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An economic impact assessment of climate change in Guyana—agriculture, coastal and human settlements and health sectors

Research was conducted by ECLAC on the potential economic impact of climate change on the agriculture, coastal and human settlements and health sectors in Guyana.

The fundamental aim of the research was to assist with the development of strategies to deal with the potential impact of climate change on Guyana. The results have the potential to provide essential input for identifying and preparing policies and strategies to help support the Caribbean subregion in identifying solutions to problems associated with climate change and in attaining individual and regional sustainable development goals.

Some of the key anticipated impacts of climate change for the Caribbean subregion include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios that were developed by the Intergovernmental Panel on Climate Change until 2050 (agriculture and health sectors) and 2100 (coastal and human settlements sector). An exploration of various adaptation strategies was also undertaken for each sector using standard evaluation techniques.

The study of the impact of climate change on the agriculture sector focused on three leading sub-sectors within this sector: sugar-cane, rice-paddy and fisheries.

In estimating costs, the sugar sub-sector is projected to experience losses under A2 between US$ 144 million (at 4% discount rate) and US$300 million (1% rate); comparative statistics for rice are US$795 million and US$1577 million, respectively; while for fisheries, the results show that losses range from US$15 million (4% rate) and US$34 million (1% rate). In general, under the B2 scenarios, there will be gains for sugar up to 2030 under all three discount rates while for rice the performance is somewhat better with gains realized under all three discount rates up to 2040. For fisheries, gains are forecasted under all three rates up to 2050, following marginal losses to 2020.

In terms of the benefit-cost analysis conducted on selected adaptation measures under the A2 scenario, there were net benefits for all three commodities under all three discount rates. For the sugar-cane subsector these are: drainage and irrigation upgrade, purchase of new machinery for planting and harvesting, developing and replanting climate tolerant sugarcane.

The rice-paddy sub-sector will benefit from adaptive strategies, which include maintenance of drainage and irrigation systems, research and development, education and training. Adaptation in the fisheries sub-sector must include measures such as, mangrove development and restoration and public education.

To investigate the effect of climate change on the health sector four diseases were examined under the three climate scenarios.

During the first decade, the number of malaria cases and their associated direct and indirect costs were highest under the A2 scenario. Between 2021 and 2050, this trend was reversed with the largest number of cases and the highest costs being associated with the B2 scenario.

The number of dengue cases and the value of the direct and indirect costs were highest under the BAU scenario between 2011 and 2050. In terms of the A2 and B2 scenarios, for the majority of the forecast series between 2021 and 2050 the treatment and indirect costs are higher under the A2 scenario. The number of leptospirosis cases and the associated direct costs and productivity losses were highest under the BAU scenario. The analysis of gastroenteritis indicates that the number of additional cases is larger among the over-5 population. The A2 scenario shows the highest number of cases, the highest direct costs and the largest productivity losses between 2011 and 2050. ▶

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An economic impact assessment of climate change in Guyana

Policy should place emphasis on programmes that will assist in monitoring the likelihood of outbreaks by monitoring the volume of rainfall and the maximum temperatures in each period as part of an early warning mechanism that would preempt potential increases in the number of malaria cases that are observed. This early warning monitoring system is also likely to have a complementary, secondary impact in terms of reducing the number of additional cases of dengue and leptospirosis that are observed. Gastroenteritis prevention costs are approximately equal for those under and over 5 years old. In addition, the interventions should take into consideration the complementarities in terms of reduced cases and costs (increased benefits) between two or more diseases.

The analysis of the Coastal and Human Settlements Sectors has shown that based upon exposed assets and population, SLR can be classified as having the potential to create catastrophe in Guyana. The main contributing factor is the concentration of socioeconomic infrastructure along the coastline in vulnerable areas. The A2 and B2 projections have indicated that the number of catastrophes that can be classified as great, is likely to be increased for the country. This is based upon the possible impacts that the projected unscheduled impacts can have on the economy both in terms of loss of life and economic infrastructure. Global changes have meant increased vulnerability nearly everywhere, however, the A2 and B2 projections represents mainly a change in population density and increased economic activity. These results arise from the A2 and B2 projections, thereby indicating that the growth in numbers and losses is largely due to socioeconomic changes over the projection period

Preliminary analysis of the adaptation strategies for the coastal and human settlements sectors indicated that the adaptation strategies should include energy mitigation strategies, improving building design and building codes and involve an increase in coastal planning (including relocation of critical infrastructure to less vulnerable areas, enforcement of setbacks in vulnerable areas and planned retreat). With regard to a response strategy for SLR, a progressive abandonment of land and structures in highly vulnerable areas is suggested. This should be accompanied by policies that recommend a rejection and eventual phasing out of development in susceptible areas. This should also be accompanied with advance planning to avoid worst impacts and the strict regulation of hazard zones. With regard to the main areas of high population and high economic value, it is recommended that mangrove beds be expanded to stabilize the coastlines and provide protection for the seawall. Finally, there should be important emphasis placed on defending vulnerable areas, population centers, and economic activities and natural resources by employing hard structural options, increased use of dykes, levees and floodwalls/flood gates and tidal barriers and the reinforcement of seawalls, revetments and bullheads. ■

An economic impact assessment of climate change in Barbados—coastal and human settlements, tourism and transport sectors

The potential economic impact of climate change on the coastal and human settlements, tourism and transport sectors in Barbados was assessed by ECLAC.

The fundamental aim of the assessments was to assist with the development of strategies to deal with the potential impact of climate change in Barbados. Some of the key anticipated manifestations of climate change for the Caribbean subregion include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios of the Intergovernmental Panel on Climate Change until 2050 (tourism and transport sectors) and 2100 (coastal and human settlements sector), using discount rates of 1%, 2% and 4%. An exploration of various adaptation strategies was also undertaken for each sector using standard evaluation techniques.

With regard to the tourism sector, it was found that by combining the impacts due to a reduction in tourist arrivals, coral reef loss and SLR, estimated total economic impact of climate change is US $7,648 million (A2 scenario) and US $5,127 million (B2 scenario).

An economic analysis of the benefits and costs of several adaptation options was undertaken to determine the cost effectiveness of each one and it was found that four (4) out of nine (9) options had high cost-benefit ratios. It is therefore recommended that the strategies that were most attractive in terms of the cost-benefit ratios be pursued first and these were: (1) enhanced reef monitoring systems to provide early warning alerts of bleaching events; (2) artificial reefs or fish-aggregating devices; (3) development of national adaptation plans (levee, sea wall and boardwalk); (4) revision of policies related to financing carbon neutral tourism; and (5) increasing recommended design wind speeds for new tourism-related structures.

The total cost of climate change on international transportation in Barbados aggregated the impacts of changes in temperature and precipitation, new climate policies and SLR.

The impact for air transportation ranges from US$10,727 million (B2 scenario) to US$12,279 million (A2 scenario) and for maritime transportation impact estimates range from US$1,992 million (B2 scenario) to US$2,606 million (A2 scenario). For international transportation as a whole, the impact of climate change varies from US$12,719 million under the B2 scenario to US$14,885 million under the A2 scenario. Barbados has the institutions set up to implement adaptive strategies to strengthen the resilience of the existing international transportation system to climate change impacts. Air and sea terminals and facilities can be made more robust, raised, or even relocated as need be, and where critical to safety and mobility, expanded redundant systems may be considered. ▶

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An economic impact assessment of climate change in Barbados

The analysis has shown that based upon exposed assets and population, SLR can be classified as having the potential to create potential catastrophe in Barbados. The main contributing factor is the concentration of socioeconomic infrastructure along the coastline in vulnerable areas. The A2 and B2 projections have indicated that the number of catastrophes that can be classified as great is likely to be increased for the country. This is based upon the possible effects of the projected unscheduled impacts to the economy both in terms of loss of life and economic infrastructure. These results arise from the A2 and B2 projections, thereby indicating that growth in numbers and losses are largely due to socioeconomic changes over the projection period and hence the need for increased adaptation strategies. A key adaptation measure recommended is for the government of Barbados to begin reducing the infrastructure deficit by continuously investing in protective infrastructure to decrease the country's vulnerability to changes in the climate. ■

An economic impact assessment of climate change in Jamaica—agriculture, health and tourism sectors

An assessment of the economic impact of climate change on the agriculture, health and tourism sectors in Jamaica was conducted by ECLAC in order to determine the magnitude of the impact with a view to identifying and costing appropriate adaptation and mitigation strategies. Also, the results were expected to provide essential input for identifying and preparing policies and strategies to support the Caribbean subregion in solving problems associated with climate change and attaining individual and regional sustainable development goals.

Some of the key anticipated manifestations of climate change for the Caribbean include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios as developed by the Intergovernmental Panel on Climate Change until 2050, using discount rates of 1%, 2% and 4%. An evaluation of various adaptation strategies was also undertaken for each sector using standard evaluation techniques.

The results regarding the tourism sector suggested that the sector is likely to incur losses due to climate change, the most significant of which is under the A2 scenario. Climatic features, such as temperature and precipitation, will affect the demand for tourism in Jamaica. By 2050 the industry is expected to lose US$132.2 million and 106.1 million under the A2 and B2 scenarios, respectively. In addition to changes in the climatic suitability for tourism, climate change is also likely to have important supply-side effects from extreme events and acidification of the ocean. The expected loss from extreme events is projected to be approximately US$5.48 billion (A2) and US$4.71 billion (B2). Even more devastating is the effect of ocean acidification on the tourism sector. The analysis shows that US$7.95 billion (A2) and US$7.04 billion is expected to be lost by mid-century.

The benefit-cost analysis indicates that most of the adaptation strategies are expected to produce negative net benefits, and it is highly likely that the cost burden would have to be carried by the state. The options that generated positive ratios were: redesigning and retrofitting all relevant tourism facilities, restoring corals and educating the public, developing rescue and evacuation plans. Given the relative importance of tourism to the macro economy one possible option is to seek assistance from multilateral funding agencies. It is recommended that the government first undertake a detailed analysis of the vulnerability of each sector and, in particular tourism, to climate change. Further, some realistic socio-economic scenarios should be developed so as to inform future benefit-cost analysis.

The analysis of the health sector demonstrated the potential for climate change to add a substantial burden to the future health systems on Jamaica, something that that will only compound the country's vulnerability to other anticipated impacts of climate change. The results clearly show that the incidence of dengue fever will increase if climate change continues unabated, with more cases projected for the A2 scenario than the B2. The models predicted a decrease in the incidence of gastroenteritis and leptospirosis with climate change, indicating that Jamaica will benefit from climate change with a reduction in the number of cases of gastroenteritis and leptospirosis.

Due to the long time horizon anticipated for climate change, Jamaica should start implementing adaptation strategies focused on the health sector by promoting an enabling environment, strengthening communities, strengthening the monitoring, surveillance and response systems and integrating adaptation into development plans and actions. Small-island developing states like Jamaica must be proactive in implementing adaptation strategies, which will reduce the risk of climate change. On the global stage the country must continue to agitate for the implementation of the mitigation strategies for developed countries outlined in the Kyoto protocol.

The outcomes from investigating the agriculture sector indicate that for the sugar-cane subsector the harvests under both the A2 and B2 scenarios decrease at first and then increase as the mid-century mark is approached. With respect to the yam subsector the results indicate that the yield of yam will increase from 17.4 to 23.1 tonnes per hectare (33%) under the A2 scenario, and 18.4 to 23.9 (30%) tonnes per hectare under the B2 scenario over the period 2011 to 2050. Similar to the forecasts for yam, the results for scallion suggest that yields will continue to increase to mid-century. u

Adaptation in the sugar cane sub-sector indicate that replanting and irrigation appear to generate net benefits at the three selected discount rates for Scenario A2, but only at a discount rate of 1% for Scenario B2. For yam and escallion, investment in irrigation will earn significant net benefits for both Scenarios A2 and B2 at the three selected rates of discount. It is recommended that if adaptation strategies are part of a package of strategies for improving efficiency and hence enhancing competitiveness, then the yields of each crop can be raised sufficiently to warrant the investment in adaptation to climate change. ■

An economic impact assessment of climate change in Montserrat—health, tourism and transportation sectors

An assessment of the economic impact of climate change on the health, tourism and transportation sectors in Montserrat was conducted by ECLAC in order to determine the magnitude of the impact with a view to identifying and costing appropriate adaptation and mitigation strategies.

Some of the key anticipated manifestations of climate change for the Caribbean include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios of the Intergovernmental Panel on Climate Change until 2050, using discount rates of 1%, 2% and 4%. An exploration of various adaptation strategies was also undertaken for each sector using standard evaluation techniques.

The assessment of the health sector demonstrates the potential for climate change to add a substantial burden to the future health systems on Montserrat. Monetary valuation was based on a transfer value of statistical life approach with a modification for morbidity. The results show mean annual costs (morbidity and mortality) ranges from $0.61 million (in the B2 scenario, discounted at 4% annually) to $1 million (in the A2 scenario, discounted at 1% annually) for Montserrat. These costs are compared to adaptation cost scenarios involving increased direct spending on per capita health care. This comparison reveals a high benefit-cost ratio suggesting that moderate costs will deliver significant benefit in terms of avoided health burdens in the period 2010-2050. The methodology and results suggest that a focus on coordinated data collection and improved monitoring represents a potentially important 'no regrets' adaptation strategy for Montserrat. It is also recommended that the adaptation option be part of a coordinated regional response that avoids duplication in spending.

With reference to the tourism sector, the results suggest that under both scenarios, the island's key tourism climatic features will likely decline and therefore negatively impact on the destination experience of visitors. It was found that the total cost of climate change for the tourism industry was projected to be 9.6 times 2009 GDP if nothing is done to adapt to likely effects of climate change. Given the potential for significant damage to the industry a large number of potential adaptation measures were considered. From these a short-list consisting 9 potential options were selected using 10 evaluation criteria. Using benefit-cost analyses 3 options were put forward: (1) increase recommended design speeds for new tourism-related structures; (2) enhanced reef monitoring systems to provide early warning alerts of bleaching events, and; (3) deployment of artificial reefs or fish-aggregating devices. While these options had positive benefit cost ratios, other options were also recommended based on their non-tangible benefits: irrigation network that allows for the recycling of waste water, development of national evacuation and rescue plans, providing retraining for displaced tourism workers and the revision of policies related to financing national tourism offices to accommodate the new climatic realities.

The total cost of climate change on international transportation in Montserrat was calculated by combining the impacts of changes in temperature and precipitation, new climate change policies in advanced countries, sea level rise and an eruption of the Soufriere Hills volcano. The impact for air transport could range from US$630 million (B2 scenario) to US$742 million (A2 scenario) and for maritime transport impact estimates range from US$209 million (B2 scenario) to US$347 million (A2 scenario). For international transport as a whole, the impact of climate change varies from US$839 million under the B2 scenario to US$1,089 million under the A2 scenario. Montserrat has the institutions set up to implement the adaptive strategies to strengthen the resilience of the existing international transportation system to climate change impacts. Air and sea terminals and facilities can be hardened, raised, or even relocated. The adaptive strategies that are eventually employed depends on the associated costs, and the relative effectiveness of those strategies will have to be determined on a case-by-case basis, based on studies of individual facilities and system-wide considerations.

Despite revealing a number of areas worthy of further research, the results of this study are important because the framework utilized and the analyses undertaken have generated examples of data that are not only specifically geared for inclusion in a formal decision-making context, but are also intended to contribute to the overall process of adapting Montserrat to the future risks associated with climate change. ■

An economic impact assessment of climate change in Saint Lucia—agriculture, health and tourism sectors

Research was conducted by ECLAC on the potential economic impact of climate change on the agriculture, health and tourism sectors in Saint Lucia.

The fundamental aim of the research was to assist with the development of strategies to deal with the potential impact of climate change in Saint Lucia. It also has the potential to provide essential input for identifying and preparing policies and strategies to help advance the Caribbean subregion closer to solving problems associated with climate change and attaining individual and regional sustainable development goals. Some of the key anticipated impacts of climate change for the Caribbean subregion include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios of the Intergovernmental Panel on Climate Change until 2050, using discount rates of 1%, 2% and 4%. An evaluation of various adaptation strategies for each sector was also undertaken using standard evaluation techniques. ▶

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An economic impact assessment of climate change in Saint Lucia

The key subsectors in agriculture are expected to have mixed impacts under the A2 and B2 scenarios. Banana, fisheries and root crop outputs are expected to fall with climate change, but tree crop and vegetable production are expected to rise.

In aggregate, in every decade up to 2050, these sub-sectors combined are expected to experience a gain under climate change with the highest gains under A2. By 2050, the cumulative gain under A2 is calculated as approximately US$389.35 million and approximately US$310.58 million under B2, which represents 17.93% and 14.30% of the 2008 GDP respectively. This result was unexpected and may well be attributed to the unavailability of annual data that would have informed a more robust assessment. Additionally, costs to the agriculture sector due to tropical cyclones were estimated to be $6.9 million and $6.2 million under the A2 and B2 scenarios, respectively.

There are a number of possible adaptation strategies that can be employed by the agriculture sector. The most attractive adaptation options, based on the benefit-cost ratio are: (1) Designing and implementation of holistic water management plans (2) Establishment of systems of food storage and (3) Establishment of early warning systems. Government policy should focus on the development of these adaption options where they are not currently being pursued and strengthen those that have already been initiated, such as the mainstreaming of climate change issues in agricultural policy.

The analysis of the health sector placed focus on gastroenteritis, schistosomiasis, ciguatera poisoning, meningococcal meningitis, cardiovascular diseases, respiratory diseases and malnutrition. The results obtained for the A2 and B2 scenarios demonstrate the potential for climate change to add a substantial burden to the health system in the future, a factor that will further compound the country's vulnerability to other anticipated impacts of climate change. Specifically, it was determined that the overall Value of Statistical Lives impacts were higher under the A2 scenario than the B2 scenario.

A number of adaptation cost assumptions were employed to determine the damage cost estimates using benefit-cost analysis. The benefit-cost analysis suggests that expenditure on monitoring and information provision would be a highly efficient step in managing climate change and subsequent increases in disease incidence.

Various locations in the world have developed forecasting systems for dengue fever and other vector-borne diseases that could be mirrored and implemented. Combining such macro-level policies with inexpensive micro-level behavioural changes may have the potential for pre-empting the re-establishment of dengue fever and other vector-borne epidemic cycles in Saint Lucia.

Although temperature has the probability of generating significant excess mortality for cardiovascular and respiratory diseases, the power of temperature to increase mortality largely depends on the education of the population about the harmful effects of increasing temperatures and on the existing incidence of these two diseases. For these diseases it is also suggested that a mix of macro-level efforts and micro-level behavioural changes can be employed to relieve at least part of the threat that climate change poses to human health. The same principle applies for water and food-borne diseases, with the improvement of sanitation infrastructure complementing the strengthening of individual hygiene habits.

The results regarding the tourism sector imply that the tourism climatic index was likely to experience a significant downward shift in Saint Lucia under the A2 as well as the B2 scenario, indicative of deterioration in the suitability of the island for tourism.

It is estimated that this shift in tourism features could cost Saint Lucia about 5 times the 2009 GDP over a 40-year horizon. In addition to changes in climatic suitability for tourism, climate change is also likely to have important supply-side effects on species, ecosystems and landscapes. Two broad areas are: (1) coral reefs, due to their intimate link to tourism, and, (2) land loss, as most hotels tend to lie along the coastline.

The damage related to coral reefs was estimated at US$3.4 billion (3.6 times GDP in 2009) under the A2 scenario and US$1.7 billion (1.6 times GDP in 2009) under the B2 scenario. The damage due to land loss arising from sea level rise was estimated at US$3.5 billion (3.7 times GDP) under the A2 scenario and US$3.2 billion (3.4 times GDP) under the B2 scenario.

Given the potential for significant damage to the industry a large number of potential adaptation measures were considered. Out of these a short-list of 9 potential options were selected by applying 10 evaluation criteria.

Using benefit-cost analyses 3 options with positive ratios were put forward: (1) increased recommended design speeds for new tourism-related structures; (2) enhanced reef monitoring systems to provide early warning alerts of bleaching events, and, (3) deployment of artificial reefs or other fish-aggregating devices.

While these options had positive benefit-cost ratios, other options were also recommended based on their non-tangible benefits. These include the employment of an irrigation network that allows for the recycling of waste water, development of national evacuation and rescue plans, providing re-training for displaced tourism workers and the revision of policies related to financing national tourism offices to accommodate the new climate realities. ■

"The fundamental aim of the research was to assist with the development of strategies to deal with the potential impact of climate change in Saint Lucia.

An economic impact assessment of climate change in Trinidad and Tobago—agriculture, health and energy sectors

An assessment of the economic impact of climate change on the agriculture, health and energy sectors in Trinidad and Tobago was conducted by ECLAC in order to determine the magnitude of the impact with a view to identifying and costing appropriate adaptation and mitigation strategies.

The fundamental aim of this report is to assist with the development of strategies to deal with the potential impact of climate change on Trinidad and Tobago. It also has the potential to provide essential input for identifying and preparing policies and strategies to help advance the Caribbean subregion closer to solving problems associated with climate change and attaining individual and regional sustainable development goals. Some of the key anticipated impacts of climate change for the Caribbean include elevated air and sea-surface temperatures, sea-level rise, possible changes in extreme events and a reduction in freshwater resources.

The economic impact of climate change on the three sectors was estimated for the A2 and B2 scenarios of the Intergovernmental Panel on Climate Change until 2050, using discount rates of 1%, 2% and 4%. An exploration of various adaptation strategies was also undertaken for each sector using standard evaluation techniques.

The study of the impact of climate change on the agriculture sector focused on root crops, green vegetables and fisheries. For these sectors combined, the cumulative loss under the A2 scenario is calculated as approximately B$2.24 and approximately B$1.72 under the B2 scenario by 2050. This is equivalent to 1.37% and 1.05% of the 2008 GDP under the A2 and B2 scenarios, respectively.

Given the potential for significant damage to the agriculture sector a large number of potential adaptation measures were considered. Out of these a short-list of 10 potential options were selected by applying 10 evaluation criteria. All of the adaptation strategies showed positive benefits. The analysis indicate that the options with the highest net benefits are: (1) Building on-farm water storage, (2) Mainstreaming climate change issues into agricultural management and (3) Using drip irrigation. Other attractive options include water harvesting. The policy decisions by governments should include these assessments, the omitted intangible benefits, as well as the provision of other social goals such as employment.

The analysis of the energy sector has shown that the economic impact of climate change during 2011-2050 is similar under the A2 (US$142.88 million) and B2 (US$134.83 million) scenarios with A2 scenario having a slightly higher cost (0.737% of 2009 GDP) than the B2 scenario (0.695% of 2009 GDP) for the period. On the supply side, analyses indicate that Trinidad and Tobago's energy sector will be susceptible to the climate change policies of major energy-importing countries (the United States of America and China), and especially to their renewable energy strategies. Implementation of foreign oil substitution policy by the United States of America will result in a decline in Trinidad and Tobago's Liquefied Natural Gas (LNG) export (equivalent to 2.2% reduction in 2009 GDP) unless an alternative market is secured for the lost United States of America market. China, with its rapid economic growth and the highest population in the world, offers a potential replacement market for Trinidad and Tobago's LNG export. In this context the A2 scenario will offer the best option for Trinidad and Tobago's energy sector.

The cost-benefit analysis undertaken on selected adaptation strategies reveal that the benefit-cost ratio of replacing electric water heaters with solar water heaters is the most cost-effective. It was also found that the introduction of Compact Fluorescent Light (CFL) and Variable Refrigerant Volume (VRV) air conditioners surpasses the projected cost of increased electricity consumption due to climate change, and provides an economic rationale for the adoption of these adaptation options even in a situation of increased electricity consumption occasioned by climate change. Finally, the conversion of motor fleets to Compressed Natural Gas (CNG) is a cost-effective adaptation option for the transport sector, although it has a high initial cost of implementation and the highest per capita among the four adaptation options evaluated.

To investigate the effect of climate change on the health sector dengue fever, leptospirosis, food borne illnesses, and gastroenteritis were examined. The total number of new dengue cases for the period 2008 to 2050 was 204,786 for BAU, 153,725 for A2 and 131,890 for the B2 scenario. With regard to the results for leptospirosis, A2 and B2 seem to be following a similar path with total number of new cases in the A2 scenario being 9,727 and 9,218 cases under the B2 scenario. Although incidence levels in the BAU scenario coincided with those of A2 and B2 prior to 2020, they are somewhat lower post 2020. A similar picture emerges for the scenarios as they relate to food-borne illnesses and to gastroenteritis. Specifically for food-borne illnesses, the BAU scenario recorded 27,537 cases, the A2 recorded 28,568 cases and the B2 recorded 28,679 cases.

The focus on the selected sources of morbidity in the health sector has highlighted the fact that the vulnerability of the country's health sector to climate change does not depend solely on exogenously derived impacts, but also on the behaviour and practices among the population. It is clear that the vulnerability which became evident in the analysis of the impacts on dengue fever, leptospirosis and food-borne illnesses is not restricted solely to climate or other external factors. The most important adaptation strategy being recommended targets lifestyle, behaviour and attitude changes. The population needs to be encouraged to alter their behaviours and practices so as to minimise their exposure to harmful outcomes as it relates to the incidence of these diseases. ■

Climate change

It is well established that climate change will have unprecedented impacts on the lives of many people especially in the areas of energy demand and supply, food security and health. It is expected that these impacts may well erode gains made in achievement of the Millennium Development Goals (MDGs) and exacerbate inequalities among many vulnerable groups.

The concept of climate justice recognizes that although the poorer nations of the world would suffer the majority of impacts, the world's richest countries have contributed most to the problem and as such have a greater obligation to take responsibility and to act quickly. Climate justice is a vision to dissolve and alleviate the unequal burdens created by climate change. "As a form of environmental justice, climate justice is the fair treatment of all people and freedom from discrimination with the creation of policies and projects that address climate change and the systems that create climate change and perpetuate discrimination"[1].

"The pursuit of climate justice should address the principle of equity."

In order to pursue the concept of climate justice, three sets of issues need to be addressed:

1. Disparities in development

In pursuing development, many countries utilise environmental resources to produce goods. However, in so doing, they also generate waste such as greenhouse gases and destroy the environment (deforestation). These activities threaten food security and the ability of communities to sustain livelihoods.

The Environmental Justice movement has demonstrated that pollution's effects often fall disproportionately on the health of low-income communities. These groups are the first to experience negative climate change impacts such as heat death and illness, respiratory illness, infectious disease, and economic and cultural displacement.

Developed countries with large economies are mainly responsible for increased levels of greenhouse gases but the developing countries are the ones who suffer the greatest impacts. Also developing countries, with their smaller economies are forced to exploit the environment in order to produce food, energy and water and in so doing tend to destroy the natural resource base. It is necessary to provide some balance between large and small economies and to increase the flow of technology and financial resources from the larger to the smaller economies in addressing developmental imbalances. Of importance here is the need to address the needs of women, migrants and indigenous peoples to ensure equitable allocation of resources.

2. Participating in decision-making

All groups of people should have the opportunity to participate in decision making with respect to climate change. This is very important to developing countries that, although contributing little to emissions of greenhouse gases, are being impacted the most. For example a rise in temperature of 2.0°C is expected to cause a rise in sea level of 6 – 9 metres that would inundate the majority of small island developing states (SIDS) (Hance, online). However, the G77 and China[2] as well as developed countries are promoting this as an acceptable level as opposed to the most recent target for temperature increase by SIDS of 1.5°C (Kovi, 2009). This temperature increase, is indeed expected to result in a rise in sea level but one that could be accommodated by SIDS without inundation.

3. Financial responsibility

Developed countries that are the emitters of greenhouse gases need to provide support to developing countries that are being impacted by these emissions through the transfer of resources. Developing countries have stated that funds to address adaptation to climate change need to be "additional" to the existing ODA. After the COP 15 in Copenhagen, an adaptation fund had been agreed to but to date, little of that has been made available by developed countries to developing countries.

The pursuit of climate justice should address the principle of equity. Some starting points for this include:

1. Place justice at the core of a climate justice agenda.

This approach could foster sustainable economies and be politically acceptable to the majority of countries. To date, climate change discussions and negotiations have not easily reached consensus[3] and decisions to reduce inequities may be postponed while climate threats continue to grow (Adams and Luchsinger, 2009).

2. Examine and improve existing development and human rights agreements.

It is important that strategies to address climate change do not erode gains made in poverty eradication or overall national development. Therefore adaptive and mitigative strategies should be developed and implemented within the context of existing human rights frameworks.

3. Step up action to slow climate change.

Efforts to reduce emissions of greenhouse gases and therefore slow climate change should be pursued as part of a climate justice agenda. Indeed, such efforts need to be implemented around the core principles of equity and sustainable development. ▶

[1] See: http://www.actforclimatejustice.org/about/what-is-climate-justice/

[2] The G77+China group of states is the largest negotiating bloc at the COP15 in Copenhagen. It currently consists of 130 developing countries and was established in 1964 to promote the collective economic interests of the developing countries and increase their negotiating powers within the United Nations.

[3] Negotiations into the post-2012 Kyoto Protocol are still ongoing

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Climate justice

"As a form of environmental justice, climate justice is the fair treatment of all people and freedom from discrimination with the creation of policies and projects that address climate change..."

4. Adopt the most ambitious targets.

In setting targets for greenhouse gas emissions, the special case of small island developing states needs to be considered as they will be the first to suffer from the negative impacts of climate change. As such, it is important to adopt the most ambitious targets (world maximum of 1.5°C as proposed by the Caribbean Community Climate Change Centre[4]) thereby increasing the likelihood of developing appropriate strategies that would closely approach the target.

5. Pursue adaptation as a matter of urgency (Sanderson and Islam, 2007).

SIDS are contributing minimally to emission of greenhouse gases and it is recommended that they pursue adaptation measures as a priority. Considerable work in the area of adaptation has been conducted by the Caribbean Community Climate Change Centre (CCCCC) and it is necessary to build on this work rather than aggressively pursuing mitigation strategies.

6. Transform the systems and institutions that have created climate change.

This should focus on balancing the benefits that may be derived from current political and economic configurations to make them more equitable and sustainable.

7. Improve inclusion in global decision -making.

SIDS face a number of special threats and vulnerabilities that are not affecting developed countries. It is therefore important that the voices of SIDS and the less privileged should be heard in decision-making fora. Strategies for the inclusion of these groups need to be developed and as such the United Nations System is critical to facilitating this.

8. Include both developed and developing countries to set climate targets.

Under the existing Kyoto Protocol, industrialised developed countries as signatories, have taken a leading role in establishing binding targets for reducing greenhouse gas emissions. However, developing industrialised countries such as China and India[5] (Difiglio, 2007) do contribute significantly to global greenhouse emissions and as such could take some responsibility for reducing emissions but these should not be binding. The industrialised countries could provide support to developing countries in adaptation through technology transfer and financing that are in accordance with national development plans.

9. Challenge market-based cap and trade and offset programmes.

These mechanisms have a small track record in reducing greenhouse gas emissions and as such should be closely monitored to determine impact especially in terms of reducing inequities. One challenge here is to estimate if emissions are actually being reduced or are being transferred from country to country with no net reduction in levels of greenhouse gases in the atmosphere.

10. Engage the general public in debate about the significance and urgency of climate change.

It is imperative that developing countries be part of the climate change debate so that they would be sensitised to the challenges in order to take corrective action. Interaction would also provide the forum for the voices of SIDS to be heard so that their unique challenges would be considered in global negotiations.

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[4] See: http://www.caricom.org/jsp/community/ccccc.jsp?menu=community

[5] For 2005 China emitted 98 billion tonnes of carbon dioxide and India emitted about 22 billion tonnes. On a per capita basis both China and India emit less than the United States