptions towards CC mitigation and adaptation. Public never accepts a change until credible information and reasons are provided for the change. Inherited uncertainty of CC impacts causes complexity during conveying information to public. In such situation, Singapore and Sri Lanka have undertaken actions to face CC impacts. Based on the outcomes, factors that have significant impacts on CC policy objectives are listed as follows.

- Lack of political will and socio-economic dynamics
- Existing barriers for implementation as such the conflicting policies, non-compliance of technical knowledge among decision makers, and lack of long-term planning
- Natural setting of the country (geographic and climate related barriers)
- Non-availability of appropriate tools to implement policy objectives
- Distorted timeline for action plans without considering the socio-political behavior of the economy

Many factors can result in CC policy failure. It is noted, that none of the individual efforts matter unless global emitters agreed upon immediate binding targets. One motive to undertake this study is the uncertain global CC negotiations. Failure of Kyoto protocol is important to view with comparative perspective of other similar treaties involved in global community. Vienna convention of reducing ozone depletion substances and United Nations Convention on the Law of the Sea (UNCLOS) are deemed successful as per the adherence of over 90% of parties. Comparatively, UNFCCC has not succeeded in convincing the economic impacts or significance of

threats. Following list of key conditions have proposed through this study in order to achieve a collective target.

- Integration of Climate Policy with Trade Policy
- Enforcement of Binding Targets and Polluter Pays Principle mandatory for every country
- Independent Climate Policy Planning
- Transition Management through Climate Change Policy

The recommendations are based on identifying possible ways to follow strategies that can be adopted as a learning exercise. In such situation, two countries can exchange the adaptation and mitigation strategies to be climate resilient. Most of the identified issues are due to the conflicts between economic strategies of the country with climate change action plan. As per the identified criterion for CC policy analysis, recommended policy actions are listed in Table 7.

Table 7 Recommended Actions under Adaptation and Mitigation Criterion (Source: Compiled by Author)

Adaptation/ Mitigation Theme	Policy Recommendations for Singapore	Policy Recommendations for Sri Lanka
Consumption Pattern and Food Security	• Development of localized agricultural policy with the use of technology • Responsible consumption practices among citizens through mass media promotions • Reduction of carbon footprint by regulating imports and sustainability accredited products	• Restrictions on import policy in order to promote local agricultural output • Strong waste management strategy in line with CC policy recommendations • Promote responsible consumption
Resource Management and Bio Diversity Conservation	• Protection of primary forest cover (nature reserves) from development projects • Introduce natural green belts, and coral growth in order to mitigate extreme CC impacts through independent environmental policy	• Strengthen the legal protection of national parks and rainforests from development projects • Improve linkage with international environmental protection agencies to conserve existing natural resources
Human Settlement and Land Use Planning	• Development of land use policy and population distribution policy in line with CC policy recommendations • Long-term population growth policy to achieve minimum conflicts between citizens and environment	• Integrate the land use planning policy with population distribution strategy in line with CC policy recommendations
Disaster Management	• Link up the land use policy with mainstreaming CC adaptation actions for the community to move away from vulnerable areas • Integration of disaster impacts of CC with economic policy to evaluate the economic loss	• Land use policy amendment for disaster risk reduction for coastal vulnerable zone and fragile eco systems prone to CC induced disasters • Long-term actions based on development plans to reduce disaster risks
Energy Consumption	• Integrate energy policy with CC policy recommendations in order to harness renewable sources of energy production	• Amendment of energy policy to reduce the fossil fuel sources and R&D in renewable energy sector • Implement energy efficiency regulations, building codes, and incentive system for energy savings in the industrial sector
Infrastructure Development and Transport Management	• Use of enforcement tools to encourage public transport, bicycling, and walking together with supportive infrastructure • Reduce private vehicle use by tightened road use policies and parking system	• Integrate the road development policy with transportation plan to improve public transportation efficiency • Encourage BRT system, vehicle electrification, and other clean energy sources for vehicle standards
Industrial Development	• Industrial value addition and promotion of non-polluting and less energy intensive industries	• Improvement of industrial distribution strategy to minimize pollution and emissions • Target non-polluting industries which can

		utilize local resources
Research and Development (R&D)	• Use of R&D into CC action plans to improve mitigation and adaptation policy recommendations	• Integration of CC policy with R&D institutions to identify mitigation options • Utilize local education system in to CC based R&D
Institutional Set-up and Governance	• Link institutions with other stakeholders such as general public and NGOs to avoid policy failure	• Reform institutional set up for CC policy implementation as a collective form • Allow institutions to conduct independent research and decision making so as to guide CC resilience as apex bodies

Selection of Singapore and Sri Lanka provided the opportunity to explore the preparation for common challenges especially in the context of vulnerability, to unpredictable impacts of CC on island states. The study can extend further by using different proxies that define CC response as follows:

- Use of cost-benefit analysis in terms of damages incur during extreme weather conditions and the actions taken for CC mitigation and adaptation
- Use of socio cultural impacts of CC as a proxy to determine the resilience of population of the country with respect to expected objectives of CC policy
- Evaluation of CC policy by measuring short-term and long-term success of strategies
- Compare and contrast the external linkages (external trade, emissions of neighboring countries or regions, foreign exchange earnings) that effect on CC policy failure

Compare and contrast the external linkages (external trade, emissions of neighboring countries or regions, foreign exchange earnings) that effect on CC policy failure

Different proxies can provide results in terms of sector-based priorities. Uncertainty and unpredictable nature of impacts can create the CC policy vulnerable to failures. Therefore, inclusion of sensitivity analysis and progress monitoring into the assessment can improve evaluation technique.

The priorities of governments are different in each sector of the economy and sector evaluation can use suitable weightage matrix (or similar interpretation) to highlight the comparative magnitude of impacts. Further, the method can apply into individual policy actions to recognize success or failure of individual sector-based policies such as transportation policy, land use policy, or disaster management policy.

Lessons that can be learnt from each other play a vital role in successful implementation of policies to avoid CC policy failure. Adaptation and mitigation policies generally depend on the capacity of the country and political economic objectives for the future. As a result, Singapore focused on mitigation actions and Sri Lanka on adaptation action plans. In order to derive on sustainable global climate change policy, international CC negotiations, avoid free rider roles of developing countries in CC policies, integrate economic impacts of CC impacts, and bottom up approach in CC action plans are vital. Consumerism and dependency on imports has created blowhole in country specific CC response as carbon footprint of individual countries is increasing. This study identified core sector-based improvements for Singapore and Sri Lanka, which then can relate in to island nations.

References

Abeysinghe, T., & Choy, K. (2007). The Singapore Economy: An Econometric Perspective. 70. Singapore: Routledge.

Bartelmus, P. (2015, January 05). How bad is climate change? Environmental Development. 1-17.

Bradshaw, C., Giam, X., & Sodhi, N. (2010). Evaluating the Relative Environmental Impact of Countries. *Plos One*. 1-16.

Carr, M., & Krukowska, E. (2009, December 21). Carbon Prices Tumble After 'Modest' Climate Deal (Update2). Retrieved January 12, 2015, from Bloomberg: http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a8TD.WeBNprk

Chang, A., & Kleyn, G. (2010). Singapore Secures China as Future Food Source. West Perth: Future Directions International.

Climate Change Secretariat. (2010). National Climate Change Adaptation Strategy for Sri Lanka: 2011 to 2016. Colombo: Ministry of Environment.

Climate Change Secretariat. (2014). Sri Lanka Climate Profile. Retrieved January 10, 2014, from Climate Change Secretariat Sri Lanka: http://www.climatechange.lk/Climate_Profile.html

Climate Change Secretariat Sri Lanka. (2012, December). The National Climate Change Policy Of Sri Lanka. Retrieved December 01, 2014, from Climate Change Secretariat of Sri Lanka: http://www.climatechange.lk/policy.html

Condon, B., & Sinha, T. (2013). The Role of Climate Change in Global Economic Governance. New York: Oxford University Press.

Cust, J. (2011). Using Intermediate Indicators: Lessons For Climate Policy. *Climate Policy*. 450-463.

Davison, G. (2007). Urban Forest Rehabilitation – A Case Study from Singapore . Keep Asia Green.

De Silva, C., Weatherhead, E.K., Knox, J., & Rodriguez-Diaz, J. (2007). Predicting the impacts of climate change—A Case Study Of Paddy Irrigation Water Requirements In Sri Lanka. *Agricultural Water Management*. 93(1): 19-29.

Dessler, A. (2012). Introduction to Modern Climate Change. New Delhi: Cambridge University Press.

DMC. (2010). Vulnerability Profile of Sri Lanka. Colombo: Disaster Management Centre (DMC).

Ecofys & Climate Analytics. (2011, December 21). CLIMATE ACTION TRACKER: Country Assessment Methodology. Retrieved from Climate Action Tracker: http://climateactiontracker.org/methodology
Energy Market Authority. (2013). Singapore Energy Statistics. Singapore: Energy Market Authority of Singapore.

Frankland, R., Hardwick, L., & Watkin, S. (2012). Climate Change Adaptation In A Small Pacific Island Nation. *Proceedings of the Institution of Civil Engineers*. 46-51. ICE Publishing.

Giddens, A. (2008, September). The Politics Of Climate change: National Response To The Challenge Of Global Warming. London, United Kingdom.

Hamilton-Hart, N. (2012). Singapore's Climate Change Policy: The Limits of Learning. *Contemporary Southeast Asia*. 28(3): 363-384.

Harris, P. (2007). Collective Action On Climate Change: The Logic Of Regime Failure. *Natural Resources Journal*. 47(1): 195-224.

Harris, P. (2013). What's Wrong with Climate Politics and How to Fix It. Cambridge: Polity Press.

Heiskanen, E., Kivisaari, S., Lovio, R., & Mickwitz, P. (2009). Designed to Travel? Transition Management Encounters Environmental And Innovation Policy Histories in Finland. *Policy Sci*. 1-19.

Helbron, H., Schmidt, M., Glasson, J., & Downes, N. (2011). Indicators for Strategic Environmental Assessment In Regional Land Use Planning To Assess Conflicts With Adaptation To Global Climate Change. *Ecological Indicators*. 90-95.

Hood, C. (2002). The Risk Game And The Blame Game. *Government And Opposition*. 37(1): 15-37.

Hoods, C., & Margetts, H. (2007). The Tools of Government in the Digital Age. Basingstoke: Palgrave Macmillan.

Howlett, M. (2011). Designing Public Policies: Principles and Instruments. Oxon: Taylor & Francis Group, Routledge.

Howlett, M. (2014). Why are Policy Innovations Rare And So Often Negative? Blame Avoidance And Problem Denial In Climate Change Policy-Making. *Global Environmental Change*. 29: 395-403.

Huhne, C. (2011, December 6). Durban Climate Change Talks: Developing Countries Must Take On More Responsibility, says Chris Huhne. Retrieved from The Telegraph: http://www.telegraph.co.uk/

IPCC. (2013). "Climate change 2013: The physical science basis." Summary for Policy Makers. New York: Cambridge Univ Press.

IPCC. (2014). Climate Change 2014: Synthesis Report. Intergovernmental Panel for Climate Change, United Nations Environmental Programme.

IPS. (2014). Sri Lanka: State of the Economy 2013. Colombo: Institute of Policy Studies of Sri Lanka.

Jayatunge, R. (2014, August 27). Climate Change related Initiatives in Sri Lanka. Retrieved March 2, 2015, from Climate Action Network South Asia: http://www.slideshare.net/CANSA2014/sri-lanka-initiatives-on-climate-change?next_slideshow=1

Kildow, J. (2011). The Utility of Economic Indicators to Promote Policy-Relevant Science for Climate Change Decisions. In Ommer, Perry, Cochrane, & Cury, World Fisheries: A Social-Ecological Analysis. 139-150. Blackwell Publishing Ltd.

Kjosavik, D., & Vedeld, P. (2012). The Political Economy of Environment and Development in aGlobalized World. Colombo 5: Tapir Academic Press.

Klein, N. (2014). This Changes Everything: Capitalism vs. Climate. London: Penguin Books Limited.

Lai, R. (2011, January 22). Lower CO2 emissions anyone? Retrieved January 21, 2015, from ONESHIFT.COM: http://www.oneshift.com/features/826/lower-co2-emissions-anyone

Latin, H. (2012). Climate Change Policy Failures: Why Conventional Mitigation Approaches Cannot Succeed. Hackensack: World Scientific Pub. Co.

LePoer, B. (1991). Singapore: A Country Study. Washington: Library of Congress: Federal Research Division.

Ley, T. (2013, January 5). Climate Change Impacts Pacific Islands. Majuro, Republic of Marshall Islands.

Lim, L. (2008). Singapore's Economic Growth Model – Too Much or Too Little? Singapore Economic Policy Conference, (pp. 1-11). Singapore.

Low, M. (2015). Compliance for Intended Nationally Determined Contributions in the 2015 Climate Change Agreement. Singapore: Energy Studies Institute.

Lye, L. (2008). A Fine City in a Garden: Environmental Law & Governance in Singapore. *Singapore Journal of Legal Studies*. 68-117.

Mahanama, P., Abeynayake, C., Jayasinghe, A., & Bandara, P. (2014). Climate Response of Local Authorities: A Case of Sri Lankan Coastal Urban Areas. *International Journal of Research in Social Sciences*. 59-66.

McCarney, P. (2012). City Indicators on Climate Change: *Implications for Governance. Environment and Urbanization ASIA*. 3(1): 1-39.

MEWR, & MND. (2015). Sustainable Singapore Blueprint. Singapore: Ministry of the Environment and Water Resources and Ministry of National Development.

Ministry of Power & Energy. (2015, April 30). Generation Plants. Retrieved from Ministry of Power & Energy: http://powermin.gov.lk/english/?page_id=1507

NCCS. (2011). About NCCS, Singapore. Retrieved January 10, 2015, from National Climate Change Secretariat: Prime Minister's Office: https://www.nccs.gov.sg/about-nccs

NCCS. (2015). Climate Change and Singapore. Singapore: National Climate Change Secretariat.

Never, B., & Betz, J. (2014). Comparing the Climate Policy Performance of Emerging Economies. *World Development*. 1-15.

Ng, W., & Mendelsohn, R. (2005). The Impact Of Sea Level Rise on Singapore. *Environment and Development Economics*. 10: 201–215.

Nordhaus, W. D. (2013). The Climate Casino: Risk, Uncertainty, And Economics For A Warming World. Yale University Press.

NPTD. (2013). Population White Paper 2013. Singapore: National Population and Talent Division.

OECD. (2009). Governing Regional Development Policy: Use of Performance Indicators. Paris: Organization for Economic Co-operation and Development.

OECD. (2009). Green Growth: Overcoming the Crisis & Beyond. Organisation for Economic Co-operation and Development.

Peake, S., & Smith, J. (2010). Climate Change: From Science to Sustainability. Oxford: Oxford University Press.

Raleigh, C., & Urdal, H. (2007). Climate Change, Demography, Environmental Degradation and Armed Conflict. Political Geography On Climate Change & Conflict. 27-33.

Sanderatne, N. (2012, December 9). Economy Vulnerable To Climate Change. Retrieved from The Sunday Times: http://www.sundaytimes.lk/121209/columns/economy-vulnerable-to-climate-change-23972.html

Scrieciu, S., & Chalabi, Z. (2014). Climate Policy Planning and Development Impact Assessment. *Mitigation & Adaptation Strategies for Global Change*. 255-260.

Scrieciu, S., Belton, V., Chalabi, Z., Mechler, R., & Puig, D. (2014). Advancing Methodological Thinking And Practice For Development-Compatible Climate Policy Planning. *Mitigation & Adaptation Strategies for Global Change*. 261-288.

Senaratne, A. (2014, April 01). Policy Challenges In Climate Adaptation In Sri Lanka: Identifying Major Gaps. Retrieved January 05, 2015, from IPS CLIMATEnet Blog: Climate change policy network of Sri Lanka: http://climatenet.blogspot.sg/2014/04/policy-challenges-in-climate-adaptation.html

Seo, S., Mendelsohn, R., & Munasinghe, M. (2005). Climate Change And Agriculture In Sri Lanka: A Ricardian Valuation. *Environment and Development Economics*. 10(5): 581-596.

Shove, E. (2010). Beyond the ABC: climate Change Policy And Theories Of Social Change. *Environment and Planning A*. 1273-1285.

SIDS. (2014, November 28). Towards Actions for Small Island Developing Nations. Retrieved from United Nations Department of Economic and Social Affairs, Division for Sustainable Development: http://www.sids2014.org

Sinclair, M. (2011). Let them Eat Carbon. London: Biteback Publishers Ltd.

SingStat. (2012). Yearbook of Statistics Singapore 2012. Singapore: Department of Statistics Singapore.

Stern, D., Common, M., & Barbier, E. (1996). Economic Growth And Environmental Degradation: The Environmental Kuznets Curve And Sustainable Development. World Development. 24(7): 1151-1160.

Stern, N. (2007). The Economics Of Climate Change: The Stern Review. Cambridge University Press.

Sundaresan, J., Sreekesh, S., Ramanathan, A., Sonnenschein, L., & Boojh, R. (2013). Climate Change Impacts Pacific Islands and Coastal Vulnerability. New Delhi: Capital Publishing Company, Springer.

Tan, S. (2013). Framework for Formulating Environmental And Climate Change Policies: Perspective From Environmental Macroeconomics. 42nd Australian Conference of Economists. 1-35. Perth.

Tan, S. (2013). Long-Term Land Use Planning in Singapore. Singapore: Lee Kuan Yew School of Public Policy.

Thampapillai, D. (2014). The Need for a Serious Rethink on Economics. Lee Kuan Yew School of Public Policy Research Paper. 14-27.

Tompkins, E. L. (2005). Defining Response Capacity To Enhance Climate Change Policy. *Environmental Science & Policy*. 562-571.

UNFCCC. (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. Kyoto: United Nations.

UNFCCC. (2007). Bali Action Plan - CP 13:1. Bali: Climate Change Secretariat (UNFCCC).

UNFCCC. (2007). Investment & Financial Flows to Address Climate Change Impacts. Bonn: Climate Change Secretariat.

UNFCCC. (2014, November 28). Parties & Observers. Retrieved from United Nations Framework Convention on Climate Change: http://unfccc.int/parties_and_observers/items/2704.php

UN-HABITAT. (2008). State of the World Cities. Geneva: United Nations Human Settlement Programme.

UNHabitat. (2011). Climate resilient action plans for Coastal urban areas in Sri Lanka (CCSL). Colombo: United Nations Human Settlements Development Program.

UN-HABITAT. (2012). State of the World's Cities 2012/2013. New York: Routledge Press.

Vasa, A., & Michaelowa, A. (2011). Uncertainty in Climate Policy – Impacts on Market Mechanisms. In G. Gramelsberger, & J. Feichter, Climate Change and Policy: The Calculability of Climate Change and the Challenge of Uncertainty. 127-144. Berlin: Springer.

Voß, J., Smith, A., & Grin, J. (2009). Designing Long-Term Policy: Rethinking Transition Management. *Policy Science*. 42: 275-302.

Wang, Q., & Chen, X. (2013). Rethinking and Reshaping The Climate Policy: Literature Review And Proposed Guidelines. *Renewable and Sustainable Energy Reviews*. 469-477.

Withanachchi, S., Köpke, S., Withanachchi, C., Pathiranage, R., & Ploeger, A. (2014). Water Resource Management in Dry Zonal Paddy Cultivation in Mahaweli River Basin, Sri Lanka: An Analysis of Spatial and Temporal Climate Change Impacts and Traditional Knowledge. *Climate*. 2(4): 329-354.

Withgott, J., & Laposata, M. (2014). Essential Environment: The Science behind Stories. London: Pearson Education Inc.

WMO. (2013, November 13). Provisional Statement on Status of Climate in 2013. Retrieved December 26, 2014, from World Meteorological Organization: http://www.wmo.int/pages/mediacentre/press_releases/pr_981_en.html

World Bank. (2009). Climate Resilient Cities. World Bank.

World Bank. (2011). From Growth to Green Growth: A Framework. Washington DC: Office of the Chief Economist, Sustainable Development Network.

World Bank. (2014). Data by Country and Lending Groups. Retrieved January 29, 2015, from The World Bank: http://data.worldbank.org/about/country-and-lending-groups

WWF. (2014). Living Planet Report 2014. Gland: World Wide Fund for Nature.