PROJECT PROPOSAL
2022 DOST-GIA FUNDING

I. PROJECT PROFILE

(1) Project Title: STRENGTHENING WEATHER MONITORING SYSTEM THROUGH HYDROLOGIC RESPONSE MODELING IN MAG-ASAWANG TUBIG WATERSHED

(2) Project Leader/Sex: ENGR. CHRISTIAN B. HERNANDEZ / M
Agency: MINDORO STATE UNIVERSITY- Main Campus, Alcate, Victoria, Oriental Mindoro
Address/Telephone/Fax/Email: cbhernandez1@up.edu.ph

(3) Cooperating Agency/ies: Mindoro State University-Main Campus (MinSU-Main Campus)

(4) Site/s of Implementation (Municipality / District / Province / Region)
Base Station: Mag-asawang Tubig Watershed
Other Implementation Site (s): _____

(5) Project Duration: October 2022 to September 2023

(6) Total Project Cost: (indicate Counterpart Funds; use Form A for the Line-Item Budget)

Source of Fund / Site(s) of Implementation	PS	MOOE	EO	Total
A. DOST-MIMAROPA	249,600.00	464,492.38	1,873,707.62	**2,587,800.00**
B. MinSU-Main Campus Oct -Dec 2022)	266,472.00	346,090.00		**612,562.00**
C. MinSU-Main Campus Jan-Sep 2023	799,416.00			**799,416.00**
TOTAL	**1,315,488.00**	**810,582.38**	**1,873,707.62**	**3,999,778.00**

II. PROJECT SUMMARY

(7) Rationale (Not to exceed one page)

Oriental Mindoro is highly susceptible to natural hazards. It is prone to tropical cyclones, earthquake, tsunami, and floods. Flash flood is the most frequent hazard that affects the province. Conditions that cause floods include typhoons as well as heavy or steady torrential rains for several hours or days that saturate the ground. Flash floods occur suddenly due to rapid rising of water along a stream or low-lying area.

The whole island of Mindoro has a myriad of rivers and streams. Among these prominent rivers posing immediate hydrologic hazards are Bucayao and Mag-asawang Tubig River Systems that flow in the alluvial plains of Calapan City, Naujan, and Victoria. Eighty-five barangays or 19.95 percent of the total 426 barangays in Oriental Mindoro are identified as highly susceptible to flooding.

Mag-asawang Tubig River Basin with an estimated area of 42,000ha is one of the 5 principal river basins in Oriental Mindoro which also includes Butas River Basin, Alag-Baco River Basin, Pula River Basin, and Catuiran-Bucayao River Basins. These 5 principal river basins in the province drains along the Verde Island Passage and Tablas Strait with at least 3 recognized drain outlets located at the Northeast of the Province. This proposed watershed has exposed to two types of Climates based on Köppen-Geiger Climate Classification which are Type III climate and Type I climate.

Also, considering orographic effect based on the orientation of the island of Mindoro where mountains divided the island into 2 province which resulted to more frequent rain events at the location of clustered watershed at Oriental due to Easterly winds. The highest topography of the proposed area is located at Mount Halcon and Mount Iglit-Baco which is the upstream of the watershed area while the downstream are in low-lying elevation with estimated slope of 0-3% or level which Baco, most of Calapan City, and Naujan were located, also the said Municipalities at the downstream areas were populated and dedicated for agricultural production which large damaged observed during flooding and flashfloods due to excessive rainfall even without typhoon. Based on the thematic maps of BSWM the cluster river basin is composed of 16 different soil types with soil texture ranging from moderately coarse to fine.

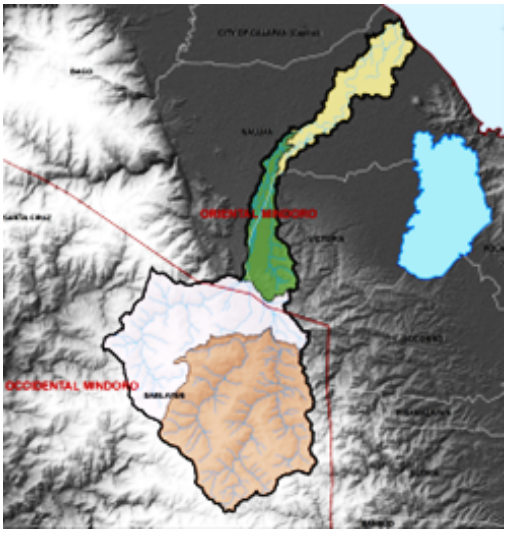


Figure 1. Mag-Asawang Tubig River Basin (*GIS Delineated*)

Based on geographical and hydrological studies, flooding occurs when large volumes of water traverses from Mag-asawang Tubig and Bucayao rivers which would directly affect Calapan City, Naujan, Victoria, and Baco.

Among the challenges that are currently encountered by the PDRRM and MDRRM personnel and researchers are the limited number and uneven distribution of weather monitoring stations in strategic places coupled with erroneous time series data. Moreover, historic microclimate data restored from these devices are not readily accessible which can be a reliable source of information to create an effective early warning protocols to minimize potential impacts of flood hazards in highly susceptible communities.

Hence, development of an automated Arduino-based synoptic weather station that can provide readily accessible near real-time and historic microclimate data necessary to model hydrologic responses of Mag-asawang Tubig Watershed and further strengthen weather monitoring systems in the Oriental Mindoro.

(8) Project Description (Not to exceed 15 pages)

OBJECTIVES (General and Specific)

This project intends to strengthen real-time and reliable weather monitoring system in Mag-asawang Tubig Watershed in Naujan using an automated Arduino-based synoptic weather station through modeling of hydrologic activities.

Specifically, the study aims to:

1. Develop an automated Arduino-based synoptic weather station equipped with microprocessors and wireless fidelity data-transmitting device.
2. Deploy and evaluate the performance of the developed Arduino-based synoptic weather station in accordance with the required statistical weather parameters (rainfall, relative humidity, air temperature, solar radiation, wind speed, wind direction, soil moisture content, soil temperature, pressure and stream flow);
3. Assess and analyze microclimate data transmitted by the deployed synoptic weather station;
4. Evaluate the suitability of SWAT model in Mag-asawang Tubig watershed using remotely sensed climatic data.
5. Simulate the hydrologic responses to land use and land cover change of Mag-asawang Tubig watershed; and

6. Calibrate and validate the model at the streamflow monitoring point of the watershed using SUFI-2 algorithm in SWAT-CUP.

METHODOLOGY

As the project is approved, the cooperating agency in coordination with the proponent will facilitate the procurement of equipment for the development of the Arduino-based synoptic weather station.

The proponent shall develop the automated Arduino-based synoptic weather station equipped with microprocessors and Wi-Fi data-transmitting device. The device will be deployed on assessed and validated strategic sites in Mag-asawang Tubig watershed. The proponent, with DOST's assistance, shall also conduct capability-building activities on the operation, maintenance, and troubleshooting of the developed device among DRRM personnel.

An evaluation will be conducted before, during, and after the implementation of the project to monitor the effectivity and accuracy of the proposed technology.

A project staff from DOST and the proponent will be assigned and therefore compose the Project Management Team (PMT) which will oversee and administer the implementation of the project. Real-time hydrologic and microclimate data will be recorded by the device and transmitted to three (3) servers where the data will be analyzed, and hydrologic response modeling will be done.

After one year, the project should have been implemented and data gathering would go on for another year. The impact of the project would be assessed based on its objectives and would be reported after the second year.

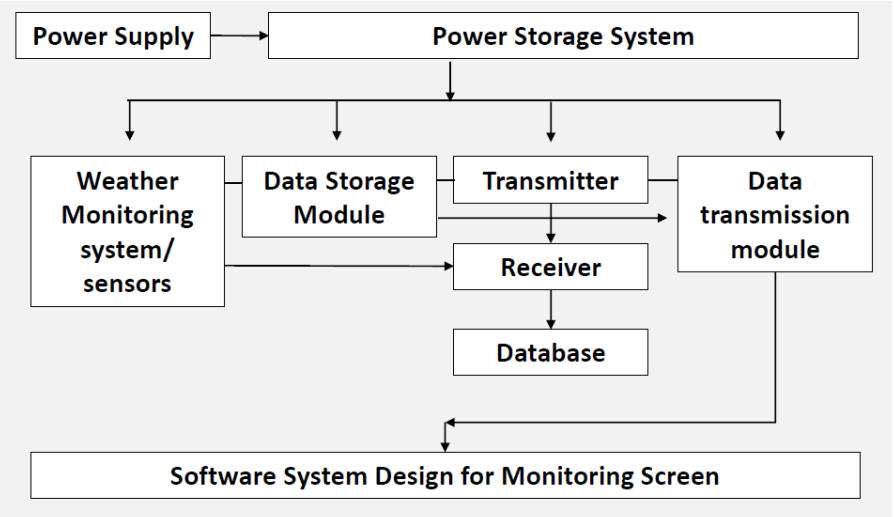
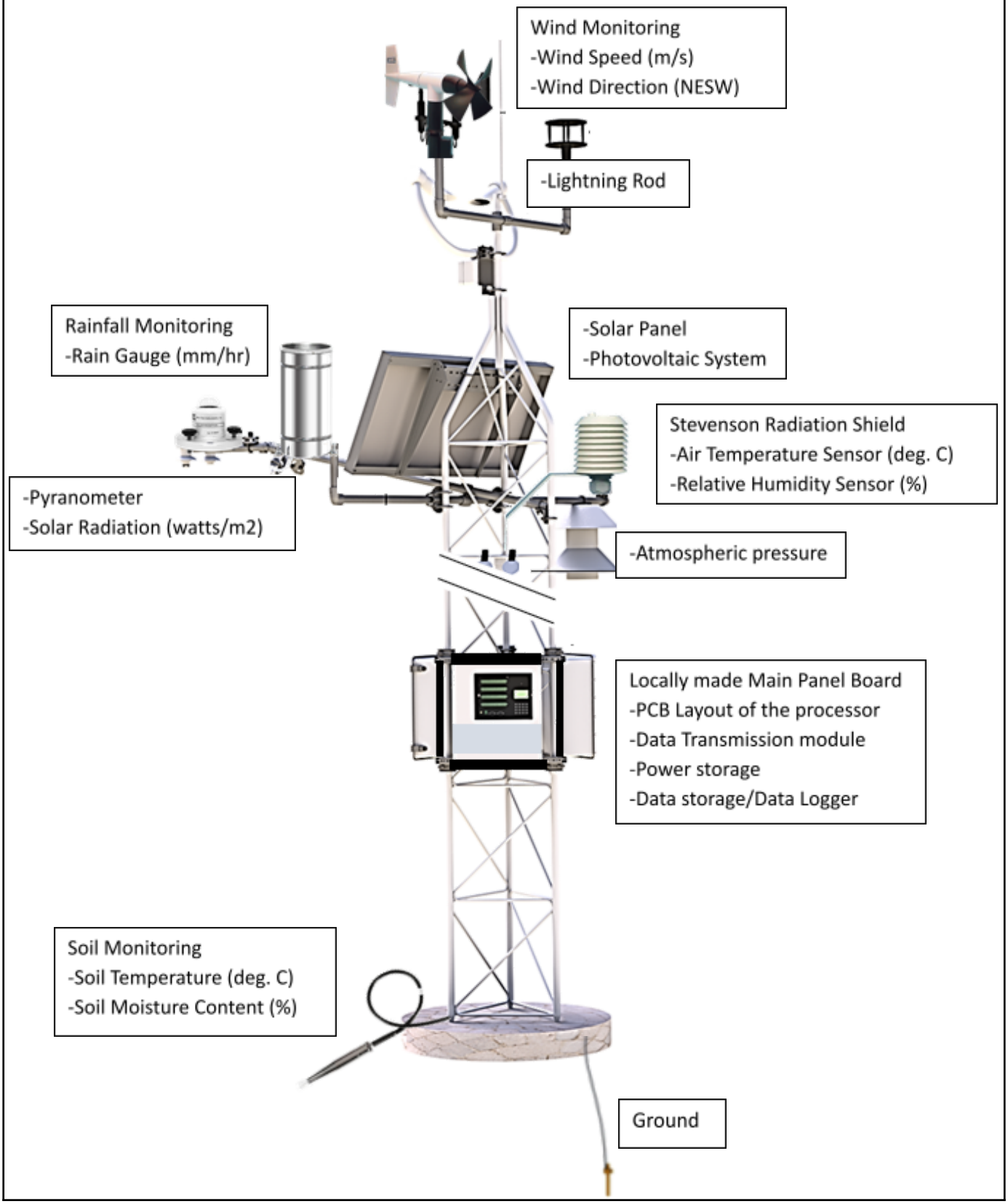
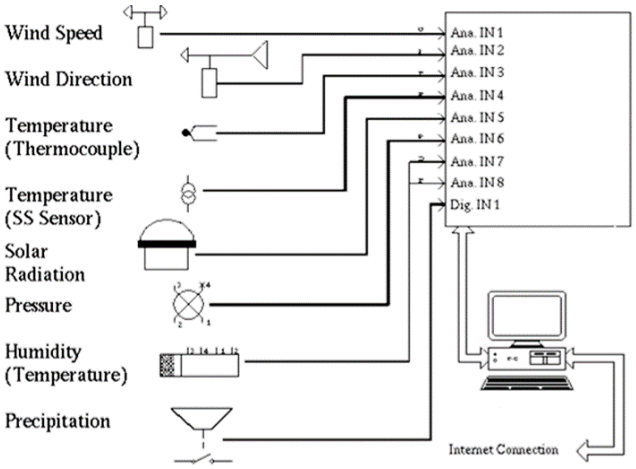


Figure 2. General Structure of the Proposed System

Diagram of the proposed Locally made Automatic Weather Station.

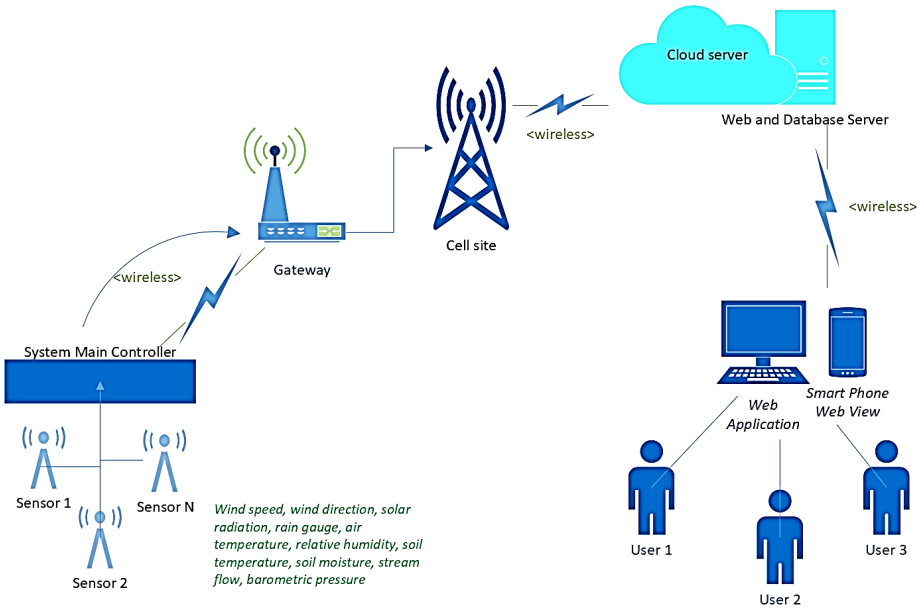




SCHEMATIC DIAGRAM OF MONITORING SENSORS

This proposed technology to be known as Locally Made Automatic Weather Station composed of different monitoring instruments that will gather site specific weather condition at the proposed study area. Atmospheric variables are very important to many researchers and concerned authorities to have an accurate and reliable near real time actual weather data at specified areas, since now we still don't have this kind of technology in the province which we can visualized the data analytics and analyzed the changes and development of different diurnal atmospheric conditions which include wind speed, wind direction, precipitation, solar radiation, atmospheric pressure, air temperature, relative humidity, soil moisture content, and soil temperature. This technology has built-in locally made data transmission and data logger which is very important for ease of maintenance and troubleshooting instead of returning the device to the supplier which will affects the continuous data management. With this technology, we can visualize the condition at site specific even during calamities to alleviate problems in planning and monitoring. In addition, satellite office for monitoring real-time weather condition can be established in the province to strengthen weather monitoring system in time of calamities.

How does the data transmission work.



IOT-BASED NETWORKS OF DATA TRANSMISSION FROM SITE TO BENEFICIARIES AND PEOPLE

The data transmission will be initiated as soon as the sensors actively detect and collect data from the natural sources. In the said scenario, upon receiving the data from the sensors the system main controller will read, validate, and transmit the data wirelessly to the gateway. The gateway will secure all the transmissions. Upon collecting all the necessary data, the transfer will commence, and all the data will be transmitted to the cloud server that act as database server for the data storage and web server for the application interface. Users can access the application and the data wirelessly through devices connected to the internet.

Additionally, the collected data readings from node sensors will be logged to a local storage of the system (SD card) and will be transmitted to the cloud server database via wireless interface (LoraWAN, P2P, SMS). In case of failure of data transmission, the system will pull out data from local storage collectively.

The system will record real time data from the sensors (ie. every 5 minutes). Additionally, the system to be developed is capable to transmit bulk of data (ie. 4 times a day) that will serve as the validation of the data collected. Validation of data will be done on the server side through the developed web application.

EXPECTED OUTPUTS

Publication:

The project targets to publish at least one (1) research output using the historical hydrologic data that can be gathered and analyzed from the proposed technology.

Patent/Intellectual Property:

After the development and optimization of Arduino-based synoptic weather station, the technology will be applied for intellectual property rights protection under Utility Model.

Product:

This project aims to develop an efficient and effective Arduino-based synoptic weather station that can be utilized in providing localized real-time microclimatic weather information from the identified watershed.

People Service:

The primary objective of this project is to improve the community's disaster preparedness and risk management. It also aims to capacitate DRRM officers on the operation, maintenance, and troubleshooting of equipment. It will also address the current problems encountered by researchers in the lack of access to credible historical weather data from the watersheds in the province.

Place and Partnership

The development of Arduino-based synoptic weather station will be done at Mindoro State University – Main Campus, Alcate, Victoria, Oriental Mindoro. Then, pilot testing of this technology will be conducted at Mag-asawang-tubig Watershed situated in Naujan and Victoria, Oriental Mindoro. Two servers located at MinSU-Main Campus,and DOST-Oriental Mindoro will be provided where collected data will be transmitted.

This project will be a collaborative undertaking between DOST-MIMAROPA, MinSU-Main Campus.

Policy

This study may be a possible basis for the improvement of disaster preparedness and mitigation plan and policies in the province, specifically on typhoon and flooding scenarios.

EXPECTED OUTCOMES

The Arduino-based synoptic weather station will be the first of its kind in the region which will strengthen real-time weather monitoring system in the largest watershed in Oriental Mindoro, the Mag-asawang Tubig watershed. It is targeted to provide and analyze readily accessible and reliable real-time microclimate data on the watershed which can be used in DRRM planning.

PERCEIVED IMPACT

Social Impact

The Mag-asawang Tubig watershed is the largest watershed in Oriental Mindoro, covering 140,222 hectares of land cover. This river traverses through portions of municipalities of Naujan and Victoria in Oriental Mindoro, and Sablayan in Occidental Mindoro. The monitoring system that will be developed in this study will establish an improved early warning protocol for PDRRMO and MDRRMOs that will effectively minimize impacts of flood hazards in highly vulnerable communities within the watershed.

Economic impact

Through the strengthening of weather monitoring system and improvement of disaster prevention and mitigation protocols, economic losses will be minimized. Economic activity in the province will not be hampered or disrupted.

SUSTAINABILITY PLAN

The collaborative efforts among DOST-MIMAROPA, and MinSU-Main Campus will ensure the continuity of this project upon implementation. Alongside the implementation of this project, DRRM policies and guidelines may be also developed to cater to this study to provide a more effective and efficient disaster preparedness and mitigation plan for the community.

After the success on the implementation of this study, deployment, and installation of the developed technology in other watersheds in Oriental Mindoro will be considered for a province-wide strengthening of disaster prevention and mitigation.

(9) Workplan (See Form B)

(10) Project Management (not to exceed one page)

The project leader will be in charge of the development of the Arduino-based synoptic weather station and will be leading the conduct of site assessment and validation for the proposed site of installation of the device.

A staff from DOST-Oriental Mindoro will assist in the deployment, performance evaluation, maintenance and troubleshooting of the deployed synoptic weather station, assist in monitoring, inspection, maintenance and troubleshooting of the installed weather monitoring device, assist in the conduct of capability building activities, and conduct project monitoring, documentation, and evaluation

- **DOST-MIMAROPA:**
  - ➢ Provide technological assistance for the development of automated Arduino-based synoptic weather station;
  - ➢ Assist in the deployment, performance evaluation, maintenance and troubleshooting of the deployed synoptic weather station;
  - ➢ Assist in monitoring, inspection, maintenance and troubleshooting of the installed weather monitoring device;
  - ➢ Assist in the conduct of capability building activities; and
  - ➢ Conduct project monitoring, documentation, and evaluation.

- **Beneficiary (MinSU-Main Campus)**
  - ➢ Design and develop an automated Arduino-based synoptic weather station equipped with microprocessors and wireless fidelity data transmitting device;
  - ➢ Conduct assessment and validation on the proposed strategic site in Mag-asawang Tubig Watershed;
  - ➢ Comprehensive soil survey to define soil properties in more detailed approached and conduct topographic mapping in areas bounded by the proposed study site
  - ➢ Deploy developed synoptic weather station and servers, and conduct performance evaluation;
  - ➢ Assess and analyze microclimate data transmitted by the deployed synoptic weather station;

➢ Simulate hydrologic responses of Mag-Asawang Tubig Watershed as to land use and land cover change;
➢ Conduct capability building activities on the operation, maintenance and troubleshooting of the developed automated Arduino-based synoptic weather station; and
➢ Conduct project monitoring, documentation, and evaluation.

III. ATTACHMENTS (Please refer to the DOST-GIA Guidelines for the necessary documents.)

Prepared by:

ENGR. CHRISTIAN B. HERNANDEZ
Instructor I
MinSU-Main Campus

Recommending Approval:

JESSE M. PINE
Provincial S&T Director
DOST-Oriental Mindoro

Endorsed by:

DR. LEVY B. ARAGO, JR.
President
MinSU

Approved by:

Digitally signed by Abilay Ma. Josefina Pormento
Date: 2022.09.23 10:58:42 +08'00'

DR. MA. JOSEFINA P. ABILAY
Regional Director
DOST-MIMAROPA

DOST Form A

DEPARTMENT OF SCIENCE AND TECHNOLOGY
Project Line Item Budget
CY 2022

Project Title: Strengthening Weather Monitoring System Through Hydrologic Response Modeling In Mag-Asawang Tubig Watershed

Project Duration: One (1) Year
Project Duration: October 2022 - September 2023
Implementing Agency: MinSU- Main Campus
Project Leader: Engr. Christian B. Hernandez / Instuctor 1
Monitoring Agency: **DOST-MIMAROPA**

	COUNTERPART FUNDING			GRAND
	MinSU (Oct.-Dec.)	MinSU (Jan.-September.)	DOST-MiMaRoPa	TOTAL
I. Personal Services				
A. Direct Cost				
Salaries				
Three (3) Instructor I @ PhP 29,608.00/mo	266,472.00	799,416.00		
Honoraria				
1 Project Leader (PhP8,800 x 12 mo.)			105,600.00	**105,600.00**
2 Project Staff Level 2 (PhP6,600 x 12 mo.)			144,000.00	**144,000.00**
Sub-total for PS	**P 266,472.00**	**P 799,416.00**	**P 249,600.00**	**P 1,315,488.00**
II. Maintenance and Operating Expenses				
A. Direct Cost				
Travelling expenses				
Local	30,000.00		142,141.00	**172,141.00**
Supplies and Materials				**-**
Office supplies	12,500.00		12,500.00	**25,000.00**
Semi-Expendable-Machinery Expenses				**-**
1 Printer (L3110 Eco-Tank 3-in-1)			12,500.00	**12,500.00**
Fuel, Oil and Lubricants Expenses	15,000.00		50,069.42	**65,069.42**
Communication (Internet, Postage, Telephone)				**-**
Postage and Courier Expenses			6,000.00	**6,000.00**
Telephone Expenses - Mobile			20,650.00	**20,650.00**
1 Year Load Subscription 3mbps @ PhP 2,000.00 per mo			24,000.00	**24,000.00**
Internet Subscription Expenses			47,282.00	**47,282.00**
Dedicated Server 1 year Subscription + Domain Name (www.sample.com) @			104,349.96	**104,349.96**
Utility Expenses				
Water Expenses				
Electricity Expenses				**-**
Training and Scholarship Expenses (Please indicate)				
Printing and Binding Expenses			5,000.00	**5,000.00**
Rent Expenses (van and boat rental)			25,000.00	**25,000.00**
Presentation Expenses (e.g. food for meetings, etc.)	20,000.00		15,000.00	**35,000.00**
Professional Services				
Two (2) Science Research Assistant SG 11 (PhP 23,877 x 3mo.)	143,262.00			**143,262.00**
One (1) Computer Programmer (Software) SG 11 (PhP 23,877 x 3mo.)	71,631.00			**71,631.00**
One (1) Utility Foreman (Hardware) SG 7 (PhP 17,899 x 3mo.)	53,697.00			**53,697.00**
B. Indirect Cost				
Utilities				
Supplies and Materials Expenses				
Sub-total for MOOE	**P 346,090.00**	**P**	**P 464,492.38**	**810,582.38**
III. Equipment Outlay				
2 High-end Laptop				
50YE i5 8gb 512 SSD RTX 3050			120,000.00	**120,000.00**
15.6" FHD IPS 144H				
2 sets Arduino-based synoptic weather station			1,453,707.62	**1,453,707.62**
2 sets Perimeter Fence and Tower			250,000.00	**250,000.00**
1 set Perimeter Fence and Pole at Bridge Outlet			50,000.00	**50,000.00**
Sub-total for Equipment Outlay	**P -**	**P -**	**P 1,873,707.62**	**1,873,707.62**
				-
GRAND TOTAL	**P 612,562.00**	**P 799,416.00**	**P 2,587,800.00**	**3,999,778.00**

Prepared by:

ENGR. CHRISTIAN B. HERNANDEZ
Instructor I, MinSU

Noted by:

DR. LEVY B. ARAGO, JR.
President, MinSU

Endorsed By:

JESSE M. PINE
Provincial S&T Director, DOST-Oriental Mindoro

Certified Funds Available

JEFFREY D. VARELA
Chief Administrative Officer, DOST-MIMAROPA

MARIA CRISTINA D. SISCAR, C.P.A
Accountant III, MinSU

Approved by:

Digitally signed by Abilay Ma. Josefina Pormento
Date: 2022.09.23 12:54:10 +08'00'

DR. MA. JOSEFINA P. ABILAY
Regional Director, DOST-MIMAROPA

DOST Form B

PROJECT WORKPLAN

(1) Program Title: Local GIA
(2) Project Title: STRENGTHENING WEATHER MONITORING SYSTEM THROUGH HYDROLOGIC RESPONSE MODELING IN MAG-ASAWANG TUBIG WATERSHED

(3) Total Duration (in months): 12 months **(4) Planned Start Date:** October 2022 **(5) Planned End Date:** September 2023

(6) OBJECTIVES	(7) TARGET ACTIVITIES	(8) TARGET ACCOMPLISHMENTS (quantify, if possible)	Y1				Y2				Y3			
			Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Develop an automated Arduino-based synoptic weather station equipped with microprocessors and wireless fidelity data-transmitting device.	1. Coordination/Linkages 2. Project proposal preparation 3. Proposal revision and compliance of documents requirements 4. MOA signing and approval 5. Procurement of hardware components and other materials	Project proposal presented to RTEC, DOST-MIMAROPA and MinSU and revised accordingly. MOA signed based on the completion of documentary requirements Procurement of hardware components and other materials												
Deploy and evaluate the performance of the developed Arduino-based synoptic weather station in accordance with the required statistical weather parameters (rainfall, relative humidity, solar radiation, wind speed, wind direction, and stream flow).	6. Coordination with LGUs and respective barangays Training on operation, maintenance and troubleshooting of developed device 7. Site validation and assessment 7. Installment of perimeter fence Deployment of device in identified and validated sites	Coordinated with respective LGUs and barangays Capacitated DRRM and LGU staff Identified sites for deployment of device Installed parameter fence for the device Deployed device in identified sites												
Assess and analyze microclimate data transmitted by the deployed synoptic weather station. Evaluate the suitability of SWAT model in Mag-asawang Tubig watershed using remotely sensed	8. Project Analysis and Development	Validated data and developed system												

climatic data as warm-up historical data that will be integrated to the designed synoptic weather station.															
Simulate the hydrologic responses to land use and land cover change of Mag-asawang Tubig watershed.	9. Project Testing and Evaluation	Tested and evaluated the developed project													
Calibrate and validate the model at the streamflow monitoring point of the watershed using SUFI-2 algorithm in SWAT-CUP															
(9) EXPECTED OUTPUTS (6Ps)	**(10) DETAILS** (quantify, if possible)		**Y1**				**Y2**				**Y3**				
			Q 1	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	
Publications	One (1) research paper														
Patents/IP	Application under Utility Model														
Products	Four sets of Arduino-based synoptic weather station														
People Services	Training on operation, maintenance, and troubleshooting of equipment														
Places and Partnerships	The development of Arduino-based synoptic weather station will be done at Mindoro State University – Main Campus, Alcate, Victoria, Oriental Mindoro. Then, pilot testing of this technology will be conducted at Mag-asawang-tubig Watershed situated in Naujan and Victoria, Oriental Mindoro. Three servers located at MinSU-Main Campus, PDRRMO and DOST-Oriental Mindoro will be provided where collected data will be transmitted														
Policy	Possible basis for improvement of disaster preparedness and mitigation plan and policies														