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Meeting of the High-Level Advisory Committee (HLAC)  
of the Project: A Review of the Economics of  
Climate Change in the Caribbean (RECCC)  
Port-of-Spain, Trinidad and Tobago  
18-19 November 2010

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**REPORT OF THE MEETING OF THE  
HIGH-LEVEL ADVISORY COMMITTEE (HLAC) OF THE PROJECT:  
A REVIEW OF THE ECONOMICS OF CLIMATE CHANGE  
IN THE CARIBBEAN (RECCC)**

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## **A. DECISIONS AND RECOMMENDATIONS**

The following decisions and recommendations were adopted:

- The BAU will be projected based on historical climatological data which should be accessed from the respective States where possible
- Discount rates of 1% to 2% would generally be used and, where this was not feasible, discount rates would be standardised by consensus on a sectoral basis
- Consultants would continue to collaborate and take the opportunity to visit their country of study
- The next meeting of the High Level Advisory Committee (HLAC): Review of the Economics of Climate Change in the Caribbean will be held in March 2011
- Completion date of the current phase of the project is 31 January 2011, by which time all national studies must be submitted.

## **B. ATTENDANCE AND ORGANIZATION OF WORK**

### **1. Place and date**

The Meeting of the HLAC: Review of the Economics of Climate Change (RECC) in the Caribbean was convened by the Economic Commission for Latin America (ECLAC) Subregional Headquarters for the Caribbean on 18-19 November 2010 in Port of Spain, Trinidad and Tobago.

### **2. Attendance**

Representatives of six member States attended the meeting: Antigua and Barbuda, Bahamas, Guyana, Saint Lucia, Saint Vincent and the Grenadines and Trinidad and Tobago. Three associate members were represented: Aruba, the British Virgin Islands and Montserrat.

The Caribbean Community (CARICOM) Secretariat as well as the University of Havana and the University of the West Indies (UWI) attended.

### **3. Agenda**

1. Opening of the meeting
2. The economic impacts of climate change on the tourism sector
3. The economic impacts of climate change on the health sector
4. The economic impacts of climate change on the agriculture sector
5. The economic impacts of climate change on the water sector
6. The economic impacts of climate change on other sectors
  - (a) Transport
  - (b) Energy
  - (c) Coastal and human settlements, and
  - (d) Coastal and marine
7. Recommendations, conclusions and closing remarks.

## C. SUMMARY OF PROCEEDINGS

### 1. Opening of meeting

Welcome and opening remarks were made by Hirohito Toda, Officer-in-Charge, ECLAC Subregional Headquarters for the Caribbean.

The Officer-in-Charge, ECLAC Subregional Headquarters for the Caribbean, welcomed participants to the meeting and asked that they consider ways in which the models could be improved and whether there were additional issues for incorporation. He urged the consultants to use the meeting as an opportunity to collaborate, discuss and seek to benefit from the challenges already addressed by their more experienced colleagues.

### 2. The economic impacts of climate change on the tourism sector

The first presentation was given by Sandra Sookram, Consultant, on the economic impacts of climate change on the tourism sector in Aruba and the former Netherlands Antilles. The report examined the factors that influenced the demand and supply of tourism in both countries and forecasted the cost of climate change to the sectors until 2050 under A2, B2 and Business as Usual (BAU) climate scenarios. The study used empirical methodology based on Johansen's system of cointegration analysis and a Vector Error Correction Model. It gave estimates of the cost of selected adaptation and mitigation strategies that could be undertaken to address climate change.

Consultant, Ramon Martin, gave the second presentation which focused on the economic impacts of climate change on the tourism sector in the Bahamas. The report estimated the costs of identified and anticipated impacts associated with climate change on tourism expenditure in the Bahamas under the A2 and B2 scenarios, in comparison with a BAU baseline. It analyzed the focal points of climate change on components of the tourism sector through major impacts on visitor arrivals, tourism expenditure, tourism attraction losses and other losses in related sectors, presented a detailed list of possible adaptation/mitigation actions and provided a brief list of investment opportunities for both adaptation and mitigation actions using cost-benefit analysis.

The third presentation was given by Winston Moore, Consultant, on the economic impacts of climate change on the tourism sector in Montserrat and Saint Lucia. A general structural time series model was used to highlight tourist arrivals in Montserrat and Saint Lucia and two explanatory variables were employed in the regression: real Gross Domestic Product and the Tourism Climate Index (TCI). The negative impact of climate change on coral reefs and land loss under the various climate change scenarios was estimated and an economic valuation of impacts made. Potential options were selected using 10 evaluation criteria and three options were put forward using benefit-cost analysis.

In the discussion which followed the first three presentations, the chair of the session and Review Team member, Temisan Agbeyegbe, asked Winston Moore his reason for using the TCI rather than the Climate Index for Tourism (CIT) in his model for Montserrat and Saint Lucia.

Review Team member, Wilma Bailey, congratulated Sandra Sookram on her presentation and questioned the combination of the semi-arid and humid islands of Aruba and the former Netherlands Antilles in the time series data. She also suggested that the figure of 500cm, per month rainfall in the climatic data be verified.

Review Team member, Mark Bynoe, congratulated Winston Moore on his clear and lucid presentation on Montserrat and Saint Lucia. He recommended the use of different discount rates and noted that adaptation options would need to take cognizance of other development activities taking place in the respective countries. He also suggested that sea level rise ought to be considered, given that recent statistics showed sea level rise occurring at a faster rate. Referring to the presentation on

Aruba and the former Netherlands Antilles, he observed that it was too heavily focused on tourism demand and not enough on tourism supply.

The representative of CARICOM observed that assumptions were missing from the tourism presentations and, as such, there was need for a clearer understanding of the scientific data. He said that the tourism sector was becoming more capital intensive and that needed to be factored in to the discussion and that flooding was the most important consequence of hurricanes and, therefore, ought to be high on policymakers' agendas for managing risk and securing private sector contributions. Referring to the presentation on the Bahamas, he questioned changes in the 'mean' in the Providing Regional Climates for Impact Studies model used, and drew the presenters' attention to the Multilateral Environment Agreements (MEAs), pointing out the need to include in their discussions what governments were doing with respect to conservation of coral reefs. He also expressed concern with the way in which 'adaptation and mitigation' were treated in the presentation on Montserrat and Saint Lucia.

In her response, Sandra Sookram explained that the data on semi-arid and humid islands could not be disaggregated because they had to be presented to the respective governments as country studies. She further explained that all the data required for the studies was not readily available and requested assistance in approaching the Caribbean Catastrophe Risk Insurance Facility (CCRIF).

Responding to the comments made, Ramon Martin indicated that he would consider variables such as storm surge for inclusion in his model for the Bahamas.

Winston Moore stated that the discount rate he used was 6%, and agreed that different rates could be introduced in the models for Montserrat and Saint Lucia. He explained that there was no major difference in the component indices of the TCI and the CIT and agreed to include MEAs and to treat adaptation and mitigation options separately in his study.

The tourism sector consultant, Murray Simpson, acknowledged and agreed with previous comments on sea level rise and brought the meeting's attention to recently completed work on storm surge in CARICOM countries using an actuarial approach. He advised that the figures derived from the study could be used in generating economic analyses.

In bringing the discussion on the first three tourism sector presentations to a close, the chair emphasised the need for consultants to explicitly state the assumptions that inform their analyses.

The fourth presentation was given by Murray Simpson on the economic impacts of climate change on the tourism sector in Barbados. The report provided an overview of other sectors related to tourism and analyzed 'Three Additional Critical Core Layers', climate policy changes in source countries impacting on tourist mobility, the impact of climate change on coral reef-related tourism, and a critical analysis of sea level rise on tourism which included land loss, tourism expenditure loss, and rebuild/relocation cost. A costing of adaptation and investment opportunities for the sector was presented.

Ian Boxill, Consultant, gave the presentation on the economic impacts of climate change on the tourism sector in Jamaica. The study estimated the likely cost of climate change for the Jamaican tourism industry, concentrating on tourist arrivals, climate (represented by temperature and precipitation) and relevant economic data from 1976 to 2008. Using the autoregressive distributed lag (ARDL) error correction model it provided a costing of climate change for Jamaica under the A2 and B2 and BAU scenarios for extreme events, sea level rise and acidification. Recommendations regarding mitigation and adaptation strategies for the tourism sector were presented.

In the discussion following the final presentations on the tourism sector, health sector consultant, Georgiana Gordon-Strachan, drew the attention of Ian Boxill to already existing linkages

between the ministries of tourism and energy in Jamaica's Vision 2030 Sector Plan and a related Inter-American Development Bank project that focused on energy efficiency.

Abdullahi Abdulkadri, the energy sector consultant, questioned the approach of the two presenters on the sector to the BAU scenario and their method of costing the different scenarios.

The representative of Saint Lucia commented on the benefits to be derived from adaptation measures such as energy efficiency and conservation using existing technologies. She referred to the recent disastrous effects of Hurricane Tomas on Saint Lucia and reminded the meeting of the need to make linkages between the climate change literature and real-time events.

The representative of the Bahamas pointed out the costs associated with tourists on the islands at the time of extreme weather events. These included the cost of evacuating visitors who wished to leave and the cost to the industry due to deferred visits. He noted the importance of sunshine hours as a variable and suggested the study on the Bahamas take that into consideration.

The representative of CARICOM asked Murray Simpson how capital intensive the 'alternative attractions' recommended for Barbados would be and asked Ian Boxill whether the tourist arrivals cited in his study included Jamaican nationals. He drew the consultants' attention to two important documents which provided guidance on the integration of renewable energy in the climate change discussion: A Framework for Regional Cooperation in Energy by Professor Norman Girvan and the Draft Regional Energy Strategy. He added that in any discussion on tourism, water was an issue that needed to be explicitly addressed.

Review Team member, Mark Bynoe, suggested that the costing of economic impacts should be done on the assumption that some adaptation measures would have previously been put in place. He commented that the 2-4 days time required for a return to normalcy after an extreme weather event, estimated in the presentation on Jamaica, seemed overly optimistic and stated that in addition to the focus on cyclones, the impact of El Niño and La Niña had to be considered.

In his response, Ian Boxill noted the comments given and undertook to revisit Jamaica's energy plan based on the observations made and to revisit the time estimated for recovery from an extreme weather event. He acknowledged that the tourist arrival figures presented included Jamaican nationals.

Murray Simpson indicated that the BAU scenario in his study had altered since the last HLAC meeting as a result of work done on the three core layers, which allowed for a more realistic portrayal of economic loss for Barbados. He stated that the alternative attractions presented in his study were speculative and commented that consultants' reports were not expected to give highly detailed options, but that it was left up to countries to carry out required cost/benefit analyses. He further noted that the Carbon Neutral Initiative of the Caribbean Community Climate Change Centre (CCCCC) included, under Option 9, the costs to implement emissions reduction in the tourism sector.

Review Team member, Mark Bynoe, stated that the Carbon Neutral Project would help to resolve some of the issues raised by the representative of Saint Lucia and observed that a major factor influencing tourist arrivals would be energy, particularly if airfares were to increase again.

Murray Simpson referred the meeting to a study on tourist mobility which was carried out in 2007 for Barbados and observed that quick changing climate policies and voluntary initiatives on the part of countries were impacting user behaviour and affecting decisions and costs in the tourism sector. He drew attention to the anomalies involved in the recently introduced United Kingdom Air Passenger Duty and emphasised the direct link between policy and expenditure. On another note, and in response to the chair's query of the various methodologies used by consultants in the tourism sector, he explained that there was no great difference in their approaches and that they had agreed earlier to take a common approach towards the end result.

The representative of Aruba suggested that a formula could be included in the methodology to achieve comparability among the tourism studies and provide a stronger methodology for the use of all consultants. He also commented that climate change impacts were not mitigatable but were adaptable. Ian Boxill then requested further discussion and clarification on the issue of 'mitigation'.

The representative of CARICOM noted the importance of paying close attention to the physical sciences, from an economic standpoint. He said that because regional historical data on disasters were largely obsolete, using the scenario approach became even more important. He urged consultants to assess the magnitude of risk in light of scientific data.

Winston Moore, Consultant, observed that the tourism studies differed only on the smallest component. He described the demand side impacts in the tourism sector as small compared to those on the supply side, where coral reef and land loss were estimated to cost billions of dollars, and suggested that as consultants they focus on methodology for that aspect of the sector.

Review Team member, Temisan Agbeyegbe, indicated that he was of a different opinion as to whether all the tourism studies used a similar approach on the supply side.

Murray Simpson explained that a variety of sources depicting the tourism demand and mobility for Barbados existed, all bona fide and substantiated, including the work of academics and that done by actuaries for the United Nations. He strongly defended including the analysis of sea level rise in models in the sector, explaining that while it could not be said that climate change would cause increased hurricanes, with sea level rise, hurricanes would have greater impact. He called for the focus in the studies to be placed on the areas where there was no commonality.

Review Team member, Mark Bynoe, suggested that at this stage all hazards to which the subregion was vulnerable should be considered, including hurricanes, sea level rise and El Niño, even though the impact would be different in some countries. He reminded the meeting that the next stage of the project would involve regional assessments, which would be made simpler if comparability between country studies was established at the initial stage.

Agriculture sector consultant, Michael Witter, expressed his concern at the conceptual organization of the project. He suggested that there was an inherent difficulty in simultaneously determining climate change frequency and intensity and the impacts of hazards on economic activity. He stated that while climate change was of interest, the initial connections might not always have been properly understood in the sector.

In bringing the discussion on the tourism sector to an end, the Chair observed that more information needed to be collected particularly in the areas of energy use and efficiency, impacts of different hazards and how climate change affected domestic residences. He restated the need for clarification on how the work on the country studies was done, called for a uniform and transparent approach among the consultants, asked that the difference between adaptation and mitigation be recognized and that estimates of costs given be derived from regional data.

### **3. The economic impacts of climate change on the health sector**

Elizabeth Emanuel, Consultant, made the first presentation on the economic impacts of climate change on the health sector in Guyana. It focused on an economic analysis of the impacts of climate change-related impacts on the sector over the next 40 years under a BAU scenario and the International Panel on Climate Change (IPCC) SRES A2 and B2 scenarios. The methodology, which was based on an understanding of the relationship between climate change and health outcomes within the country, included a simple cost-effectiveness analysis and presented adaptation and mitigation options with recommendations.



In the ensuing discussion following the presentation on Guyana, agriculture sector consultant Claremont Kirton, enquired whether the diseases discussed originated outside of Georgetown and if the data on Georgetown were reflective of other areas of Guyana.

The representative of Guyana explained the need to understand the weather variables in Guyana and advised that it was not wise to use Georgetown data to develop hinterland scenarios. He noted that while studies tended to focus on the coast, over 70,000 people lived in the hinterland. He observed that the presentation required further work on cost analysis and thought this would lead to more specific recommendations and conclusions. He further observed that while the study used recent data, even more recent data could be accessed and that an in-country visit would benefit the study as well as fulfil the wider project objective of building in-country capacity to continue the work in the future.

The representative of CARICOM expressed concern at the study's conclusion which he interpreted as suggesting that precipitation and temperature rise had no impact on health. He referred to economic studies that reported an impact on labour productivity in the subregion and suggested these be factored into the model. He also suggested the elaboration of a risk reduction strategy.

In her response, Elizabeth Emanuel, affirmed that the study had in fact identified a significant relationship between malaria, gastroenteritis and rainfall. She stated that a risk reduction strategy could be incorporated in the country climate change strategy and offered to further elaborate on it in her study.

The Economic Affairs Officer of ECLAC observed that malaria was trending downwards in the BAU, whereas it was likely that increased temperature would impact on malaria. She suggested that it was possible that the downward trend was associated with particular environmental conditions. Elizabeth Emanuel suggested that it could be a result of stronger public health interventions, which had been identified in the study's situation analysis.

Review Team member, Juan Llanes-Regueiro, suggested that the construct 'value of a human life lost' be replaced with 'the estimate of the value of a human life lost'.

The chair of the session, Dave Chadee, suggested that there was a problem with the model, noting that while gastroenteritis and malaria were water related, one would have an increased impact as a result of flooding while the incidence of the other would decline.

Georgiana Gordon-Strachan, Consultant, presented a study on the economic impacts of climate change on the health sector in Jamaica. The report used an empirical statistical predictive model to determine whether a significant historical relationship existed between the prevalence of selected climate sensitive diseases and the explanatory climate variables (temperature and precipitation). The regression equation obtained was used to calculate disease prevalence estimates for 2011-2050 using projected climate data from the ECHAM A2 and B2 and from the historical projections of the BAU scenarios. The economic impact of the disease was calculated, based on projected morbidity, mortality, productive days lost and no option/no regret costs.

In the discussion which followed, Winston Moore suggested, to both presenters on the health sector, ways in which to improve their climate projections. He further suggested that they fit a trend to their health outcomes to arrive at the BAU and that a framework be developed to include the ARDL model in a manner that was more econometrically sound.

The representative of CARICOM noted that the subregion had been successful in its regional approach to health issues and suggested that the presenters focus their recommendations on what needed to be done to fast track that process. He expressed his discomfort with the prevailing tendency to predetermine discount rates, saying that as small States it was troubling to have a standard discount rate to deal with a range of sectoral issues.

Murray Simpson noted that while neither study took account of 'relative humidity' as a variable, it might be worth considering for its potential impact.

Review Team member, Wilma Bailey, commented that while the health study on Jamaica had justified the infectious diseases being considered, it was to be noted that chronic diseases were the major cause of illness and death. She suggested that the consultant look for the link to cardiovascular and heart disease and, referring to the relationship between gastroenteritis and rainfall, pointed out that the important fact was the compromising of water sources rather than actual rainfall.

One representative of UWI questioned the models used in the studies on Jamaica and Guyana and their projections over time. He asked whether population growth and its resulting demands had been taken into consideration as well as the effect of clinical action, such as early diagnosis and treatment, which could result in declining rates of disease. He posed the question, "What is the cost of a reliable water supply for the region?" given the prevalence of water borne vectors and suggested a reliable water supply as an adaptation approach.

A representative of UWI presented the third and final study on the health sector which focused on the economic impacts of climate change on the health sector of Trinidad and Tobago. The report presented an analysis of the impact of selected climate-related diseases, dengue, leptospirosis and food-borne illnesses on the health system. A model linking climate change to economic and health outcomes was employed to highlight the vulnerability of the country and its potential for resilience in the face of climate change. Empirical results were presented for climate and disease incidence and disease incidence was calculated under BAU, A2 and B2 scenarios. An economic valuation of the impacts on the health sector was presented along with adaptation and mitigation options and recommendations.

In the discussion following the presentation, Review Team member, Juan Llanes-Reguiro, commented on the need to determine whether links existed between temperature and precipitation, and some diseases within seasons, notwithstanding the findings of the IPCC.

The representative of CARICOM drew the meeting's attention to targets on water and sanitation set for the subregion in 2002, which had been declared as achieved in 2008, without sufficient documentation to explain the achievement, to underscore the need for proper documentation. In addition, he suggested that countries put economic incentives with respect to sanitation in place.

In his role as chair, Dave Chadee made the distinction between incidence and prevalence, observing that data presented in studies referred to incidence and not prevalence. He asked whether incentives, such as jobs and carbon credits, could not be given to communities to secure their buy-in to environmental programmes. Making communities the implementers of adaptation, he suggested, was a more sustainable approach than using governments. Referring to the association made between leptospirosis and forests, he noted that forests were reservoirs of leptospirosis and that there was a strong correlation between cases of leptospirosis and communities residing on the edge of forests. He asked consultants to consider whether there was a significant difference between Small Island Developing States (SIDS) and continental countries in the adaptation measures to be taken. Finally, he commended the presentation for its interesting ideas.

In response, Elizabeth Emanuel, Consultant, explained that both consultants had agreed to a compare the results for Guyana and Jamaica in the second draft of their studies, which would allow for a comparison between mainland and island countries.

Responding to a query of the initial choice of malaria for Guyana and dengue for Jamaica, Georgiana Gordon-Strachan, Consultant, explained that malaria was more important to Guyana because Jamaica had been declared malaria-free since 1965.

The representative of CARICOM, responding to the chair's question on the adaptation responses of SIDS and continental countries, stated that climate change data indicated that continental countries were going to be wetter, while countries in the Caribbean were going to be hotter. He suggested that consultants on the health sector deal with urban, rural and hinterland areas separately and suggested that ECLAC could focus on filling the data gaps identified.

Review Team member, Mark Bynoe, stated that malaria was always a major problem for Guyana, explaining that the growth of the mining sector, which engaged in open pit mining with its accumulation of water was a contributing factor. He emphasized the importance of separating such factors from climate change impacts and understanding the role of sanitation and hygiene issues in the sector.

Wilma Bailey, Review Team Member, drew the consultants' attention to research done by the Rockefeller Foundation in Guyana in the 1960s which made the association between improvement in health and a decline in malaria.

The chair brought the discussion to a close and thanked the consultants for their presentations.

**(a) General discussion (consultants and review team)**

A general discussion was held between consultants and members of the Review Team. As chair of that impromptu session, Mark Bynoe emphasized the importance of completing Phase Two of the project in 2011 and before the publication of the IPCC 5<sup>th</sup> Assessment Report to avoid obsolescence.

Review Team member, Juan Llanes-Regueiro, made the following recommendations and suggestions to consultants for the improvement of their reports:

- (a) Writing the report: get straight to the issues, avoid repetition and be sharply relevant; place definitions in an annex if necessary. Develop a matrix of cross-cutting issues and read other consultants reports on these issues
- (b) The Discount Rate: it was necessary to explain why one or the other rate was used, literature will be made available on how to use a discount rate, to help consultants' decision making.
- (c) Correct concepts: use terms weather and climate correctly, use scientific concepts and not common vocabulary, consult the study done by Jwala Rambarran with respect to concepts of adaptation and mitigation and use the IPCC 4th Assessment Report definitions.
- (d) Temperature: note the difference between terms such as 'low' and 'mean'.
- (e) Sea Level Rise: IPCC information on sea level rise is not yet available; consult Dr. Murray Simpson's Report, the UWI study on the Caribbean Sea and the study on the Caribbean Sea done by the University of Puerto Rico.
- (f) Linkages: the link between climate change and tourism is based on the deterioration in quality and quantity of ecosystem services, studies must put a value on those and not on reefs per se, to quantify the impact on tourism; consult Dickson's study on Bonaire done 20 years ago. Scenarios can include hurricanes but should not attempt to establish a direct link between these and climate change.
- (g) Cost benefit analysis: also use the concept of cost effectiveness, refer to the study done by the Independent University of Patagonia in Spain. Studies must use common metrics to allow comparability.
- (h) Accuracy of facts: the report must be accurate; IPCC only uses peer-reviewed studies so these must be conducted to be assured of the highest level of factual accuracy.

In the discussion which followed, consultants requested information on sources of data, clarification on the treatment of hurricanes in scenario analyses, the methodology for constructing the BAU scenario, and whether the climate change assumptions should be the same for all sectors of a

given country. Consultants were reminded of the CARICOM timetable for addressing issues of climate change, the region's 1994 recommendation that sea level rise be dealt with separately from climate change and the significance of coastal zones and their components for countries of the subregion because of their small size. They were also reminded to interpret correctly the requirements of the literature review and to use empirical studies in their reports.

A lengthy dialogue ensued on the approach to be taken in developing the BAU scenario, the need to establish a common base year of assessment for all studies and the determination discount factors.

Winston Moore suggested that the BAU should be arrived at by projecting the trend of the particular non-climate variables under consideration. The climatic relationship would be introduced in the A2 and B2 scenarios using econometric models. In light of contending interpretations offered by other participants, the Chair promised a response from the Review Team on the issue.

In the discussion on the discount rate, it was suggested that the level of uncertainty, type of assets and the saving rate were to be considered when making a decision and that the rate being applied in most studies was too low. It was explained that consultants had taken the rate of 5.0% and 4% from an ECLAC study conducted on the Caribbean and nearby regions. It was suggested that a rate of 1%-2% should ideally be used, however, an explanation and justification of the chosen rate would be required.

A discussion on the base year of assessment to be used in country studies veered between the choice of 2008 and 2009 used by most consultants, and 2003, officially used in Jamaica. The Chair observed that a common base year allowed for sector comparability among countries and would become critically important in the regional phase of the project. He stated that it was a decision to be taken by ECLAC and CCCCC.

#### **4. The economic impacts of climate change on the agriculture sector**

The first study on the economic impacts of climate change on the agriculture sector in Jamaica was given by Michael Witter, Consultant. The presentation focused on the methodology for estimating the impacts of climate change on the sector. Yam, sugar cane and scallions were selected and impacts estimated under the A2, B2 and BAU climate scenarios. Preliminary findings were presented on the estimates of potential impact and the challenges of adaptation.

The second presentation was given by Sharon Hutchinson, Consultant, on the economic impacts of climate change on the agriculture sector in Saint Lucia and Trinidad and Tobago. It focused on the characteristics and performance of the sector in both countries and examined the potential impact of climate change on cocoa, green vegetables, root crops and fisheries in Trinidad and Tobago and bananas in Saint Lucia. Model results were presented as well as forecasts of changes in agricultural output for the key subsectors under the A2 and B2 scenarios to 2050, and possible mitigation and adaptation strategies suitable for Trinidad and Tobago and Saint Lucia were outlined.

The third and final study on agriculture was presented by Claremont Kirton, Consultant, on the economic impacts of climate change on the agriculture sector in Guyana. The report determined that climate change was likely to affect agriculture in Guyana through temperature changes, increased sea levels, salt water intrusion, and increases in rainfall intensity, drought, and sea temperature changes. Available data for rice and sugar cane was examined and a basic production function framework used to model the effect of climate change on rice and sugar cane yield with control for several economic and technical non-climate variables.

Review Team member, Juan Llanes-Regueiro, commented that the link between climate change and agriculture was better established than in most other sectors and called for the issue of climate change and food security to be considered.

The water sector consultant, Eleanor Jones, questioned the second presenter's assertion that there were no extreme weather events in Trinidad and Tobago, noting that there were events of short duration but high impact such as floods, however, data collection was weak.

The representative of CARICOM observed that the agriculture sector was complicated because its subsectors constituted renewable and non-renewable resources, to which the same variables could not be applied, and for which more explanatory variables need to be added. Referring to the sugar sector in Guyana, he suggested more of a focus on drainage and irrigation as well as soil quality as explanatory variables.

The Economic Affairs Officer of ECLAC asked what environmental parameters were used for the fisheries analysis, what species were considered and whether average prices had been given.

Winston Moore noted the non-linear relationship between agricultural production and climate variables. He suggested the use of more than one unit root test in the Consultant's models for Saint Lucia and Trinidad and Tobago, and drew her attention to inaccurate terminology employed in the studies. He advised Claremont Kirton of the need to justify some of the terms used in the Guyana study and suggested that all the agriculture studies include a forecast evaluation.

In his response, Claremont Kirton acknowledged the importance of food security, which he said had been raised in Guyana's National Development Plan. He agreed that the sector was a complicated one and noted that the category 'other crops' was growing in importance in Guyana. He highlighted the fact that data on Caribbean fisheries was unsatisfactory and thanked Winston Moore for his comments.

Sharon Hutchinson agreed to include food security in her study and explained the need for data on rainfall intensity which differed from data on tropical cyclones. She stated that the study did not use environmental parameters, explaining the absence of relevant data except for air temperature and rainfall. Fisheries' categories, she explained, were 'artisanal and semi-industrial' for 'all species and all gear' and the prices given were ex-vessel.

The Economic Affairs Officer of ECLAC commented that environmental parameters for fisheries were completely different to those for agriculture, and included salinity, sea surface temperature, active chlorophyll and water currents. Rainfall data for the Amazon, she suggested, would be of more use than local rainfall for studies on regional fisheries. She drew reference to useful information on sea surface temperature and salinity done in 1974 for the Caribbean area stretching from Suriname to Colombia.

Michael Witter stated that the interpretation of food security had been shifting in the subregion over many years but had not been redefined in terms of policy. While he thought the issue to be intrinsically important, it was not clear from the terms of reference of the project that it should be included, however, there was first the need to agree on a definition of 'food security'. He explained that irrigation data was not normally disaggregated, that soil types has been taken account of and that the model used for the Jamaica study had been subjected to a technical peer review.

Mark Bynoe noted the need to make the distinction between food security and food sufficiency security including issues of nutrition which would be outside the scope of the project. He observed that not just cash crops but how small-scale holders were affected needed to be captured as there were implications for country output and food sufficiency. Highlighting the need for risk assessments in the studies, he recalled the extreme weather events of 2005-2008 in the subregion and the crop damage suffered.

The representative of Saint Lucia referred to anecdotal evidence from that country, that changes in rainfall patterns were not just affecting yield but quality and the timing of the agricultural

output. Sharon Hutchinson agreed to review quarterly data on temperature and precipitation to determine crop season duration changes.

Responding to the issue of food security, the representative of CARICOM suggested that consideration be given to the generally accepted orientation of that concept with respect to health, which factored in nutrition. It was an issue soon to receive the attention of the Council for Trade and Economic Development. With respect to the assessment of risk, he referred to a document emanating from a regional ministerial meeting which established an insurance mechanism for determining components in the agriculture sector which, he suggested, should be circulated. Referring to the generally reported inadequacy of regional data, he observed the necessity to upgrade meteorological and hydrological infrastructure and the need for advocacy in this regard.

Wilma Bailey commented that the Food and Agricultural Organization's commitment was to ensure that households met and satisfied their needs which did not only include local food production.

In his response, Michael Witter stated that yam and scallions were selected for his study in order to capture Jamaica's small rural farmer. He noted that the costs to the sector from extreme weather events were more associated with physical infrastructure than crop damage. He agreed that there were changes in the timing of crops and pointed to the need to tap into indigenous knowledge for such specifically local issues.

The representative of Guyana, in his role as chair, commented on the need to consider the rainy season and to note that drainage, irrigation and water reserve management were critical to coastal activity in Guyana. He stated that the country's agriculture plan included expansion and diversification both on the coast and inland, with a focus on 'other crops', a range of new crops resilient to extremes of weather and climate and for which there were available markets. He indicated that a seminar on 'Climate Friendly Agriculture' was at that time being held in Guyana, exploring new ways of thinking about agriculture which, he emphasized was critical to the diversification of the subregion's economy.

## **5. The economic impacts of change on the water sector**

The first presentation was given by Eleanor Jones, Consultant, and focused on the economic impacts of climate change on the water sector in Grenada and Saint Vincent and the Grenadines. The report considered the issue of climate change and water security and presented an economic analysis of climate change related impacts on the water and allied sectors over the next 40 years under the BAU, A2, and B2 scenarios. Adaptation and mitigation options were considered, as well as investment opportunities, with an analysis of relative costs and benefits and key recommendations.

Sharri Byron, Consultant, presented on the second and final study on the water sector, with the economic impacts of climate change on the water sector in the Turks and Caicos Islands. The report examined the factors that influenced the demand for water resources and the projected impact of climate change on water resources. Forecasts of the cost of climate change on the water sector were considered under the A2, B2, and BAU emissions scenarios. Residential and waste disposal water demand, irrigation water demand and industrial water demand were estimated along with the cost of identified adaptation and mitigation options in the sector.

In the discussion following the presentations, the representative of Saint Vincent and the Grenadines enquired about sea level rise in the islands of the Grenadines.

Winston Moore indicated that there was a standard approach to assessing the climate change impact on water users and recommended that the consultants read 'Managing Water Resources in the face of Climate Change' a paper authored by Farrell, Nurse et al. He also suggested the inclusion of the ratio of GDP to water consumption in the analysis.

The representative of CARICOM stated that a critical dimension in the water sector was forecasting, given that most Renewable Energy Sources would place a greater demand on water. He urged consultants to state their data set requirements clearly and informed them of several initiatives in the water sector being undertaken by CARICOM to arrive at a common water policy framework for the subregion.

Review Team member, Mark Bynoe, reiterated that water was a critical issue and noted the need for studies to focus more on the smaller Grenadines islands of Carriacou and Petit Martinique, which received water by barge, a fact which had serious implications for the cost of living as the situation was exacerbated. He referred to the Special Pilot on Adaptation to Climate Change, which provided some data for Union Island.

The representative of the Bahamas suggested that meteorological data for the Turks and Caicos Islands could be obtained from the Turks and Caicos Civil Aviation Authority. If this was not possible however, data could possibly be obtained from the Bahamas Department of Meteorology, due to the close proximity to the Southern Bahamas.

The representative of Saint Lucia reminded consultants that identifying the form and format of the data required was critical to data capture.

Review Team member, Juan Llanes-Regueiro, suggested that the term 'water production' be changed in the studies, because water could not in fact be produced and the representative of Montserrat enquired about the studies' consideration of the impact of salinity on water supply.

In response, the consultants on the water sector thanked participants for their comments and the first presenter, Eleanor Jones, acknowledged that sea level rise was of absolute importance to coastal aquifers and erosion in Saint Vincent and the Grenadines.

In closing the session, the Chair summarized that there was more to water than the issue of quantity, that the impact of extreme weather events on the sector should not be ignored and that climate change was not only affecting coastal areas but that there were emerging problems in the interior areas of countries. She urged consultants to collaborate widely and to consult the available data from recent regional projects.

## **6. The economic impacts of change on other sectors:**

### **(a) Transport; (b) Energy; (c) Coastal and human settlements; and (d) Coastal and marine**

Anston Jwala Rambarran, Consultant, gave the first presentation of the session which focused on the economic impacts of climate change on the transport sector in Barbados and Montserrat. The report examined the impacts of climate change on air transportation and sea transportation in both countries. An 'International Transportation Demand Forecasting Model' was presented and the variables included in the model identified. The total costs of air and sea transportation incurred for Barbados and Montserrat under A2 and B2 scenarios were estimated and some adaptation options for both air and sea transportation were presented.

The second presentation was given by Abdulahi Abdulkadri, Consultant, on the economic impacts of climate change on the energy sector in Trinidad and Tobago. An economic analysis of climate change-related impacts on the energy and allied sectors based on BAU, A2 and B2 scenarios was presented for the next 40 years. The costs of identified and anticipated impacts were estimated, several energy demand models were highlighted and an empirical model presented. Data included energy series from 1981-1997 and macroeconomic and climatological data from 1961.

Maurice Mason, Consultant, presented a study on the economic impacts of climate change on the coastal and human settlements in Barbados and Guyana. The report estimated the potential economic impact of the manifestations of climate change under the A2 and B2 scenarios. Climate

change impact variables included sea level rise (inundation and beach erosion), precipitation, temperature and increased frequency of high impact hurricanes. The economic cost of projected impacts was estimated as well as the adaptation costs of a projected one metre sea level rise.

The fourth presentation on the sector was on the economic impacts of climate change on the coastal and marine sector in Saint Kitts and Nevis and the British Virgin Islands. Troy Lorde, Consultant, presented an economic analysis of the projected impacts on the coastal and marine sectors under the A2, B2 and BAU climate scenarios. He included a valuation of coastal and marine services (biodiversity) and gave quantitative and qualitative estimates of climate change impacts on marine and coastal services as well as on coastal zones, including beaches and fisheries.

In the discussion which followed, the question was asked whether or not a cost benefit analysis had been conducted for the relocation of Guyana's coastal communities to the interior. Review Team member, Temisan Agbeyegbe, commented that the presenters on the sector had properly captured the BAU, having used historical data to determine a progressive trend and arrive at the best estimation of a BAU scenario.

Wilma Bailey commented on the first presenter, Anston Jwala Rambarran's, interpretation of transportation, saying that she would have preferred to see more emphasis in the early part of his study on people and goods carried.

The representative of Guyana stated that its sea wall cost Guyana US\$4,500.00 per metre, which constituted a major expenditure, but observed that resettling communities resulted in very few success stories. He noted that Guyana had been in a state of continual adaptation, which became more pronounced in the recent past due to the extreme levels of precipitation and resulting floods experienced in both the coast and hinterland regions from 2005.

In his capacity as chair, the Economic Affairs Officer of ECLAC called for more of an emphasis in the presentation on coastal and human settlements on the catastrophic possibilities facing Guyana. He suggested to Anston Jwala Rambarran that his estimates for the transport sector were necessarily low because there was no corresponding variable that picked up the feedback effect and recommended the use of confidence interval values in his model.

Maurice Mason responded that the cheapest option available to Guyana was to rebuild the sea wall. He observed that the costs estimated for the impacts on agriculture on the coast seemed to be miniscule compared to the human and social costs.

Anston Jwala Rambarran acknowledged the need to balance mobility and infrastructural issues in the transport study and agreed to search for a variable that would incorporate the feedback effect as recommended.

Murray Simpson drew attention to a study on the sea wall and coastal communities in Guyana done by the European Union (EU) in 2008 and emphasised the very important role of the Conservancy Dam, which he said must be taken into account. Referring to the infrastructure of international transportation, he stated that in the mid-level range of sea level rise there would be damage to 35%-50% of CARICOM sea ports, data which needed to be strengthened to inform regional tourism and communication interests, among others.

The Economic Affairs Officer of ECLAC noted that the coastal and marine presentation emphasized the data challenges existing and the need for more specific studies.

The representative of Saint Lucia asked Troy Lorde for more information on his use of World Resources Institute data and pointed out the importance of temperature and salinity variables for marine ecosystems. In his response, Troy Lorde agreed to consider other estimation techniques and to



take salinity into account. Abdulahi Abdulkadri said that he would develop a ‘what if?’ scenario for the supply side of the energy study that included renewable energy.

Responding to Michael Witter’s comments on the advisability of moving the centre of gravity in Guyana away from Georgetown, the Chair observed that the incentives were large in the case of Guyana to relocate some portion of the population, particularly those living near rivers. Juan Llanes-Regueiro suggested that two scenarios be developed for Guyana, one with the population on the coast and building the sea wall and the other relocating the coastal population to the interior. Both scenarios were to be developed with their associated costs and benefits.

## **7. Recommendations, conclusions and closing remarks**

Following brief discussions of their specific challenges, the consultants reported on recommendations and decisions adopted by each sector in going forward with the project.

The representative for the tourism sector indicated that: (a) a common approach to the BAU was agreed upon, (b) there would be modelling layers for all studies, (c) for sea level rise, the estimates provided by CARIBSAVE would be used and that forecasting evaluations would be included, (d) discount rates of 1%, 2% and 4%, which were low enough to take account of social factors would be used, and (e) 2008 would be taken as the evaluation year.

The health sector consultants agreed to include dengue, leptospirosis and respiratory diseases in the Guyana study and to consider dengue, cardiovascular disease and mental health in the Jamaica study. The model would review the best fit line for climate to ensure the best linear or quadratic fit. Scenario analyses would consider the case for fatality rate to estimate treatment and detection, 1%, 2% and 4% would be the discount rates applied, 2008 would be the base year, the studies would include confidence intervals, comparisons between Guyana, Jamaica and Trinidad and Tobago would be made, and the second draft of the studies would be submitted at the end of November.

The agriculture sector representative reported that the entire sector team at UWI, Mona Campus, would be briefed on the meeting and their feedback solicited. A work plan would be drawn up to complete the exercise and the consultants on the agriculture sector would collaborate with counterparts preparing other sector studies on Jamaica and Guyana.

The representative of the water sector indicated that the consultants had agreed on a common approach to their studies and that, with respect to the terms of reference, they would define potential and available water supply, look at water supply infrastructure, the hydrologic cycle and get data on water demand.

In bringing the meeting to a close, the Economic Affairs Officer of ECLAC observed that the meeting had moved further than had been anticipated regarding using the opportunity for dialogue and collaboration on common challenges. He urged participants to continue the dialogue and continue to learn from each other and emphasized the need for them to seek every opportunity to ‘ground truth’ data and enhance their understanding of realities by visiting the countries being studied.

He identified the broad conclusions of the meeting as agreement that the BAU scenario would be arrived at by trending out variables for particular sectors excluding climate change variables. It was also agreed to use discount rates of 1% to 2% and, where that was not feasible, to standardise the discount rates by consensus on a sectoral basis. He remarked that ECLAC and CCCCC had configured the meeting to achieve objectives and overcome challenges, using a strategic approach whereby it would seek to answer questions that would inform policymaking, and that had been achieved. On behalf of ECLAC he thanked chairpersons, consultants and delegates for their participation, the ECLAC team for their work, and indicated that the next meeting of the project would be held in March 2011.

In his closing remarks, Mark Bynoe gave 31 January 2011 as the completion date for the current phase of the project, by which time the national studies must be submitted. He explained that there were project timelines with implications for sourcing funds for the financial phase of the project, but that the first priority was getting national leaders to understand the context of the studies before developing the regional framework. He commented that while there was agreement with regard to the discount rate, at 1%-2%, it did not negate other options and noted that clarifications made to the BAU scenario, ensured that all the consultants would be able to progress towards completion of their studies. Reminding participants of the project objective of capacity building, he urged them to pay attention to that aspect by doing work in-country, stating that it was one way that policymakers would buy into the idea of climate change.

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