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Economic Commission for Latin America and the Caribbean  
Subregional Headquarters for the Caribbean

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Expert group meeting on modelling methodologies and practices to  
guide macroeconomic policies to enhance growth and efficiency  
while reducing economic vulnerability  
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**REPORT ON MODELLING METHODOLOGIES AND PRACTICES TO GUIDE  
MACROECONOMIC POLICIES TO ENHANCE GROWTH AND EFFICIENCY  
WHILE REDUCING ECONOMIC VULNERABILITY**

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## **A. INTRODUCTION**

1. The Economic Commission for Latin America and the Caribbean (ECLAC) Subregional Headquarters for the Caribbean, with Support from the Australian Agency for International Development (AusAID), implemented a project entitled “Development of Economic Frameworks in support of an assessment of the Economic and Social impacts of climate change in the Caribbean”. In implementing this project, it was expected that a Caribbean-specific model that would project and cost climate impacts would be developed.
2. ECLAC has convened this meeting to share the preliminary results of the research with technical experts in the area of econometric modelling. The objective of the meeting is to examine the assumptions underlying the Caribbean-specific model being constructed, the methodology employed and the parameters of the model as well as the robustness of the preliminary results. The ultimate aim of these series of meetings is to enable effective forecasting by national authorities so that a science-based foundation could be established for adaptation planning and policymaking.

## **B. SUMMARY OF MODELLING PROCESSES PRESENTED**

3. Three modelling processes were examined as follows:
  - (a) Climatic modelling in the Caribbean: In this session the context and background of climatic modelling in the Caribbean was explained. General Circulation Models (GCMs) were used to determine future climate changes. PRECIS (Providing Regional Climates for Impact Studies) was the regional modelling system being employed and PRECIS-Caribbean was now in its second phase at the 25km resolution.
  - (b) The T21 model of Jamaica: The modelling framework of the T21 model was described as being based on general system dynamics and included three sectors: the economy, the social sector and the environment. The model was explained as being comprehensive, integrated, transparent, forward-looking and customized to Jamaica.
  - (c) The Integrated Assessment Model (IAM) for the Caribbean: The methodology of this model is based on the standard GTAP CGE (Global Trade Analysis Project Computable General Equilibrium) core. The key components of the prototype model consist of a shock generator, a standard CGE model and a downscaling element to obtain more information on a particular country. A decision emanating from this model is that three ‘areas’ would be undertaken for the Caribbean region (Caribbean, Suriname and Belize) and downscaling would be done for certain countries depending on data availability.
4. The following strategies regarding the on-going project on developing economic frameworks in support of assessing the economic and social impacts of climate change in the Caribbean were established:
  - (i) Consultant should pursue whatever downscaling is possible to tease out country level information
  - (ii) Consultant must lay out carefully the assumptions that reflect the Caribbean experience especially as they relate to the sectoral coefficients in the first stage of the analysis
  - (iii) The sectoral spillover effects must be carefully identified and reported
  - (iv) The consultant should send a list of data requirements for the downscaling analysis
  - (v) Wherever possible country information should also be provided in addition to the regional analysis
  - (vi) The data sources and model set up must be carefully explained.

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

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

5. The expert group meeting on modelling methodologies and practices to guide macroeconomic policies to enhance growth and efficiency while reducing economic vulnerability was convened by the Economic Commission for Latin America (ECLAC) Subregional Headquarters for the Caribbean, on 22 August 2012 in Kingston, Jamaica.

### **2. Attendance**

6. Regional experts and resource persons attended the meeting. The Caribbean Community Climate Change Centre (CCCCC) and the Caribbean Community (CARICOM) were also represented. See Annex I for the list of participants.

### **3. Agenda**

7. The meeting adopted the following agenda:

1. Opening of meeting
2. Adoption of agenda
3. Climatic modelling in the Caribbean
4. The T21 model of Jamaica
5. The integrated assessment model for the Caribbean
6. Conclusions and recommendations
7. Closure

## **D. OUTLINE OF PROCEEDINGS**

### **1. Opening of meeting**

8. Welcome and opening remarks were made by Diane Quarless, Director, Economic Commission for Latin America and the Caribbean Subregional headquarters for the Caribbean. She indicated that she was pleased to be in Jamaica at this time and thanked participants for attending the meeting. Ms. Quarless stated that the purpose of the meeting was for developing economic frameworks to assess the impact of climate change in the region. She emphasised that the meeting provided an ideal opportunity to probe more deeply into modelling and modelling methodologies and to focus on a range of related issues. The key objective was to discern the economic and social impact of climate change on the Caribbean using a consistent framework. She also highlighted that there was a need to consider the win-win approaches to adaptation measures since they presented the most attractive methods to policy makers, who had multiple objectives to balance and fulfil.

9. The models being used were global models, which were not ideal due to the vulnerabilities that are characteristic of small island states. She stressed that one of the signal objectives of this project was to build a Caribbean-specific model to determine the impact of climate change and sea level rise on

Caribbean countries. Ms. Quarless pointed out that the challenge was to build models appropriate to the Caribbean region for the chosen sectors. She acknowledged the challenges of the data gaps and the limits that it placed on modelling, and concluded by stating that as the project moved forward, she hoped that the policy recommendations would be suitable for the region and be implemented.

## **2. Adoption of the agenda**

10. The agenda was adopted.

## **3. Climatic modelling in the Caribbean**

11. Mr. Abel Centella, Scientific Director, Institute of Meteorology (INSMET), Cuba, began his presentation by providing the context and background of climatic modelling in the Caribbean. He explained that General Circulation models (GCM) were the primary tools to answer the question as to how the climate will change in the future, and described the process of moving from a low resolution to a higher resolution or what is known as ‘downscaling’ using the technique of dynamical downscaling.

12. Mr. Centella explained that PRECIS was a regional modelling system that could be applied to any area of the globe to generate detailed climate predictions at 25 or 50 km resolution. Further, he stated that PRECIS-Caribbean was created in 2003, with Phase I being started in 2004, and Phase 2 now being developed to assess uncertainties and increase spatial resolution.

13. He emphasized the importance of Regional Climate Modelling (RCM) and provided information on three (3) main groups of experiments being carried out by INSMET, along with some of the results from these experiments. He pointed out that PRECIS-Caribbean Phase 2 would be undertaken at the 25 km resolution since adaptation strategies requires detailed spatial information at the regional, national and local levels. He concluded by presenting some results on temperature and precipitation changes until 2040.

14. The discussion began with the question of whether the output from PRECIS was treated for error. The response was in the affirmative. The important issue of the sea level rise at the regional level was then raised. It was pointed out that information on sea level rise would be at the global level and not from the PRECIS model at present, since it was necessary to have information related to other variables in the modelling process (for example, tectonic movements) when forecasting sea level rise.

15. The topic of extreme events was raised in connection with hurricanes and whether it was possible to generate data on such events. It was explained that while it was possible to generate information concerning hurricanes, it was a complicated process and the detection methods regarding hurricanes in the model had to be improved. The issue of the intensity of extreme events and its prediction was then mentioned. It was pointed out that climate change models produced results at the mean and although it may be forecast that the number of hurricanes shall increase under a particular model, the time and intensity of the hurricanes cannot be predicted. It was suggested that other available climate data (global) be used to complement the information from INSMET. It was also pointed out that while historical data assists with the accuracy of the prediction, such data was difficult to acquire in the region. The issue of using trends to determine climate change was broached, but it was emphasised that it was not the best strategy to examine climate change.

16. The session concluded with the undertaking by Professor Martin to share data for the climate change variables with the other consultants.

#### 4. The T21 model of Jamaica

17. Mr. Hugh Morris, an economist at the Planning Institute of Jamaica, initiated his presentation by explaining that the Threshold 21 (T21) model is a dynamic simulation tool which was the result of decades of research and application. He further indicated that the purpose of T21 was to support comprehensive integrated and long-term national development planning. He outlined the modelling framework of the T21 model in terms of its system dynamics, which consisted of stocks and flows (investment, capital depreciation), delays (input, lags output), non-linearity (per capita income and life expectancy) and feedback loops (positive and negative).

18. He stated that the T21 model was based on general development models with adapted sector models from the economy, the social sector and the environment. He highlighted the main features of T21 as being comprehensive (economic, social and environmental factors modelled), integrated (links the economy, society and the environment), transparent (modelling process can be traced), forward-looking (projects economic, social and environmental indicators and identifies possible opportunities and threats) and customised (includes modules unique to Jamaica).

19. He further explained the disaster module in particular and presented some results of the module. He concluded his presentation by emphasizing that the T21 model permitted the assessment of the impact of different policies and shocks in a comprehensive and integrated framework which provides results for economic, societal and environmental indicators.

21. The discussion commenced with questions about the macro Social Accounting Matrix and the T21 model, the informal sector, capital stock (specifically the value of environmental resources), the energy sector and health and health care. To address the issues raised it was pointed out that there was a macro SAM available for Jamaica, which utilized datasets from the year 2000 but that the T21 model was different and consisted of three aggregated sectors. These aggregated sectors in the model may deal with the issues raised in various ways. As an example, the issue of health and health care would be addressed as it relates to human capital and life expectancy since there was a mortality module in the T21 model. All other issues, which were outside the purview of the included sectors, required additional modules and specific software.

22. In response to a question on the classification of the model, the presenter stated that T21 was a dynamic model, which employed features (outputs) from CGE models as modules to project the future. As an example, while hurricanes were included in the model, other hazards (for example, a drought) were dealt with by including the output of various studies in the model.

23. In response to a concern raised regarding the usefulness of T21 as a planning tool, the presenter indicated that the model was indeed useful and was employed to examine the outcomes and implications of new projects and policy measures. The government then used the information generated to inform their actions. He revealed that there was evidence to show that the T21 model had been used by politicians in the decision-making process.

24. It was pointed out that the model originated from the Millennium Institute and that it could be customized for any particular country based on country-specific data and the issues faced by the particular country. Detailed information on the T21 model could be found at: [http://www.millennium-institute.org/integrated\\_planning/tools/T21/](http://www.millennium-institute.org/integrated_planning/tools/T21/). The software used for running the model was Vensim and a free version was available at: <http://www.vensim.com/freedownload.html>. The presenter indicated that he used the more advanced version of the software to run the T21 model.



25. One of the other key issues raised was the level of detail that could be obtained from the model's results and the links and implications for the social sector. It was emphasised that the capabilities of this model depended on the data available. An important concern was whether the model could incorporate mitigation. The presenter stressed that mitigation could be included in the modelling process, but that it would require information on the type of mitigation, the cost of the measure and the impact on infrastructure.

26. The session concluded with the question on whether other Caribbean countries were using the model and the possibilities for future use in the region. It was noted that at present no other Caribbean countries were using the model, but that Saint Lucia was a possibility and other Caribbean countries could make requests to the Planning Institute of Jamaica for possible future use.

### **5. The integrated assessment model for the Caribbean**

27. Dr. Roberto Roson, consultant, presented a modelling framework for assessing the economic impacts of climate change in the region. He began his presentation by indicating that the overall approach taken was one built upon methodology experimented at the "Abdus Salam" International Centre for Theoretical Physics (ICTP) and the World Bank, which involved inputting damage functions into Computable General Equilibrium (CGE) models.

28. The consultant outlined the key objective of the IAM as being to analyze the economic impacts of climate change in the Caribbean. He continued by stating that the general equilibrium framework would provide system-wide effects and show linkages among markets. He stressed that the model would be cross-cutting and was expected to permit the assessment of multiple impacts simultaneously.

29. He pointed out that the methodology relied on the standard GTAP CGE core and explained the components of the prototype model as follows:

- (a) Shock Generator: an excel spreadsheet (included parameters, shocks, SRES, and AuxData) used to select the climate scenario to generate shocks and exogenous changes. The output from this element was used as an input into the next component
- (b) Standard CGE model: the core model was not developed to take into account the climate in particular, so the strategy was to interpret the climate shock as a special shock
- (c) Downscaling: this would be done to obtain more information on a particular country

30. The consultant indicated that the inputs for the components of the model consisted of the following:

- (a) LibreOffice or OpenOffice software suite (Calc)
- (b) RunGTAP program
- (c) Generator.ods
- (d) JAM-downscale.ods
- (e) Specially aggregated SAM database from file GTAP 8/07 (eclac07.zip)

31. The session became interactive as the consultant proceeded to give a practical demonstration on how the model worked.

32. The CGE core model takes into account the systemic effects of climate change impacts, which propagate throughout the whole economic system, beyond the specific region or the specific industry which may be initially affected. A major advantage of this approach is the availability of a platform for consistently assessing a number of heterogeneous impacts of climate change, for which studies are

available only at the sectoral level, and can hardly be compared. It is also possible to assess the interaction between climate change adaptation/mitigation policies with other economic policies.

33. The consultant showed how a typical CGE model could be employed using a program he developed. He showed the output of the macro program which was in the form of a text file.

34. He used the RunGTAP program to operate the CGE model and provided a short description of the components of the program. He concluded his presentation by demonstrating how equations and parameters may be altered in the model by using Generator and JAM-downscale.

35. The discussion commenced with questions about how Caribbean countries would be featured in the model. The consultant stated that he was using the latest version of the GTAP (version 8, 2007 data) model but it was still not possible for the Caribbean region to be divided into smaller parts or according to individual countries, due to the composition of the GTAP datasets. He added that he would use the output of the model and auxiliary data to generate country-specific cases for certain countries according to data availability.

36. Concerns were raised as to the source of the data employed in GTAP and whether there was some way of verifying the data. The consultant indicated that he was uncertain about the source of the data and there was no real way to validate the dataset. The suggestion of comparing data from individual countries with the GTAP dataset was proposed. It was recommended that a note be included in the ensuing report to reflect the source and method of verification of the dataset. Additional notes should also include how the region was composed and how the various sectors were represented in the model.

37. It was stated that there was the need for an institutional framework at the regional level within the model so that linkages among sectors could be made, since it was one of the ways that policy could be informed and coordinated within the region. The consultant indicated that he would start with the standard GTAP model and add other elements as necessary. He pointed out that in the practical example JAM-downscale was used to change the equations and add to the model.

38. The issue regarding the source of the parameters in the practical example was raised. The consultant explained that all parameters employed in the model were obtained from existing studies. The concern of how technology entered the model was also broached. The consultant revealed that technology entered the model through the cost structure in the model and its subsequent changes.

39. The sensitivity of the parameters to the Caribbean region was then discussed. The consultant explained that the results obtained would vary according to the variables entered into the model. He further added that the model could generate a result on sensitivity with regard to the parameters and shocks in the model. It was also possible to change a particular value (or set up shock sensitivity) for the shocks due to a specific variable and a systematic sensitivity analysis could also be obtained from the model output.

40. The session ended with the decision that three 'areas' would be done for the Caribbean region (Caribbean, Suriname and Belize) and that some downscaling would be undertaken for certain countries (for example, Jamaica and Trinidad and Tobago) depending on data availability.

## **6. Conclusions and recommendations**

41. Dillon Alleyne began with the comment that the presentations regarding modelling being done in the Caribbean were interesting and informative. He then turned to specifically addressing the IAM for the Caribbean, which was presented by Professor Roson. He emphasized that the purpose of the session was to delve into the 'nuts and bolts' of the modelling process for the IAM in preparation for the first report from

the consultant. He pointed out that the model must deal with Caribbean-specific characteristics and that the consultant needed to grapple with this problem and also draw on the work of the other colleagues who were undertaking partial analysis on the various sectors in the region. He stressed the need for consistency among the studies and for a document that outlined the composition of the models and interpretation of the results and parameters in a clear, transparent way.

42. He underscored the need for the consultant to submit the input requirements for the model to ECLAC so that the model may be guided to becoming more Caribbean-specific. He noted that there were opportunities for tinkering with the model and there was a rich menu of results which could be obtained from the model. He underlined the need for a weightier report from the consultant regarding the model. He suggested that the work done by ECLAC in the first phase of the climate change project be consulted.

43. He concluded by indicating to the consultant that ECLAC would send a list of expectations /requirements for the report based on the meeting notes. He further added that in the future the report would need to be downscaled when being presented to the policymakers.

## 7. Closure

44. Charmaine Gomes brought the meeting to a close by individually thanking each of the presenters for their highly informative presentations on modelling and climatic modelling in the region. Participants were asked to submit their comments regarding the IAM in writing after they have had an opportunity to further consider the consultant's presentation on the model.

45. She indicated that the next meeting on modelling would be held in Saint Lucia on 17 October 2012, with the final meeting on assessing the economic and social impacts of climate change in the Caribbean being held on 16 October 2012. *She asked participants to note that these dates may change to the 18 and 19 October, respectively.*

46. She reminded participants that the next preparatory meeting would be held in Cuba from 4-5 September 2012.

**Annex I****LIST OF PARTICIPANTS**

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