EVALUATION OF THE RESILIENCY of the SILANG-SANTA ROSA SUBWATERSHED Laguna, Philippines

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Study area: Silang-Santa Rosa Subwatershed
Silang-Santa Rosa Sub-watershed traverses through the Municipality of Silang, Province of Cavite in the upstream and three cities of Laguna which is Biñan, Santa Rosa, and Cabuyao in the downstream area.
Municipality of Silang, Cavite:
• it is a landlocked- first class municipality with 64 barangays and mainly depends on agricultural economy
• it serves as a vital recharge area for the Watersheds of Laguna which drain to the Laguna Lake and adjacent towns of Cavite that drains into Manila Bay (WWF Hydrogeology study)

City of Biñan, Laguna:
• a first class component city with 24 urban barangays
• some of the Philippines' largest industrial estates and export processing zones can be found in the area

City of Cabuyao, Laguna:
• a first class city with 18 barangays and formerly known as the "Richest Municipality in the Philippines" because of the large number of migrants working in the town's industrial estates
• there are still productive rielands in the area

City of Sta. Rosa, Laguna:
• predominantly a suburban residential community of Metro Manila with 18 barangays
• numerous commercial, industrial, and business establishments (in the western part)
• residential areas and subdivisions, schools, industrial zones and various business establishments (in the eastern side)
Land Use Change

The Subwatershed is experiencing rapid land conversion due to increasing population.
Drivers and impacts of land cover change

Upland

Deforestation
- in-migration & abaca planting

Coffee
- income source & desire for land tenure

Pineapple
- marketability

Mid slope

Sugarcane
- presence of Hacienda Seiz

Sugarcane with industries
- influx of land investors

Industrial & residential
- high price of land

Lowland

Rice fields
- source of livelihood

Industrial & residential
- sold lands for economic gains

Flooding

Soil erosion

Soil acidity
### Land Cover Change in Silang-Sta Rosa Sub-watershed

#### AREA (Hectares)

<table>
<thead>
<tr>
<th>LAND COVER</th>
<th>Year 2009 (source: WWF-Philippines)</th>
<th>Year 2014 (Current)</th>
<th>Year 2025 (Future Plan based from PRA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-up</td>
<td>4,031.02</td>
<td>4,904.81</td>
<td>9,823.59</td>
</tr>
<tr>
<td>Agricultural/Mixed Crop</td>
<td>930.26</td>
<td>441.92</td>
<td>113.40</td>
</tr>
<tr>
<td>Ricefield</td>
<td>2,097.90</td>
<td>1,309.94</td>
<td>405.62</td>
</tr>
<tr>
<td>Coconut</td>
<td>783.02</td>
<td>644.16</td>
<td>0.02</td>
</tr>
<tr>
<td>Idle/Grassland</td>
<td>2,675.97</td>
<td>1,951.19</td>
<td>530.03</td>
</tr>
<tr>
<td>Mix Scrub/Broadleaf/Forest</td>
<td>853.48</td>
<td>2,004.92</td>
<td>383.21</td>
</tr>
</tbody>
</table>

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**Diagram Description:**
- **2009:** Shows the land cover distribution in 2009, with color-coded areas indicating different land uses.
- **2014:** Illustrates the current land cover as of 2014, with similar color codes.
- **2025:** Depicts the future plan for land cover changes from 2025, based on PRA (Participatory Rural Appraisal).

**Legend:**
- Green: Agricultural/Mixed Crop
- Red: Built-up
- Purple: Coconut
- Orange: Idle/Grassland
- Pink: Mix Scrub/Broadleaf/Forest
- Yellow: Ricefield

**Map Features:**
- Laguna Lake is prominently marked.
- Sub-watershed boundaries are clearly delineated.
Land Conversion in the Downstream Area

Year 2007 & 2014 Orthophotos in the downstream barangays of Sta. Rosa experiencing Land conversion from Rice fields to Subdivisions
Portion of Downstream Area experiencing Flooding from a 5 meter increase in the Lake’s water level
<table>
<thead>
<tr>
<th>Year</th>
<th>Typhoon</th>
<th>No. of Affected Barangays</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Frank</td>
<td>4</td>
</tr>
<tr>
<td>2009</td>
<td>Nando</td>
<td>3</td>
</tr>
<tr>
<td>2009</td>
<td>Ondoy</td>
<td>8</td>
</tr>
<tr>
<td>2009</td>
<td>Santi</td>
<td>8</td>
</tr>
<tr>
<td>2010</td>
<td>Basyang</td>
<td>4</td>
</tr>
<tr>
<td>2011</td>
<td>Pedring</td>
<td>4</td>
</tr>
<tr>
<td>2012</td>
<td>Habagat</td>
<td>10</td>
</tr>
<tr>
<td>2012</td>
<td>Ofel</td>
<td>10</td>
</tr>
</tbody>
</table>

Recent Flooding in the City of Santa Rosa
Recent Flooding in Luzon (2012 Habagat)
Major flood disasters and related damages and losses as brought by typhoons in 2006 and 2009 in Laguna region

Low lying urbanized areas, like the City of Santa Rosa have suffered flooding in the recent typhoon events

<table>
<thead>
<tr>
<th>Major disasters</th>
<th>Casualties</th>
<th>Damaged houses</th>
<th>Damage to Agriculture (in PhP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. dead</td>
<td>No. injured</td>
<td>Totally</td>
</tr>
<tr>
<td>Typhoon (Milenyo)-Flood (September 2006)</td>
<td>162</td>
<td>462</td>
<td>47</td>
</tr>
<tr>
<td>Typhoon (Ondoy)-Flood (September 2009)</td>
<td>172</td>
<td>311</td>
<td>9</td>
</tr>
<tr>
<td>Typhoon (Santi)-Flood (October 2009)</td>
<td>16</td>
<td>52</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: RDRRMC, 2011)
We need to Mainstream CCA – DRR in the CLUP and CDP...

- To provide information and analysis on hazard prone areas and extent of people, physical and natural assets at risk;
- To provide the necessary DRRM and CCA measures that need to be included in the developments plans and adopted for implementation;
- To produce a viable and risk sensitive and responsive CLUP and CDP.

Adopted from Ms. Erlinda Carrasco-Creencia, EnP(City-ENRO) presentation
Legal Mandates for Mainstreaming CCA and DRR

- **Republic Act 9729 or the Climate Change Act of 2009** - Section 14 on *Local Climate Change Action Plan* states that “The **LGUs** shall be the **frontline** agencies in the formulation, planning and implementation of **climate change action plans** in their respective areas, consistent with the provisions of the Local Government Code, the Framework, and the National Climate Change Action Plan.

- **RA 10174 “Peoples Survival Fund Act”** - policy of the State to “systematically **integrate the concept of climate change** in various phases of policy formulation, development plans, poverty reduction strategies and other development tools and techniques by all agencies and instrumentalities of the government.”

- **Republic Act 10121 or "Philippine Disaster Risk Reduction and Management Act of 2010** - section 2 “**Mainstream disaster risk reduction and climate** change in development processes such as policy formulation, socioeconomic development planning, budgeting, and governance, particularly in the areas of environment, agriculture, water, energy, health, education, poverty reduction, land-use and urban planning, and public infrastructure and housing, among others.”

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience.”
Communities will adapt to climate change and disasters by...

1. Preparing and updating the CLUP,
2. Building structures that will withstand the expected hazard,
3. Developing a disaster preparedness plan,
4. Relocating people from high risk areas,
5. Educating and providing outreach programs, and
6. Public Participation and consciousness-raising strategies

(Source: HLURB Presentation of Comm. Hornilla in terms of Local CCA – DRR adaptation)

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience”
Through the IGES/UPLB project, we aim to make our land-use, climate sensitive.

Supporting local governments: Silang-Santa Watershed, Philippines

Stakeholder consultation

Scenario analysis

Risk assessment

Land-use improvement

Climate measure

Improve plans

Devise actions

Develop risk map
Consultation with local governments: Future development & land-use planning
Current Land Use (2014)

Future Land Use Plan (2025)*

*Future land use plan map based on the results of a participatory land use mapping session with representatives from four local government units (LGUs)
FLOOD MODELLING

**Generation of Basin Model using ArcGIS10**
with HEC-GeoHMS and HEC-GeoRAS extensions

**Generation of Rainfall-Runoff Curve**
*using HEC-HMS:*
Hydrologic Engineering Center - Hydrologic Modeling System

**Generation of Flood Model using HEC-RAS:**
Hydrologic Engineering Center - River Analysis System
Visualization using RAS Mapper or ArcScene
To develop an ecological profile for the Silang-Santa Rosa River and its riparian vicinity to meet the needs of development planning, and design an environmental program for the sustainable development of the resource.
Potential Flood Prone Areas were identified based on Slope, River Depth, Width, and Hydraulic Conductivity (K)
ACTIONS MADE BY THE CITY OF SANTA ROSA

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience.”
RISK ASSESSMENT

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience “
City of Santa Rosa – Flood Hazard Map

- Almost half of the land area of the city experience flashflood during the rainy seasons.
- In the case of Typhoon Ondoy, wherein the water level in the lake was elevated, the coastal barangays experienced month-long flooding.

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience.”
City of Santa Rosa – Liquefaction Map

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience.”
CONDUCTED A GHG EMISSION INVENTORY

GHG Inventory Report for the City of Santa Rosa
(Community Level)

September 2012

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With support from:
USAID
FROM THE AMERICAN PEOPLE
Climate Change & Clean Energy Project

Adapted from Creencia (2014) presentation entitled "Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience"
CONDUCT SEVERAL STUDIES
i.e. HYDROLOGY AND FLOOD ANALYSIS

FLOOD CONTROL AND DRAINAGE MASTER PLAN

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience.”
The Waterways
Flooding Scenario

Adapted from Creencia (2014) presentation entitled “Improving land-use for integrated climate action: an approach taken at the local level in the Philippines – the Santa Rosa experience”
Capacity building & public awareness

- **Training needs assessments** on CCA, CCM, disaster preparedness and management
  - Develop survey/assessment instrument to determine the needs for training and other IEC; Conduct the TNA
- **Development of campaign materials and training modules** for CCA, CCM, disaster preparedness and management
  - Develop campaign materials and training modules for CCA, CCM, disaster preparedness and management
- **Conduct of trainings and events**
  - Organize trainings and events to increase awareness and preparedness
(IGES-UPLB Project)

Consultation meeting with LGUs: Climate Change measures
Possible measures for climate change mitigation (CCM) and adaptation (CCA) (example)

<table>
<thead>
<tr>
<th>Category</th>
<th>Measures</th>
<th>CCM</th>
<th>CCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved land-use</td>
<td>Development control in high-risk areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green space, urban greening</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Flood-tolerant, environment-conscious building</td>
<td>Strengthened <strong>building codes</strong> in high-risk areas (e.g., embankment, high-floored housing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roof greening, <strong>green building</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecosystem-based, integrated watershed management</td>
<td>Maintenance and improvement of watershed protection function (flood alleviation, water retention ability) of ecosystem</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development control in upriver areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Afforestation</strong> &amp; reforestation</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td><strong>Watercourse management</strong> (e.g., riverbank reinforcement, dredging, river cleaning)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Change in varieties and cultivation methods</strong> of agricultural products to prevent soil runoff</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(IGES-UPLB Project)

Preliminary list of climate change measures by local governments

- Zoning/building ordinance
- River rehabilitation
- Information, Education, and communication (IEC)
- Run-off mitigation development
- Green space/building/urban agriculture
- Relocation of informal settlers
- Strict law enforcement
Inter-city cooperation

Memorandum of agreement (MOA) for cooperation

Establishment of Council for Integrated Watershed Management

December 2, 2014

Catalyzed by 5-year WWF Hydrology Project
Institutional building: Strengthen IWMC

• Review MOA / legal documents and plans
• Identify gaps/needs
• Help establish/facilitate regular communication among local governments and with LLDA
• Help create workplan/action plan
• Provide technical assistance or connect with experts/institutions
• Share information, experience, and lessons learned with other local government with similar climate change problems in and beyond the Lake Laguna watersheds
THANK YOU VERY MUCH!