Water Information Systems Experts Planning and Development Workshop

7 – 10 June, 2011
Castries, Saint Lucia

Water Information Systems Experts

Planning and Development Workshop

June 7th to 10th 2011

Coco Creole Resort

Rodney Bay, St. Lucia

Day 1 - Opening Ceremony

The opening of the Workshop commenced at 9:30am. The head table comprised Mr. Hubert Emmanuel, Permanent Secretary, Ministry of Agriculture, Mr. Christopher Roberts, Finance and Administration Director, Caribbean Environmental Health Institute (CEHI), Mr. Christopher Corbin, Programme Officer, UNEP-CAR/RCU and Ms. Deborah Bushell, Consultant attached to CEHI.

Ms. Bushell acted as Chair for the opening session and morning sessions in the absence of Dr. Christopher Cox, Programme Director, CEHI.

Ms. Deborah Bushell welcomed the participants and head table and invited the Permanent Secretary to address the participants.

Opening remarks by Mr. Hubert Emmanuel, Permanent Secretary of Agriculture

The Permanent Secretary acknowledged the head table and welcomed participants. In his opening statement the Permanent Secretary spoke of the Water Commission. He stated that the decision: *came on the heels of Hurricane Tomas which devastated St. Lucia's water sector. It was gratifying to hear from the Prime Minister of Saint Lucia that the Water Resources Agency (WRA) will be fully functional as resources will be made available.*

In recent years, with the advent of Climate Change, politicians as well as NGOs have seen the need to come together to adopt common water policy across the Caribbean – a step in the right direction for the region. Hurricane Tomas and other natural disasters exposed Saint Lucia's our vulnerability and showed a lack of coordination in the sector. As a Caribbean group, we need to come together and adopt water policies and ideas that will sustain economic growth in the various islands and territories. We have taken the issue of water and the environment too lightly and need to come up with ideas and policies that will help sustain economic growth. St. Lucia is very dependent on water, without a supply of fresh, very little can be done. The tourism industry which we are dependent on and other industries rely heavily on water.

The timing of this workshop comes a few days into the new hurricane season. It is hoped that over the next few days, participants will dig deep and come up with solutions that will help not only St. Lucia, but the entire Caribbean and put together policies and systems in place that will ensure that no matter what happens with Climate change we can survive.
Welcome to St. Lucia and the best for a productive workshop and looking forward to the proceedings of the workshop.

Christopher Roberts, Finance and Administrative Director, CEHI
Mr. Roberts acknowledged the presence of participants in particular CARIWIN, represented by Catherine Senecal who is supporting this workshop. He also extended welcome to participants from Haiti and Cuba. It is good to see the number of countries and agencies

represented here today. It speaks well to the level of expertise and knowledge that is resident all in one room.

- *The water sector is under increasing threat and those present at the workshop are very well aware of the problems and challenges. Problems posed by climate change, water scarcity, the issue of land use, encroachment in watershed areas, problems associated with pollution and the degradation of fresh water supplies.*
- *Look at the issues of wastage not withstanding scarcity, there is still a large percent of the population who are oblivious to the issues of scarcity. People still wash their cars, and carry out other activities in times of water crisis. There is still a need for education.*
- *Water is important in terms in terms of food security, health; the water cycle in terms of habitats, and natural environments and biodiversity.*
- *why are governments not giving more attention to the water sector. Why is it not high up on their list of priorities? Why does it not feature prominently on the national and regional agendas? Why is the water sector the most under resourced sectors in the region?*
- *Those within the sector have fallen short in terms of advocacy. Lack of qualitative and quantitative data that is necessary to make our case.*
- *Following on from Tomas, St. Lucia has a problem right now. The water sector is in a very vulnerable state and one of the good things that has come out of it is the fact the government has seen it fit to have an inventory of the water supplies, springs and water collections around the island and to see how best to augment the existing supply.*
- *CEHI been called upon to assist in that regard to collect water quality data to see what can be useful in determining which of these resources can be tapped into. This is the kind of information that is lacking in the Region. As sector managers we need information to drive investment decisions and guide the path forward.*
- *The workshop should be seen as an opportunity to be able to understand all the tools, and technology, database and an opportunity to learn from the agencies like UNEP-CAR/RCU, CARIWIN, CMIH, CATHLAC and the others that are here to share their own experiences and expertise.*

Mr. Roberts thanked the staff at CEHI for bringing the workshop to this point. Ms. Bushell, who has worked hard getting us to this point, Ms. Avril Isaac, Ms. Sharon Pierre Louis and Dr. Christopher Cox.

Mr. Christopher Corbin, Programme Officer, AMEP, UNEP CAR/RCU

CEHI and UNEP are seen as representing the IWCAM as co executing agencies. I wish to acknowledge to significant partnership support provided by the regional partner agencies CMIH and CARIWIN. I think this really exemplifies what we have to do in the region in terms of water resource management.
Real challenges are being faced in management of the sector in terms of the resources, and also in terms of the data – quality and quantity. How is it generated, complied and presented. How is it transformed into meaningful, visual data that the decision makers can use for policy making and policy review. How do we take technical data and transform to make it palatable for the public; how do we use it to guide their decision making. This workshop the idea of bringing together not just the fresh water management but also the coastal water environment.

UNEP as a whole also has fresh water management extremely high on its agenda. We have been working in many countries, looking at what it the most appropriate technology we need to consider. We also need to look at what implications do these activities have for our coastal and marine environment in a small island context. Many of you, whether you work in the water sector or coastal and marine sector you know that any activities that take place on land will affect the marine environment or the coast immediately. We are very excited about the prospects of this workshop and wish to congratulate the organizers for the vision and as mentioned we have a wealth of knowledge around.

He made mention of St. Kitts' recent achievement – *in the gazetting of the Basseterre Valley Aquifer - one of the objectives of the project.* Participants gave a round of applause.

We have expertise in the technical areas in terms of mapping, water quality analysis. What we really hope is an exchange and sharing of ideas as to what can work and I think that's the message that we would like to end with.

Mr. Shawn Boyce, CMIH

Mr. Boyce stated that the workshop is timely not only because of what is happening in the region as it relates to water management but also there are a number of ongoing activities as it relates to data management, database programmes that are being installed across the region. He expressed for any type of system to be sustainable, quality management is important. Mr. Boyce extended wishes for a productive workshop.

The remarks were followed by general introductions of participants. An overview of the workshop was provide to participants.

Day 1 will look at what protocols and reporting requirements that exist for countries. Discussions will follow the presentations and then country experiences will provide (1) minute presentations. Later will look at how NGOs and CBOs deal with water quality monitoring and what are the applications that CBOs can use. This will be followed by general discussion on challenges and limitations and what will work best. At the end of Day 1 participants should achieve a better sense on what is available, and what can be done as countries.

Day 2 will take the form of work group sessions and hoped that a common framework will be developed so that countries like St. Lucia can use to work towards.

Day 3 will look at spatial applications and provide better guidance.
Day 4 was sponsored by CARIWIN and will look at sustainability issues.

Session 1 -State of water information systems in the region; review of existing and previous initiatives

Presentation: *International Water Management Protocols*

Presenter: Shawn Boyce

Reference was made to the following documents:

1. WRA handbook: the scope of this publication is to provide direction for review of basic WRA programmes. http://www.wmo.int/pages/prog/hwrp/wrahand.html
2. Guide to Hydrological Practices -http://www.hydrology.nl/mainnews/_1-latest-news/189-guide-to-hydrological-practices-new-edition-by-wmo.html
3. Guide to Met instruments and observations - http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO%20Guide%207th%20Edition,%202008/CIMO_Guide-7th_Edition-2008.pdf

Presentation: *Challenges, Limitations and Opportunities for the Management of Water Resource Data/Information in the Caribbean*
Presenter: Emil Cherrington, CATHALAC

Presentation highlights:

- Next year will be 40 years since the US installed LandSAT 1 program. The LandSAT Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey. There are also plans to install an eighth LandSAT. It has been 40 years of environment remote sensing and even longer than that there has been meteorological remote sensing. He commented that the information captured by these satellites have not been taken advantage of by agencies in the Caribbean.
- Provided an overview of CATHALAC which is based in Panama.
- Operating a web interface called SERVIR (www.servir.net) and provides data and products that can assist with better decision making. The interface takes advantage of satellite access of NASA, USGA, and NOAA
- SERVIR is linked into global initiatives such as the Space-based Information for Disaster Emergency Response (UN-SPIDER). SERVIR is also part of the global earth observation system which is still in development.
- The system allows for various combinations: Climate change data can also be combined with sedimentation, using a dataset from Canada; Climate change scenarios can also be combined with habitat maps
- Projected how habitats and ecosystems can be affected by climate change.

- The web interface incorporates visualizations and forecasting capabilities.
- In collaboration with UNEP, CATHALAC developed and published the Latin America and the Caribbean Atlas of our changing Environment. This publication is available in print and online and shows the environmental changes based on remotely sensed images acquired by different satellites. The atlas can also be explored online in Google Earth.
- CATHALAC also provides training for disaster management agencies, environmental ministries, universities and meteorological service providers.
- Other types of information available – Japanese satellite which expired (12 May 2011) a few weeks ago; N-SPECT; SWAT; INVEST
- Blog: www.caribbeangis.org – information about what is out there in spatial information systems

Session 1 -Existing reporting obligations by treaty

Presentation: *Challenges, Limitations and Opportunities for the Management of Water Resource Data/Information in the Caribbean – Reporting Requirements*
Presenter: Christopher Corbin, UNEP CAR/RCU

Outlined the services of the UNEP Caribbean Environment Programme, based in Kingston, Jamaica. Also the Secretariat for the only regional binding multilateral agreement dealing with the sustainable development of the Caribbean Sea – otherwise known as the Cartagena Convention.

Presentation highlights:

- Challenges relating to multilateral environmental agreements is the issues of reporting. A lot of work has been done on the generation of data relating to environmental quality.
- Governments have to meet for the particular requirements of the multilateral environmental agreements.
- Obligation to report -report on data, information, status of what has been done or not done to meet the obligations of these agreements. This is an area of challenge to Governments as reporting is not seen as being done nationally; reporting is seen as being done only for the multilateral environmental agreements. Reporting should be seen as a valuable tool that allows utilizing of data and information at the national, regional level and meets some form of the regional and global obligation.
- Agreements also established related to Conventions – Climate Change, Biodiversity, Cartagena
- Significant aspect of the work being done as managers especially in the field – the need to have a target to know what has to be achieved in terms of policy. What is the target for the amount of forest we maintain; the target that we want to have in terms of water cover, in terms of reduction of pollution of the environment, pollution of our water sources? There should be a system of reporting both at the national level and also reporting to the Parties at the regional level.
- Monitoring being done within the MEA context allows you to identify where your priority areas of action are; what needs to be done.
- Very limited financial resources, limited money coming from central budget; there is a need to prioritize.
- Donor communities - less likelihood that the donors are now providing financial support
- Challenges - how do we start to integrate reporting that is being done on a wide range and in many cases of water quality, climate change, water resources management, biodiversity, hydrological and meteorological data; how do we integrate them into systems of management.

- Outlined of the Cartagena Convention. Showed examples of the range of issues and information that is needed in a reporting context.
- Possession of information related to water quality, whether is the fresh water; how to better manage the information.
- Some activities that UNEP will be interested in from a reporting context – how much pollution is entering the water environment – ground, rain, surface, marine; what is the load of sediment, agrochemical runoff, biochemical oxygen demand (BOD), wastewater, solid waste.
- Measuring and reporting- *is it recorded accurately; do we have information relating to where the oil spills are, waste water is being discharge; what implications that has for management of water resources.*
- Monitoring in terms of water quality – concerns regarding contamination
- Engaging communities –provided an example of the IWCAM project in Jamaica. An effort was made to engage local communities in terms of monitoring – explaining the importance of the monitoring data.
- He encouraged the group to *look at the continued sensitivity of certain types of water quality data. Rainfall and hydro data and run-off etc does not raise eyebrows in tourism sector. Faecal Coliform levels does….. how do we make that from a purely water supply issue to issues of potential impacts of human health, and tourism. How do we address the issues of information available to the public.* Encouraged participants to share information of best practices.
- Look at both data management and information systems management.
- Consensus on Regional approaches - Mentioned CEHI's efforts in piloting regional approaches to guidelines on water quality and waste water.
- Classification on waters
- Highlighted the various reporting instruments and for different conventions. Efforts are being made at clustering/ grouping having one standard reporting, data base or system. Countries have had varying degrees of success in terms of reporting. There is a need to rationalize in the context of the reporting.
- UNEP CAR/RCU has been identified through the IWCAM to be a clearing house for the information for that project. A system of sharing of information to know that each agency has relating to the water resource management sector is needed.
- Are we monitoring the most appropriate indicators that will guide decision making? Where is the water quality data, recreational data - who has it, who has access to it; who does not have access to it. Is the potable water quality data just as sensitive? Can the public get access to it.?
- LBA on marine pollution – now a legally binding agreement. To date, 9 countries in the region have signed. It is hoped that more countries will sign on. It offers opportunities when dealing with issues of pollution prevention, control and opportunity to approach donors – indicating that the region now has an instrument.

Questions and comments
Generation of many products recently. What sort of information was demanded in terms of products, maps, data?

Response:
Disaster, flooding/ flooded area maps. In Panama for example maps were used for to determine routes to gain access to affected areas during floods. In Belize, information was requested to view damaged forests. Maps for reporting are being put together for presentation to donors.

Session 1– State of the hydrometric and water quality observations stations in select countries; tools and instruments used; data archival processes; administrative processes.

Presentation: *Barbados Experience:* State of hydrometric and water quality observation stations in Barbados.
Presenter: Alex Ifill, Barbados Water Authority (BWA)

Presentation highlights:

- Barbados has approximately 21 well sites belonging to the BWA; 36 sites are being used for water quality monitoring.
- Samples taken: Chemical parameters are done once a month; metals are sampled quarterly; Pesticides are monitored quarterly
- Wide screen analysis are done depending on money available because it is expensive
- 100 wells at which water level readings are done intermittently
- 30 bore holes for salinity profiles and water level data intermittently
- The BWA uses topographical maps in order to locate an incident – important to the administrators and public.
- Also use satellite imagery – used to develop models that interact with the public because it enables them to identify with.
- Rainfall data monthly not as in-depth as the Caribbean Institute for Meteorology and Hydrology (CIMH) – the data dates back to 1950; groundwater catchments - 1:10000 resolution; point data for service reservoirs – not the big, open reservoirs; groundwater sample locations.
- Well points are used to get water level data – there are over 100 spread over the island. The data is not consistent every month at every well.
- Also have production data for some of the metered wells – all are not metered. Those databases are in Excel. Also have bore hole data.
- The BWA also has Town and Country Development Planning (TCDP) data – application development because each service zone is supplied by a well or series of wells and particular series of reservoirs. BWA wants to know what the demand will be in the area based on TCDP applications – the amount of houses and the TCDP applications that are submitted- in order to expand the network.
- The BWA also has Population data - latest is 2000 census in GIS format.
- The landuse data outdated - needs to be updated.
- Soil types are used for risk analysis in conjunction with contours and rainfall and water table levels.
- Weekly chlorination and bacteria samples are taken at 50 distribution points around the island

- Software used by the BWA use for GIS: ESRI, ARCView, ARCGIS; Databases: Access and Excel, any DBF format and text. Salinity profile: DBF format and direct download xls.
- Hydro data is received from the MET services and CIMH and are stored on the office server.
- Looking forward the BWA hopes to increase the usage and understanding of GIS capabilities in the organization.

Presentation: *Cuba Experience:* Water Quality indicator in Cuban bays (tools, instruments, data archival)
Presenter: Marlen Perez Hernandez, Center of Engineering and Environmental Management of Coasts and Bays (CIMAB)

- CIMAB is one of the Regional Activity Centers for the Protocol for activities concerning pollution from Land Based sources. The centre's mission is to contribute to the preservation of the marine and coastal environment.
- The centre has three departments: pollution, industrial ecology, oceanographic and coastal engineering
- Highlighted the three classifications of water quality indicators – compulsory or mandatory, complementary, and optional.
- CIMAB analyses groups of water quality indicators – each is important to measure organic pollution;
- Listed the indicators, quality criteria and methods used at CIMAB's laboratory
- In Cuba there are 2 water quality standards: - NC22: places of bath in coasts and masses of inner waters. Sanitary requirements hygienic; and NC25: Fisheries
- Depending on the importance the area is analyzed every 2 or 3 years.
- Management of coastal water data at CIMAB:
    - Laboratory data management is carried out according to ISO 17025
    - Complicated because the lab has standards
    - Research is used for what is important at the time; what is needed at the time.
    - Data is used for weather report etc
    - Tools used: ARCGis, Excel, Access. Examples where shown of the databases.

Questions and Comments:

Q: Is any of the information easily accessible to the public?
A: Some of the information, not all are public. Some studies are being done for the business sector and is not public information. Also research done for Ministry of Environment.

Presentation: *Jamaica Experience:* Status of the Hydrometric and Water Quality Observation Network in Jamaica
Presenter: Herbert Thomas, Water Resources Agency (WRA), Jamaica

The WRA is responsible for the monitoring of streamflow, water quality. Work started from the early 1950's as a unit in the public sector department and evolved over the years. Since 1995 the WRA has operated based on an Act of Parliament. This gives the agency responsibility for water resources, data management for planning, in particular the water resources master plan and water quality control plan for water allocation, and license process.

- **STREAMFLOW**
    - Hydrometric/streamflow network, WRA has a total of 117 streamflow stations: 5 are recording, 45 are loggers, 1 telemetry –pilot warning gauges – provide early warning of the water level to guide for persons that move through a narrow gorge that leads to the north and southcoast of the island; 66 manual stations – this also includes stations without gauges. Manual spot measurements are done on a monthly basis.
    - Monthly measures of the flow and water level
    - Two databases are used: HYDATA and WRAMIS. The WRAMIS database developed by Jim Joseph is used to facilitate and show the information in the website. Proved very useful so far as less time and effort is spent on preparing data for the public.
    - Information about annual data flows, peak flows etc can be downloaded from the WRA's website
- **GROUNDWATER**
    - Over 2000 well - 296 are monitored. Only 5 well with logger attached. All the others are manual systems. On a monthly basis the same technicians who measure the streamflows in the river, measure with a depth probe to measure groundwater level. Regular checking o the elevation of the wells. Data is quality checked, computed and stored in the groundwater database (Excel).
- **RAINFALL NETWORK**
    - Rainfall monitoring is done by the MET office. Total number of 351 gauges, 327 are manual gauges, 43 are loggers, 4 telemetry – support a telemetric streamflow gauge – they facilitate flood early warning. Of the 43 gauges the WRA manages 21 of them.
    - Information is used to facilitate modeling in the respective basins
    - Over the years, WRA has increased the rainfall intensity gauge coverage around the island.
- **WATER QUALITY**
- The WRA does not monitor water quality as a routine program. The National Environment and Planning Agency (NEPA) responsible for environmental planning, the environment health unit, and several agencies conduct water quality monitoring based on the license they hold.

- **SHORTCOMINGS**
    - A mechanism is needed to be in place to verify the data received is consistent. The WRA hopes to embark of this project this year.
    - Need for sediment data
    - Bombarded from time to time for data on sediment data, suspended load and bed load.
    - Only data that exist is short spans of data associated with small projects
    - No routine monitoring for sediment data. Hope to address that problem in the near future.
    - Two-thirds of Jamaica is largely limestone, characterize by sinkholes. Information on sinkhole location is very crucial. It is important not to only understand the hydraulics of the groundwater resources but as it relates to development – blocking those holes can result in flooding and inundation of houses on hills. Need a GIS databank to inform sinkhole locations and secure area for houses.
    - A system for data sharing – the system needs to be effective. There is a challenge in accessing data when needed. The introduction of the web enabled database could have been expanded to include all the various functions as it carries great flexibility. Some agencies have used the database but a lot of work needs to be done in that area.
    - Presently the database is dated - not the current version. Funding is needed.

Questions and Comments:

Q: Is raw data accessible to the public and at what cost?
A: In terms of products we will ask the client to defray cost. Raw data is available through the website.

Q: When and how did WRA moved to the open access; was it a challenge; how time consuming was?
A: Guided to the WMO policy that organizations should provide free and unrestricted basic essential data. After a visit to St. Lucia in 2005 the database being considered at the time suited the purposes of the WRA.

Q: Notice there is no water quality data is uploaded.
A: Data is sparse but not as extensive as streamflow. There is also no wastewater.

Q: Agencies to put information into website
A: It has been our dream that the other agencies input data. This is compromised by limited man power in these agencies. NEPA conducts water quality along with other agencies. Quarterly meetings are held with those agencies. The bauxite company has been asked to stream profiles several miles down because of the nature of their operations.

Presentation: *St. Vincent and the Grenadines Experience:* Status of the Hydrometric and Water Quality Observation Network in
Presenter: Marco Audain, Central Water and Sewerage Authority (CSWA), St. Vincent

- Multi island state with 600 isles and islets
- 7 of the islands are populated
- Most of the settlements are along the coast. A number of small streams that flow to the coast. Interior of the island is a large mountain range.
- Rainfall network failed in 2005. There is no systematic records for river discharge – measurements for river discharge are done if there is an interest in that particular river
- Ground water assessment for the island of St. Vincent was last undertaken in 1971 and 1990 for the Grenadines
- Information was gathered in 2007/8 – Most of the information is very recent - started gathering information in 2008. This came about from this project which was implemented in 2007. This project came about after the national irrigation project it was realized that other sectors using the water –bottle water providers and VINLEC for use for hydro water.
- The National Water Resources Management Study project was approved in 1999. A French company EGIS-BCEOM was awarded the technical contract; the equipment contract was awarded to a German company.
- An assessment of the water resources was undertaken; recommendations for institutional reform and capacity building were formulated and an economic assessment for the Grenadines water sector was carried out.
- The assessment gave an idea for the way forward for providing a regular supply to the Grenadines.
- The hydrological monitoring system – equipment and gauges were ordered. Water level sensors were used because of the terrain. It was intended that the equipment would last a while instead of being washed away
- 26 rain gauges were installed.
- Sustainability issues as the water agency carries the bulk of the cost.

Software used by the CWSA includes HYDATA and Mike Basin (DHI)

Questions and Comments:

Q: What about simulation?
A: the software has been received – data accuracy not achieved yet. Basically used a management tools

Q: Monitoring tool - what is currently being done?
A: Receive support from suppliers but not a permanent arrangement

Q: are most of the stations located where there is electrical power?
A: The CWSA chose to use power as there are close to government buildings.

Q: What about solar power?
A: 2 climate stations are solar powered. Carries a guarantee of 10 years. The Trinidad and Tobago WRA used solar power for equipment. The worry is mechanical repair and vandalism. Solar panels attract people who want them. Disadvantage: once the battery dies the data is lost.

Session 1– The community perspective for water quality monitoring

Presentation: *Community Based Monitoring in Saint Lucia*
Presenter: Mary Beth Sutton, Caribbean Student Environmental Alliance (SEA)

The presenter introduced Keiwa Simpson, one of the young leaders from the community of Marigot. She attends the SALCC.

- The young people and community members are involved in restoration projects and other fields like renewable energy because of sewage which relates back to clean water.
- An EPA approved method for measuring e-coli called the Coliscan Easygel. Membrane filtration or a direct of the water into the broth and 24 hours later it produces results.
- An area of coral where red mangrove seedlings were planted hoping that they will grow and help prevent sedimentation.
- The young persons in Marigot have done testing and hot spot determination in the Marigot bay because they noticed a lot of sediment. In Mabouya Valley they worked with IWCAM and did a partnership and got a grant from the National Fish and Wildlife foundation to help with the pig waste issues. The young people in the valley did the monitoring and looked at the levels of nitrates, phosphates and e coli etc.
- Collaboration with the Marigot Bay Business Association was not easy at first. The group planted mangroves and somebody ripped them up; despite having permission to plant. During the meeting with the MBBA they confronted hoteliers about the sewage in the water; the MBBA didn't think the young people had any creditability. Within a year the MBBA agreed and sought the help of the young people.
- A benefit of the project is that it gives the young people an avenue to channel their energy positively and they have stayed in schools longer. They also learned how to use the GPS instruments.
- Benefits: makes a community take ownership of their resources; young people instill proper procedures for the future; they can assist with helping the environment recover.
- Some pitfalls – data reliability. Strong leadership is also important or the projects may not continue. It should be noted that the results may not be reliable but the trend will provide good information. The data was spot-checked by CEHI and has been within +/- 10% for E. coli.
- How data can be used in communities: Highlighted the Kamal Kar Community-led Total Sanitation (CLTS) – assists with behavioral change by helping communities eliminate open defecation.
- Marsha Serville, UWI grad student looked at the connection between water quality and health in the Mabouya Valley, St. Lucia with the engagement of communities. In Dominican Republic, a group of fishermen are focused on protecting their mangroves and the reefs.

- Connecting coral reef health with water quality and the fishermen can result in better protection.
- As a result of the hotpots identification, the Marigot Bay Association intends to come together to address the issues.

Questions and comments:

Q: Is there any mandated law in St. Lucia to deal with the pig farmers and disposal of waste? Who has the responsibility?
A: There is a law- the problem is enforcement of the law. There have been many meetings with Ministries of Agriculture; Health; Sustainable Development to ensure that Ministry of Agriculture will undertake the mandate. The WRMA and GEF IWCAM have had meetings with the relevant ministries encourage proper standards regarding livestock production.
Protocol and standards are being developed. Ministry of Health is trying to push for the strict enforcement.

Session 1 – WebMap Applications

Presentation: *Community Based Monitoring in Saint Lucia*
Presenter: Jim Joseph, Programmer/Analyst, Government of St. Lucia

- The system is an internet based application for remote date, information access and retrieval and visualization. Includes interactive vector maps, enhanced user interaction. It can also show raw data and GIS maps simultaneously. Access is via a web browser
- The WebMap systems have been successfully installed in the Caribbean countries
- Excel, Access can be incorporated including documents, images; audio and video presentations can be geo-coded. Includes tools for map zooming, panning, formatting, copying and printing
- The software operates off the internet and access for users is via a web browser. The system is installed on a server and can render maps from a database and project in geo web browser. No client installation is necessary - each user enters the system through the website with username and password.
- Data can be taken from any GIS system example ARCView and import as a layer. Shape files can be imported to the system.
- It should be noted that heavy traffic on the internet can slow down upload/download process
- Images can be rastered to Google Earth. Google has the ability to provide 3-D perspective. Layers can be taken from the application and rendered to Google Earth Data can be viewed as a table in the browser. It can also present the data in the form of a chart. Also shows statistics – minimum, average etc.
- All objects in the database are geo-referenced - the information available for a specified location will be revealed

Questions and comments:

Q: What platform is used?
A: Uses MYSQL as database, PHP, java script, no framework.

Q: What about the countries that have it but not using it? It is because of data issues?
A: In the case of SLU where it was installed there is a problem with WRM department - waiting for new staff. By then the application has grown in capacity and there was the case of funding to get equipment. Hopefully it will be up and running soon. Guyana just came on board. Data has been uploaded for the stations; however, there are problems with decimal spaces. Georeferencing is needed for points. Have to revisit Guyana.

Plenary Discussion

Reflections on Day 1
Facilitator: Trevor Thompson, Grenada

- Huge gaps because of financing
- Gaps create problems when analysis are needed or to make recommendations.
- An EU project means that the equipment must come from the EU and there is a compatible issue. Supply issues, spare parts issues etc. Another challenge is continuation. Projects that fund data collection - when they end, what happens to the collection procedure? In most cases the staff is not permanent.
- Caribbean SEA project - interesting. Shows that it can and will fill the gap where government cannot. Government does not have the staff to collect data at the community level. The groups will play a fundamental role however a lot of us lack there community groups in most countries. How can they be activated to do the type of work.
- Collaboration with the private sector – can businesses fund data collection? It benefits them - the hotel industry benefits when the data is collected – shows the problems and help find solutions that arise from data collection.
- Data collected – who has ownership? The community, the government, the NGO? Further discussion needed in this area.
- Pitfalls – data can be unreliable if the collectors are not trained properly.

Ownership of data

- There some Departments that collect data but do not share.
- In the Caribbean we have that culture of holding on to data.

- Town and Country Planning in Barbados provides data for purposes of planning; some information cannot be made public. Public should get approval/permission. There is the issue of sensitive data and the impact on the economy. **CASE: data regarding pesticide was once given out and was wrongly reported in the national newspaper. Created the wrong impression.**
  There is a need to be careful how information is shared and disclosed. Implications can be detrimental.

Q: Is water quality data available to the public in Grenada?
A: Not yet. But it's in the works. Continuous debate on how much of the data should be public.

Discussion and comments:

- Disclosing information must be accurate before being published.
- Standardization of the data and interpretation of data is important.

- The advent of web based systems and social networks it is difficult to keep data under wraps-It is a challenge. In Jamaica, the Public Awareness Unit handles the public.
- Training media personnel is important. In Trinidad the media was invited to training on how to report on water resources and related issues. Other countries in the Caribbean should do the same.
- Agencies should disclose information of findings. It depends on the role of the organization that is involved. If is a community based group, then the findings should be made known to the specific community. The intentions of the respective group should be considered.
- In St. Lucia, a recreational beach was monitored and results were well below acceptable national and regional standards. The results were taken to the Ministry of Health, with a recommendation that that beach be closed temporarily – the Minister of the time disagreed. The source was from a hotel whose treatment plant was not working – untreated sewage was going directly into the water. There is a form of civil/public responsibility in terms of data and data management in terms of sharing information.
- There is an increasing demand from a trade standpoint to show that agricultural produce is free from particular pesticides. Laboratory facilities need to be put in place to certify that the products are at the acceptable standards.
- Intervention is important. The focus is about people. Information should be disclosed to take the necessary actions.
- Barbados: Data is shared with Ministry of Health, EH department and the Chief environmental health officer so that the water quality is known; also an awareness of the status of the distribution system. BWA do wide screen samples and share with other agencies and ministry departments.

End of Day 1

Presentations for Day 1 are in Appendix 1

Session 2 – Working Sessions on Development of a common Framework for Water data capture, archival and dissemination

Objectives of Day 2: Participants provided with instruction for workgroups. This will include assignment of Chairs and rapporteurs and mode of reporting. The intention is to capture information that will provide a basis for the production of a framework. Participants will be divided into 2 working groups: **Group 1**: Climatic working group will consider best approaches to data structure for hydro meteorological monitoring; **Group 2:** Water quality working group will consider best approaches for surface, groundwater and coastal water quality monitoring look at parameters of interest, data encoding and formatting using standard practice.

Facilitator: Christopher Cox, CEHI

Instructions for work groups

- Today participants will be doing an experiment.
- Participants were divided into 2 groups.
- The groups discussed the parameters of importance, using country presentations from Day 1 are a basis. This was followed by an in depth discussion on the actual design e.g. Excel database used in Barbados. Based on what is discussed we should try to figure out an appropriate template that has the structured information.
- Map out an appropriate structure for a database. Participants then tested various data scenarios, how it worked in real life circumstances; relate the template to various uses, bearing in mind whether it is important to capture external influencing parameters e.g. land use. The final template should be prepared in Excel, Access or Word format. The intention is to use this template as an initial draft to develop guidelines for practitioners in the Caribbean. Findings of the work groups will be merged and a common protocol will be finalized.
- The Water Quality group was lead by Ms. Marlen Perez and the Climatic Group was lead by Dr. David Farrell.

The Working Group documents for Day 2 are in **Appendix 2**

Working Group 1

Working Group 2

Session 3 - Integrating GIS and spatial application in water resources information systems

Facilitator: Dr. Christopher Cox
Provided and overview for the day's deliberations and the expected outcomes.

Presentations – Representing water parameters spatially

Presentation: ARCView 3.2
Presenter: Alex Ifill, BWA

- The BWA has ARCView 9.3 but still use ARCView 3.2 regularly because the updates are not as expensive or memory hungry.
- The Population database and the Town Planning files are integrated to execute the information faster and easier
- The St. Michael catchment - problems of nitrate pollution
- Applications in GIS make it informative
- Weekly sampling for chlorine and bacteria – showed stats for chlorination. There is also interest in what is happening regarding town planning in some areas. Can easily query developments. Also used for EIAs and for some developments one needs to know the general setting for the particular zone. This same database is being used to help BWA develop the national database. Used for in-depth queries.
- Risk analysis - looked at a DRASTIC susceptibility map of Barbados – to show how vulnerable a particular area is to surface level pollution.
- Showed an application that was developed to look at land use
- What types of pesticides to look for in the groundwater. Problem: difficult to find databases relevant to the region. Barbados uses the U.S. database - (PPIS-USA), but fate and transport in temperate and sub tropical areas in the U.S. do not relate to the Caribbean.
- Simulations/scenarios can be set up to show damage to areas and can be stored.

Questions and comments:

Q: The assumption is that Barbados does not use many pesticides – why not create its own list. Can the Ministry of Agriculture provide that information?
A: there is an indexing formula used for fate of pesticide in groundwater. Developed by the French indexing system called SIRIS. Cannot find what is generally used in the Caribbean.

Presentation: Integration of GIS with Coastal Zone Management
Presenter: Ramon Roach, CZMU, Barbados

- Looked at general use of GIS within the marine environment
- Allows for effective environmentally sound planning and engineering decisions. It is achieved by combining various types of spatial data and various types of information and can see how future development or current impacts can affect the environment.
- Coastal zone management unit is divided into 3 sections: coastal planning, engineering, and marine research.
- CZMU decided to implement coastal setback limits to protect both the environment – beaches from erosion and also to protect the residents and property.
- GIS allowed the CZMU to develop Barbados into 7 coastal zone management sub areas. Each has particular coastal setback regulations, depending on the type of coastline
- GIS applications - allows to see setback regulations and limits
- Beach profiling is carried out every 4 months – approx. 40 beaches are profiled. Carryout grain size analysis and monitor highwater mark analysis using historical aerial images. GIS also informs decision makers regarding prioritization of shoreline protection works from high erosion risk beaches. Can help distinguish between seasonal and long term trends
- How GIS works for CZMU: GIS is an essential tool for resource management and requires significant investment for training of personnel to use tools, purchasing of equipment and software. Costly, but allows for accurate decision making – improves management of resources and decision making.

Presentations – National Applications of GIS for water resources management

Presentation: GIS Applications for Water Resource Management in Barbados
Presenter: Ramon Roach, CZMU, Barbados

- Justification for monitoring marine water quality – habitats are at risk from inland and coastal activities
- GIS can be used to interpret various data to identify possible sources of pollution; monitor the effectiveness of pollution reduction measures. Water quality information can be analyzed for both spatial and temporal trend by means of GIS.
- Drawbacks: in terms of analysis – time intensive; lack of automation in terms of producing products; limited access to data information – need for a more user friendly system; Need for a database that can be accessed by other agencies;
- Future Planning: collaborative monitoring projects – more integrated approach to data collection; resource management; web based mapping and database applications for both internet/intranet operations; public access. More training in the use of databases, modeling. Department will be expanding.

Questions and comments:

Q: What tangible outputs influence investment in public health.
A: Barbados has an EIA Panel which comprises of BWA, CZMU, EPD, Planning, and Works to review EIAs which has helped significantly. Information collaboration can save time and eases fears. Lobby government to use GIS to ensure collaboration.

Presentation: *National applications of GIS for water resources management: Cuba Experience*
Presenter: Marlen Perez, CIMAB and Minerva Sanchez-Llull, CEAC

Marlen Perez, CIMAB

Showed some experience in … with GIS.

- Examples of water quality analysis in bays and coastal areas in Nicaragua; model of erosion and diffused pollution using NSPECT tools for ARCGIS
- GIS tools are used to promote the LBS protocol
- Next step - incorporate with regional initiatives such as Geonetwork opensource
- CIMAB will provide data to the node of coastal marine zones.
- The national information system is big and complex. The idea is that each province will support this system of information.
- Metadata is specific to the laboratory not at the national level – only at the province level.

Minerva Sanchez-Llull, CEAC

- All centres are linked to the AMA system
- IWCAM provided funds for equipment and EIA system

Questions and Comments

Comments:
- Important to have a certain regulatory and legal framework in terms of standards and criteria;
- Recreational water quality standards - how robust are they
- Need to evaluate country by country - what is the status of them. Potable water seems better, but recreational water quality may need to be looked at.
- St. Lucia developed a recreational water quality standard, but right now is trying to figure out how the activities on the land are tied into the compliance settings –
- Business operators receiving concessions - these concessions should be tied into an assessment process to ensure compliance
- Operators should participate in monitoring.

Session 1 – State of the art in Caribbean water information system (WIS) applications

Presentation: *State of the art in Caribbean water information systems (WIS) applications*
Presenter: Marc Morell, CARIBSAT

- Overview of CARIBSAT – the Caribbean Satellite Environmental Information system project; from satellite to decision makers.
- Implement at least one information system in the Caribbean - remote sensing data
- Impressed with the presentation from Barbados. Learnt much from presentations and would like to receive more information from other organizations in the Caribbean. Spoke about the transfer of work done in Martinique with other islands.
- Listed 8 actions of the project. Has a map of biocenoses – would like to share with other islands
- Extended invitation to participants to attend a meeting slated for "BALWOIS" in May 2012
- Intention - one system, free access, use of web mapping – one of the tools to display the information
- Participants were invited to visit the website to access.

Questions and comments:

Q: any completion date for the products mentioned.
A: 10 engineers working in Martinique and Fr. Guyana. Have products. Not available on the website – hope to with people to improve what is being done and to continue this work.

Presentation: Administrator functionality of the *water information systems (WIS) applications*
Presenter: Jim Joseph, Consultant

- Demonstrate the administrator functions of the application – how to use the WIS system as an administrator – create/upload videos, data, create layers, specify parameters etc.
- Unlike some systems - the structure is simply in design – the table structure in the system is easy. The system allows importation of layers from shape files - shape files are converted then pushed to the application. The next version will allow direct importation to the application. A video can be attached to any particular object. There is a bulk data upload that can be used to upload data to the application. Users can upload data via the web. Application has predefined templates that can be used. Data upload facility is simple – makes it easy to attach any type of object – spreadsheet, word, video, pdf, mp3 etc. Also has security that can be assigned to the various functions within the application. The system has a built-in user manual.

- The next version of the software will incorporate other software changes in terms of trends. The vision is that as tech changes the new version of Windows 8 geared towards the same type of functions on mobile devices – think long term. The application to replicate in terms of trends. Move towards the web based environment.

Presentations – Experiences by national users; decision making context

Presentation: *Experiences by national users; decision making context: Grenada Experience*
Presenter: Trevor Thompson, Ministry of Agriculture

- Important strategic decision was made by the policy makers.
- Presentation was prepared for the Minister, Permanent Secretary, Chief technical officer and department heads in the ministries – they are some of the main stakeholders
- Policy makers' minds be captured
- Media release of the system prior to the launch
- One of the main recommendations from the water policy was the setting up of this system. Prior to the system being setup, a focus group was set up to move forward with the idea.
- Key strategic persons from the main institutions both regional and national (schools, water authority, airports) were involved.
- Anyone in possession of information or data was contacted. Looked at what the highest priority gaps
- Data should be transparent and accessible
- Not limited to climate data or water production; also looked at land, geology, marine etc.
- Sharing of data increases awareness and building support for data collection.
- Focus group could decide where it should be housed.
- Select hardware and software that will serve for at least a minimum of 10years.
- Cost – short and long term needs to be evaluated early – build into system or organizational structure.
- The NWIS was not expensive - hardware, software, training, data collection, inputting the data, GIS work etc cost about CDN32,000.00. One additional staff assisted by an administrator
- Most programs have been created for specific purposes such as during a project – once a project is done that's the end of it – staff is sent home etc.
- Build staff into organizational structure – they can benefit the entire organisation.
- Data is now being provided for all the ministries and departments
- Information can be accessed online using an approved username and password.

- The system is not confined to its initial focus of the water sector.
- During the drought, the National Water and Sewage Authority (NWASA) used the systems as part of its media briefings.
- Information generated is used by water managers in media briefings, national sustainable council meetings; presentations have been made to Permanent Secretaries of all ministries, senior management board of the public service.
- Database is being expanded with more data and coverage added. It is becoming a national system
- Now the data is centralized in one location, one system. Cost has to be considered- traditionally data was sold. Need to put in place a component that can allow payment with credit card to get the data.
- Keep it simple and use it. Manual is very simple about 20 pages and trained other persons so that the knowledge is transferred; other staff can use the system – add data etc.
- Website: http://www.cariwin.gd/webmap/app/db/index.php

Presentation: *Usage in Decision Making: Jamaica Experience*
Presenter: Herbert Thomas, Water Resources Agency

- Presently the GIS personnel are young and inexperienced. Have lost all the experienced GIS staff.
- Also includes maps on hydrostratigraphy, soil, geology, land use, hydrologic basin and WMUs are the water resources management unit.
- In terms of point data: well, springs, sewage treatment plants and the lines include: rivers, and fault locations.
- Computer software: ARCGIS, ARCINFO, AutoCAD, Excel is widely used, Access, Dbase, Hydata and Webmap.
- Water resources demand, both current and in the future, information on areas of water surplus and shortage, and unmet demands.
- The WRA interest is to be able to, for each of the sub water shed to say what the water source potential and demand.
- How does GIS help? Allows for the volume of rainfall which goes into the overall equation to determine effective rainfall, evapotranspiration losses etc.
- Demand assessment - in trying to ascertain areas where you have water surplus, you need to determine the water demand.
- Have information as to the per capita consumption, per day. Distinctions and calculations can be done using the existing database. Use the population census, to assist with projecting the demand for water. For each unit WRA can say how much water is available, what the current demand, future and allocation. This information is very important for planning procedures.
- Important and crucial matter – the issue of water resources protection.
- GIS maps show: soil and well data; groundwater flow direction; flood prone areas; faulted area and proximity to major surface and river courses.
- WRA also supports the disaster agencies in development of flood maps.

- Produced a booklet – contains a range of information: hydrological basins, watershed management units, wells and rivers in Jamaica. The Information was taken from the GIS database. The idea is to empower the nation to participate in water resources decision making.

Questions and comments:

Q: WRA wish list?
A: Seeking continued buy-in into the system. Have a number of agencies providing information. Meteorological data is crucial for the system; hope to have met services on board. Water quality control not given much attention at the moment as a result of attention being given to requests.

Presentations for Day 3 are in Appendix 3

Session 4 – Sustainability of National Water Information systems

Chair: Dr. Adrian Cashman, CERMES, UWI:

Presentation: *Sustainability of National Water Information Systems*
Presenter: Catherine Senecal, McGill University

- Stress on IWRM – have been talking about without mentioning it. It has been a common thread of the discussions over the over the last three days.
- Need to underscore again the importance of IWRM
- National water information systems really are a tool to facilitate IWRM.
- For those who are not familiar with the CARIWIN project – it is a project funded by the Canadian International Agency CIDA, through the Association of Universities and Colleges of Canada (AUCC) and has been an honor to work with many of the partners over the last five years on improving water management in the region, thanks to CIDA and AUCC.
- Worthwhile to continue and focus on how to make it sustainable in the long term.
- **Intent:** for the water information systems to work, there has to be the intention, a conscious decision. A firmly fixed purpose to make them sustainable.
- **Commitment:** to make it work, bring together a group of dedicated and interested people and engaged stakeholders.
- **Relevance:** WIS has to be relevant to the needs of society and has to be relevant to the development needs. Need government's approval
- **Political involvement:** involve the politicians in the discussions.
- **Dedicated financing**: budget allocation set aside or they have to be self financing.
- Discussion themes on sustainability for the day:
    - ✓ First session deals with institutional hurdles
    - ✓ Second session - increasing relevance of WIS by sector
    - ✓ Third session - information products
    - ✓ Forth session - education training, research and other related partnerships

Presentation: *Sustainability of National Water Information Systems: the St. Lucia Experience*
Presenter: Deborah Bushell, IWRM Consultant, CEHI

- In St. Lucia the water sector whereby people took it for granted that there was an endless supply of water for the water utility company and no need for information
- St. Lucia was one of the first Caribbean countries to embark on the development of water information system.
- Process was disrupted - government changes – main actors now longer in office; different employment opportunities, without those actors there was a knowledge gap
- WMRA has been instituted; although the WIS was developed it was not previously launched. With IWCAM support there is currently a move to launch the WIS.
- Challenges: The water manager and others are aware of the issues not all policy makers and public are aware of the issues.
- The WRMA is not fully functional - staff not fully trained. Monitoring program has shrunk significantly
- Human resources - lack persons related to general lack of appropriate HR; relatively high turnover of staff. need to depend on a local driver –a dynamic person.
- Need to mainstreamed IWRM for continuance
- Current opportunities: semblance of interagency coordination currently with funding from IWCAM, there is a IRWM road map for St. Lucia which charts the course, the steps to achieve IWRM in SLU.
- Broad-based committee which channels the IWRM roadmap. Currently trying to have coordinated approach for WQ monitoring.
- Have support at the highest policy level - Cabinet appointed a sub-committee on water.
- New Water Sector Project under the Ministry of finance which has express interest in the WIS
- Discussions have taken place regarding placing the information both in the WRA and St. Lucia's document centre.
- Sustainability: major aspect is financing
- Develop a fee schedule – different levels of fees, protocols allowing you to get different aspects of the data to be charged a fee.
- Issues of what is happening to the climate is creating interest amount the political and policy makers – should assist with sustainability.
- The way forward – poised for launching of the WIS.
- Learn lessons from Grenada and other countries. Explore other measures for financial sustainability - the fact the Ministry of Finance is involved, this is a very important step in making this possible

Presentation: *Sustainability of National Water Information Systems: the Jamaica Experience*
Presenter: Herbert Thomas, Water Resources Authority, Jamaica

- Strategy identified is the implementation of the IWRM approach.

- Have attempted to implement a NWIS from as early as 2008. Jamaica was a part of the St. Lucia initiative when it started.
- Very few agencies input information. Data supplied is selective and sparse.
- Need for legislative framework/policy that will give effect to the body that should have the responsibility to manage the database. Institutions cannot be forced to put information into a database.
- Recruiting and maintain human resources – WRA has trained persons in GIS etc but not able to keep the staff. Low salaries.
- Ensure several persons are trained to sustain the work – backup is important.
- Political support and financial resources
- Presently the cost to upgrade - can't get support of the professionals in terms of what type of upgrade to use.
- Access and data security: some agencies are willing to share data freely, for others there is a cost.
- Need for the current database - good at displaying the data;
- Interagency coordination.
- WRA collects, disseminate and shares data.
- Reshuffled several regulatory and planning bodies are under one ministry, so there is a window of opportunity to discuss the approach for an integration of water information system platform. Need for an apex body that can coordinate the activity – coordinate the WIS.

Presentation: *Sustainability of National Water Information Systems: the Grenada Perspective*
Presenter: Trevor Thompson, Ministry of Agriculture, Grenada

- Change in government – many things came to a standstill. In the process of trying to set up a water resources unit.
- Poor record keeping is serious in the public sector. Most persons have the information in the minds when they leave it is lost.
- Present reports in digestible format for senior managers.
- Strategies –long-term data is important.
- Work closely with the Ministry of Environment
- Regional issues – many of the models difficult to bring them to country level.
- Human resource – must be trainable and have the right attitude
- Securing financial resources – funding – for added coverage –
- Corporate with international, regional and local – integrate other related and relevant data from other programmes and projects.
- Interagency coordination – coordinate with other agencies on functional testing
- Recording of requests can help present a strong case for funding.
- Shortcomings: absence of avenue for feedback on changing conditions and effectiveness of programs and policies

- Threats: limited human capacity – brain drain; poor documentation of metadata; diverse location and format of data and loss of institutional memory.

Dr. Cashman:

Common points from presentations

1. Need for an apex or a home for such systems. Who is responsible for an information system
2. Human resources aspect – brain drain, poor salaries, training of persons
3. Financing – implantation of the system and operations, upgrade – keeping pace with the challenges as they develop
4. Politics/champions – need to move from the arena of the political agenda and not be questioned
5. Relevance – not only to the needs of the water sector but other sectors. Also to show others the relevance and the benefits
6. Bridging the local and regional needs – how to make the sharing of information and ideas relevant not just at the local or national but at the regional level
7. Need to move beyond just data collection and to where data information is used and compatible with other systems like hydrogeology and other forms.

Savitri Jetoo: Scientific Services Manager, **Guyana Water Incorporated**

- **PRESENT STATUS:** Water Information System in infancy stages. Primarily used to capture hydrological data. Water quality at the utilities captured data from the wells.
- Data is captured fortnightly. Works with the Ministry of Health to look at data on waterborne diseases
- GWI has developed a Water Safety Plan for the Linden Water Supply System with focus on quality assurance. Catchment to consumer approach to mitigate the risk.
- Disaster risk management - incorporating water quality with the hydrological data and using to help manage adverse weather events
- **Challenges**:
- Brain drain - Human resource a factor – migration of skilled staff – lack of staff to populate and maintain database
- – lack of coordination of the agencies. National stakeholders are on a water committee but hydromet services are not part of the committee. Will seek to invite Hydromet.
- Coordination and communication is still a problem. Financial resources are also a challenge – need to look at

Questions and comments:

Q: Is GIS database development training being offered?

A: Being done; UWI can assist. Advanced diploma courses may help. Short courses are advertised every year however no one applies. Financial resources can be a problem in some countries; costs often too high to send persons to Barbados from Guyana. CIMH and University of Guyana has collaborated for delivery of specialized courses in Guyana to overcome disadvantage.

Universities can also assist with updating databases.

Comment: Concern of water data in public domain which can affect the tourism sector.

Sustainability: a private sector approach to marketing might be used for advertising on the website paid by hits. Using Google or other search engine.

Models for sustainability assigning economic value to show return on investment from use of WIS. Funding can be received through clear demonstration of application of data - show examples of how the system benefited the government in decision making.

Mr. Emil Cherrington (of CATHALAC) demonstrated the Facebook page he created for the group of professionals working in water information systems. Entitled **Caribbean Water Information Systems Experts (WISE) community**, it is an online community for the dissemination of information about the implementation of geospatial technologies for water resources and environmental information applications across the Caribbean. Participants were encouraged to access the page; allows group to share link, upload documents, etc. Questions can also be posted to other users.

Panel Discussion: *Environmental Indicators: perspectives on successful use of water quality data in various sectors; strategies to include water quality data n national WIS. Demonstrate private sector partnerships toward financing of water information systems based on value of data*

Chair and Moderator: Dr. Chandra Madramootoo, McGill University
Panelists: Ramon Roach, Herbert Thomas, Savitri Jetoo and Trevor Thompson. Invited Jacob Opadeyi, Chris Cox, Chris Corbin, Vincent Sweeney to contribute.

Each panelist allotted 5 minutes. Panelists provided discussion points regarding country status.

Savitri Jetoo:

- Guyana during the 2005 flooding, there was scare of leptospirosis and did intensive monitoring of water supply. Used that information to take measures to treat the water to prevent the spread of the diseases. One of the key uses of the water quality information is protection of public health and prevention of diseases.

- The water quality data -Guyana subscribes to the millennium development goals – used to measure progress toward achieving those goals.
- Use the water quality data to look at the challenges in those regions.

Trevor Thompson:

- Grenada exports fish to Europe and adopted the EU standards for drinking water quality. Random testing is done. EU also sends persons to collect samples.
- Water data needed.

UNEP:

- At the national level in St. Lucia, looking at indicator development – a lot has been done. It is important not to reinvent the wheel.
- IWCAM is an excellent resource. Recently, CARICOM had overlooked this resource and was talking about doing an analysis of new indicators for the region.
- UNEP functions within a mandate of being a regional seas program and a convention secretariat; interested in environmental indicators as they relate to coastal marine environment.
- Work has been done in terms of what are the appropriate indicators both in fresh and groundwater but also marine water.
- UNEP's committed to being a clearing house for environmental information relating to the coastal marine environment of the wider Caribbean. Received support from IWCAM
- planning an expert workshop towards the end of September to look at coastal water quality monitoring and identify what are the most appropriate environmental

indicators for to recommend to the region, now that the LBS protocol has entered into effect.

- UNEP is now committed to looking at issues of contaminants related to endocrine disruptors, issues of hormones and pharmaceuticals - some of the parameters need to consider looking at. The issues of ballast water and invasive species – mode of transport is water.
- The issues of microplastics which is transportable by water, but becoming a potential source of pesticide, heavy metals from a consumption standpoint.

Impacts of Certification efforts – Jamaica - Blue Flag programme. Should also recognize the ISO, Green Globe and international certification regimes are driving indicator efforts by section of the private sector – tourism and industry.

Chris Cox:

- The Government invests in private sector agriculture, and provides incentives, but there is no tie in to indicators. There is nothing within the conditions of the applications for incentives – fertilizer inputs, agronomic input by technical experts, and vehicles - to make certain that the practitioner is using indicators that will meet environmental standards.
- Appropriate indicators should be "hard-wired" into the regulatory processes. It is opportune to bring the input out of this meeting to another forum - where discussions are held on common framework for enterprise development and standards.
- The upstream enterprises have to think about the end of pipe discharges. Linked into the LBS protocol which is driving national standards which should in turn drive how government provides incentives or disincentives.
- The importance of the indicators not fully understood; how to participate, their role in monitoring.
- need for building awareness for the public and business practitioners.

Vincent Sweeney: Regional Project Coordinator, GEF-IWCAM Project

Contributions of the GEF-IWCAM project to water/GIS information outputs
The project is interesting in supporting the development of WIS in the Caribbean. There are 13 countries involved in the project.
The project supports improved integrated management of water resources and coastal zones in the Caribbean. **Component 2:** development of indicators – stress reduction, environment status and process indicator. Indentified by the GEF as international water indicators. Work was done to support the development of an indicators framework.
Recommendations: Identify a suite of basic priority indicators that address needs and regional and national information systems should be strengthened. On the basis of the second recommendation that work is being supported for WIS development in Grenada, St. Lucia, Trinidad and Tobago and other countries. In terms of GIS, IWCAM did an assessment

of the GIS capabilities in the region – Emil Cherrington and Jacob Opadeyi were the consultants involved in the assessment. Some activities included training workshops, national workshop for Trinidad and Tobago. Work was done in Tobago as part of the Buccoo Reef project – data collected by various groups, project staff, community members - housed in the Buccoo Reef trust.

Recommendations to consider: the countries needs to develop strategies for GIS, more training needed, capacity building, standardization of data and decisions related to application and dissemination of results from analysis.

Questions and comments

- **Comment:** To indicate change – have to have good record of data. That indicator must be sensible enough to respond to environmental change – chemical parameter, bacterial organism etc.

- There is an effort by countries towards national environmental/ statistical databases which is driven by statistics departments. The information being generated through the water interventions but does it make its way into the national database management? – inputs to UNDP Human development reports, millennium development goals at the country level?

- Cuba: There is a national office for statistics in Cuba that provides environmental and statistics for water quality. Mainly for decision makers - national level. Not sufficient at the local level.

- The Jamaica WRA provides the Planning Institute with water quality data on an annual basis. Used to update State of the Nation report. The Institute also uses an adaptation of DevInfo data for tracking Millennium Development Goals (MDGs) called JamStats

- The Bureau of Statistics of Guyana is responsible for the census report. Water quality information and environmental indicators needed for the MDGs report, come from individual agencies; data, compiles it in a report, and then channels to the relevant international agency. Various agencies like the Guyana Water, EPA Ministry of Housing have representative that sits on the committee organised by the Ministry of Finance that puts together the data for those reports.

Cashman:

- the Green Economy Scoping Study in Barbados looks at the efficiency with which resources are used and the degree to which they contribute to the productivity of the economy.
- need to use indicators, also benchmark that you want to achieve.
- what indicators should be used or would be appropriate.

- Barbados has been chosen as the case study country, because there is no representative from this part of the world. There is much more work that needs to be done – we need to think in terms of water information systems in a much bigger than at the moment. That way, the problems of sustainability can be addressed.

Discussions

Chandra Madramootoo:

- Politicians and decision makers are overwhelmed with large numbers of indicators.
- Amalgamated or single reference indicator that will provide an idea the life of an ecosystem.
- Indicators such as endocrine disruptors and invasive species – need to be aware that they threaten life and quality of ecosystems and we need to able to measure and report on these.
- Economic valuation of water
- Need to be able to quantify economical value. Need to determine where it should be allocated.
- water is moved from lower economic value to high economic value.
- Food safety and water quality and international markets of trade
- Link environmental indicators to economic activities - Global Gap

GROUP PHOTO

Participants pose for group photo

Afternoon Session
Moderator: Dr. David Farrell, CIMH

Presentation: *Caribbean Drought and Precipitation Monitoring Network (CDPMN) – Drought monitor*
Presenter: Adrian Trotman, CIMH

- The product is partially operational – the regional part of the product works – struggling with the national.
- The CDPMN was initially conceptualized to monitor drought but it was recognized that the indices and indicators also, provide an indication of excessive rainfall – flooding etc.
- The network was expanded to include various types of drought including meteorological drought.
- Background on the CDPMN - it was launched in January 2009 under the CARIWIN. Monitoring network – monitoring rainfall at 2 scales: Caribbean Basin/regional scale and the national/country level scale. The intention was to monitor the state of precipitation using a number of indices; including the final precipitation status determined by consensus by persons from a network of persons from various sectors – environmentalists, farmers, water resources managers, communities etc.; to utilise CIMH's rainfall forecast to determine if a drought is likely to commence, continue or end.
- Outcomes of the CDPMN: monitoring of hydrometric stations; trends of rainfall and temperature; projected future status of drought using CIMH precipitation outlook – act as an early warning for drought and precipitation; Building adaptation and response strategies to droughts and floods.
- Developing drought plans - indicators can assist countries in combating floods and droughts. Impacts of droughts: crops and livestock losses; less food production – increased food prices; increased bush fires – utilising water to reduce, land degradation – flooding and landslides after droughts; Energy – decline in hydro electricity – increased in use of diesel and higher fuel surcharge.

Lessons learnt:
- need for improvement in rainfall forecasting and monitoring
- national scale monitoring integrating other indicators are needed
- need to support the strengthening of national hydrological networks – rain gauges, river gauges, monitoring of groundwater wells etc
- relate the indices to the potential impacts on the ground
- timely data collection; and human capacity to process and interpreted in a timely manner
- need for greater storage and improved leak detection, recycle grey water for irrigation use
- support the development of water safety plans and support water source protection

Recommended policy interventions:

- adopt the principles of integrated water resources management
- development of national actions that address drought management plans
- data collected be made available to national and regional institutions
- explore the possibility of drought insurance
- ensure availability of skilled professionals and these are investments in tertiary education, not only short courses but including at graduate level

Comments:

- CDPMN and Caribbean Water Monitoring are components of a delivery of climate services – now a major focal point globally being worked on to ensure that MET and hydro services deliver products and services as opposed to forecast. Integrated into user needs.
- Standardized Precipitation Index (SPI) is now the globally recognized standard for meteorological drought monitoring
- Drought is now a part of discussion of disaster risk reduction. It has been included in CDEMA's concept on disaster risk reduction

Presentation: *Role of Training, higher education and examples of education opportunities*
Presenter: David Farrell, CIMH; Jacob Opadeyi, UWI, Adrian Cashman, UWI

Jacob Opadeyi: Challenges faced in the region in terms of higher education.

- The challenge faced: how to position water quality management studies.
- Which domain does WIS belong – social sciences? Collaboration is important across the various disciplines. Tertiary institutions should look at short level courses for professionals.
- Develop diplomas courses and first degrees that have specialization in WRM. On the other hand, we need to start PhDs in this area–need for administration/directorship for this type of institution

David Farrell:

- Need for persons with post graduate skills in the region to help with problems that require scientific integration.
- CIMH has had a hydrology programme since 1982 and generated a number of hydrologists across the region. Problem is that the graduates are good in particular areas but but not broad enough. Not been focus on developing technical expertise in the area of water quality. The OAS programme extended the ability in field monitoring and training students to do water samples, protocols for collecting water. Working towards filling gaps in terms of water quality.
- Internship programme – about 6 university students participate. 2 -3 months, some for entire year. Exposes students to research and projects. Some students have received scholarships to do graduate work. Students have also been merged into collaborative work being done. Use internships to add modules to the WIS programme in the region.

Adrian Cashman:

- UWI is not doing a good job focusing on water; highlights inadequacies of what exists
- Edulink programme – funded by the EU – has courses with the University of Guyana and UWI-Trinidad.
- Attempted to estimate what the demand for post graduates with training expertise in the water sector - thought there would be a demand in the region between 11 – 12 students per year. To train that number across the region is expensive – how to justify educational infrastructure for small numbers.
- Pressure on the UWI in general to become more relevant to teaching at the post graduate level it offers. Are the disciplines appropriate and relevant?
- Mode of delivery – UWI has recognised the need for change. Invested Open Campus Set back: not translated into water related studies
- Funding can be an issue; not able to build a critical mass of researchers. PhDs are not the solution; rather need persons in academics environments as post-Docs to carry out research and provide input into the education programmes. PhD students require supervision and time and cannot engage in research.
- Collaboration with other universities – lacking. Presently done with international universities. Need to look at the regional universities to do research.
- Opportunities – more interest being taken in the UWI the provision of funding for post grad work. There have been opportunities for climate change. Weak – need an avenue to push, e.g. UWI, CIMH. Centre needed to progress educational needs of water sector in the Caribbean. Resources need to be in place soon

Discussion:

- Twinning of a centre for learning - looking of instrumentation of a centre where knowledge can be shared.
- Need to train persons who can be creative and multidisciplinary; also need to passionate about work
- Areas of research in the US and Canada are funded and students from the Caribbean migrate for that purpose. The region needs to look at a similar programme for its students. Collaborate with the private sector for funding

Catherine Senecal:

McGill University will be offering an online certification course for IWRM for professional development - available in 2012. General course - case studies with relevance to the Caribbean region. 3 main concepts – integrated water resources management, adaptive management and water governance.

Highlights from the workshop deliberations:

- Setup a user group on Facebook for the exchange of knowledge throughout the Caribbean and peer support group in GIS technology for water information systems – created and led by Emil Cherrington
- Setup a user group for the exchange of knowledge throughout the Caribbean and peer support for hydrological equipment, purchase, installation and maintenance – need for a leader for this area
- Initiate a recurring workshop on WIS and GIS at regional events e.g. CEF and CWWA
- Develop training or documentation relating to standards
- Look at comparative studies of features and capabilities of databases and platforms available in the region for WIS
- Dissemination of WIS and GIS capabilities within organizations
- Suggestion of a newsletter – update, notes on WIS in terms on regional issues

Closing Remarks

Chris Cox:

Expressed thanks to CIMH as a key partner in the organization of the workshop. Thanks to UNEP/CAR-RCU and the CARIWIN project; and the GEF-IWCAM project that funded the workshop.
Wish to thank the resource persons, and Emil Cherrington for creating the Facebook page, and Jim Joseph for organizing the social activities. He also thanked the facilitators and staff of the Caribbean Environmental Health Institute and GEF-IWCAM.

Cashman: expressed Dr. Cox for his efforts in organizing the workshop.

Presentations for Day 4 are in Appendix 4