Integrated Nutrient Management in the Caribbean:
A presentation to U.S. AID

January 2, 2014
The U.S. Water Partnership’s mission is to unite and mobilize the best of U.S. expertise, resources, and ingenuity.

Visit our website www.uswaterpartnership.org to learn more.
Value Proposition for U.S. AID and the Caribbean

- Increased farmer yields, food security and economic potential – higher quality jobs
- Leverage UWI Centre for Food Security & Entrepreneurship – assist in meeting targets to transition to more food production
- Leverage GPNM regional Caribbean platform to share information
- Accelerated WWT goals – treat, reuse, reduce nitrates, IWRM
- Assist in achieving Cartagena Convention LBS protocol
- Reduced environmental footprint
- More effective coordination
- Lower costs
- Improved, integrated, credible capabilities
Nutrients cause eutrophication (leading to adverse impacts including mortality of benthic organism, collapse of fisheries and shellfish poisoning)

>500 eutrophic/hypoxic coastal systems

>245,000 km² of water area worldwide

Global loss of ecosystem services = USD 200 billions/year
The Global Partnership on Nutrient Management (GPNM) has been launched to answering this challenge

- a global partnership of governments, scientist community, industry, NGOs and international organisations

- an One UN initiative

- guided by a Steering Committee; UNEP is the Secretariat

GPNM Members are:
Government:
Industry: IFA, WPI, NFC, IPNI
Science: IGBP, INI, IFDC, SCOPE, ING, NEC, WU-USA, NEL, ETH-Zurich, UoU- Netherlands, AU-India, CU-Bangkok, CAU - Beijing, China – UK SAIN, Global TraPs..........
UN System: FAO, UN-Habitat, IOC/UNESCO, UNDP, IAEA, UNEP
NGOs: GETF, TNC, SCON, Water Stewardship Inc.
Regional projects: BOBLME, PEMSEA
Global Sanitation Challenges

Over 2 billion people lack access to sanitation

Source: JMP. 2012
Global Sanitation Challenges

61% of global population uses improved sanitation facilities

Figure 2 Regional use of improved sanitation facilities in 2008 and percentage point change 1990-2008

2.6 billion people – 72% of whom live in Asia – do not use improved sanitation facilities

Figure 3 Regional distribution of the 2.6 billion people not using improved sanitation facilities in 2008, population (million)

Global Ratio of Wastewater Treatment

Source: http://maps.grida.no/go/graphic/ratio-of-wastewater-treatment
Impacts on Watersheds: DIN Export Variation in Dominant Source (Single largest source)

From: Dumont, et al. 2005 GBC
Drivers for Change

1. Balancing economic development with environmental stewardship
2. Continuing population growth
3. Maintaining links to the local Caribbean approaches
4. Controlling point source WW discharges & non point source agricultural pollution & erosion
5. Addressing inappropriate disposal of solid waste & septic leakage
Impact on Watersheds

- Leaching of human waste into shallow groundwater
- Contaminating aquifers that impacts the clean water supply
  - Public health – blue baby syndrome, increasing nitrates
  - Biodiversity
  - Economic growth
An Integrated Solution

Training

Providing integrated wastewater, environmental & nutrient management training, leveraging current GPA /GETF approach

Converging Forces

Technology Deployment

Accelerating the use of clean WWT & NM technologies through partnerships

Nutrient Reduction BMPs

Helping farmers identify the most cost effective and efficient practices
Training: Improved Wastewater Management

Strategy: Leverage UNEP delivered wastewater management training jointly with UNESCO-IHE, and in partnership with UN/DOALOS, funded by UNDP-GEF and the European Union.

- Focus on all levels of mgmt
- Promote new ideas
- Develop Demos
- Embed in gov’t structures

Objective-Oriented Planning
Technology Innovation
Systematic Stakeholder Involvement
Financial Models

Outcomes:
- Reduce nutrient pollution
- Improve coordination
- Lower Costs
Training: Improved Nutrient Management

1. Leverage & modify the UNEP Global Nutrient Management Partnership & Black Sea/Central & Eastern European curricula to meet Caribbean needs

2. Capitalize on the expertise of the USDA, producer associations (the Fertilizer Institute, IPNI. Iowa Soybean Association), UNEP, Water Stewardship, UWI and IBM

Outcomes:
- More effectively manage the nitrogen cycle
- Promote on farm EMSs, 4As
Nutrient Reduction Best Practices

Leverage GEF/UNEP project to promote nutrient reduction best practices and relationships with the USDA Natural Resources Conservation Service, eXtention, the Chesapeake Bay Program, the Fertilizer Institute, IPNI and others to promote key BMPs:

<table>
<thead>
<tr>
<th>Potential BMP</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Ammonia emissions reduction</td>
<td>Poultry litter acidifier treatment, biofilters and permeable plastic covers</td>
</tr>
<tr>
<td>Dairy precision feeding</td>
<td>Feed formulation so as to reduce N and P in manure</td>
</tr>
<tr>
<td>Dirt/gravel road erosion/sediment control</td>
<td>Driving surface aggregate, raising the profile, grade breaks, additional drainage outlets, berm removal</td>
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<tr>
<td>Horse pasture management</td>
<td>50% cover, managed species, traffic management</td>
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<td>Livestock/poultry mortality composting</td>
<td>On-farm composting vs. burying</td>
</tr>
<tr>
<td>Livestock pasture management</td>
<td>Rotational grazing, dairy managed intensive grazing, beef and other livestock intensive grazing</td>
</tr>
<tr>
<td>Infiltration filtration</td>
<td>Bio-retention, filters, open channel, Permeable pavement and pavers Infiltration basins and trenches</td>
</tr>
<tr>
<td>Nutrient use efficiency</td>
<td>Reduce application rate, “decision farming”</td>
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</tbody>
</table>

Outcomes: Improve farm efficiency, Reduce nutrient pollution, Lower costs, Reduce erosion
### WW Solutions Comparison

+ better than average; o mid range; - worse than average

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>Cap Ex</th>
<th>O&amp;M</th>
<th>Energy use</th>
<th>Treatment Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated sludge</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Filtration</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vertical Biological Reactors</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Natural</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Septic</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>
1. Increase access to WWT & sanitation by:
   - Facilitating purchasing relationships with primary conventional & innovative, decentralized technology developers
   - Evaluating & offering recommendations on appropriate technologies for local conditions

**Strategies:**

Sample decentralized options

8,000 GPD Natural WWT

Outcomes: $3 per gal packaged system

**Sample conventional options**

<table>
<thead>
<tr>
<th>Size</th>
<th>People</th>
<th>Capacity</th>
<th>Average Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>&lt; 10,000</td>
<td>&lt; 1 MGD</td>
<td>$1.5 M to $2 M</td>
</tr>
<tr>
<td>Medium</td>
<td>&gt;10,000, &lt;100,000</td>
<td>1 to 5 MGD</td>
<td>$2 M to $15 M</td>
</tr>
<tr>
<td>Large</td>
<td>&gt;100,000</td>
<td>5 to 20 MGD</td>
<td>$15 M to $100 M</td>
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</tbody>
</table>
Technology Deployment: *Critical Success Factors*

1. Shared understanding of problem and a sense of need—thirst for solutions
2. Financing mechanisms
3. A business model and partners that support a sustainable enterprise
4. Continuous improvement cycle
Technology:
Energy vs. Footprint

Energy Use (kWhr d⁻¹ m⁻³) vs. Treatment Footprint (m² m⁻³)

- Membrane Bioreactor
- Activated Sludge Package Plant
- Recirculating Textile Filter
- Aerated Wetland
- Tidal Wetland Living Machine
Low Cost Intervention

- Constructed Wetlands:
  - Less expensive (between $145,050 - $255,012 per hectare)
  - Long life expectancy
  - Pleasing aesthetics
  - Removes pathogens
  - Provides denitrification
  - Removes nitrogen and phosphorous with no sign of reduced capacity
  - Multiple uses (biodiversity and carbon sequestration)
  - Most promising technology to be applied in developing countries, because of the simplicity of their design, operation and maintenance and lower cost
Initial Next Steps/Sample Work Plan

Develop a joint programme on integrated nutrient management, partnering U.S. Water Partnership, Caribbean governments, IBM, University of Nebraska, USDA, Valmont, and the UN System – Seed funding needed

**Month 1-3**
- Secure initial funding
- Partnership development
- Translate & modify materials & curricula
- Plan to implement the GPA

**Months 4-12**
- Technology evaluation
- Greater institutional coordination in the region
- Capacity building WW & NM
- Technology and methodology transfer on wastewater treatment and fertilizer use
- Initial WW training
- Initial farmer training
- Best practices workshop

**Months 13-24**
- Implement integrated programme
Discussion & Questions??????