Current Areas of Research

Water Quantity
- Water availability
- Water table management
- Water use efficiency
- Irrigation scheduling
- Developing drought indices

Water Quality
- Decision-making tools
- Computer modelling
- Nutrient management
- Cyanobacteria
- Point-of-use treatment

Climate Change
- Modelling
- Impact on water availability
- Impact on water quality
- Sensitivity analyses
- Downscaling

Brace Centre for Water Resources Management
The Brace Team

- **Catherine Senecal**, CARIWIN
- **Marie-Claire St-Jacques**, Community water strategies
- **Ajay Singh**, Water table management interactions with water and nitrogen use efficiency
- **Rufa Doria**, Impact of a changing climate on water availability for crop production in Eastern Canada
- **Sajjad Ali**, Evaluation of soil moisture sensors for irrigation scheduling of strawberries
- **Felix Jaria**, Increasing water use efficiency and improved nutrient management for processing tomatoes
- **Olanike Aladenola**, Development and application of an agricultural water demand model
- **Johanna Richards**, Development of drought indices for Jamaica
- **Mohamed Chikhaoui**, Decision-making tools, water quality management
- **Colline Gombault**, Climate change impacts on the water quality of the Pike River
- **Frank Ferber**, Sensitivity analysis of climate data using SWAT
- **Felexce Ngwa**, Developing approaches for early detection and quantification of toxigenic cyanobacteria in freshwater bodies
- **Candice Young**, Development of appropriate point-of-use water treatment systems for an Amerindian community in Guyana
- **Ahmed Nafea, Yong Liu**, MSc interns
- **Emily McGill, Simone Bourke and Eddy McKyes**, Summer students
Community Water Strategies
Marie-Claire St-Jacques, M.Sc. IWRM

Main Objective:
To establish a framework to guide the development and implementation of Community Water Strategies (CWS) in the Caribbean

Based on:
- International IWRM Best Management Practices for community-level applications
- Lessons learned from case studies
Examples of Applications

- Water Supply and Sanitation
- Capacity Building
- Watershed Management
- Agricultural Practices
- Environmental Sustainability
- Rainwater Harvesting
- Flood and Drought Management
IWRM & Community-based Management

Identify the necessary conditions for successful community empowerment and participatory management

- Integration
- Ownership & accountability
- Capacity & empowerment
- Transparency & information
- Adaptation & flexibility
- Gender mainstreaming
# A Quick Overview of the Framework:

<table>
<thead>
<tr>
<th>Phases</th>
<th>Components</th>
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<tbody>
<tr>
<td><strong>Assessment</strong></td>
<td>A1. Stakeholder analysis</td>
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<td>A2. Socio-economic context</td>
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<td>A3. Governance framework</td>
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<td>A4. Environmental assessment</td>
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<td>A5. Information management</td>
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<td>A6. Awareness-raising</td>
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<td><strong>Planning</strong></td>
<td>B1. Priority setting</td>
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<td>B2. Detailed plan development</td>
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<td>B3. Creation/reform of decision-making body</td>
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<td>B4. Definition of roles &amp; responsibilities</td>
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<td>B5. Enabling environment</td>
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<td>B6. Financing &amp; cost recovery</td>
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<td>B7. Conflict management</td>
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<td><strong>Implementation</strong></td>
<td>C1. Plan implementation</td>
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<td>C2. Process monitoring and documentation</td>
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<td>C3. Information sharing &amp; communications</td>
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<tr>
<td><strong>Monitoring</strong></td>
<td>D1. Development of indicators</td>
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<td>D2. Monitoring system</td>
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<td>D3. Sharing &amp; learning</td>
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Water Table Management Interactions with Water and Nitrogen Use Efficiency
Ajay Kumar Singh, PhD Candidate

OBJECTIVES

• Investigate the water and nitrogen use efficiency of corn under water table management scenarios

• Predict crop growth response to various water table and nitrogen management scenarios using a coupled water management and a crop growth model
Research Sites

Controlled Environment
- Greenhouse, Macdonald campus 2007

Field Sites
- Bedford, QC 2007
- St. Emmanuel, Coteau-du-lac, QC (2008 & 2009)
1. The numbers indicate drainage pipes in the control station linked to plots.

2. 8, 10, 12, 14, 17, 19, 21 and 23 are outlets for surface runoff plots and not used in this year's experiment.
Impact of a changing climate on water availability for crop production in Eastern Canada
Rufa Doria, PhD Candidate

OBJECTIVES

• To investigate the impacts of a changing climate on water requirements of crops for future periods of 2020, 2050 and 2080

• To define effective strategies for crop producers to adapt to climate change.
Study areas

Weather Stations

Legend
- Principal cities
- Weather stations

Data Source: Geodatabase, MRNC, 2008
Study areas

Weather Stations in Southern Ontario

LEGEND

△ Major Cities

 Weather Stations

 Coastline

Lake Erie

TORONTO

WINDSOR

LONDON

CHATHAM-KENT REGION

HARROW

Ridgeway

Vineland

St. Catharines

100 0 100 200 Kilometers
Expected output on this research (in manuscripts form)

- Climate change impacts on irrigation water requirements of peach and grape crops in Southern Ontario *(Transactions of the ASABE)*

- Estimation of irrigation requirements for some crops in Southern Quebec using CROPWAT *(Irrigation and Drainage Journal)*

- Development and application of an irrigation requirements model for peaches and grapes in Southern Ontario under climate change scenarios *(ASABE Meeting Presentation Paper No. 083755)*

- Estimation of future crop water requirements for 2020 and 2050, using CROPWAT *(EIC Climate Change Technology Conference Article No. 4057324)*
Evaluation of soil moisture sensors for irrigation scheduling of strawberries in Southern Ontario
Sajjad Ali, MSc Candidate

OBJECTIVES

- Monitoring soil moisture - *in situ* evaluation of two sensors as tools for irrigation scheduling.
- Comparison of water use for open field and plastic high tunnel strawberries
- Validate soil moisture sensor data using gravimetric soil moisture measurements as a standard
### Soil Water Sensors

<table>
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<tr>
<th>Time domain reflectometry</th>
<th>Frequency domain reflectometry</th>
<th>Tension-based</th>
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Recommendations

- The study highlighted the following key findings:
  - The importance of sensor installation location for accurate monitoring of soil moisture.
  - Appropriate soil depth for monitoring, based on crop type and growth stages, maybe by varying depth of monitoring with growth stage.
  - Site-specific sensor calibration helps in identifying the right triggers for turning irrigation on and off.
  - Irrigation schedules needed to be monitored more closely to be able to compare water use between the two management systems.
  - Capacity building of the growers, to interpret soil moisture data, setting triggers for irrigation scheduling.
OBJECTIVES

• Develop a web-based irrigation scheduling model for use by tomato growers in southern Ontario

• Determine optimal soil moisture trigger levels for irrigation

• Ascertained the effects of soil moisture uniformity on crop yield and quality
# Experimental design (buried and surface drip)

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OBJECTIVES

- To develop a model for estimating agricultural water demand based on
  - projected changes in irrigated area
  - precipitation variability due to climate change
  - introduction of more efficient water application technology and practices
Model Development Framework

Input parameters

CROP
- Growth stages
- Growing season
- Crop coefficient
- Crop height

CLIMATE
- Temperature
- Wind speed
- Solar radiation
- Relative humidity
- Rainfall

MANAGEMENT
- Soil type
- Irrigation depth
- Initial soil moisture
- Rooting depth
- Irrigation efficiency

• Calculate reference evapotranspiration ($ET_0$ – Penmann Monteith)
  • Calculate Effective rainfall ($P_{eff}$: USDA Soil Conservation method)

Water Demand Model

OUTPUTS
- Water requirement
- Irrigation scheduling
Development of Drought Indices for Jamaica
Johanna Richards, MSc Candidate

OBJECTIVES

- Develop Standard Precipitation Indices (SPI) for Jamaica
- Improve the performance of the Aggregated Drought Index (ADI) by making it spatially variable over small areas
- Predict the behaviour of the Rio Nuevo sub-watershed under future urbanization scenarios
Methodology

- The Rio Nuevo sub-watershed, St. Mary, is the study area for this research.
- SWAT has been used in order to simulate the soil moisture conditions over small land areas (10 km$^2$).
- Inputs include land use, soil types, Digital Elevation Model (DEM), daily rainfall and temperature.
Development of Appropriate Point-of-Use Water Treatment Systems for A Rural Amerindian Community in Guyana
Candice Young-Rojanschi, PhD Candidate

GOALS

• Water use
  • Identify water uses, sources, gender roles

• Water quality
  • Characterize water sources, quality, changes over time

• Water treatment
  • Test PoU technologies in households
Point of use treatment technologies
- Biosand filters (bottom left)
- Ceramic filters (top)
- Chlorine addition (top left)

http://www.handpump.org/kisii/index.htm