CARIBBEAN AGRO-METEOROLOGICAL INITIATIVE

Progress Report

November 30th 2010

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CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Contents

List of Acronyms

CAFAN	Caribbean Farmers Network
CARDI	Caribbean Agriculture Research and Development Institute
CCCCC	Caribbean Community Climate Change Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organisation
CTA	Technical Centre for Agricultural and Rural Cooperation
IICA	Inter-American Institute for Cooperation on Agriculture
NMHS	National Meteorological and Hydrological Services
NOAA	National Oceanographic and Atmospheric Administration
RCOF	Regional Caribbean Outlook Forum
USGS	United States Geological Survey
WMO	World Meteorological Organisation

CARIBBEAN AGRO-METEOROLOGICAL INITIATIVE

FED/2009/217069

Project number:	**GRANT No. FED/2009/217069**
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Contact Person:	**ADRIAN TROTMAN (Project Coordinator)**
Staff:	**SHONTELLE STOUTE (Technical Assistant)**
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I. PROJECT SUMMARY

Goal

To increase and sustain agricultural productivity at the farm level in the Caribbean region through improved dissemination and application of weather and climate information using an integrated and coordinated approach.

Project objectives

Assist the farming community in the Caribbean region through provision of information through the regional network of Meteorological and Agricultural Services and research institutes on predictors of the rainy season potential and development of effective pest and disease forecasting systems for improved on-farm management decisions; preparation and wide diffusion of a user-friendly weather and climate information newsletter and organization of regular forums with the farming community and agricultural extension agencies to promote a better understanding of the applications of weather and climate information and to obtain feedback to provide better products from the meteorological services for use by the farming community.

Activities

- Training of personnel of the participating meteorological and agricultural services and research institutes in relevant aspects of agrometeorology, climate and crop modelling.
- Analysis of rainfall and development of predictors of the rainy season potential and provision of near-real time weather information for improved crop management.
- Developing an effective pest and disease forecasting system through improved crop monitoring and use of modelling approaches.
- Rescuing of hard copy data and entry into CIMH database
- Preparation and wide dissemination of a user-friendly weather and climate information newsletter for the Caribbean farming community.
- Organisation of regular fora with the farming community to promote a better understanding of the applications of weather and climate information.

Partners include the National Meteorological and Hydrological Services (NMHSs) of Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St Vincent and the Grenadines and Trinidad and Tobago under the overall coordination of the Caribbean Institute of Meteorology and Hydrology (CIMH) and the World Meteorological Organization (WMO). CARDI is the Regional Institute collaborating in this Action**.**

Target Countries

Caribbean region.

Beneficiaries

This initiative is expected to benefit the farming and wider agricultural communities in the ten CAMI countries and Caribbean Region (about 1.4 million) as a whole.

Expected outcomes

- Improved ability of policy makers and farmers to fully exploit the rainy season
- Better informed farming community regarding the climate situation before and during the crop growing season.
- Improved capabilities in the farming community to make strategic and tactical decisions for soil, crop and irrigation management
- Enhanced capacity of the farming community to understand and apply weather and climate information in their operational decisions.
- Enhanced linkages between meteorological services and agricultural research and extension agencies.
- Increased interactions between meteorological services, agricultural extension agencies and the farming community resulting in the provision of better services to farmers.
- Enhanced capacity of meteorological and agricultural services and research institutes in agrometeorology, climate and crop modelling

II. PROGRESS TO DATE

Steering Committee Meetings

The First Steering Committee meeting of the Caribbean Agrometeorological Initiative was held on August 9 and 10 2010. On the first day, the meeting was held at the campus of the Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados. On the second day the committee members met with officers of the Ministry of Agriculture at their Headquarters in Graeme Hall, Christ Church, Barbados.

Please see full report at Annex 1

The second Steering Committee Meeting is scheduled for the first week in December 2010.

Stakeholder Meeting

The first Stakeholders Meeting took place on 11 February 2010, at the offices of the Caribbean Institute for Meteorology and Hydrology and marked the launch of the project. It involved meteorological and agricultural personnel from the ten project countries.

Other invited non-partner institutions included the Caribbean Community Climate Change Centre (CCCCC), the Caribbean Disaster Emergency Management Agency (CDEMA), the Caribbean Meteorological Organization (CMO) Headquarters Unit, the Inter-American Institute for Cooperation in Agriculture (IICA), the United States Department of Agriculture (representing as key note speaker) and the European Commission Delegation in Barbados and the Eastern Caribbean.

Please see full report at Annex2

Regional Technical Workshops

The first regional workshop entitled 'Rainy Season Predictors and Interpretation and Management Workshop', took place at the offices of the Caribbean Institute for Meteorology and Hydrology from June 15th to 19th 2010.

The purpose of this workshop was to assist the NMHSs of the ten Caribbean countries involved in this Action to develop relevant products applicable to agriculture through the analysis of rainfall (and temperature). CARDI also took part in this training. This training, which involved the proposed statistical approach, was conducted by Dr. Roger Stern of the Statistical Services Centre of the University of Reading, globally recognized for his statistical applications in climatology. Apart from the theoretical training much of the focus was on providing guided hands on activity.

Through CAMI's interest in seasonal rainfall prediction, the project developed synergy with a NOAA/USGS meeting that was hosted by CIMH which focused on re-establishment of Regional Climate Outlook Forum (RCOF). CAMI participants stayed on for this workshop, which ran from 21-23 June, 2010.

The full report is attached at **Annex 3**.

Data Rescue

As at November 30, 2010 the data rescue exercise was completed for six of the ten countries. Staff of the CIMH visited Guyana, Grenada, St. Lucia, St. Vincent and the Grenadines and Antigua and Barbuda to complete the data recovery process. The intention is to continue this activity during year two as the remaining partner countries prepare themselves, while seeking to overcome some challenges to this effort. (See **Relationship with State Authorities**).

Training Attachments

Three CIMH staff members visited the University of Reading in the UK, to take part in a training attachment that expanded their statistical analysis skills. The Training furthered the application of the INSTAT and GENSTAT packages introduced at the training workshop held in Barbados.

See **Annex 5** for the full report.

Other Workshops / Seminars attended by Project Manager

Presentations made on the CAMI Project by Project Coordinator

"From Strategic Plan to Implementation" presented at the conference on **Climate Change and Agriculture in the Caribbean: Protected Agriculture – An Adapatation Option** 17-19 October 2010, Grenada. Sponsored by the CTA and CARDI. This was one of the conferences as part of the annual Caribbean Week of Agriculture held in Grenada. The presentation discussed the birth of the CAMI concept, which was embedded in a strategic plan developed for agrometeorology in the Caribbean, to the point where it is being implemented.

"Weather and Climate Information for policy making and on-farm decision making" at the **Seminar for farmers of the Barbados Agricultural Society.** This seminar was prompted by agricultural losses from weather and climate phenomena in Barbados during the year. Hurricane Tomas was the most recent of these, but losses earlier in the year were catastrophic from drought; and flood once the drought was over. It was a year of weather/climate –related losses. The presentation showed how CAMI through the provision of information to farmers and the wider agricultural community will be able to reduce such losses as well as reduce the costs of inputs on farms.

Added to these Mr. Gary Ramirez, the CAMI focal point for the Ministry of Agriculture Belize, wrote an article on CAMI in Issue 9 of the Belize Ag Report (Nov-Dec 2010). A copy of this article is attached at **Annex 6**.

III. MANAGEMENT

The Project is being coordinated by Mr. Adrian Trotman who is the Agrometeorologist and Chief of Applied Meteorology and Climatology (Ag.) at the CIMH.

Ms. Andrea Applewhaite, the Administrative Assistant officially assumed duties for the project on 01 April 2010. With the hiring of Shontelle Stoute as Technical Assistant on 03 May 2010 the Project Implementation Unit is now fully established and has already commenced working towards ensuring the timely completion of the project.

IV. BUDGET AND FINANCIAL IMPLEMENTATION

64.74% of the estimated total eligible cost of the action will be financed by the contracting Authority.

Local Counterpart is approximately comprises contribution from CIMH along with the Caribbean Agricultural Research and Development Institute (CARDI) and the Meteorological Services of the ten participating countries.

V. WORKING PLAN FOR 2011

Data Rescue – this aspect of the Action continues during 2011 with capture of data from the remaining 4 countries. Entry of data into a format compatible with CIMH databases by the CAMI data entry staff will also continue until April 2011.

Farmers Forums – These forums form the essential link between the meteorological entities with their information and the farming communities. The forums are expected to break the barriers between these two groups and begin meaningful dialogue that would result 1) in a better understanding of weather phenomena and the application of weather information by farmers and 2) a better appreciation for the weather related needs of the farming community

Pest and Diseases modeling – Late in year 1 of the Action there was a search for an expert to develop a needs assessment for the region in weather and climate related pest and disease modeling. This activity continues during December 2010 with meetings in Belize and Jamaica between the CAMI consultant, CARDI specialist, Ministry of Agriculture Officials (entomologists, pathologists, agronomists, extension officers) and farmers. A second round of visits is anticipated for the eastern Caribbean in January 2011. It is expected that the findings of the assessment be presented at a training workshop during the first or second quarter of 2011. As proposed, personnel from CARDI and CIMH will be trained during an attachment at an international institution.

Crop Simulation Models - Training for regional meteorologists in the use of crop simulation models is anticipated to take place in late 2011. Experts in the DSSAT software from the United States and the APSIM software from Australia are expected to conduct these training workshops.

Publications and Communications Strategy - During the first half of 2011 there will be a training workshop on developing agrometeorological bulletins and newsletters catering to the farming and agricultural communities. Discussions on the development of a Communications Strategy for weather and climate information for the farming community will commence during this workshop.

Rainfall Analysis – CIMH and CAMI staff has developed a demonstration document of rainfall and temperature analyses as an example for CAMI National Meteorological Services to follow. As more analyses are done during 2011, this demonstration document will be updated. Once the publications workshop has been completed, more routine analyses will be included for NMHS to include in their bulletins and newsletters.

Changes were recommended to the proposed action plan which may affect year two programming. These changes are yet to be approved.

VI. FUTURE PERSPECTIVES

Spin-off projects and initiatives – Statistics in Applied Climatology – CCCCC

- Re-establishment of RCOF

As word spread about CAMI throughout the region via presentations and discussions, other global and regional initiatives sought to develop synergies with CAMI. These particularly included 1) the re-establishment of the Regional Climate Outlook Forum, 2) the potential introduction of the global Agriculture Risk Insurance Training Programme developed by the World bank and funded by EU AAACP programme, 3) the development of the First Caribbean Statistics In Applied Climatology (SIAC) Programme.

1) Re-establishment of the Regional Climate Outlook Forum – The National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS) teamed with CIMH and the CAMI project in a workshop on seasonal climate forecasting. As agriculture is one of the sectors that stand to benefit climate forecast, the workshop provided the exposure that CAMI wanted for its rainfall workshop participants. It allowed the CAMI workshop to place greater emphasis on rainfall statistical analysis. Activities in re-establishment of the forum are expected to continue in 2011 with funding being sought from the United States government.

2) The World Bank launches its global programme in Agricultural Risk Insurance training. With word on the work being done by CIMH and the CAMI project, the CAMI coordinator was approached about introducing this training in the Caribbean for Meteorological Services and Financial and insurance companies to be exposed to weather index insurance for farmers. The CAMI Project Coordinator will attend the launch workshop at the offices of the World Bank in Washington, DC during December 2010. It is anticipated that this training will be introduced in the Caribbean in 2011.

3) At the end of the Rainfall Analysis workshop in June 2010, participants wanted to delve even further into the statistics and the two software packages (INSTAT and GENSTAT) to which they were exposed. In pursuing discussion on this with the Caribbean Community Climate Change Centre (CCCCCC) and the University of Reading, UK, the region proposes to launch a training programme in Statistics in Applied Climatology in 2011. With funding from the United nations Institute for training and Research (UNITAR) managed by CCCCC the programme will be launched with the introduction of the e-SIAC course (http://www.reading.ac.uk/ssc/courses/siac/index.html) at the end of January 2011.

It is proposed that the Pest and Diseases Modeling and Publication workshops will be held together to reduce spend on airfare.

Last stakeholder and steering committee meetings will be held together in Jamaica again to reduce spend on airfare.

The USDA will be contracted to perform an evaluation of the project.

VII. PARTNERS AND OTHER CO-OPERATION

Working relationships existed amongst the Meterological partners of this action for many decades. The countries represented by National Meteoroloical Services in this Action are ten of sixteen member states of the Caribbean Meteorological Organisation of which the Caribbean Institute for Meteorology and Hydrology is the Training, Research and data archiving arm. At least 80 % of the staff of CMO NMHS were trained by CIMH. Also, CIMH is a WMO Regional Training Centre and collaborates on many initiatives with WMO.

The NMHS (except Grenada) are contributing members of WMO. So there has already been an atmosphere of trust in collaborating which continues in CAMI. CARDI, and agricultural research and development institution does not share the history with the Meteorological Services, but as a Caribbean Regional Organisation, has a longstanding relationship with the CIMH, the applicant and the CAMI project coordinator. Such a history of collaboration and atmosphere of trust is paramount for successful implementation of projects. Communicating on the Action because of these has been very cordial as the main players are quite familiar with each other.

The benefit of the Action allows for collaboration in an area of meteorology that there is not as much collaboration and this marks a key breakthrough in the region in agrometeorology. This provides an opportunity for the NHMS to develop similar relationship with agricultural institutions including CARDI.

Relationship with Other non-Partner Organisations

As the regional agricultural research institute, CARDI has a longstanding working relationship with agricultural Ministries and departments, providing R & D in many aspects of agriculture. This work has involved working with the farming community in many initiatives. National Meteorological Services are often called upon by their agricultural ministries to provide climatological data and information as well as forecasts. Whereas in the past some of the

member states issued farmers forecasts, only Belize now has a routine agrometeorological forecast. Prior to CAMI, dialogue with the agricultural community was on an as needed basis.

CAMI has provided the forum for Meteorological Services and agricultural entities to engage in meaningful discussions as to the needs of the agricultural policy makers and farmers, whilst also providing an avenue for meteorologist to outline their capacities for provision of information. During the first year of CAMI, this dialogue has taken place between meteorologists and agriculturists to a large extent. There had been some discussions during the Stakeholder Meeting with representatives of the Caribbean Farmers Network. However, engaging the farming community in such discussions will take place in earnest from year two during the farmers' forums.

Relationship with State Authorities

The major State Authorities with which CIMH interacts within this Action are the National Meteorological Services and their relevant Ministries. These relationships have been very strong for many decades and have been discussed previously. The other major sector authorities with which the Action requires CIMH to interact are the Ministries/Departments of Agriculture. In some countries (for example Barbados and Guyana) the NMHS are already administered by the Ministries of Agriculture. In the other cases, the strength of the relationship varies with strong history of interaction in some cases and weaker ones in other cases. But in all cases CMH have had some level of direct interaction with the Ministries of Agriculture in the past, whether through our training or research programmes or as a result of installing or calibrating their instruments.

The primary concern during the Action is the pace of the data rescue, which has more to do with tracking or accessing some forms of paper data than any relationship with State Authorities. For example, in the case of Dominica, authorities have reports of station records, but likely due to poor record keeping the exact location of the data has not yet been determined. In the case of Trinidad and Tobago, data exist in a room in the Water Resources Authority. It has been reported that this data has been locked away in a room for many years that have been flooded during a rain storm earlier in the year. This room has been classified as a bit of an environmental hazard and some of the paper data may have to be cleaned before capturing. We may find that there may be similar concerns with the data in other countries, for example Dominica. In these cases, what is required for the capture of such data may go beyond what CAMI can provide. CIMH is currently seeking funding through other channels to tackle these very difficult cases to augment what CAMI can make available.

There have also been the odd occasion where staff could not have been released or were unavailable to attend a meetings/workshops. These three cases were because of internal circumstances rather than relationship issues. Such occurrences are to be expected during and Action. For example, the Rainfall Analysis workshop came days after a General Election in Trinidad and Tobago, and where the Meteorological Officer was released the new Authorities were still in the very early process of assessing its workforce and determining its strategy and therefore a Ministry of Agriculture person was not released.

Other than these, Ministries of Agriculture have been very responsive and keen to take part in the Action. They have taken part in the Stakeholder meetings and joined the Rainfall Analysis workshop (apart from those countries affected by the strike action of the regional airline carrier) for the last two days as designed.

CIMH and Relationship with others

Subcontractors

The relationship with the Statistical Services Centre (SSC) of the University of Reading, and in particular Dr. Roger Stern, is not a new one. Staff from CIMH (Mrs. Lisa Kirton Reed, Ms. Lisa Agard, and Mr. Anthony Moore) involved in this action have graduated from the SSC programme in Statistics in Applied Climatology. Staff of other CAMI partner institutions (the National Meteorological Services of Dominica, Trinidad and Tobago and St. Vincent and the Grenadines) involved in this Action have also been graduates of this programme. Also, the project coordinator was a student of Dr. Stern in Statistical Climatology during his graduate degree at the University of Reading. It is this wealth of world renowned experience in the field that CAMI sought to draw upon. This, we think went very well to the point where, because of this initial CAMI effort, a full programme is begin developed with the SSC in Statistics in Applied Climatology in collaboration with the Caribbean Community Climate Change Centre.

Farming Community

CIMH does not have a strong history of dealing directly with farmers. As a regional organization, CIMH tends to have more of a working relationship with agricultural ministries, with the

intention that national Meteorological Services and Agricultural Extensions Services will deal directly with the farming communities in their respective nations. This has not been successful in the region since information is not being tailored for the farming community – hence the genesis of CAMI. However, due to CAMI, CIMH has developed a relationship with the Caribbean Farmers Network (CAFAN) and some its national associates (e.g. the Barbados Agricultural Society and the Trinidad and Tobago Agricultural Society). It is expected that the relationship with this group would grow even stronger once the farmers' forums begin in 2011.

VIII. VISIBILITY ACTIONS

Banner designed for use at all meetings.

Posters developed and sent to all partners

Brochures created and sent to various organizations. Most brochures to be distributed at the farmers forums

All contain the EU logo prominently displayed.

IX. ANNEXES

Annex 1

REPORT OF THE FIRST

CARIBBEAN AGROMETEOROLOGICAL INIATIVE (CAMI) STEERING COMMITTEE MEETING

9 - 10 February, 2010

Prepared By: Mr. Adrian Trotman
Agrometeorologist, CIMH
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Meeting of Steering Committee

The First Steering Committee meeting of the Caribbean Agrometeorological Initiative was held on 9 and 10 August 2010. The first day was held at the campus of the Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados. On the second day the committee members met with officers of the Ministry of Agriculture at their Headquarters in Graeme Hall Christ Church, Barbados.

The committee was welcomed during a brief presentation by the Principal of CIMH, Dr. David Farrell. He remarked on the timeliness and importance of the CAMI project and wished the committee well in its decision making as it sought to move the CAMI project forward, particularly during its first year.

After members introduced themselves with their brief professional backgrounds, the tone for the meeting was set by a presentation on the project and the background to its development by Project Coordinator, Mr. Adrian Trotman. The presentation informed the committee of the strategic plan for agrometeorology, developed for CIMH as well as the WMO/FAO (World

Meteorological Organization/Food and Agriculture Organization of the United Nations) Seminar on the Application of Climate Data for Desertification Control, Drought Preparedness and Management of Sustainable Agriculture in the Caribbean Region held in 2004 in Antigua. It was at this meeting that the concept for CAMI was discussed and subsequently developed. The Science and Technology Programme of the ACP was seen as a real opportunity to finally get the region's agrometeorology agenda started in a meaningful coordinated way. Mr. Trotman also reminded the committee of the specific activities of the CAMI project which include:

• Development of predictors of the rainy season potential characteristics through analysis of long-term climatic data and use of seasonal to inter-annual climate prediction models.
• Interpretation of the climate predictor and near-real time weather information to support management decisions, especially irrigation scheduling.
• Working with the agricultural research and extension agencies in developing an effective pest and disease forecasting system.
• Preparation and wide diffusion of a user-friendly weather and climate information newsletter for the farming community.
• Organization of regular forums with the farming community and agricultural extension agencies to promote a better understanding of the applications of weather and climate information.
• Building capacity of the Meteorological and Agricultural Services and research institutions.
• Data Rescue.

These were discussed during the meeting. A summary of the discussions is as follows:

• Data Rescue – committee members from meteorological services pledged its support in sourcing the paper data to be archived. Some perceived some challenges in obtaining all the data from sources that may not be as cooperative. Belize suggested that most f not all of its data from its stations are already digitized.
• Rainfall Analysis and Seasonal Climate Forecasts – due to the proposed topics to be covered (e.g. analysis of dry days, dry spells, and rainfall extremes) under rainfall analysis, Dr. Roger Stern of the Statistical Services Centre (SSC) of the University of Reading, U.K., was recommended as one resourceful person capable of providing the desired results. His experience and the staff of SSC were internationally renowned for training in this area. There was however some concern as to whether one trainer that can be sourced that can provide such rainfall analysis and still be verse enough in seasonal climate forecasting and modelling. It was agreed that this be raised with Dr. Stern. It was also agreed that the subsequent attachment of CIMH staff to build upon the work started at the workshop should also be done at the University of Reading. It was however agreed that the WMO representative Mr. Stefanski will initiate contact with Dr. Stern.

• Pest and Disease – the project coordinator suggested that of all the outputs to be achieved this one could be the most challenging due to the data demands, the diversity in pests and diseases and the dearth of experience in the region on this topic. Mr. Stefanski (WMO) however suggested that there was a wealth of experience in the United States and we can seek assistance from the US Department of Agriculture (USDA). He also suggested there is some experience in Europe, e.g. in Italy. WMO will assist in sourcing potential scientist/research centres later in the year. CARDI is expected to be a pivotal organisaton in this regard.

• Crop Weather Models – The project coordinator informed members that Decision Support System for Agrotechnology Transfer (DSSAT) and Agricultural Production Systems Simulator (APSIM) models were being targeted for training and use under the project. DSSAT developed in the USA by the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) project with further development through collaboration among scientists from the University of Florida, the University of Georgia, University of Guelph, University of Hawaii, the International Center for Soil Fertility and Agricultural Development, Iowa State University and others. APSIM was developed by Agricultural Production Systems Research Unit (APSRU), Australia. The committee was informed that DSSAT was already introduced to the region through training sponsored by the Caribbean Community Climate Change Centre, but it was thought that the region needed more than this introduction to be meaningfully used in the region, and that it was best to be trained by those who developed and continue to develop these models. This will be developed during the 2nd and 3rd years of the project. It was agreed that trainers for this course should come from University of Florida or Georgia (in the case of DSSAT) and the Commonwealth Scientific and Industrial Research Organisation of Australia (in the case of APSIM).

• General Agrometeorology and Crop Water use – there was brief discussion on this, but mention was made of Luis Pereira of Instituto Superior de Agronomia Lisbon, Portugal as a potential trainer. Dr. Pereira co-authored the popular FAO text on "Crop evapotranspiration - Guidelines for computing crop water requirements" and was one of the trainers at the regional drought and desertification meeting where the CAMI concept was born.

• Farmers Forums – even though expected to be a 2nd and 3rd year activity, there was some discussion on the much anticipated forums. These forums were expected to follow the climate field schools already carried out in parts of Africa.
Members were informed that national meteorological and agricultural extension services as well as CARDI are expected to participate in the forums. Much further discussion will be made on this during the 2nd Steering Committee meeting where plans for the forums will begin.

• Newsletters and Bulletins – this is seen as a critical part of the project as it determines the success of the process of communicating the information to the users – farmers, Ministries of Agriculture and Agro research entities. It is hoped that CTA communications division can play a pivotal role in this, particularly the workshop. This topic will be revisited at the next steering committee meeting.

• Research and Publications Potential – it was agreed that the level of work expected to emanate from the CAMI project should reach a standard that is publishable in journals. These would particularly include the work surrounding the workshops and attachment at international institutions.

• Visibility of project –one member thought that brining CAMI to the level of the schools through a schools competition on the topic of climate and agriculture.
Members were reminded that this activity was not budgeted in the project. It is expected that as much as possible, there be media awareness of the activities of the project, particularly when

there are meetings in the varying countries such as the Steering Committee meetings and farmers' forums. The steering committee was informed of the intention to have a documentary video of the project to be distributed within the partner countries and institutions by the end of the project.

• The project coordinator was advised to limit, as much as possible, the hosting of workshops during the hurricane/rainfall season since staff are often on call and meteorological services prefer to have as close as possible to full staff compliments during these periods. It was suggested that some shifting of the timeline would be necessary for this but, the project coordinator agreed to satisfying the request as much as is possible, concentrating most training workshops during the region's dry season.

• The Director of the Belize Hydrometeorological Service agreed to pursue the possibility of his country hosting the 2nd Steering Committee Meeting of CAMI at the end of year 1/beginning of year 2.

The Director of the Belize Hydrometeorological Service agreed to pursue the possibility of Belize hosting the 2nd Steering Committee Meeting of CAMI at the end of Year 1/beginning of Year 2.

Meeting with Officers of the Ministry of Agriculture, Barbados

On 10 February, 2010, the Steering Committee met with officers of the Ministry of Agriculture, Barbados led by the Deputy Chief Agriculture Officer (crops), Mr. Ralph Farnum. This was to make the Ministry more au fait with the project and the potential benefits it offers to agriculture and farming in Barbados, as well as to solicit from the officers what they perceived as the important issues in agriculture related to weather and climate.

After a brief introduction of the members of the Steering Committee, the CAMI Project Coordinator outlined the aims, objectives and specific activity of the project to the officers. This led into a discussion on the important issues in Barbados. Some of the main talking points are summarised below.

• It was agreed that information provided by such projects as CAMI was long overdue.

• The need for accurate weather (rainfall) forecast with higher-resolution country details was identified. The desired detail was thought to be difficult but such information will improve with the construction of the EU funded radars in the region, one of which is stationed in Barbados and was completing its testing phases.

• It was thought that there was a need for weather and climate information tailored to farmers. Mention was made of the farmers' forecasts in the media in Barbados in the distant past. It was suggested that this can be re-introduced probably in a modified way. There was some concern that the Barbados Meteorological Services was not catering enough to agriculture. It was explained that the meteorological services in the region were established for aviation purposes, and therefore primarily exist at airports. It was agreed that the meteorological service diverts it activities to provide more meaningful information to sectors such as agriculture. CAMI is expected to be the driving force for this in the agriculture sector.

• There was much enthusiasm over the planned farmer's forums. The format of the forums was outlined for the Ministry officials.

• One of the major points of discussion was the existing drought, which began during the 2009 dry season. The drought was getting progressively worst and causing major concern to the country's farmers. There was a query as to whether or not the drought conditions could have been forecasted earlier. The officers were informed that the products and information related to drought is provided under the Caribbean Drought and Precipitation Monitoring Network (CDPMN - another regional initiative launched by the project the Caribbean Water Imitative) based at CIMH. Ministry officials were also informed that the CDPMN was also the responsibility of the CAMI project coordinator. The project coordinator informed officers that when launched in January 2009, the monitoring network was expected to be developed such that it would be operational by the end of 2010, but the region found itself in a drought before the end of 2009 (a year earlier), but in-spite of not being totally ready the information had was enough for CIMH to warn Barbados and the rest of the region of the existing drought and the expectation that the situation would continue to deteriorate. There were also plans afoot to introduce indices and indicators of agricultural drought. The officers were informed that drought information and the CDPMN will be on the agenda at the farmers' forums.

• There was also some interest in irrigation information being provided.
Information on timing is expected to be important. What was also important was that there not be over-watering by farmers.

• Projection/outlook of rainfall 6 to 12 months in advance to facilitate more long term strategic planning. Mention was made of the current 3 month tercile probabilistic forecast produced by CIMH. This was thought to be useful but the longer lead forecast was also important. It was pointed out to the officers that the accuracy of such projections decreases with the increase in lead time, but research continues to improve the accuracy of such products. The officers suggested that information of even the climate signals presented would be useful. It was agreed that this is something CIMH can consider.

COMMITTEE PARTICIPANTS

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ANNEX 2

REPORT OF THE FIRST CARIBBEAN AGROMETEOROLOGICAL INIATIVE (CAMI) STAKEHOLDERS MEETING

11 February, 2010

Prepared By: Mr. Adrian Trotman
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BARBADOS

INTRODUCTION

The first Caribbean Agrometeorological Initiative (CAMI) Stakeholders Meeting, hosted at the offices of the Caribbean Institute for Meteorology and Hydrology on Thursday 11th February 2010, marked the launch of the activities of the project.

REPRESENTATION

Attendees included meteorological and agricultural personnel from the national meteorological services of the ten participating countries (Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago,). The only exception to this was the absence of the Hydrometeorological Services of Guyana. (See full list of attendees at **Annex 1**).

http://www.cimh.edu.bb/cami/files/Steering%20Committee%20Meeting%20Report%20-%20Feb%202010.pdf

Also represented were other CAMI partner institutions, namely the Caribbean Agricultural Research and Development Institute (CARDI) and the World Meteorological Organization (WMO). Other invited non-partner institutions included the Caribbean Community Climate Change Centre (CCCCC), the Caribbean Disaster Emergency Management Agency (CDEMA), the Caribbean Meteorological Organization (CMO) Headquarters Unit, the Inter-American Institute for Cooperation in Agriculture (IICA), the United States Department of Agriculture and the European Commission Delegation in Barbados and the Eastern Caribbean.

PRESENTATIONS

The session commenced with the welcoming of participants to the meeting by the Principal of the CIMH, Dr. David Farrell, followed by an address by the European Commission delegate Mr. Robert Baldwin. (See full Agenda at **Annex 2**) Mr. Baldwin took delegates through some of the other funded ACP Science and Technology awarded projects in the Caribbean, as well as other EU funded initiatives with potential links to CAMI.

Keynote Address – Dr. Raymond Motha

During the morning session, Dr. Raymond Motha, Chief Meteorologist of the United States Department of Agriculture, delivered the keynote address.

It was thought fitting to invite the USDA because of its wealth of experience in providing agrometeorological information to the agricultural - in particular farming – community, to deliver this address. The USDA's mission statement reads: "Keep the Nation's growers, USDA commodity analysts, as well as the Secretary and top staff informed of worldwide weather related developments and their effects on crops and livestock".

Dr. Motha guided the participants through the routine operational work of the agrometeorology department, some of which is done with other agencies and includes daily highlights of agricultural development, the preparation of weekly weather and crop bulletins and special reports, Secretary Briefings and drought monitoring. He also highlighted the importance of monitoring and aftermath assessments from natural hazards such as hurricanes. Dr. Motha emphasised the importance of having a feedback mechanism involving the clientele (in this case farmers groups). This is important in modifying the type and way information is disseminated such that it maintains the interest of clients. Dr. Motha went on to make specific comments on the role of CAMI in the region. He noted the importance of understanding, from early, the weather and climate parameters that most affect agricultural economies of the region. In order for CAMI to be successful, it must also be established, from the beginning that this must be a group effort and the commitment must be for the long term.

Dr. Motha then commented specifically on the weather bulletins to be prepared in the Caribbean.

The following recommendations were made:

- A standardised approach and format.
- Each country prepares its own bulletin and disseminates it in a timely fashion, with a standardised version sent to regional host server for display, archiving and backup.
- There should be a coordinated effort between scientists and experts among different nations; thereby pooling resources for the best products for all involved.

WMO and Agremeteorology – Mr. Robert Stefanski

Another important presentation from outside the region was made by Mr. Robert Stefanski of the World Meteorological Organization (WMO), a partner of the CAMI project. Mr. Stefanski presented an overview of the WMO and its Agrometeorology Division. He highlighted the WMO Inter-Regional Workshop on Improving Agrometeorological Bulletins, which was held in Barbados in 2001 as an exercise relevant to CAMI.

The workshop proceedings documented guidance as to the approach, content and means of dissemination for CAMI bulletins.

One of the major outcomes of this workshop is the web-based international agrometeorological bulletin, WAMIS (World Agrometeorological Information System). WAMIS hosts tools and resources aimed at helping members improve the quality and presentation of their agrometeorological bulletins. Another WMO initiative with synergies with CAMI is the METAGRI project, which facilitated Roving Seminars on Weather, Climate and Farmers in West Africa. It was recommended that CAMI's farmers' forums could follow, where appropriate, the approach of these seminars.

Finally, Mr. Stefanski presented a programme being developed to concentrate on drought impacts and management; another initiative with links to CAMI.

The second session featured the regional presentations. These included:

Agrometeorology and National Hydrometeorological Services – Mr. Tyrone Sutherland

Mr. Tyrone Sutherland, Director of the Caribbean Meteorological Organization spoke on Agrometeorology in the Member States of the CMO. He highlighted the output from the region's meteorological services that can be used in agriculture, including radar outputs. He particularly highlighted the agrometeorological information emanating from Belize.

Agriculture and Climate in the Caribbean – Dr. Leslie Simpson

The next presentation on Farmers'Adaptation to Climatic Variability in the Caribbean was given by Dr. Leslie Simpson, Natural Resources Management Specialist, CARDI. He particularly identified rainfall extremes, tropical cyclones and the difficulty in planning for weather and climate systems that, in his opinion, are increasingly unpredictable.

He then outlined farming practices that can reduce the impacts of some of these weather and climate impacts including:

- 1) mulching, water harvesting, construction of ferro water tanks, drip irrigation to combat drought.
- 2) the use of raised beds, adjusting planting dates to combat excessive rainfall.
- 3) the planting of specific crops to combat hurricanes.
- 4) exclusion cages to reduce pest damage that are collapsible with the approach of a hurricane.

Mainstreaming Climate Change in Agriculture – Mr. Carlos Fuller

Mr. Carlos Fuller, Deputy Director of the Caribbean Community Climate Change presented on CentreClimate Change and Agriculture Activities in the Caribbean. Mr. Fuller gave an overview of the Centre. He also identified some of the key results from the Vulnerability Assessment of Agriculture in Belize, which focused on yield fallout of dry beans, rice and maize from climate change. He noted the capacity building exercises on use of biophysical models in climate change impact assessment, where the DSSAT software was a major focus.

The Caribbean Agrometeorological Initiative – Mr. Adrian Trotman

Another key presentation of the workshop was 'From Strategic Plan to Implementation', which introduced the CAMI project itself. This was presented by the CAMI Coordinator Mr. Adrian Trotman.

Mr. Trotman provided a background of the development of the CAMI through a strategic plan for agrometeorology, developed for CIMH and WMO/FAO Seminar on the Application of Climate Data for Desertification Control, Drought Preparedness and Management of Sustainable Agriculture in the Caribbean Region held in 2004 in Antigua. CAMI was presented as one of the three initiatives satisfying the CIMH Strategic Plan for Agrometeorology, the other two being the Caribbean Drought and Precipitation Monitoring Network and the Caribbean Agrometeorology Network.

Mr. Trotman emphasised the overarching object of the CAMI, which is:

To increase and sustain agricultural productivity at the farm level in the Caribbean region through improved applications of weather and climate information using an integrated and coordinated approach.

The partners of this EU funded project include CIMH (the applicant), WMO, CARDI and the governments of ten CMO territories (Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago,) as represented by their Meteorological Services. The project runs for three years until November 2012.

Mr. Trotman proceeded to highlight the specific activities within the project for the next three years:

- Development of predictors of the rainy season potential characteristics through analysis of long-term climatic data and use of seasonal to inter-annual climate prediction models.
- Interpretation of the climate predictor and near-real time weather information to support management decisions, especially irrigation scheduling.
- Working with the agricultural research and extension agencies in developing an effective pest and disease forecasting system.
- Preparation and wide diffusion of a user-friendly weather and climate information newsletter for the farming community.
- Organization of regular forums with the farming community and agricultural extension agencies to promote a better understanding of the applications of weather and climate information.
- Building capacity of the Meteorological and Agricultural Services and research institutions.
- Data Rescue.

To facilitate the expected outputs, the approach towards achieving these outputs including working toward the overarching goal was outlined. This included:

- Training workshops for National Met Service and Agricultural Extension Service Personnel.
- Attachments to the region of experts on (i) DSS for pest management (ii) Crop-weather models and Irrigation Models.
- Attachment of CIMH and CARDI staff at international research institutes (mainly to finish/improve upon work begun at regional training workshop).
- Publication and Dissemination of AgrometBulletins and other forms of weather and climatic information for farming and wider agricultural communities.

Some of the expected outcomes from CAMI as outlined by Mr. Trotman include:

- Improved ability of policy makers and extension agencies in exploiting the rainy season potential fully through strategic decisions and better preparedness strategies.
- Better informed farming community regarding the climate situation before and during the crop growing season.
- Improved capabilities in the farming community to make strategic and tactical decisions for soil and crop management and more efficient irrigation scheduling.
- Conservation-effective soil and crop management practices to reduce land degradation and improved long-term crop productivity.
- Greater farm incomes for small farmers due to improved crop quality and reduced use of insecticides through more effective pest and disease management.
- Enhanced incomes at the farm level for the small farmer through better applications of weather and climate information in soil and crop management.
- Enhanced linkages between meteorological services and agricultural research and extension agencies.
- Enhanced capacity of the farming community to understand and apply weather and climate information in their operational decisions.

- Enhanced capacity of Meteorological and Agricultural Services, CARDI and CIMH to perform the tasks relevant to the goals of the action.
- Increased interactions between the meteorological services, agricultural extension agencies and the farming community, resulting in the provision of better services to farmers.
- Availability of regular feedback to the meteorological services on the nature of services and products needed by farmers, resulting in the preparation of user-friendly products from the meteorological services.

Links with other Projects - CARIWIN National Water Information Systems - Mr. Trevor Thompson

A very useful aspect of the day was the recognition that other initiatives/projects in the region can provide important links to and information that can feed into CAMI. The Caribbean Water Initiative (CARIWIN), jointly implemented by the Brace Centre for Water Resources Management of McGill University, CIMH, and the partner countries of Grenada, Guyana and Jamaica, is the example presented at the workshop. Two activities of CARIWIN were presented; the National Water Information System (NWIS) of Grenada and the Caribbean Drought and Precipitation Monitoring Network (CDPMN).

Mr. Thompson of the Ministry of Agriculture, Grenada provided a background to the NWIS. Its significant contributions to water management in Grenada are:

1) the organizing of water data
2) providing easier access to data and
3) assesses the country's water resource.

The stakeholders of the NWIS include the Ministry of Agriculture, the Meteorological Services of Grenada, the national Water and Sewerage Authority and the St. George's University. He presented the many layers of variables within NWIS, but admitted that currently, mainly rainfall data is inserted. These can also overlay google earth.

Mr. Thompson also presented the different presentation formats of the information: tables of data and information, charts, ACSII files and maps. He emphasised that the system is very cheap, CAD30,000.00, which included the cost of the software, the consultation fee, training of staff and the collection and input of data.

Other advantages of the NWIS articulated were

1) that is uses open source software
2) there is one system for all agencies, data entry in any format
3) data extracted in many formats
4) can extract selected variables
5) reduced chance of transcribing errors.

Links with Other Projects – Rainfall Monitoring – Mr. Adrian Trotman

Caribbean Drought and Precipitation Monitoring Network presented by Mr. Adrian Trotman, Coordinator of the CDPMN. The vision of the CDPMN was articulated as "*creating a culture of rainfall monitoring to combat the negative impacts of climate extremes and any future climate change"*.

Mr. Trotman noted that CDPMN was there to provide information on both extremes but was particularly developed with drought in mind. The indices and indicators often provide information on both sides of the rainfall scale. He indicated that the intention is to monitor rainfall on a regional scale (using rainfall indices only) and the national scale (where other indices/indicators such as soil moisture, vegetation information, stream flow and groundwater status can be used). He articulated that the rainfall status would be determined by consensus by a diverse community with interest in drought. He also indicated that the current precipitation outlook will be used along with the monitoring information to provide index outlook with a three month lead time.

In addition to monitoring trends, implementing early warning systems, and networking, the CDPMN will define knowledge gaps and uncover the needs to address extreme events and coping mechanisms.

WORKING GROUPS

For the final session, the participants were divided into working groups by country.

Each working group was asked the following six questions.

1. **What information does the Meteorological Service in your country currently/normally provide?**
2. **What are the key crops in your country?**
3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

4. **Should the project focus on large or small scale farmers?**
5. **What additional products would you like to see from your meteorological service?**
6. **Which of 5 above do you think can be provided by your meteorological service?**

A summary of responses from the individual countries is recorded below.

ANTIGUA AND BARBUDA

1. What information does the Meteorological Service in your country currently/normally provide?

- Met services in Antigua cater to Aviation, Tourism, and Agriculture etc. Agriculture
- Data bank reflects on a fair picture of climatology for many years over forty (40) years for rainfall.
- Hourly data collected including
- Temperature (daily Min and Max – mean and extremes can be determined.
- Rainfall data collected from 13 stations on island.
- Airport rain station is most keenly monitored on a daily basis (4 readings every 24 hours)
- Cloud cover.
- Relative humidity
- Rainfall estimates (using models)
- Rainfall forecast (every four days)
- Evaporation (as it pertains to transpiration and key economic crops).
- Imports over $30 million of fresh vegetables and plants, annually. North America and Central America, Caribbean (medium term weather outlook for these countries).

ANTIGUA

2. What are the key crops in your country?

- Onions
- Carrots
- Sweet Pepper
- Tomato
- Cabbage

- Pineapple
- Sea Island Cotton
- Mango

3. What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?

- Frequent imports
- Drought, floods hurricane, seasonal pests and diseases

4. Should the project focus on large or small scale farmers?

- All farmers

5. What additional products would you like to see from your meteorological service?

- Rainfall information (short and medium range forecast)
- For land preparation, planting ……..
- Module in the daily television presentation, to focus on agricultural weather report.
- Forecast for ash fall from Montserrat.
- Medium term weather outlook for north and Central America.
- Ministry of Agriculture establish a focal point to indicate to the meteorological station the relevant needs for agri-weather reports on a regular basis.

BARBADOS

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - Rainfall from at least 2 stations in each parish (St. Andrew 7/8 in the parish).
    - Evaporation/ Evapo-transpiration – at airport (Penman-Montieth)
    - Sunshine Hours
    - No UV index , Heat
    - Temperature (max and min), humidity, wind speed, wind direction, cloud cover, low and high tides.
    - Forecasting- 3 times daily, 4 day forecast (updated every day/week).
    - Prepare information for weather news at night.
    - Major events- get requests from insurance companies for a client/claim.
    - Forecasting for aviation.

2. **What are the key crops in your country?**

    - Sugar cane
    - Sweet potatoes
    - Yams
    - Tomatoes
    - Onions
    - Carrots
    - Cucumbers
    - Cabbage
    - Lettuce
    - Sweet Peppers
    - Beans
    - Cassava

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

- Droughts (Dry Season)- Costly
- Cane Fires (in dry season) – Costly, Frequent
- Wind Damage (in early months of the year) – Frequent
- Pest and Disease (all year round e.g. powdery mildew in dry season, downy mildew in wet season).

4. **Should the project focus on large or small scale farmers?**

- We have emerging small scale vegetable farmers (more devastating on small scale), and we are committed to growing sugar cane for several other uses.

5. **What additional products would you like to see from your meteorological service?**

- Newsletter/ Bulletin
- Evapotranspiration data for Irrigation Scheduling
- Education on how Agro- Meteorology can influence production and improve yields.
- UV index data
- Solar Radiation Data
- Forecasting for agriculture.
- Meteorological data for use in developing crop insurance plans or policies.
- Yearly climate projections based on past climate data and worldwide climate patterns.
- GIS and remote sensing

6. **Which of 5 above do you think can be provided by your meteorological service?**

- Meteorological data for use in developing crop insurance plans and policies.

- Evapo-transpiration data for irrigation scheduling (if government or farmers are willing to provide a secure property).

BELIZE

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - 3- Day weather outlook
    - Monthly rainfall

2. **What are the key crops in your country?**

    - Traditional : sugar, banana and citrus
    - Non-traditional: cereal crops, beans, peppers and vegetables

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Rainfall (too much; too little)
    - Temperature – becoming more relevant for new production systems
    - Wind

4. **Should the project focus on large or small scale farmers?**

    - Ministry of Agriculture and Fisheries mandate is service to small and medium farmers.

5. **What additional products would you like to see from your meteorological service?**

    - Rain/dry season onset or cessation
    - Almanac- moon phases etc.
    - Day length information
    - Evaporation

DOMINICA

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - The meteorological service presently provides daily weather forecasts and information to aviation.

2. **What are the key crops in your country?**

    - Economic crops in order of importance.
    - Banana/ Plantain
    - Root crops (yams, sweet potatoes, dasheen, tannia)
    - Passion fruit, pineapple
    - Vegetable production
    - Peppers (hot, seasoning)

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Weather related impacts.
    - Pest and diseases
    - Irrigation Planning (droughts/floods)
    - Wind damage

4. **Should the project focus on large or small scale farmers?**

    - Focus should be on small scale farmers.

5. **What additional products would you like to see from your meteorological service?**

    - Quarterly/ Weekly forecast

6. **Which of 5 above do you think can be provided by your meteorological service?**

    - Quarterly Forecast Online (CIMH)

GRENADA

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - Early warning
    - Forecasting
    - Rainfall
    - Temperatures
    - Relative humidity
    - Wind
    - Pressure
    - Cloud Cover - limited capability to do Evapo-transpiration Analysis and presentation.

2. **What are the key crops in your country?**

    - Cocoa
    - Nutmeg
    - Bananas
    - Vegetables
    - Citrus
    - Food Crops.

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Damages/loss of crops.
    - Soil/Gully Erosion
    - Pest/Diseases

- Financial Loss because of inability to harvest in areas where roads are not properly surfaced.

4. Should the project focus on large or small scale farmers?

- Both. In many areas the farms are small but add up to one large farming Area/Community.

5. What additional products would you like to see from your meteorological service?

- More detailed forecasting, early warning for dry or wet spells.
- Agricultural Weather Bulletin/Briefing on a weekly or monthly basis.
- Evapo-transpiration analysis/data.

6. Which of 5 above do you think can be provided by your meteorological service?

- Limited evapo-transpiration information.
- Agric Weather Bulletins

GUYANA

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - Information such as climate (3 monthly rainfall outlook) and weather forecasts (12 hour, 1 to 7 days).
    - Data in weather and climate and water resources.
    - Low and high tide alerts, etc. are disseminated via radio, television, through newspapers, bulletins and facsimile to various stakeholders.

2. **What are the key crops in your country?**

    - Rice
    - Sugar

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Drought
    - Flood
    - Pest and Disease outbreaks
    - Saline Intrusion
    - Breach in Sea Defences

4. **Should the project focus on large or small scale farmers?**

    - The project should focus on all farmers

5. **What additional products would you like to see from your meteorological service?**

    - Agro-Advisory Services
    - Short and Medium Term Forecast – 7 days

  - Rainfall (intensity)
  - Temperature
  - Humidity
  - Wind Direction
- Agro-advisory
  - Crop specific
  - Livestock
- Crop Status Projection

6. Which of 5 above do you think can be provided by your meteorological service?

- Specific information on Agriculture Meteorology is not done, due to inadequate human resources skills in Agro Meteorology. This area in Hydromet needs needs to be strengthened and it my hope that via the CAMI project it can be done.

JAMAICA

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - Daily weather forecasts and outlooks for towns and cities e.g. severe weather warnings.
    - Give synopsis 3-4 times per day (Outlook)
    - Provision of monthly rainfall summary and drought analysis to specific clients, also available on the website.
    - Provision of added information at clients request e.g. evapotranspiration, rainfall data etc.
    - Offer technical assistance to agencies in siting zones for potential met stations.

2. **What are the key crops in your country?**

    - Sugar cane
    - banana
    - citrus
    - coffee
    - root tubers
    - ginger
    - condiments

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Drought
    - Bush fire
    - Floods
    - Hurricane
    - Landslides.

4. **Should the project focus on large or small scale farmers?**

    - Both, however delivery of the information may differ considering the majority who are small farmers may not be privy to technology of readily receiving the information and may require group meetings as opposed to accessing via email for example.

5. **What additional products would you like to see from your meteorological service?**

    - Better pest and disease forecasting.
    - Improvement of rainwater harvesting infrastructure.
    - Improve livelihood of farmers.
    - Increase yield and consistency in production.

6. **Which of 5 above do you think can be provided by your meteorological service?**

    - Considering the available resources and workforce, not much more can be done at this point.

ST. LUCIA

1. **What information does the Meteorological Service in your country currently/normally provide?**

Raw data:

- Temperature, Evaporation
- Relative Humidity
- Sunshine, Wind speed

Other:

- Climatological analyse
- Rainfall projection
- Summary
- Report

2. **What are the key crops in your country?**

- Bananas
- Cocoa
- Vegetables
- Root crops
- Citrus Fruits

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

- Droughts
- Floods
- Tropical cyclones
- Humidity diseases

4. **Should the project focus on large or small scale farmers?**

- Small scale agricultural farmers

5. **What additional products would you like to see from your meteorological service?**

- Medium to long term forecast in agriculture
- Integrated database for the Caribbean (Agro-met data)
- Bulletin/ Newsletter
- Estimate for agriculture

6. **Which of 5 above do you think can be provided by your meteorological service?**

- Forecast projections for agriculture

ST. VINCENT & THE GRENADINES

1. **What information does the Meteorological Service in your country currently/normally provide?**

    - Daily forecasts in collaboration with the Barbados Meteorological Office. This includes tide information and weather forecasts are distributed to radio and television and other agencies.

2. **What are the key crops in your country?**

    - Bananas
    - Plantains
    - Root crops (e.g. dasheen, eddoes and tannias)
    - Vegetables – for local market
    - Arrowroot
    - Ginger

3. **What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?**

    - Wind
    - Drought and heavy rains
    - Pests and Diseases
    - Soil erosion and landslides
    - Leaching of fertilizers

4. **Should the project focus on large or small scale farmers?**

    - Small farmers – These represent over 95% of the total farming population with over 70% of their farms being less than 5 acres in size. This group has few resources to address their issues on their own. There is a greater social impact on the country when there is a stable small farmer community.

5. What additional products would you like to see from your meteorological service?

- Longer term weather forecasts – 3 days to 1 week
- Drought forecasts
- Rainfall intensity forecasts
- Information to help in obtaining risk information.
- Also needed – Greater collaboration and networking between meteorological services, agricultural, water and electricity, guiratini services, as well as farmers' organisation, and agricultural agencies both locally and regionally, and other entities which are involved in weather data collection.

6. Which of 5 above do you think can be provided by your meteorological service?

- Yes, three day weather forecasts. Some of these could be done through regional networking.

TRINIDAD & TOBAGO

1. What information does the Meteorological Service in your country currently/normally provide?

- Provide public weather forecast, includes rainfall, temperature, sunrise/sunset, sea conditions, wind.
- Specialised reports, either on requests or what is continuously produced i.e. monthly precipitation and seasonal forecast.
- Provide data for clients' usage.
- Bulletins

2. What are the key crops in your country?

- Tree crops – cocoa, assorted fruits, coffee, coconut, citrus, forestry (wood)
- Vegetable crops – pumpkin, peppers, lettuce, okra, bandenia for local and international consumption.
- Root crops- recently within 3 to 4 years, mainly local consumption, cassava, yam, dasheen, eddoes to replace dependency on cereals.

3. What do you see as frequent /costly impacts related to weather and climate that we have within our farming system?

- Flooding – Primary lost of entire crop.
- Ministry provide extension officers to process flood damage reports
- Dry season incentive to persons who construct ponds impact on pest and diseases,
- Weather oriented:
  - Dry season – increase in insects; mites, thrips in vegetables.
  - Wet Season – bacteria and fungi increase
    - splash borne disease
  - Wind - Airborne diseases, fungal pathogens

4. Should the project focus on large or small scale farmers?

- Small scale farmers in majority and tend to be greater affected.
- Prefer to look at agricultural zones to ensure there is a capture of the microclimate of the agricultural community, so both large and small scales are looked at.

5. What additional products would you like to see from your meteorological service?

- Weather information across all agricultural zones, rainfall, temperature, humidity, wind etc.
- Farmer perspective, what to expect over short term period.
- A weekly advisory with a day to day distribution for short term planning.

6. Which of 5 above do you think can be provided by your meteorological service?

- Tailor made precipitation forecast for agriculture.
- Increase in data availability to cover agricultural zones which would improve a precipitation forecast geared towards agriculture.

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29	Trotman	Adrian	CIMH	atrotman@cimh.edu.bb
30	Yearwood	Ricardo	Caribbean Disaster Emergency Management Agency (CDEMA)	ricardo.yearwood@cdema.org

ANNEX 2

Caribbean Agrometeorological Initiative (CAMI)
Stakeholders Meeting
11 February, 2010
AGENDA

Time	Topic	Speaker/Leader
8:45 - 9:15	Registration	
9:15 - 9:25	Welcome	David Farrell, CIMH
9:25 - 9:35	Remarks	European Commission Representative
9:35 - 9:55	WMO and Agrometeorology	Robert Stefanski, WMO
9:55 - 10:25	Key Note Address	Ray Motha, USDA
10:25 - 10:40 Break		
	Chairperson: Mr. Chester Layne, Barbados Meteorological Services	
10:40-11:00	Agrometeorology and National Hydrometeorological Services	Tyrone Sutherland, CMO
11:00-11:20	Agriculture and Climate in the Caribbean	Leslie Simpson, CARDI
11:20-11:40	Mainstreaming Climate Change in Agriculture	Carlos Fuller, CCCCC
11:40-12:20	The Caribbean Agrometeorological Initiative	Adrian Trotman, CIMH
12:20-1:30 Lunch		
	Chairperson: Mrs. Sheryl Etienne-LeBlanc, Meteorological Services of Dominica	
1:30-1:50	Links With Other Projects- CARIWIN National Water Information Systems	Trevor Thompson, Grenada
1:50-2:10	Links With Other Projects Rainfall Monitoring	Adrian Trotman, CIMH
2:10-3:00	Working Groups According to Countries	
3:00 – 3:15 Break		
	Chairperson: Mr. Adrian Trotman, CIMH	
3:15-4:05	Reports from Working Groups	
4:05-4:30	Summary and Close of Meeting	

Annex 3

Rainy Season Predictors and Interpretation and Management

Workshop Report

June 15th - 19th 2010

Prepared By: Mrs. Shontelle Stoute
Technical Officer
CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Contents

I. INTRODUCTION

The Rainy Season Predictors and Interpretation and Management Workshop took place at the offices of the Caribbean Institute for Meteorology and Hydrology from June 15th to 19th 2010.

The purpose of the workshop was to assist the National Meteorological and Hydrological Services (NMHS) of the ten Caribbean countries involved in this Action to develop predictors of the rainy season potential in different countries applicable to agriculture. CARDI also took part in this training. This training, which involves the proposed statistical approach, was conducted by Dr. Roger Stern of the Statistical Services Centre of the University of Reading, globally recognized for his statistical applications in climatology.

The training was focused heavily on hands-on training.

The full agenda is attached at **Annex 1**.

II. REPRESENTATION

Attendees included representatives from the National Meteorological Offices of the ten participating countries along with officers from the Ministries of Agriculture.

(See full list of attendees at **Annex 2)**.

III. WELCOME AND INTRODUCTION - Mr. Adrian Trotman – CIMH

The participants were welcomed to Barbados and CIMH by the CAMI Project Co-ordinator, Mr. Adrian Trotman. He emphasised the importance of the training and the translation of the training into meaningful, productive activity once the participants returned to their offices. Mr Trotman told the participants that it would be a very intense week of exercises. He also highlighted the importance of the Regional Climate Outlook Forum (RCOF) workshop in the second week, as being a crucial part of the outcome of CAMI. The RCOF meeting was being convened by CIMH, Caribbean Community Climate Change Centre (5Cs), the National Oceanic and Atmospheric Administration (NOAA), the US Geological Survey (USGS), the US Agency for International Development (USAID) and the International Research Institute for Climate and Society (IRI). The CAMI has collaborated on the RCOF since seasonal rainfall prediction for agriculture is one of the proposed areas of interest for CAMI and this was being dealt with under the RCOF workshop, so CAMI sponsored personnel for the rainfall analysis workshop stayed on for the workshop.

IV. FROM STRATEGIC PLAN TO IMPLEMENTATION – Mr. Adrian Trotman – CIMH

Mr. Trotman provided a background of the development of the CAMI through a strategic plan for agrometeorology. He indicated that CAMI was developed by CIMH and the World Meteorological Organzation (WMO) during a WMO/FAO (Food and Agricultural organization of the United Nations) Seminar on the Application of Climate Data for Desertification Control, Drought Preparedness and Management of Sustainable Agriculture in the Caribbean Region held in 2004 in Antigua. CAMI was presented as one of the three initiatives satisfying the CIMH Strategic Plan for Agrometeorology, the other two being the Caribbean Drought and Precipitation Monitoring Network and the Caribbean Agrometeorology Network.

Mr. Trotman emphasised the overarching object of the CAMI, which is:

To increase and sustain agricultural productivity at the farm level in the Caribbean region through improved applications of weather and climate information using an integrated and coordinated approach.

The partners of this EU funded project include CIMH (the applicant), WMO, the Caribbean Agricultural Research and Development Institute (CARDI) and the governments of ten Caribbean Meteorological Organisation (CMO) territories (Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St. Vincent and the Grenadines and Trinidad and Tobago,) as represented by their Meteorological and Hydrological Services. The project runs for three years until November 2012.

Mr. Trotman proceeded to highlight the specific activities within the project for the next three years:

- Development of predictors of the rainy season potential characteristics through analysis of long-term climatic data and use of seasonal to inter-annual climate prediction models.
- Interpretation of the climate predictor and near-real time weather information to support management decisions, especially irrigation scheduling.
- Working with the agricultural research and extension agencies in developing an effective pest and disease forecasting system.
- Preparation and wide diffusion of a user-friendly weather and climate information newsletter for the farming community.
- Organization of regular forums with the farming community and agricultural extension agencies to promote a better understanding of the applications of weather and climate information.
- Building capacity of the Meteorological and Agricultural Services and research institutions.
- Data Rescue.

To facilitate the expected outputs, the approach towards achieving these outputs including working toward the overarching goal; was outlined. This included:

- Training workshops for National Met Service and Agricultural Extension Service Personnel.
- Attachments to the region of experts on (i) DSS for pest management (ii) Crop-weather models and Irrigation Models.

- Attachment of CIMH and CARDI staff at international research institutes (mainly to finish/improve upon work begun at regional training workshop).
- Publication and Dissemination of Agromet Bulletins and other forms of weather and climatic information for farming and wider agricultural communities.

Some of the expected outcomes from CAMI as outlined by Mr. Trotman include:

- Improved ability of policy makers and extension agencies in exploiting the rainy season potential fully through strategic decisions and better preparedness strategies.
- Better informed farming community regarding the climate situation before and during the crop growing season.
- Improved capabilities in the farming community to make strategic and tactical decisions for soil and crop management and more efficient irrigation scheduling.
- Conservation-effective soil and crop management practices to reduce land degradation and improved long-term crop productivity.
- Greater farm incomes for small farmers due to improved crop quality and reduced use of insecticides through more effective pest and disease management.
- Enhanced incomes at the farm level for the small farmer through better applications of weather and climate information in soil and crop management.
- Enhanced linkages between meteorological services and agricultural research and extension agencies.
- Enhanced capacity of the farming community to understand and apply weather and climate information in their operational decisions.
- Enhanced capacity of Meteorological and Agricultural Services, CARDI and CIMH to perform the tasks relevant to the goals of the action.
- Increased interactions between the meteorological services, agricultural extension agencies and the farming community, resulting in the provision of better services to farmers.
- Availability of regular feedback to the meteorological services on the nature of services and products needed by farmers, resulting in the preparation of user-friendly products from the meteorological services.

V. INTRODUCTION TO STATISTICAL PROGRAMS - Dr. Roger Stern – University of Reading

Dr. Stern noted that before delving into the statistical programs, it was necessary to first determine what products can be developed to satisfy the needs of the user.

What are the questions the user would ask?

- When will/ do we have rain?

- How intense will the dry season be?

- How is rainfall distributed?
- How much rain is likely over a particular period?
- Where can we obtain agrometeorological information and at what cost?
- What are the most likely daily max & min temperatures (for climate change applications)
- What time of year is best for planting?
- What is the dependable rainfall during the dry season?

Dr. Roger Stern presented the data to be used. He emphasized the importance of making sure the data is correct and thoroughly checked for quality. He insisted there is nothing worse than having poor quality data. Dr. Stern also presented statistical programs which could be used to provide products for the end user. The tools to be used included CAST (Computer Assisted Statistical Textbooks), InStat and GenStat. The statistical program InStat can be used to answer some of the previously mentioned questions such as: when will/ do we have rain; how intense will the dry season be (dry spells), whereas, the GenStat program would be able to analyze temperatures and show trends.

CAST is a Computer Assisted Statistics Textbook with some design for climatic analysis. It is an electronic book with dynamic graphs and interactive exercises. CAST can be very useful in teaching and learning statistics.

InStat is a general, interactive statistics package developed by the Statistics Services Centre, University of Reading, UK. This package has a wide range of facilities - some of which include good data manipulation, descriptive statistics, plotting and simple and linear regression. The climatic guide of the InStat package is used by Meteorological Services in many countries, particularly for agro-climatic analyses. Within this type of analysis one can determine the start of rains, extreme events, spells (wet or dry) and evaporation of a particular location, amongst others.

GenStat is a very powerful statistics package also developed by VSN International Ltd. of Hempstead, UK. Like InStat, this package allows you to summarize, display and analyze data and is used for agricultural research. Despite the similarities between the two, GenStat is the more statistically advanced package.

Day 2

Introduction to InStat

The role of InStat and its link with the project

The aim of the project is to provide a tailored product which can provide information to be used by the farming community. This package would be able to provide information such as the start of rains and spells (wet and dry). The climatic menu of the InStat program is able to provide this information for these events for a specific location.

Practical Session

- Statistical analysis of rainfall (monthly summaries, start of rains and spells)

VI. GROUP DISCUSSION: What are the concerns of the met personnel?

A discussion ensued on the concerns of Meteorological Services in the Caribbean with respect to providing information for the agricultural community.

- There needs to be a lot of collaboration between met personnel and extension officers so that they can be useful.
- What analyses are being done by the extension officers/ farming community?
- What is the definition of drought for non-meteorological personnel
- How can partnerships with the meteorological service be established?
- There is a need for an understanding of what affects our climate (e.g. ENSO, NAO etc) and also that forecasters be more open about their skill (i.e. accuracy of forecasts).
- It is suggested that the means of communication (between met personnel and user) be based on risks. For example - if there is a 20% chance that there would be a dry spell lasting 10 days or more in June, rather than tell the farmer that there is a 20% risk, tell him that he has a 1 in 5 chance if he plants during that time.

Day 3

Introduction to GenStat

- The role of GenStat and its link with the project

  GenStat is able to perform climatic analysis that can detect trends in data, therefore making it useful for climate change studies. A regression analysis can determine whether temperature tends to be on the increase.

Practical session

- Evidence of temperature change (i.e. determining whether there is an increase in the minimum temperatures)

Day 4

Presentations to the agricultural personnel by the meteorological service

For the final 1½ days, meteorologist and CARDI personnel were joined by extension officers from the CAMI countries. Unfortunately, due to a strike by a regional airline three potential participants were unable to make it to the training workshop. The Extension Officers were there to see the type of products possible for the farmers they serve, as well as to discuss rainfall products needed by the farming community.

Presentations of the work done and the potential work were made to the extension officers. These presentations provided information to the agricultural personnel regarding products which can be obtained via the statistical programs. These products would answer questions that agricultural personnel would ask:

- When will rains start?
- What is the longest dry spell during the planting season?
- What is the best time to begin planting?
- Are there trends in rainfall and temperature?

VII. COLLABORATION BETWEEN METEOROLOGICAL SERVICE PERSONNEL AND EXTENSION OFFICERS

Participants were divided into smaller working groups in order to discuss the needs of the farmers as from the eyes of the extension officers that serve them. It allowed for the meteorological services personnel to hear these needs and for the extension officers to understand what can be provided within the limitations of the meteorological services.

Discussion points included:

Discussions between the Meteorological Service personnel and the Extension Officers highlighted:

- The main crop(s) grown in the various countries
- What the Met Service currently provides to the farming community and also what products/ services they can provide in the future.
- What information the farming community can provide to the Met Service that can be useful as well as what information they need from the Met Service.
- Future plans/the way forward

GROUP PRESENTATIONS

Group 1. Dale Destin (Antigua), Brent Georges (Antigua), Anthony Moore (CIMH)

- It was noted that there are other persons collecting data that the Meteorological Service is unaware of. There is a need for collaboration between the meteorological and agricultural services.

Products/information needed from meteorological services

- Precipitation and temperature outlooks (monthly and seasonally; some work is being done on monthly precipitation and temperature)
- Explore possibility of 7-10 day forecasts (current forecast is 4 days)
- Analysis of rainy days (dry spells and time to plant)
- Develop pest outbreak alerts with collaboration between meteorology and agriculture
- Creation of model similar to Mac Donalds Almanac: regarding possible “best days” to plant
- Issuing drought and precipitation statements as well as temperature trends.

The key to the success of these products would be to visit farmers and train extension officers in data collection. There should be more collaboration between the meteorological services and farmers and other partners in establishment of meteorological stations.

Group 2. Jacqueline Spence (Jamaica), Winston Shaw (Jamaica), Arlene Aaron (Trinidad &Tobago)

Objectives:

- Crop calendar

  There are 21 rain stations across the island, however, this is inadequate. A 30 year mean rainfall will be needed to develop a crop calendar.

Information needed from meteorological services:

- Average daily rainfall
- Dry and wet spell forecasts for irrigation and drainage
- Mapped image of analyses for entire country showing rainfall patterns and expectations

Information needed from agriculture:

- Crop water requirements
- Location of production areas
- Traditional crop season

Problems identified and possible solutions:

- Drought
  - Predicting drought / dry spells. This knowledge would enhance agricultural practices and influence the type of crops to plant.
- Wet spells
  - Knowledge would help to improve drainage and control pests

The way forward

- Integrating farmers into the community
- Establish an effective method of communicating information

- Collaboration of stakeholders should be maintained

Group 3. David Robertson (Grenada), Antonio Joyette (St. Vincent) and Cephus Toney (St. Vincent)

Information needed from meteorological services:

- Rainfall, temperature and wind analyses
- Start of rains
- Rainfall distribution and intensity over short periods
- Length of dry spells
- Wind direction and speeds (1 week)
- Temperature outlook (weekly/monthly)

Future plans

- Share experiences, knowledge and build capacity
- Raise awareness
- Pursue initiatives to foster data sharing and productive development

Group 4. Sheryl Etienne-LeBlanc (Dominica) and Clem Williams (Barbados)

Information needed from meteorological service

- Rainfall probabilities
- Temperature forecasts
- Wind (direction and speed)
- Seasonal outlooks
- Extremes (ENSO, droughts, floods)
- Seasonal outlook
- Forecast probabilities for planting and harvesting

- 5-7 day dry spell
- *Crop calendar*

Way forward

- Meteorological service to generate products using current data
- Meteorologcal services personnel to be encouraged to take the e-course in Statistics in Applied Climatology

Group 5. Carshena Gordon (Guyana), Lisa Kirton-Reed (CIMH), Lisa Agard (CIMH)

- Main crops in Guyana are sugar and rice

Products to be developed by meteorological service:

- Rainfall totals; no. of rain days
- Dry spells
- Evaporation

Way forward

- Possibility of conference with persons from farming community

Dissemination of meteorological information via;

- Weather bulletins
- TV programs
- Outreach programs
- Meeting with farming reps.

Group 6. Gary Ramirez (Belize), Venantius Descartes (St. Lucia) and Shontelle Stoute (CIMH)

Services provided to agriculture

Daily data is provided to the Engineering Division of the Ministry of Agriculture of St. Lucia on a monthly basis. All other data dissemination is done on upon request.

Services needed from meteorological service:

- Rainfall data analysis (Dry spells, First rain, Risk statements)
- Weather outlook (already on-going)
- Drought forecasting

The way forward:

- An expansion in the quantity and strategic location of weather stations
- Knowledge sharing
- Data organization and analysis
- Meetings/forums with extension officers and farmers
- Offer to assist Agriculture in providing tailored products to assist in deciding best planting times
- Development of a working group.

Day 5

Plenary Discussion of Analyses by Country

Participants made presentations providing information as a result of the collaboration between meteorological service personnel and agricultural extension officers on the previous day. The agricultural personnel made the presentations highlighting the main crop(s) grown in their country, the information which needs to be shared among the two entities as well as the way forward. The presentations that summarized the smaller groups discussions highlighted the following:

Information needed from met services

- Rainfall analysis
    - Average daily rainfall
    - Start of rains
    - Rainfall distribution and intensity over short periods
    - Length of dry spells
    - Dry and wet spell forecasts for irrigation and drainage

    - Mapped image of analyses for entire country showing rainfall patterns and expectations
    - Drought forecasting
- Temperature analysis
    - Temperature outlook (weekly/monthly)
- Wind analysis
    - Wind direction and speeds (weekly)
- Risk statements

Information needed from agricultural services:

- Crop water requirements
- Location of production areas
- Traditional crop season

The way forward

- Create a forum of exchange of information between the two stakeholders. This can be achieved by visits to farms by meteorological officials and training of extension officers/ farmers in data collection.
- Provide assistance to agriculture in providing tailored products to assist in deciding best planting times.
- Raise awareness
    - Sensitize farmers and extension officers as to potential use of meteorological information in their daily operations
- Determine a communication channel for distributing and interpreting information.
- Set up a national/ regional discussion board/ forum.

ANNEX 1

Agenda

Tuesday 15 June

Session 1	**9:00 – 10:30 am**
Welcome	Adrian Trotman
Introduction to CAMI the Project	Adrian Trotman
Introduction of the participants	Adrian Trotman
The general objectives	Roger Stern
Break	**10:30 – 10:45 am**
Session 2	**10:45 am – 12:15 pm**
Introduction to the data	
Skills and tools (CAST, Instat, Genstat,)	
The specific aims	
Discussion – "Questions farmers Ask"	
Lunch	**12:15 – 1:15 pm**
Session 3	**1:15 – 5:00**
Completion of topics from Session 2	
Importing and preparing the data (INSTAT/GENSTAT)	
Basic Statistical Approaches (exploration and risks)	

Wednesday 16 June

Session 4	**9:00 – 10:30 am**
Statistics in Agrometeorology	
Break	**10:30 – 10:45 am**
Session 5	**10:45 – 12:15**
Rainfall Analysis	
Lunch	**12:15 – 1:15 pm**
Session 6	**1:15 – 5:00 pm**
Statistics in Agrometeorology	
Rainfall Analysis	
Preparing a draft report	

Thursday 17 June

Session 7 **9:00 – 10:30 am**
Discussion Information requirements of the Farming Community
Tailoring the product for the farmer

Break **10:30 – 10:45 am**
Tailoring the product for the farmer

Session 8 **10:45 – 12:15**
Tailoring the product for the farmer

Lunch **12:15 – 1:15 pm**

Session 9 **1:15 – 5:00 pm**
Preparing a Report
Climate Change reflected in rainfall and temperature records
Presentation prepared for the new participants

Friday 18 June

Session 10 **9:00 – 10:30 am**
Welcome Adrian Trotman
Introduction to CAMI the Project Adrian Trotman
Introduction of new participants Adrian Trotman
The general objectives Roger Stern
Issues and responses to farmers issues (workshop approach thus far)

Break **10:30 – 10:45 am**

Session 11 **10:45 – 12:15**
Breakout Groups
Presentation of work thus far to agriculturists
Discussion (routine and tailored products)
Discussion (what is needed)

Lunch **12:15 – 1:15 pm**

Session 12 **1:15 – 5:00 pm**
Analyses (based on discussions in Session 11)

Saturday 19 June

Session 13	**9:00 – 10:30 am**
Plenary presentation of analyses (by country)	
Break	**10:30 – 10:45 am**
Session 13	**10:45 – 12:30**
Plenary presentation of analyses (by country)	
The Way Forward	
Adjournment of Workshop	

ANNEX 2

LIST OF ATTENDEES

	LAST NAME	FIRST NAME	ORGANIZATION	CONTACT INFORMATION	COUNTRY
METEOROLOGICAL OFFICES					
1	Aaron	Arlene	Trinidad & Tobago Meteorological Services	arleneaaron@gmail.com/ dirmet@tstt.net.tt	Trinidad & Tobago
2	Descartes	Venantius	St. Lucia Meteorological Services	vdescartes@yahoo.com	St. Lucia
3	Destin	Dale	Antigua and Barbuda Meteorological Services	dale_destin@yahoo.com	Antigua
4	Etienne-LeBlanc	Sheryl	Dominica Meteorological Services	sheryl8568@hotmail.com/ met office@cwdom.dm	Dominica
5	Gordon	Carshena	Hydrometeorological Services of Guyana	carshenagordon18@yahoo.com	Guyana
6	Joyette	Antonio	Ministry of National Security	meteorart@yahoo.com	St. Vincent
7	Williams	Clem	Barbados Meteorological Office	cwilliams@barbados.gov.bb	Barbados
8	Robertson	David	Grenada Airport Authority	salaam77@hotmail.com	Grenada
9	Simpson	Leslie	CARDI	leslieasimpson2000@yahoo.co.uk	Jamaica
10	Spence	Jacqueline	Meteorological Service Jamaica	jamspence21@gmail.com	Jamaica
11	Stern	Roger	University of Reading		UK
AGRICULTURE MINISTRIES					
12	Georges	Brent		trini.brent@gmail.com	Antigua
13	Ramirez	Gary	Ministry of Agriculture	garyramirez_bz@hotmail.com	Belize
14	Shaw	Winston	Rural Agricultural Development Authority	shaww@rada.gov.jm/ shaw_winston@yahoo.com	Jamaica
15	Toney	Cephus	Ministry of Agriculture Forestry and Fisheries	cist2004@yahoo.com	St. Vincent
16	Skeete	Stevenson	Ministry of Agriculture and Rural Development	hortimar@caribsurf.com	Barbados
CIMH STAFF					
16	Agard	Lisa	CIMH	lagard@cimh.edu.bb	Barbados
17	Kirton-Reed	Lisa	CIMH	lkirton-reed@cimh.edu.bb	Barbados
18	Moore	Anthony	CIMH	amoore@cimh.edu.bb	Barbados
19	Stoute	Shontelle	CIMH	sstoute@cimh.edu.bb	Barbados
20	Trotman	Adrian	CIMH	atrotman@cimh.edu.bb	Barbados

Annex 4

GUYANA DATA RESCUE

Report

May 15th - 19th 2010

Prepared By: Mr. Melvin Hall

Technical Officer

CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Report on trip to Guyana

Sunday 16th May 2010

I arrived at Timehri Guyana on Sunday May 16 2010 , took a taxi to SleepIn International Hotel , Brickdam , Georgetown.

The hotel network infected both the netbook and my personal laptop the first night causing them to be non-operable.

Monday 17th May 2010

At 7.30 am, I crossed the road to the Hydrological office only security was present, therefore I return to the hotel. I joined the workers who were waiting for the office to open at 8.30a.m., they were very friendly and accommodating.

I was assigned two of the senior staff members Michelle Patterson and Julian Françoise as helpers plus a number of juniors who were very eager to learn everything about extracting and tabulating data from the numerous charts they had accumulated over the years.

I was told the data on some of the charts were never extracted and needed to be rescued urgently. Time was spent training a number of staff members how to extract data from the charts.

On the first day we photographed climatological forms from Timehri Airport, George town maximum and minimum temperatures rain Georgetown 1916-1979, Rain fall Pakeria 1962-1964.

Tuesday 18th

I arrived at the office at about 8.30 am was forced to leave at 8.40 to purchase batteries and a battery charger. A new group of staff was trained in extraction of data from charts.

Photographs were taken of data from Georgetown for the period 1954 -1976 . These include data of wind, rainfall, dew, maximum and minimum temperatures, radiation pressure and cloud amount.

Wednesday 19th, Thursday 20th and Friday 21st

On these days more Photographs were taken of climatological forms plus rainfall data of regions 2, 4 and 9 of Guyana. Much help was given in transferring data from camera and storing on disk.

Challenges

The task of capturing the majority of data available was impossible during the time spent in Guyana, the backlog was too great. Sorting the data also took plenty time. All computer work had to be done during office hours because of infected hotel system.

Thanks

Special thanks must be given to the staff of Guyana who was very accommodating and without whose help the mission will be unsuccessful.

The above information is forwarded as requested.

…….

Melvin Hall

Technical Officer II

Hydrology

GRENADA DATA RESCUE

Report

June 13th - 18th 2010

Prepared By: Mrs. Judy Padmore

Technical Officer

CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Report on trip to Grenada

Sunday 13th June 2010

Arrived in Grenada

Monday 14th June

I was collected from the hotel at 9.15 am and was taken to the Ministry of Argiculture, there I met with Mr. Trevor Thompson –Land Use Officer, Land Use Division Ministry of Agriculture . A meeting was held at which there was discussion on how best the data can be rescued. I was then introduced to other members of the staff who were to help with the data rescue. These officers were Ann Francis-Land Use officer, Jason Felix -Agromet Officer and Jason Felix-Agromet Officer. I then set up the cameras and showed the staff how the job should be done. The data first had to be sorted , this was done by Ms. Francis and myself. Then Mr. Felix and I took the photos .During this period I had to go shopping for batteries as there was only one set of rechargeable batteries, after work for the day I went to town and bought a charger and four batteries.

Tuesday 15th and Wednesday 16th

I arrived at the office at about 8.30am, sorted the data and took the photographs. I was assisted by the same staff. We were more familiar with the camera at this time. At 3.30pm I left for the airport but the flights were grounded.

Thursday 17th and Friday 18th

There was a strike by the airlines so I was stranded for these two days, I spent some time at the airport trying to sort a flight back to Barbados, I left on Friday

Recommendations

It is recommended that the following steps be taken in order to ensure a more efficient process in the future:

- Some sort of stand can be bought on which to mount the data. This would enable whoever is taking the picture to have a better angle.

- The use of an extra flash drive for storing data

- The use of a card reader would enable the data to be input directly into the computer without the use of cables. Using cable usually cause the batteries to deplete quicker.

- It took an extra time to sort the data, this was unexpected. In future it should be known previously what need to be done to the data so that the time allotted for the trip would be allocated more appropriately.

The above information is forwarded a requested.

…….

Judy Padmore

Technical Officer II

Hydrology

ST. VINCENT DATA RESCUE

Report

September 7th - 11th 2010

Prepared By: Mrs. Judy Padmore
Technical Officer
CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Report on Trip to St. Vincent – 7th to 11th September

Tuesday 7th September

Arrived in St. Vincent

Wednesday 8th September

I was collected from the hotel by Mr. Cephas Toney, went to the airport, there we met Mr. Joyette, Head of Meteorological Services. A meeting was convened at the airport in which I was introduced to Miss Niasha Webb, Meteorological Cadet, who was assigned to assist me in the tasks assigned. We then went to the Ministry of Agriculture to start working on the tasks. We experienced much difficulty with the sorting of the data as it was hand written and faded and some of the books were not labelled. Photographs of the data were taken. Mr. Toney was very helpful in this matter.

Thursday 9th September

We sorted data and took photographs. I had a brief discussion with Mr. Charles Gumsam concerning the possibility of holding a seminar/workshop for observers. I felt that this was a very good suggestion.

Friday 10th September

We sorted data and took photographs. I had a discussion with Mr. Toney in which he indicated that there is more data not currently available. He added that when it was available he will take responsibility for the sorting and recording of this data. He also stressed that there was much data that would have been misplaced.

Saturday 11th September

Arrived at the airport at approximately 4.45 p.m. Left St. Vincent at approximately 6.10 p.m.

I would like to refer to the recommendations of the report on the trip to Grenada dated 2010-08-18 as these have not yet been addressed and would apply to the current report.

The above is forwarded for your information.

.....

Judy Padmore
Technical Officer II
Hydrology

ST. LUCIA DATA RESCUE

Report

October 26th - 30th 2010

Prepared By: Mr. Melvin Hall

Technical Officer

CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Report on trip to St. Lucia

Tuesday 26th October 2010

I arrived at George Charles airport on Tuesday 26th October 2010 around 9pm and reported to the Meteorological office where I left a telephone number to be contacted the following morning. I proceeded to La Clery where I was residing while in St.Lucia.

Wednesday 27th May 2010

At 9a.m. I was collected by Mr. Glen Antoine an officer of St. Lucia Meteorological Services, we proceeded to Roseau Wind Fresh.

At Roseau Wind Fresh we met the Lab technician Mr. Leo who presented us with registers from which we photographed Agrometeorological data.

Mr. Leo reported that some of the data I was requesting was missing because Instruments were blown away during a past hurricane. Digital data was also lost because of computer problems.

After lunch period we visited St. Lucia Water Resources Unit at union, there we met Mr. Junior. A. Mathurn and Joel Ramie. There we received a hydata MDB file containing data from 1955 -2004 for stations in St. Lucia.

Thursday 28th

I was Collected around 9.am was taken forty five miles to Hewanorra airport. There, Mr. Fredricks was assigned as my assistant. We photographed meteorological registers for the period. I was given digital data for Hewanorra period. I left Hewanorra airport around 5.pm for the return trip to Castries.

Friday 29th, 2010

Visited Meteorological office at George Charles took photographs of registers. I received digital data for period 1988-2010.

Saturday 30th, 2010

St. Lucia was visited by hurricane Tomas, the country was closed down for the day.

Sunday 31th, 2010

Visited the airport to inquire about flight home, airport was closed due to flooding of offices. St. Lucia was without the services of water and electricity.

Monday 1st, November 2010

Revisited the airport in the morning arranged for a flight out the night. Electricity was very unstable, off and on. I was unable to operate computer without risk.

The above information is forwarded as requested.

…….

Melvin Hall
Technical Officer II
Hydrology

ANTIGUA DATA RESCUE

Report

November 9th - 13th 2010

Prepared By: Ms. Lisa Agard
Technical Officer
CIMH

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James
BARBADOS

Tuesday 09th November

Arrived in Antigua at 10.05 a.m. Met by Mr. Keithley Meade from V.C. Bird Airport.

Assigned to work with Mr. Michael King, Senior Tech. Asst.

Checked for data from airport to set aside to work with.

Checked into hotel at 1.30 p.m.

Wednesday 10th November

Left hotel at 9 a.m. for Ministry of Agriculture, St. John's

Met with Mr. Owalabi Elabanjo , Extension Officer

Left Ministry at 9.45 a.m for the following stations after Mr. Elabanjo called ahead and let them know we will be on our way:

- **Christian Valley Agricultural Station** :- daily rainfall books for 1979 – present
- **Cades Bay Agriculture Station** :- monthly rainfall 1979 – 2009 (no daily data was provided)
- **CARDI** :- system was down; data is digitized and promised to be sent to St. John's
- **Dunbars Experimental Station**: - door to data was locked; spared key not available. Left my e-mail address to forward the data. However got a few years of monthly data 1993-1997

Returned to St. John's to make copies of the data received from the above mentioned stations.

Thursday 11th & Friday 12th November

Left for Met. Office to continue to collect data in the field. On arriving, Mr. Meade contacted Mr. Elabanjo to get the stations we will be visiting. He was told that we will not be going out and that was it for the collection of the data. Spent the remaining days at the Met. Office getting familiarize and accessing their database.

This database was created by Mr. Meade, where the information from the daily registers and being put in by their Data Entry Clerk. Meade said they was no need to photograph the registers as he will have the database up and ready in a years' time to be fully sent to CIMH

as he discussed with Mr. Trotman. He did however allowed me to extract what was already inside which is 1995 – present. Took daily rainfall, max and min temperatures.

Saturday 13th November

Before leaving, I checked with Mr. Meade to see if any information had come from Ministry of Agriculture or CARDI and was told no.

REPORT OF THE CARIBBEAN AGROMETEOROLOGICAL INIATIVE (CAMI)

Rainfall Analysis Attachment
Statistical Services Centre
University of Reading, U.K.

6 - 17 September, 2010

Prepared By: Mrs. Shontelle
Technical Assistant, CAMI

Caribbean Institute for Meteorology and Hydrology
Husbands
St. James

Personnel on Attachment were:

Mrs. Shontelle Stoute, Technical Assistant, CAMI

Mrs. Lisa Kirton-Reed, Technical Officer, Caribbean Institute for Meteorology and Hydrology

Mr. Adrian Trotman, CAMI Coordinator

In providing essential information to farmers, weather and its extremes need to be analyzed to provide information on such occurrences as dry spells and droughts, flooding potential, extremes in temperature as well as trends to determine the possibility of a changing climate. There were two statistical programs used in the training sessions at the Statistical Services Centre of the University of Reading, UK. These were InStat and GenStat.

Several methods were explored which included:

- Distribution-free analyses along with smoothing techniques
- Distribution fitting, which included exposure to the range of distributions and their applications
- Regression analysis and trends
- Markov chains

An initial review of some statistical terms gave a better understanding of statistics before beginning the actual analyses. Some of these terms included; standard deviation, variance and standard error that illustrate the degree of variability of the data; as well as significance tests.

Distribution Fitting

INSTAT and GENSTAT were used to find basic statistics (e.g. percentiles) on distribution free data, along with data smoothing. After this we were re-introduced to the normal distribution and its application and the circumstances under which events tend to normal distribution. Other distributions and their applications were re-introduced including the Poisson, exponential, binomial and the gamma.

The “Fit Distribution” menu of the GenStat program was used to fit a GEV (Generalized Extreme Value) Distribution to the values. This type of analysis was used to estimate the return periods and levels of extreme events (for example maximum rainfall, extremes in maximum and minimum temperature). The analyses were used to produce monthly and yearly return periods.

Return periods produced for 2, 5, 10, 20, 50 and 100 year periods. For example, the table below shows the return periods and confidence limits for January rainfall at three stations in the Caribbean.

Table 1: January Rainfall Return levels and confidence limits for Barbados, Belize and Guyana

Return Period	Barbados (CIMH)			Belize (Central Farms)			Guyana (Georgetown)		
	Level	Confidence Limits		Level	Confidence Limits		Level	Confidence Limits	
		Lower	Upper		Lower	Upper		Lower	Upper
2	12.75	8.1	17.39	29.42	20.22	38.6	42.1	31.47	52.8
5	23.1	14.39	31.82	46.64	31.55	61.7	68.1	51.20	85.0
10	32.39	15.79	48.98	59.29	36.27	82.3	88.0	60.50	115.5
20	43.69	12.03	75.35	72.47	37.03	107.9	109.3	62.82	155.9
50	62.84	-4.27	129.96	91.18	31.27	151.1	140.7	53.91	227.5
100	81.52	-29.1	192.14	106.53	21.16	191.9	167.3	36.69	298.0

Markov Chains

Markov chains, used normally to determine the likelihood of the occurrence of an event based on what has happened before, were used to analyze probabilities of having dry spells or rain. This was illustrated using the INSTAT software. Participants explored results based on producing zero, first and second order Markov Chains on daily rainfall data.

Table 2: First Order Markov Chains. The number of dry or rainy days given that the previous day was dry or wet (dd is dry given the previous day is dry, dr is dry given the previous day is rainy

dd	dr	rd	rr
57	54	58	110
70	55	53	102
74	54	55	97
99 etc.	48	46	87
93	45	47	95
102	50	46	82
121	47	48	64
108	56	54	60
134	51	48	47
130	46	52	52
125	57	51	47

This type of analysis incorporates smoothing distributions, in which the user has the choice to the degree of smoothing. The aim would be to obtain the best fit to the actual data (see Figure below).

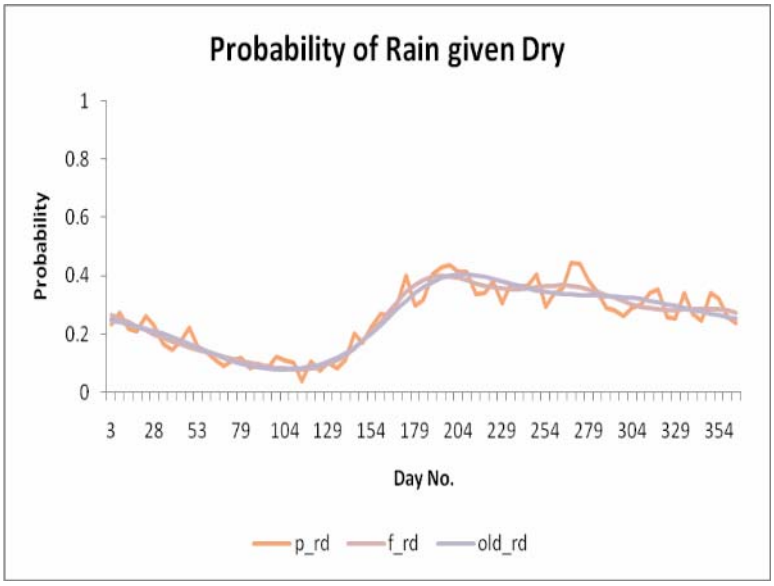

Figure 1: Probability of Rain given that the previous day was dry ***[p_rd is the probability obtained from the actual data. old_rd is the fitted probability as a result of smoothing the data where as f_rd is the new fitted probability after smoothing a second time].***

Markov chains could also give probability of spell lengths within a given period as well as probability of a specified amount of rain within a given period.

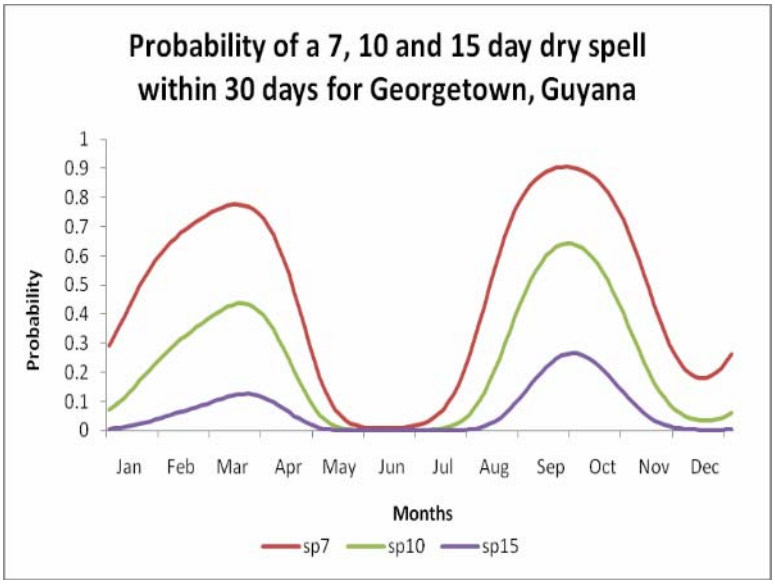

Figure 2: Probability of having a 7, 10 and 15 day dry spell within 30 days for Georgetown, Guyana for a 1st order Markov Chain analysis.

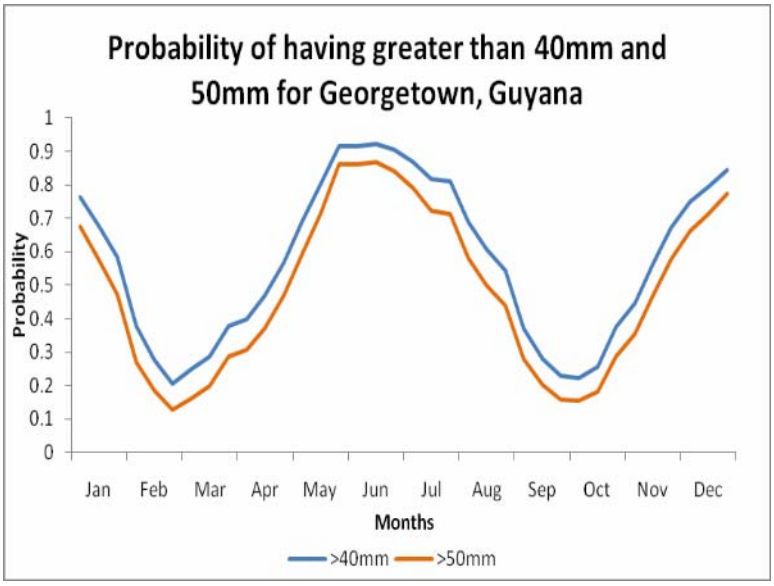

Figure 3: Probability of having greater than 40mm and 50mm of rainfall for Georgetown, Guyana

Trends

Regression analysis is very important in climate analysis, especially for detecting trends in data, and thereby inferring to the possibility of changing climates. Regression analyses were done, using the GenStat package. Here, changes in monthly or annual temperature or rainfall can be detected along with the levels of significance. The program gives the significance of the test (see Figure 4 below). The p-values for mean maximum, mean minimum and mean annual temperature were observed to be <0.001, 0.164 and < 0.001 respectively for the Guyana stations in Figure 4. This means that the increase in mean maximum and mean annual temperature is significant while there is no evidence of increase in the mean minimum temperature.

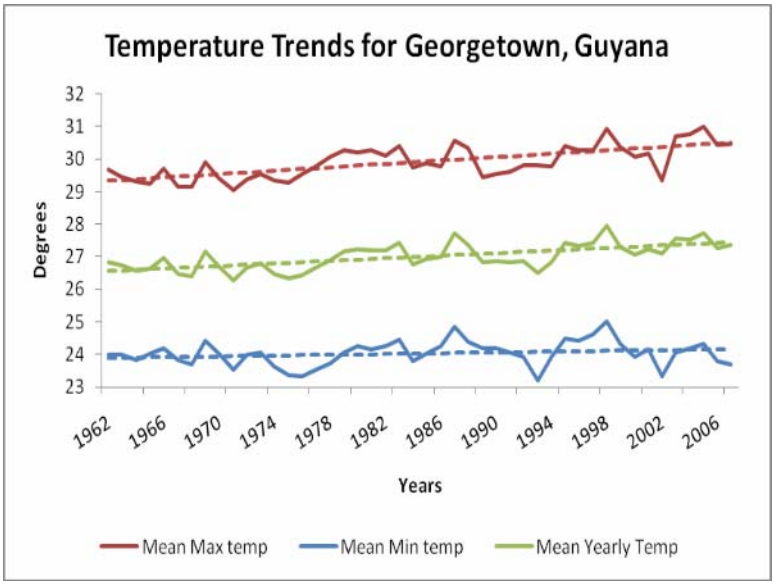

Figure 4: Temperature trends for Georgetown, Guyana

The use of the training and the analyses began at the SSC of the University of Reading will continue for the duration of the project for multiple stations across the Caribbean. The results of these analyses will be presented to and discussed with farmers during the project's farmers for a.