

### I.S.I.P. Competition Program

Program Profile	
<b>Institute</b>	Institute of Arts and Sciences
<b>Institute Dean</b>	Marilyn S. Arcilla, RN, MAN
<b>Email address</b>	glen.nolasco@mcc.edu.ph
<b>Program Name / Title</b>	River Restoration: Alleviating the Quality and Quantity of Life on Freshwater Ecosystem
<b>Category (Please mark (x) just one)</b>	<input type="checkbox"/> 1. Industrial Application <input type="checkbox"/> 2. Entrepreneurial Spirit <input type="checkbox"/> 3. Ethical Value <input type="checkbox"/> 4. Student Mobility and Openness <input checked="" type="checkbox"/> 5. Environment Crisis Management <input type="checkbox"/> 6. Progress in the Fourth Industrial Revolution
Abstract of Program (200-300 words)	
<p>This project outlines the comprehensive river restoration in the Sapang Balen, Mabalacat City, Pampanga, highlighting the collaborative efforts of the Institute of Arts Sciences (IAS) under Mabalacat City College, and the City Environment and Natural Resources Office (CENRO). Once a thriving ecosystem, the Sapang Balen tributary that is connected to Pampanga River has faced extensive degradation due to urbanization, pollution, and unsustainable land-use practices. In line with this, MCC-IAS and CENRO collaborate for the urgent restoration of this local waterway. The project targets the following Sustainable Development Goals: SDG 2 (Zero hunger), SDG 3 (Good health and Well-being), SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent work and Economic Growth), SDG 9 (Industry Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action) SDG 14 (Life Below Water), SDG 15 (Life on Land) and SDG 17 (Partnerships for the Goals). Phase 1 of the project has identified the physical and chemical parameters of the river, as well as the existing flora of the area. Results tested by the CRL Environmental Corporation indicate poor water quality based on the standards of DENR. In terms of the local flora, species number are limited, composed of angiosperms under Asteraceae, Malvaceae, Fabaceae, Poaceae, Cyperaceae, and Euphorbiaceae. The results are expected to be utilized for Phase 2 of the project.</p>	
Planning	
<b>Background</b>	<p>The eruption of Mt Pinatubo in 1991 had a profound impact not only on the agricultural lands of Mabalacat City but also the river ecosystem, resulting in the burial of the once vibrant Sapang Balen river under layers of lahar. Despite the passage of three decades, the</p>

river has yet to fully recover, but signs of life have started to emerge. Consequently, it is imperative that a comprehensive study is conducted to explore methods for reviving this lost ecosystem. In light of this, the focus area for this project will be the Sapang Balen river, situated in Mabalacat City within the province of Pampanga, Central Luzon, Philippines. The river can be precisely located at a latitude of 15.24245° or 15° 14' 33" north and a longitude of 120.59244° or 120° 35' 33" east, with an elevation of 76 meters.

In relation to the statement above, the section 19, 20, and 21 of **PRESIDENTIAL DECREE No. 1152** (see Appendix A) or otherwise known as the Philippine Environmental Code states that, “the government agencies concern shall coordinate with the National Environmental Protection Council and furnish the latter with such information as may be necessary to enable it to attain its objectives under Presidential Decree No. 1121”. In addition, “the government agencies concerned shall undertake containment, removal and clean-up operations and expenses incurred”. Moreover, “the various government agencies concerned with environmental protection shall establish to the greatest extent practicable a water quality surveillance and monitoring network with sufficient stations and sampling schedules to meet the needs of the country.”

Hence, this project aims to restore the Sapang Balen River. Specifically, *“Alleviating the quality and quantity of life on freshwater ecosystem”*.

<b>Subject (Names &amp; titles)</b>	<b>Initiator(s)</b>	Glen S. Nolasco, MSc.
	<b>Leader(s)</b>	Marilyn S. Arcilla, RN, MAN
	<b>Team members</b>	Frienchie Ann Yamauchie Jenny Lou P. Atienza Lourdes Fatima S. David, MSc. Aaron Carl V. Tejano John Eric David Michael A. Mesa, PhD Amiel Alfonso, MAEd Genesis G. Dimalanta, Ed.D. Gracia T. Canlas, MAEd Marcelino Alberto V V. Garcia Areclyn M. Adriano Edmon Y. Sampana, PhD April Ann L. Galang Arnel G. Perez, MS Ryana Leigh D. Clemente Michael Bryan G. Rosilla Jonnabelle N. De Leon Lester M. Lising Darren C. Diaz
<b>Environment</b>	<b>Nature/society</b>	Sapang Balen River, Mabalacat City, Pampanga
	<b>Industry/market</b>	N/A
	<b>Government/others</b>	City ENRO, LGU-Mabalacat
<b>Resources</b>	<b>Human requirements</b>	IAS Teaching and Non-Teaching personnel
	<b>Financial requirements</b>	Manila Bay Restoration Budget - City ENRO
	<b>Technological/other requirements</b>	Laboratory Services, CRL Clark, Mabalacat City
<b>Mechanism</b>	<b>Strategic options available</b>	Process Phase Management Project
	<b>Their relative importance</b>	This mechanism will provide a schematic progression of the project.
	<b>Their sequences for execution</b>	Phase 1 - Preliminary, Phase 2 - Intervention, Phase 3 - Sustainability
<b>Content</b>	<p>Objectives of the Project</p> <p>This project targets the restoration of Sapang Balen river, in terms of the quality and quantity of the flora and fauna.</p> <p>Specifically, this project will meet the following objectives:</p> <ol style="list-style-type: none"> <li>1. What is the status of Sapang Balen River in terms of; <ol style="list-style-type: none"> <li>A. Physical;</li> <li>B. Chemical; and</li> </ol> </li> </ol>	

C. Biological?

2. What are the identified species of flora and fauna in Sapang Balen River?
3. Are there significant differences in the results of assays/tests conducted in the freshwater ecosystems namely;
  - A. Physicochemical parameters;
  - B. Potability;
  - C. Trace of Microplastic; and
  - D. Trace of Heavy metals?
4. What are the intervention strategies to be applied in the Sapang Balen River to alleviate the quality and quantity of the freshwater ecosystems?
  - A. Phytoremediation using Aquatic Macrophytes;
  - B. Application of Activated Carbon generated from Balakat Tree;
  - C. Charcoal briquettes derived from Water Hyacinth;
  - D. Installation of Modified filter revetment; and
  - E. Application of Plant-based flocculants.
5. What are strategic policies to be implemented relative to the betterment of flora and fauna of Sapang Balen river?

Target Outcomes

The main outcomes of this project are as follows:

1. Identify the status of Sapang Balen river in terms of physical, chemical, and biological aspects.
2. Identify and characterize the species of flora and fauna inhabiting the Sapang Balen river.
3. Understand the significant differences in the results of test/assay conducted on Sapang Balen river in terms of physiochemical composition, potability, trace of microplastic and heavy metals.
4. Strategize the applicable interventions to

alleviate the quality and quantity of freshwater ecosystems.

5. Establish policies to sustain the freshwater ecosystem in Sapang Balen river.
6. Encourage and generate future collaborative actions towards resilient, renewable, and regenerative water management projects in the region.
7. Ameliorate the ecological services provided by the Sapang Balen to the neighboring community/Mabalacat City.
8. Strengthen the recreational activities on the Communities of Mabalacat City.
9. Preserve the heritage of Sapang Balen of Mabalacat City.
10. Publications from the research study of the Sapang Balen river.

#### Target Beneficiaries

The main beneficiaries of this project will be the following:

1. LGUs are located within the scope area of the project.
2. Local communities and other stakeholders of the selected river systems;
3. Government agencies and NGOs in the selected areas; and
4. Professors and students from partner state Colleges/Universities.

The project will be conducted in Sapang Balen, Mabalacat City, Pampanga. The stream traverses the Clark Area, and the barangays of Poblacion, Sta. Ines, and Mamatitang. All necessary tests will be initiated by CRL Environmental Corporation, Department of Science and Technology and Science Laboratory of Mabalacat City College.

Preliminary assessment of the Sapang Balen river will be conducted in terms of chemical, physical, and biological status. Followed by the potability test, phytoremediation using aquatic macrophytes, application of activated carbon, calorimetry test, installation of alternative revetment, and introduction of bio flocculants.

<p><b>Target SDGs</b></p>	<p>This project encapsulates the United Nations Sustainable Development Goals such as <b>SDG 2</b> (Zero hunger), <b>SDG 3</b> (Good health and Well-being), <b>SDG 4</b> (Quality Education), <b>SDG 6</b> (Clean Water and Sanitation), <b>SDG 8</b> (Decent work and Economic Growth), <b>SDG 9</b> (Industry Innovation and Infrastructure), <b>SDG 11</b> (Sustainable Cities and Communities), <b>SDG 12</b> (Responsible Consumption and Production), <b>SDG 13</b> (Climate Action) <b>SDG 14</b> (Life Below Water), <b>SDG 15</b> (Life on Land) and <b>SDG 17</b> (Partnerships for the Goals).</p>
<p><b>Key points</b></p>	<p>River Restoration; Freshwater; Sapang Balen; SDG</p>
<p><b>Differences from traditional approaches</b></p>	<p>The distinctive facets of this study are: (1) Collaborative work with LUC and LGU-CENRO; (2) The project was linked to a Community Extension Program of the Institute of Arts and Sciences; (3) A pioneer of River Restoration Project on the Province of Pampanga which one of the tributaries of Pampanga Watershed; (4) Project is centered around SDGs, tapping both societal and environmental aspects for community sustainability; (5) Strategies revolve around not just interventions, but also economic and developmental programs for the local community.</p>
<p><b>Doing</b></p>	
<p><b>Launch date</b></p>	<p>June 26, 2023 (See Appendix B and N)</p>
<p><b>Responsible organization</b></p>	<p>MCC-IAS, LGU-CENRO (See Appendix G, I, and J)</p>
<p><b>Progress as of today</b></p>	<p>Phase 1: Preliminary Assessment of Physical, Chemical, and Biological</p> <p>In terms of the physical parameters obtained from the Sapag Balen, solid waste collected (See Appendix C, G, H, L, and R) from the subsites were 67.5kg for residual, 12kg for recyclable, and 13kg for compostables, with a total of 92.5kg of solid waste. In addition, some chemical features were initially assessed in the subsite such as pH level (7.29 and 7.54), temperature (30.25°C and 30.05°C), depth (7.78 inches and 15.75 inches), and width (539.4 centimeters and 1,374 centimeters).</p> <p>Moreover, 10 species of plants were identified in the subsites. This was considered to identify the potential endemic plants present in the Sapang Balen (See Appendix D, E, F, R, and S).</p>

<p>Problems in implementation</p>	<p>(1) Anthropogenic activities; (2) Household Waste; (3) subsites accessibility; (4) Time-consuming; (5) Manpower; (6) Budget.</p> <p>(1) some problems encountered during the conduction of this project were anthropogenic activities. Upon checking the area, the Department of Public Works and Highways was improving the concrete slope of the rivers at Sta Ines (See the Supporting Documents). Moreover, some locals in the subarea were doing their recreational activities such as fishing and shepherding their livestock (See the Supporting Documents). Also, (2) household activities were also one of the contributors of the disturbances in the waterway like dumping their solid and liquid wastes around the premise of the Sapang Balen River. In addition, (3) subsite accessibility was one of this project's main concerns. Hence, the research addressed this concern by providing letters to the Barangay Leaders to grant permission to conduct and collect samples on the sub-areas (See Appendix S). Moreover, (4) time was also one factor to address in this study. Since, conducting environmental research is quite laborious and time consuming. The body concurred to make this project sustainable. Furthermore, (5) workforce and (6) budget was also considered in this project, hence City ENRO and IAS provided an understanding of the obligations of the two institutions in which budget and workforce were discussed (See the Appendix J, T, and U; Annex A.1 and A.5). Ergo, these factors generate hindrances during the conduction of the said project.</p>
<p>Approaches to solve the problems</p>	<p>(1) City Ordinance; (2) Collaboration with LGU-CENRO and Barangay Officials; (3) Talk/Seminar about waste management to the nearby communities; (4) Budget Realignment.</p> <p>To address the problems of this research, some ideas were created. (1) City ordinance will be created and proposed to the Sanguniang Bayan of Mabalacat City to provide legislation of the project. Also, regular meetings will be conducted with Barangay Officials to monitor and implement the City Ordinance which will immortalize the project and make it sustainable. Simultaneously, the faculty of Social Sciences department will initialize a public talk to the local folks of Mabalacat City, concerning the importance of the Sapang Balen and the project. Further, alignment of the</p>

	budget will be taken into action by the Head of City ENRO, Engr. Jesusa Santiago to provide progress to the Project. With these joined efforts, the feasibility of this project can be ensured.
Completion date, if completed	5 Year Project
<b>Seeing</b>	
Impacts on students	<p>(1) Community Engagement; (2) Environmental Awareness; (3) Develop critical thinking to the students concerning Environmental issues; (4) Gain micro credentials for BSBIO Students.</p> <p>As the project progresses, (1) community services of the students under Institute of Arts and Sciences were achieved by conducting clean-up drive that contributed to the project (See Appendix B, C, D, G, H, N, and Annex A.4, A.6, and A.8). Interestingly, incorporating the (2) SDGs and the project itself to the curriculum of the IAS students was implemented in the Institute to advocate Environmental Awareness (See Appendix V). Also, (3) development of critical thinking to the students is potentially strengthened as they conducted their research in the Sapang Balen River. With this, it targets not only their critical thinking but also the environmental issues (See Appendix R). In addition, the (4) President of the College, Doc. Aguilar-Ong strategized the micro credential that they could get as they participate to the Project which they can use as their credentials. Some of the related micro credentials that they could get are "<i>In situ</i> Workshop in Practical field sampling", "Plant specimen preservation: Fixation and Herbarium press", Workshop in Online tools and Software", and "Workshop on Graphpad Prism Latest Version" (See Appendix W).</p>
Impacts on Instructors and Institute	<p>(1) Community Engagement; (2) Community extension project of the MCC-IAS to the community of Mabalacat; (3) Introduce the waste management protocol to the personnel of IAS; (4) Professional growth.</p> <p>This project will be limited to the students and the Professors of Institute of Arts and Sciences. To provide professional growth and extension services to the faculty, the Dean of IAS Mrs. Marilyn S. Arcilla, formulated a community extension proposal and</p>



	<p>submitted it to the <i>Kayantabe</i> Office to officially convert this project into community extension (See Appendix N). Moreover, this project also provides knowledge to the faculty of IAS about the methods and protocols used in waste management as they involved themselves during the conduction (See Appendix G, H, O, P, and Q; Annex A.2, A.3, A.4, A.5, A.7, A.8, and A.9). Furthermore, this project is affecting their professional growth in their profession and connection with the environment.</p>
<p>Responses from industry/market</p>	<p>(1) Water quality monitoring of the freshwater reservoir; (2) Comply to the DAO 2016-08 (Revised 2021) Guidelines; (3) Proper Waste Management</p> <p>Industry and market involvement are some sectors that must be considered. With this, (1) regular monitoring of the water quality within the area of Sapang Balen River was enforced by the Presidential decree (See Appendix A) and City Ordinance of the Mabalacat City (See Appendix Y) to comply with the (2) DENR Administrative Order 2016-08 and 2021 guidelines (See Appendix X). Also, (3) proper waste management of the different sectors were monitored by the City ENRO and barangay officials to mitigate the accumulation of liquid and solid wastes.</p>
<p>Responses from government</p>	<p>(1) Generate City Ordinance; (2) Regular Water quality monitoring of City ENRO; (3) Allotment of Budget</p> <p>To involve the government in this project, (1) enhancement of the existing ordinance of the Mabalacat City is now on progress (See Appendix Y). Furthermore, biological monitoring will also be considered in the new ordinance that will propose to the SB. Furthermore, (2) constant monitoring of the City ENRO was enforced to ensure the quality of water in the Sapang Balen River. Moreover, this River Restoration Project was now considered as part of the Manila Bay Restoration Project (See Appendix Q and Annex A.8), hence making the budget accessible.</p>
<p>Measurable output</p>	<p>(1) Biological, (2) Chemical, and (3) Physical Parameters of the Sapang Balen River (See Appendix R)</p> <p>Establishing measurable outputs for parameters allows project stakeholders to systematically track the progress</p>

	<p>of restoration efforts in the Sapang Balen River. This enables data-driven decisions to enhance the overall health and sustainability of the waterway. Specifically:</p> <ol style="list-style-type: none"> <li>(1) Measurement of Biodiversity Index (species richness, diversity, and species evenness); Flora and Fauna Assessment (involves the identification of macro- and micro-invertebrates, vertebrates, and plant species); Bioindicator Assessment (involves the identification of species that can help indicate water quality)</li> <li>(2) Measurement of the river's pH can help make sure it stays within a desirable range (usually 6.5 to 8.5), as stable water chemistry is indicated by consistent pH levels; Monitoring the level of dissolved oxygen (DO), which is necessary for aquatic life, a stable or rising DO level denotes high water quality; Measuring the levels of nutrients like nitrogen and phosphorus is important for monitoring, as these elements can have an adverse effect on the quality of the water; heavy metals and toxins are detrimental to aquatic life, reduced detection frequencies or lower concentrations are preferred.</li> <li>(3) Depth and Width are recorded to assess changes in a river's physical dimensions. Natural fluctuations may occur, but significant alterations may indicate erosion or sedimentation issues; Water temperature measurements can be used to spot seasonal trends and fluctuations, extreme variations should be avoided in favor of steady temperatures; turbidity: a decline in turbidity points to better water quality and less sediment runoff; the stability and variations of a river are evaluated using its flow rate. Aquatic habitat maintenance depends on stable flow rates; Long-term River health depends on increased bank stability and reduced erosion, which can be achieved by evaluating the stability of riverbanks and estimating erosion rates.</li> </ol>
<p>Cost-benefit analysis for effectiveness</p>	<p>Initially, PHP180,220 will be consumed in this project to accomplish the restoration and briquette production. These two courses of action will be the main source of economy on the project in which the locals will be the beneficiaries. Products that they could sell or consumed could be Fish from the River and charcoal briquettes</p>

	<p>made-up of dumped logs and cogon grass which worth PHP150.00 per kilo and 300.00 per sack.</p> <p>120 x 12(year) = PHP1,440.00 per Family.</p> <p>1,440 x 100 (family) = <b>PHP144,000</b>  ***for Fish product</p> <p>300 x 12(year) = 3,600 per Family</p> <p>3,600 x 100(family) = <b>PHP360,000</b>  ***for Charcoal briquettes</p> <p>PHP144,000 + PHP360,000 = <b>PHP504,000</b>  ***Approximate Annual Income</p> <p>PHP504,000 - PHP180,220 = <b>PHP323,780</b>  ***Revenue</p>
<b>Future Planning</b>	
Where does the project go from here?	(1) Implement the protocol used in the project to other main rivers of Mabalacat; (2) Adopt the protocols used in this project and employ them to the Manila Bay Restoration Project
<b>Miscellaneous</b>	
Exhibits, pictures, diagrams, etc.	See the attached Documents, Appendices, and ANNEX
Reports, memos, monographs, books, etc.	See the attached Documents, Appendices, and ANNEX
Others which may help explain the project	See the attached Documents, Appendices, and ANNEX