MEMORANDUM OF AGREEMENT

KNOW ALL MEN BY THESE PRESENTS:

This **MEMORANDUM OF AGREEMENT** is entered into and executed by and between:

The **DEPARTMENT OF SCIENCE AND TECHNOLOGY-MIMAROPA**, hereinafter referred to as **DOST-MIMAROPA** with principal office at 4/F DOST-PTRI Building, General Santos Avenue, Bicutan, Taguig City and represented in this Agreement by its Regional Director, **DR. MA. JOSEFINA P. ABILAY;**

-and-

The **MINDORO STATE UNIVERSITY,** hereinafter referred to as **MinSU,** with principal address at Brgy. Alcate, Victoria, Oriental Mindoro represented in this Agreement by its President, **DR. LEVY B. ARAGO, JR.;**

WITNESSETH THAT:

WHEREAS, **DOST-MIMAROPA** is primarily tasked to effectively respond to the social, economic, and ecological development challenges of the region through appropriate Science and Technology interventions and quality S & T Services to uplift the socio-economic well-being of the Filipino people and ensure sustainability for future generations by extending innovation system for the implementation of the project of the proponent.

WHEREAS, **DOST-MIMAROPA** has identified the project **"Strengthening Weather Monitoring System Through Hydrologic Response Modeling in Mag-Asawang Tubig Watershed"** as a project under the **DOST-MIMAROPA LOCAL GIA** and has provided funds therefore;

WHEREAS, **DOST-MIMAROPA** has identified **MinSU** as the beneficiary of the project and has sought support and assistance from **DOST-MIMAROPA** to implement the same;

WHEREAS, **DOST-MIMAROPA, MinSU** pledge to extend their full cooperation for the effective and efficient implementation of the aforesaid project;

NOW, THEREFORE, for and in consideration of the above premises, and of the mutual covenants and stipulations hereinafter set forth, the parties hereto agree to enter into this Memorandum of Agreement under the following terms and conditions:

1. **DOST MIMAROPA shall:**
   1.1 Provide funds amounting to **TWO MILLION FIVE HUNDRED EIGHTY-SEVEN THOUSAND EIGHT HUNDRED PESOS (PhP 2,587,800.00),** for the implementation of the project as described in the Line-Item Budget of the proposal marked as **Annex A** which is made an integral part of this Agreement;

   1.2 Implement the above project in accordance with the attached Workplan in the proposal marked as **Annex B** and which is also attached and made an integral part of this Agreement;

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1.3 Facilitate the pull out of all materials, tools and /equipment procured out of project funds in the event that **MinSU** fails to implement the project as stipulated in the project proposal made as **Annex C** hereof;

1.4 Monitor, evaluate and document project activities and identify alternative courses of action to address technical problems met, if any, during the implementation of the project.

2. **MinSU** shall:

2.1 Ensure that technologies received from **DOST-MIMAROPA** are used according to the provisions stipulated in this agreement unless otherwise revoked with acknowledgement from all parties involved;

2.2 Implement project in accordance with the methodology stated in the proposal and seek permission/clearance from **DOST-MIMAROPA** regarding any major decision or action in the implementation of the project;

2.2.1 Develop an automated Arduino-based synoptic weather station equipped with microprocessors and wireless fidelity data-transmitting device;

2.2.2 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);

2.2.3 Assess and analyze microclimate data transmitted by the deployed synoptic weather station;

2.2.4 Evaluate the suitability of SWAT model in Mag-asawang Tubig watershed using remotely sensed climatic data;

2.2.5 Simulate the hydrologic responses to land use and land cover change of Mag-asawang Tubig watershed; and

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

2.3 Allow **DOST-MIMAROPA** Representatives access to the premises and facilities of the identified cooperators of **MinSU** for activities relevant to the implementation of the project;

2.4 Provide counterparts necessary for the effective implementation of this project as specified in the project proposal and attached LIB;

2.5 Submit the following progress reports:

2.5.1 Monthly report on the volume of production, employment, sales, and productivity improvement not later than one (1) week after the end of each month;

2.5.2 Semi-annual progress reports marked as Annex D hereof not later than 15 days after the end of the semester;

2.5.3 Annual progress report marked as Annex E hereof together with the List of Equipment Purchased marked as Annex F hereof not later than 30 days after the end of the year;

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2.6 Submit the completion report two months after the project duration or after the achievement of the objectives as stated in the proposal;

2.7 Allow **DOST-MIMAROPA** to monitor and collect necessary data/information when required;

2.8 Allow **DOST-MIMAROPA** to place inventory tag stickers on the individual equipment acquired out of project funds;

2.9 Be responsible and accountable for the maintenance and safekeeping of the tools and equipment assigned to the cooperators. Ownership of the equipment shall remain with **DOST-MIMAROPA** until after full ownership shall have been requested and transferred;

2.10 Authorize/allow **DOST-MIMAROPA** to pull-out all the materials, tools and equipment and other assets procured out of projects funds in case of failure of project implementation or for any violation of the contract or agreement that may be entered into by **DOST-MIMAROPA** with the beneficiary;

2.11 Liquidate the funds received and submit an Audited Financial Report, including official receipts of expenditures and Property Acknowledgement Receipt (PAR) to **DOST-MIMAROPA** not later than six (6) months after the release of funds; submit at least three (3) quotations for each item in the LIB to ensure that actions taken are most advantageous to the government;

2.12 Put up at the project site a signboard (4 ft x 6 ft), two weeks after receipt of project funds following the recommended billboard format (Annex D);

2.13 Assist **DOST-MIMAROPA** in baseline data gathering for the project and in final data gathering for assessment of project outcomes and impacts.

3. OTHER CONDITIONS

3.1 That this Agreement shall take effect upon signing hereof and shall remain in force for a period of one (1) year, unless otherwise extended or sooner terminated upon mutual consultation and written agreement of both parties;

3.2 That this Agreement shall not prohibit both parties to publish technical papers that may be derived from the above activities given their mandate of developing and promoting science and technology;

3.3 That any changes, modifications, and alterations on the foregoing provisions of this agreement shall only be made upon mutual consultation and agreement of all parties concerned.

4. PUBLICATION

Any publication arising from this contract and other related activities undertaken shall identify **DOST-MIMAROPA** as the source of assistance.

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5. **EFFECTIVITY:**

This Memorandum of Agreement shall take effect immediately upon signing of the parties hereto and shall remain in the force for the duration of the project unless sooner terminated by **DOST-MIMAROPA** for any, but not limited to the following:

- Failure of **MinSU** to submit the required financial and progress reports within the prescribed period; and
- Any violation of the condition that, as determined by **DOST-MIMAROPA**, will prejudice the successful completion of the project.

6. **PROGRAM DURATION**

The project shall be completed within a period of **One (1) Year**, from **October 2022** to **September 2023**. The project shall be implemented during the said period or immediately after the release of funds.

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IN WITNESS WHEREOF, the parties hereto have signed this Memorandum of Agreement this ___ day of ____, 2022 at Bicutan, Taguig City.

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DR. LEVY B. ARAGO, JR.
President
Mindoro State University

Sdg

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

SIGNED IN THE PRESENCE OF:

Sdg

DR. CHRISTIAN ANTHONY C. AGUTAYA
Vice President for RD
Mindoro State University

Sdg

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

CERTIFIED FUNDS AVAILABLE:

Sdg

JEFFREY D. VARELA
DOST-MIMAROPA Accountant

Sdg

ACKNOWLEDGEMENT
REPUBLIC OF THE PHILIPPINES)
TAGUIG CITY) S.S

IN WITNESS WHEREOF, the parties hereto have signed this Memorandum of Agreement this ___ day of ____, 2022 at Bicutan, Taguig City.

Before me, a Notary Public for and in the TAGUIG CITY this 28 SEP day of 2022 2022, personally appeared

NAME	RES. CERT. NO	Place/Date Issued
DR. MA. JOSEFINA P. ABILAY	PO255592B	01/15/2019-DFA Manila
DR. LEVY B. ARAGO, JR.	05104045	01/03/2022/ Victoria, Or. Mdo.

All known to me be the same person who executed the foregoing instrument and they acknowledged to me that the same is their free and voluntary act and deed as well as the voluntary act of the institution agencies they represent.

This instrument consists of six (6) pages including this page wherein the acknowledgement is written, duly signed by the parties and their witnesses on each and every page hereof.

WITNESS MY HAND AND SEAL, on the date and the place first above written.

Sdg

RACHEL G[illegible]UT-PANGWI
NOTARY PUBLIC UNTIL Dec. 31, 2023/TAGUIG CITY
Not. Com. Appt. No. 18 (2022-2023)
2/F, Parura Bldg. 427 M.L. Q. St., Lower Bicutan, Taguig City
PTR No. A-5334323/1-4-2022, Taguig City
IBP O.R. No. 165796/10-14-2021, RSM
MCLE Comp. No. VII-0007104/11-22-2021
ROLL No. 61627

NOTARY PUBLIC
DOC No.: 10
Page No.: 3
Book No.: XIV
Series of 2022

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DOST Form 2 (for Basic/Applied Research)

DETAILED RESEARCH & DEVELOPMENT PROJECT PROPOSAL

(1) PROJECT PROFILE

Program Title: **STRENGTHENING WEATHER MONITORING SYSTEM THROUGH HYDROLOGIC RESPONSE MODELING IN MAG-ASAWANG TUBIG WATERSHED**

Project Title: **DEVELOPMENT OF AN ARDUINO-BASED AUTOMATIC WEATHER STATION AT MAG-ASAWANG TUBIG WATERSHED**

Project Leader/Sex: **ENGR. CHRISTIAN B. HERNANDEZ/Male**

Project Duration (number of months):2 Years

Project Start Date: **October 2022**

Project End Date: **September 2024**

Implementing Agency (Name of University-College-Institute, Department/Organization or Company): **MINDORO STATE UNIVERSITY-MAIN CAMPUS (MinSU-Main Campus)**

Address/Telephone/Fax/Email (Barangay, Municipality, District, Province, Region): **ALCATE, VICTORIA, ORIENTAL MINDORO**

(2) COOPERATING AGENCY/IES (Name/s and Address/es)

- **Mindoro State University-Main Campus (MinSU-Main Campus)**
- **PDRRMO-Oriental Mindoro**

(3) SITE(S) OF IMPLEMENTATION

IMPLEMENTATION SITES NO.	COUNTRY	REGION	PROVINCE	DISTRICT	MUNICIPALITY	BARANGAY
1.	Philippines	IV-B	ORIENTAL MINDORO	FIRST	VICTORIA	ALCATE
2.	Philippines	IV-B	ORIENTAL MINDORO	FIRST	**TO BE IDENTIFIED** (Site Validation is still on process)	**TO BE IDENTIFIED** (Site Validation is still on process)

(4) TYPE OF RESEARCH

______ Basic

___X___Applied

(5) R&D PRIORITY AREA & PROGRAM (based on HNRDA 2017-2022)

__X__ Agriculture, Aquatic and Natural Resources
Commodity: ________________

_____ Health
Priority Topic: ________________

_____ Industry, Energy and Emerging Technology
Sector: ________________

__X__ Disaster Risk Reduction and Climate Change Adaptation
(Observation and monitoring networks, technology development and application for monitoring)

__X__ Basic Research
Sector: _Water Security/Watershed studies_

Sustainable Development Goal (SDG) Addressed

1. SDG 13 – CLIMATE ACTION
2. SDG 15 – LIFE IN LAND

(6) EXECUTIVE SUMMARY (not to exceed 200 words)

Aiming to strengthen real-time and reliable weather monitoring system in Mag-asawang Tubig Watershed in Naujan, Oriental Mindoro using an automated Arduino-based synoptic weather station through modeling of hydrologic activities, a 3-phase project entitled “STRENGTHENING WEATHER MONITORING SYSTEM THROUGH HYDROLOGIC RESPONSE MODELING IN MAG-ASAWANG TUBIG WATERSHED” was proposed. The first phase is the Suitability Analysis, second is the development of Arduino-based Weather station and the third one is the evaluation of Hydrologic response at Mag-asawang Tubig watershed.

This is a 2-year duration project with estimated budget for funding of Php. 2,764,157.58 in partnership with the Provincial Disaster Risk Reduction and Management Office (PDRRMO).

The team is led by Engr. Christian Hernandez, together with his members Mr. John Edgar Anthony, and Mr. Harold Bangalisan who are dedicated instructors and researchers at Mindoro State University, Main Campus. The project aims to improve the quality of life through precise and accurate weather data for Mag-asawang Tubig Watershed and agricultural activities nearby.

(7) INTRODUCTION

Oriental Mindoro is bequeathed with ample and rich agricultural base (Agri-Infohub, 2023) but is highly prone to natural disasters. 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. Mag-asawang Tubig, being one of the largest watershed in the province, contributes greatly to the increasing occurrences of this natural hazard (Mag Asawang Tubig Riverside Resilience, 2021).

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 mesoclimate 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 (The Global Green Growth Institute, 2021). Given that there are only few weather stations built and it is outside the radius of influence in the watershed, there is still a strong need for accessible, reliable, and accurate weather data, especially that the nearby land area of the watershed is used for Agricultural production. In the same way, there were no Agrometeorological stations provided in the province which indicates that there is scarcity in hydrometeorological data for agricultural purposes.

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

(7.1) RATIONALE/SIGNIFICANCE (not to exceed 300 words)

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.

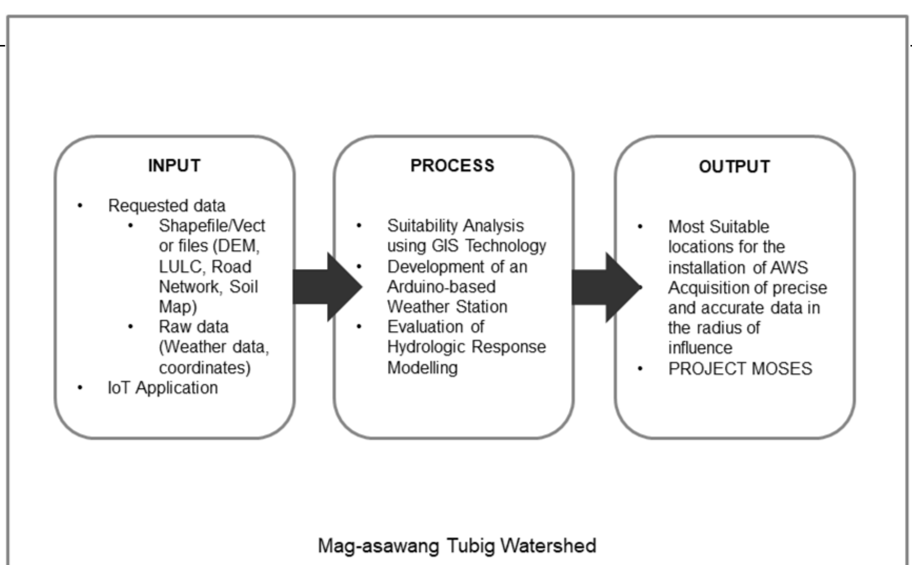
The whole island of Mindoro has a myriad of rivers and streams. Among these prominent rivers posing immediate hydrologic hazards are Bucayao and Mag-asawang Tubig River Systems that flow in the alluvial plains of Calapan City, Naujan, and Victoria. Eighty-five barangays or 19.95 percent of the total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

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.

Monitoring devices are deployed in the province to mitigate the effects of these natural hazards. In Oriental Mindoro, there are 46 Hydrometeorological devices installed which are both operational and non-operational and only two of those are AWS. In a separate record, there are 4 Synoptic Weather Stations constructed and operated by PAGASA where 2 were installed at Oriental Mindoro, particularly at Puerto Galera, station 5120, and Calapan City, station 5122, both are Synoptic Weather Station (PAGASA, 2023). There are only few weather stations built as it reflects that there is a scarcity of local meteorological data in the province. Moreover, among the presented hydrometeorological devices installed, there was no agrometeorological device given that this province is known to be Rice Granary of MIMAROPA and Fruit Basket of Southern Tagalog (Agri-Infohub, 2023).

(7.2) SCIENTIFIC BASIS/THEORETICAL FRAMEWORK

The scientific basis/theoretical Framework of the study is presented in the figure below.



(7.3) OBJECTIVES

Generally, this project intends to strengthen real-time and reliable weather monitoring system in Mag-asawang Tubig Watershed in Naujan, Oriental Mindoro 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 (temperature, pressure, rainfall, relative humidity, solar radiation, wind speed, wind direction, soil temperature and moisture and stream flow);
3. Assess and analyze microclimate data transmitted by the deployed synoptic weather station.
4. Obtain comprehensive soil survey to define soil properties in more detailed approach and conduct topographic mapping in areas bounded by the proposed study site.
5. Evaluate the suitability of SWAT model in Mag-asawang Tubig watershed using remotely sensed climatic data as warm-up historical data that will be integrated to the designed synoptic weather station;
6. Simulate the hydrologic responses to land use and land cover change of Mag-asawang Tubig watershed.
7. Calibrate and validate the model at the streamflow monitoring point of the watershed using SUFI-2 algorithm in SWAT-CUP; and
8. Assess climate change impacts in the largest watershed in Oriental Mindoro using scenario analysis in the SWAT model.

(8) REVIEW OF LITERATURE

Presented in this chapter is the review of related literatures used in the project.

Weather Monitoring

The monitoring of the weather is a vital activity in many different fields of application, such as high precision agriculture (Sawant, Durbha, & Jagarlapudi, 2017), outdoor entertainment and recreation (Finger & Lehmann, 2012), industrial production, and logistics. The use of weather monitoring equipment in the context of monitoring natural disasters is among the most important of its many potential applications. The frequency of natural disasters on a global scale has increased as a direct result of climate change (Banholzer & J. Kossin, 2014). In the last few decades, more extreme weather phenomena have occurred, such as higher and lower temperatures, significant rainfall, strong winds in tropical cyclones, and exacerbated droughts (Aalst, 2006). Extreme weather can expose people to a variety of hazards, including flash flooding in subsurface drainage galleries, landslides on slopes, river overflow, soil and coastal erosion, and the collapse of infrastructural components such as houses and buildings. Natural disasters that are caused by climate change can have a negative impact on the local economy in several ways, including the destruction of productive capital, supply linkages, and housing stock (Boustan, Kahn, Rhode, & Yanguas, 2020)

Weather Station

The weather station is a set of devices and sensors that measure the atmosphere and ground conditions. Automatic weather stations are concerned with Light, temperature, relative humidity, precipitation, and wind, which are often monitored environmental factors. Included in soil conditions are soil moisture, soil temperature, and bulk electrical conductivity (Jenkins, 2015). A local wea her station enables the monitoring of a growing area's microclimate. Significantly or data such as rainfall and weather conditions can vary over short distances, which implies that readings taken miles away as part of a public weather network may need to be more reliable for irrigation and temperature scheduling purposes (Bayer, Iersel, & Chappell, 2017).

Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) presented different field weather station categories. These are Synop, Upper-Air, Radar Station, Agromet, Official Rain, Cooperative Rain, Official Climat, Cooperative Climat, Port Meteorological Office, Airport, Hydrometeorological Station, and Evaporation Station (Field Station Categories).

This study focuses on suitability analysis to select the best area where a weather station will be developed and located. As stated above, a weather station refers to a set of devices and sensors that monitors and regulates the atmospheric conditions in a particular area where PAGASA identifies different categories. Two of those are the Synoptic Weather Station and Agrometeorological Station, the types of the station to be built in the suitability analysis.

Synoptic Weather Station

According to Khare (2018), the word synoptic is comprised of two separate words: SYN, which means "together," and OPTIC, which means "view." Synoptic refers to various viewpoints in which things are depicted concurrently. Thus, it is a branch of meteorology in which weather elements are plotted and analyzed, and the atmosphere is studied. For short-term forecasting, these actions are taken to comprehend the atmosphere's behavior and predict the future performance and movement of the various systems for up to 72 hours. The fundamental sciences of Synoptic Meteorology are Physical and Dynamic meteorology. The essential instruments necessary for the study are weather charts.

Moreover, Synop or Surface Synoptic Station is where observations of nearly all meteorological elements are made at regular intervals and transmitted to the Central Office. PAGASA is in charge of maintaining and operating these stations. It is responsible for disseminating public weather forecasts, tropical storm bulletins, warnings and advisories, and other pertinent information to save the general public's lives and property (Field Station Categories).

Observing various components is the principal and most essential method for researching the atmosphere. These measurements plot on various charts, and the analysis of these charts will aid in comprehending the three-dimensional image of the various systems or atmospheres. There are several significant aspects to consider when studying the atmosphere. Four variables are considered in a synoptic station: pressure, temperature, water vapor, and wind (Khare, 2018).

The weather station design to be built as a continuation of suitability analysis is composed of various sensors and devices, which makes it categorized as a synoptic weather station. The information above serves as the basis for the researchers to design the synoptic station after locating the best location from the suitability analysis.

Agrometeorological Station (Agro-Met)

Agrometeorological Station, also known as Agro-Met, is an additional derivative station that uses the advanced remote data-acquisition unit (arQ). It is equipped with multi-parameter weather sensors that simultaneously measure wind speed and direction; air temperature; air humidity; air pressure, rain amount, duration and intensity, soil moisture and temperature, solar radiation, and sunshine duration. According to DOST Advanced Science and Technology Institute, the station receives data from a sensor for transmission through SMS or satellite network (About Agro-Met).

Moreover, to be classified as Agricultural Meteorological Station, World Meteorological Organization (WMO) has presented several functions. First, Principal agricultural meteorological stations simultaneously give detailed meteorological and biological information and are the sites where agricultural meteorology research is conducted. The instrumental equipment, range, and frequency of observations in both meteorological and biological disciplines, as well as the competent staff, are such that fundamental research can be conducted on agricultural meteorological issues of importance to the concerned countries or regions (Guide to Agricultural Meteorological Practices, 2010).

Second, a standard agricultural meteorological station routinely delivers simultaneous meteorological and biological data and may be configured to aid in investigating particular issues. In general, the study program for biological or phenological observations will be tied to the local atmospheric regime of the station and local agriculture. Third, an auxiliary agricultural meteorological station offers meteorological and biological information. The meteorological information may include soil temperature, moisture, potential evapotranspiration, duration of vegetative wetness, and precise data in the lowest atmospheric layer. The biological data may include phenology, the initiation and spread of plant diseases, and others. Lastly, a station set up temporarily or permanently for the observation of one or more variables and remarkable phenomena is referred to as an agricultural meteorological station (Guide to Agricultural Meteorological Practices, 2010). Any of these functions must be satisfied in order to be considered an Agro-met station.

The weather station to be built in the Suitability Analysis in this study falls under the Agro-met station as it was designed to give detailed atmospheric and biological information simultaneously. These are also the sites where agricultural meteorology research is conducted, in this case, for hydrologic response modeling, which is the third micro study after suitability analysis and development of the weather station. Also, it serves as an auxiliary of agricultural meteorological information, which are the weather parameters that the weather station will detect.

IoT in Weather Station

The development of Internet of Things (IoT)-based sensing technologies has enhanced the precision with which environmental conditions may be monitored. Energy-efficient wireless sensor networks can be utilized to monitor time-sensitive occurrences in emergency management (Erd, Schaeffe, M., & Reindl, 2016). Nevertheless, meteorological measurements remotely gathered from weather stations serve a crucial role in alerting the public to the approaching risk of natural disasters. Radar and weather stations continue to be one of the primary sources of accurate and reliable weather measurements for natural catastrophe monitoring.

Meteorological Variables

The meteorological variables in a weather station are temperature, atmospheric pressure, humidity, wind speed and direction, precipitation, and cloudiness (Meteorological Models, 2021). To maintain accurate readings, meteorologists must constantly monitor these variables. There are several types of weather measurement devices; these devices measure different weather variables. Each type of device is reliable and accurate when used correctly. These instruments included in these stations are used for monitoring, measuring, and sometimes regulating the different weather variables in a large-scale area.

Temperature

In simple terms, temperature is referred as a measure of degree of hotness or coldness that can be expressed in variety of scales, particularly Fahrenheit and Celsius. Temperature shows the direction of the spontaneous movement of heat energy, i.e., from a hotter body (one with a higher temperature) to a colder body (one at a lower temperature) (Gaur A. , 2022). Likewise, temperatures of the air and water are principally influenced by how much sunlight is received by the Earth's surface and how much heat is reflected back into space by greenhouse gases. Regional temperature patterns are shaped by the circulation of the ocean and atmosphere, which redistributes heat over the Earth's surface (UGC Berkeley, 2018). Temperature affects all operations of systems in different fields which imposes its significance. According to Nowak (2021), it is critical to take into account all of the various implications that rising global mean air temperatures will have on the environment, including changes in species ranges, altered energy consumption, and effects on plant and human health.

Due to their direct and indirect effects on regulating the climate, trees and forests also have an impact on environmental quality, human health, and well-being. Globally, trees and forests have an impact on local climates by directly modifying air temperatures and other meteorological factors as well as indirectly influencing greenhouse gas emissions and atmospheric carbon dioxide (CO_2) concentration. Local climate can have a significant impact on human health and well-being in metropolitan environments because populations are densely packed into relatively limited regions. Therefore, urban forests' essential contributions to local climate regulation have a significant impact on the wellbeing of the majority of humanity. Many facets of climate are impacted by trees, but this chapter will concentrate on variations in air temperature (Nowak, 2021).

To measure temperature, thermometers are used. Thermometers come in a variety of designs. The most common ones use the features of a substance's expansion and contraction in relation to temperature, the useful electrical qualities (electrical resistance), or the characteristics between temperature and heat radiation energy released from a substance's surface. Over discrete intervals of several seconds, the temperature of the air changes continually within a range of 1 to 2 °C. The WMO suggests that if a thermometer with a very tiny time constant is being used, several readings should be obtained because the best indicative value of air temperature is the average collected over a one-minute period. A thermometer with a large time constant smoothed out rapid changes. However, lags in reaction to temperature variation will result in inaccuracies if the time constant is too great. The WMO advises that the time constant be between 30 and 60 seconds for a wind speed of 5 ms^{-1} since the time constant of a thermometer varies inversely with the square root of wind speed (WMO, 2010).

Pressure

The pressure is the force per unit area that opposes the movement of air or fluid. In weather forecasting, the pressure is measured in inches of mercury (Hg). It is calculated by multiplying the atmospheric pressure (in Pascals) by 1000 (Rodriguez, 2022). The atmospheric pressure is determined by the weight of the atmosphere above a given point. Air exerts pressure due to its weight. When the atmospheric pressure is higher at sea level than at higher elevations, the air is heavier at sea level than it is at higher elevations. Pressure, as one of the weather variables, influences the weather in a variety of ways. For example, it controls the temperature and the moisture in the atmosphere. Pressure is often measured using a barometer. A barometer is a simple instrument that measures air pressure. It has a tube connected to the top and the bottom with a liquid level in the middle. As the air pressure increases, the liquid level rises higher in the tube (Ahmad, Kanth, Parvaze, & Mahdi, 2017).

Humidity

Humidity measures the amount of water vapor in the air. When a vapor pressure value is calculated, the picture is not complete until that number is contrasted with the saturation vapor pressure at the air's temperature. The difference (given in percentage) between the saturation vapor pressure (t) at the appropriate temperature and the vapor pressure (e) is thus used to define the relative humidity (h) (Ramis, Romero, & Alonso, 2019). The higher the humidity, the more water vapor is present and the lower the temperature. A dry environment has low humidity, while a humid environment has high humidity (Cundiff, 2021). The two main types of humidity are absolute and relative humidity. Absolute humidity refers to the actual amount of water vapor present in the air, while relative humidity refers to the ratio of the amount of water vapor in the air to the maximum amount that the air can hold at a given temperature (What is Humidity ? Its Types and Effect on Temperature, 2022).

For a number of reasons, atmospheric water vapor is a significant weather variable. By absorbing thermal radiation from the Sun and the Earth, it controls the temperature of the air. Furthermore, more latent energy is available to create storms the higher the atmosphere's vapor content. Additionally, the primary cause of all condensation and precipitation is water vapor (Gaur A. , humidity, 2022).

Moreover, Hygrometers are devices that measure the relative humidity directly. The analog hygrometers use the variation in length that human hair especially that of a blond woman, experiences with a change in the relative humidity, as opposed to the digital hygrometers, which are typically based on some change of the electric properties of some material as function of the relative humidity of the air (Lotha, 2019).

Wind Speed and Direction

Among the many factors that meteorologists monitor when observing the weather are wind speed and direction. The wind's strength and direction can provide important hints for interpreting the weather and are key factors in predicting future conditions.

Wind is nothing more than air moving, and it develops as a result of climatic and weather patterns that result in variations in air pressure. As sunlight strikes the earth, pockets of warmer and cooler air form, unevenly warming the air due to diverse geographical characteristics on the surface of the planet and the varying angles at which the sunlight strikes. As warm air rises and leaves a region of low pressure behind it, temperature variations in the air result in pressure differences. Gases in the air are less dense where there is lower pressure. Gases flow from high-pressure regions to low-pressure regions as a result of the diffusion principle. The speed at which the gases flow and produce wind depends on how much pressure exists between two locations (Gaur A. , wind, 2022).

Different wind patterns can be seen on a bigger scale in various habitats and geographical areas. Because inland areas heat up on sunny days, the air above the land becomes warmer, which frequently results in sea breezes. The cooler air over the sea then diffuses its way inland, producing a breeze (Pielke, 2014). Globally, comparable patterns give rise to broad-ranging wind patterns like the trade winds. The air heats up, rises, and spreads north and south high above the ground in tropical regions that are constantly warm. The cooler air from the north and south is drawn inward and toward the tropics higher up in the atmosphere. Trade winds are caused by the Coriolis effect, in which moving air masses have a tendency to curve as a result of the Earth's rotation (What are the trade winds?, 2022).

Certain operations necessitate the measurement of wind because wind speed and direction offer crucial information about the concentration and transport of air pollutants. In order to enable regulatory air quality modelling as outlined in the Guideline on Air Quality Models, the USEPA mandates that regulatory air quality management organizations analyze specific meteorological data, such as wind speed and direction. In order to know how air pollution produced by industrial activities will be spread, many industrial operations, including power plants and mining sites, use anemometer technology (Air Quality Measurements Series: Wind Speed and Direction, 2021).

Furthermore, one of the most often used styles of wind monitoring equipment is the cup anemometer. It is intended to measure wind speed. This gadget catches the wind thanks to three or four little hemispheres or cups that are mounted on the arms. The number of rotations the cups make are counted by an electrical device, and the wind speed is then determined. These wind-monitoring tools might be useful for identifying weather trends and forecasting impending weather patterns. Cup anemometers are frequently used at weather stations and in other locations, such as airports, where it is crucial to measure wind speed (What Is a Wind Direction Instrument and How Does It Work?, 2021).

Precipitation

Precipitation is defined as water in a liquid or solid state that falls from clouds or condenses from airborne water vapor to form on the ground and other objects (Types of Precipitation, 2022). Precipitation may be continuous (temperate-intense) and produced mostly by stratocumulus clouds, heavy, from cumulonimbus, or drizzle, frequently from stratus clouds, depending on the mechanism of cloud growth and structure. Ground hydrometeors are the term for precipitation that forms on the surface of the earth and includes dew, various types of rime, hoarfrost, black and hard frost, and glaze. Common rainfall tools are used to measure the precipitation. Rainfall is recorded at meteorological stations using various rain gauges, recording rain gauges (pluviographs), or by radar, which permits assessment of both the area and intensity of the precipitation fall (Borzenkova, 2019).

Cloudiness

The presence of clouds is crucial for understanding and forecasting the weather. Cloud cover affects the sky's conditions and helps forecast precipitation, but it also helps control the local temperature. Cloud cover has the potential to reduce a region's ability to cool at night. The heat from the sun that the ground absorbs throughout the day is often released at night as Earth cools. A mechanism called as radiative cooling causes the warm air close to the ground to ascend. However, part of the heat is captured and reflected back to Earth by the clouds if there is a substantial amount of cloud cover over the area where such radiative cooling is occurring. This maintains the surface at a higher temperature than it would be on a clear night (Brown, 2022).

Understanding climate change requires a thorough understanding of clouds, including their locations and features. Low, dense clouds mainly serve to deflect solar energy and chill the Earth's surface. High, thin clouds mostly reflect incoming solar radiation; but, they also trap part of the infrared radiation that the Earth emits and reflect it back down, warming the Earth's surface. The altitude, size, and composition of the cloud's constituent particles are all important in determining whether a given cloud will heat or cool the surface. Although the balance between the cooling and warming impacts of clouds is fairly close, cooling predominates when the effects of all the clouds on the planet are averaged (Graham, 1999).

Solar radiation, as mentioned above, is a broad word for the electromagnetic radiation that the sun emits. It is also sometimes referred to as the solar resource or just sunshine. A multitude of devices can be used to collect solar radiation and transform it into useful forms of energy, such as heat and electricity. However, the technological viability and cost-effectiveness of these systems at a particular area depends on the solar resource available (Solar Energy Technologies Office, 2021).

Moreover, Solar Energy Technologies Office (2021) stated that at various periods of the year, scientists measure the amount of sunshine that strikes particular regions. The amount of sunshine that strikes areas with comparable climates and latitudes is then estimated. Total radiation on a horizontal surface or total radiation on a surface that tracks the sun are the two common ways that solar energy is measured. Kilowatt-hours per square meter (kWh/m^2) are frequently used to express radiation statistics for solar electric (photovoltaic) systems. Watts per square meter (W/m^2) can also be used to indicate direct estimations of solar energy. British thermal units per square foot (Btu/ft^2) are the standard unit of measurement for radiation data for solar water heating and space heating systems.

Observations of Physical Environment

WMO presented guidelines on the accuracy of weather variables in an Agrometeorological stations. Table 2 presents the minimum accuracy recommended by WMO.

Table 2. Minimum accuracy recommended by WMO (WMO, 2010)**.**

Variable	Accuracy Required in Daily Values
Temperature, including max/min, wet and dry bulb, soil	< ±0.5ºC
Rainfall	±1 mm
Solar Radiation	10% (±1h)
Evaporation	±1 mm
Relative humidity	±5%
Photoperiod	10% (±1h)
Wind speed	±0.5 ms^{-1}
Air pressure	±0.1 hPa

Agricultural meteorological stations' observing schedules should include measurements of some or all of the following factors that describe the physical environment which are solar radiation, sunshine and cloudiness, air and soil temperature, air pressure, wind speed and direction, air humidity and soil moisture, evaporation and precipitation, comprising observations of hail, dew and fog. From these observations and others, one can infer the water balance, evapotranspiration, and other fluxes (WMO, 2010).

The most common weather variables are temperature, pressure, humidity, wnd speed and direction, precipitation, and solar radiation. These meteorological parameters mentioned are the weather variables considered in the weather station to be built. The accuracy of these weather data in the weather station are highly dependent on this study, using Suitability Analysis as the efficiency of the weather data to be gathered are determined on the best location of the weather station using this method. Likewise, the presented guidelines will be used as basis for the instruments to be used in the construction of the weather station proceeding from Suitability Analysis.

Suitability Analysis

As stated by ArcGIS Pro 3.0, Suitability Analysis enables data to categorize, contrast, and rank potential candidate sites according to how closely they comply with chosen and specified criteria. Suitability analysis is conducted on the polygonal inputs configured in the suitability analysis layer. These could be trade areas at potential sites, typical geographies like counties, or sales regions. Based on cr teria that are chosen and controlled, suitability layer candidate analyses are rated and scored. Three additional criteria can be added from three sources.

The first source is Variable-based criteria, where the Business Analyst dataset from the GIS tool can be used to augment the Suitability Analysis layer. Demographic, socioeconomic, and spending information are a few examples of variable-based criteria. Second is P int-based criteria, where data obtained from the closeness of points in a layer can be used to enhance the suitability analysis layer. It is necessary to specify whether the relationship between the Suitability Analysis layer and points will positively or negatively affect success when creating point-based criteria. Point-based factors include things like the proximity of clients or competitors, both of which may harm candidates. When using point-based criteria, one must define the type of criteria in one of three ways. First is the Count, which returns the overall number of points that are contained within each candidate area for the suitability analysis layer (ArcGIS Pro 3.0).

Second is Weight, which aggregates and delivers the sum of a numeric field value falling within each potential region for the Suitability Analysis layer, such as sales. Based on the Distance type and Measure Units chosen, the third one, which is Minimal Distance, returns the distance of the nearest point to each candidate area for the Suitability Analysis layer (ArcGIS Pro 3.0).

ArcGIS 3.0 identified the third source, which is the Field-based criterion. From the Suitability Analysis layer attribute table's existing fields, one may choose and build criteria. Square footage, the number of parking spaces accessible, and the presence of necessary amenities are a few examples of field-based criteria.

Different studies have utilized Suitability analysis in their research, and one of them is the GIS-based Multicriteria approaches to Land Use Suitability Assessment and Allocation.

A Multi-Criteria Decision Making (MCDM) problem is used to formulate the assessment of land suitability in a Geographic Information System (GIS) setting. The development of various MCDM techniques combines variables in a suitability analysis of land for future land uses. A general appropriateness index is created using these MCDM methods (Mendoza, 2019). It is inferred that the assessment of a site's suitability is fundamentally a multi-criteria challenge. In other words, a challenge combining evaluation and decision-making and multiple aspects is land suitability analysis.

Site Suitability Analysis will be used in the study to find out the best location where the Arduino-based Weather station proposed will be built in Mag-asawang Tubig. The criteria mentioned above are generally identified, and it varies depending on the purpose of the suitability analysis.

Criteria for Suitability Analysis

World Meteorological Organization identified the criteria that should be considered in locating the best place for the installation and development of weather stations, particularly for Agrometeorological Stations. The WMO recommends flat topography, crop-producing sites that are accessible, far from lakes and other bodies of water, inside of an institution, and that have a minimum land area of 1,980 square meters when putting up an agrometeorological station (Alejo, 2018). In summary, the criteria and data required for developing an Agrometeorological station is presented in Table 1.

Table 1. Suitability criteria for weather stations (Alejo, 2018).

Factor	Suitability Criteria	Data Needed
Slope	0-3%	DEM
Land use	Cultivated, production areas, grasslands	Land use/Land Cover
Accessibility	At least 500 m from the road buffer	Roads
Location of Existing stations (synoptic and agro-meteorological)	Areas outside its 9 km radius of influence	Existing Weather Stations
Water bodies (Lakes and Coastline)	Outside 10 km buffer	LULC & coastline
Availability of Host Institution	Inside 9 km radius	Locations of research-based government institutions

Site Selection (Slope)

While the representativity of observations depends on their application, their accuracy at a given time is a determinable fixed property. The degree to which a measurement consistently depicts the value of a parameter (such as humidity or wind speed) at a given spatial scale for a particular purpose is known as representational quality. To provide stable representation, instrumentation, exposure, and observation processes must match, such as local 2-minute averages for aviation or hourly mesoscale averages for synoptic forecasts. Therefore, when choosing a location for a station, it is essential to consider the purpose of its observations first. Suppose the station is to be regionally representative, for example. In that case, an open location is preferred even in a wooded area because the station's observations must be related to the lower atmosphere of the region (Guide to Agricultural Meteorological Practices, 2010).

WMO also added that a weather station should not be located on concrete, asphalt, or crushed rock and instead be flat. Where the climate and soil do not support a grass cover, the ground should have a local natural cover to the greatest extent possible. Trees, bush s, and structures should be located within the instruments. Only when there are no shadows for most of the day can measurements of sunshine and radiation be obtained; there may be brief periods of shade near sunrise and sunset that cannot be avoided. A distance from barriers that is less than ten times their height should not be used to estimate the wind. Rain gauges should not be permitted to be dripped into trees.

Networks

For agro-met, according to WMO (2010), the number of stations within each region should depend on the region's size, the climatic kinds and subtypes, and the spatial differences of such things as the natural vegetation, significant crops, and agricultural practices. From a diff rent angle, marginal agricultural and forestry areas frequently merit special consideration. A primary g al of observations made in these areas would be to establish the geographic limits within which a particular crop could be successfully grown, or a particular agricultural or forestry practice might be profitable. Another goal would be to determine the frequency and typical geographic distributions of the main weather hazards to minimize their negative effects through preventative measures.

The presented criteria above, slope, land use, accessibility, location of existing stations, host institutions, and water bodies, serves as the basis for the study to identify and locate the best location for the development and installation of the Arduino-based Weather Station using the Suitability Analysis.

Geographic Information System (GIS)

As defined by WMO (2010), GIS stands for geographic information systems. It is a qui k way to combine different maps and satellite information sources in models that replicate the interactions of complex natural systems. GIS is significant for the suitability analysis of land uses. Also, GIS plays a vital role in decision-making for land development, maintenance, and conservation. GIS is a powerful and effective tool for analyzing spatial patterns of natural resources such as water, forest, and soil resources. GIS enables the mapping of various data such as soil type, vegetation cover, and land elevation. The tools used for GIS analysis include image analysis, explicit mapping, and analysis tools. GIS is a powerful tool that is widely used to analyze geospatial data related to land use patterns. It can be used for various purposes, including flood mapping, drought analysis, and urban planning. It can also be utilized to study the demographics of a particular area (Huisman & de By, 2009).

One of the features of GIS is that it is a collection of spatial data that can be analyzed using maps and other visual displays. It is also used to integrate and analyze different types of data cost-effectively. It helps in decision-making by providing an accurate picture of the state of a particular region. It can take analysis large amounts of information and present it in a user-friendly format. It enables the exploration of the area of interest by displaying and analyzing various data types. It also helps to minimize costs because one does not have to collect data separately from different sources and then integrate it manually. GIS is a time-saving and cost-effective tool that helps analyze and make decisions related to land use patterns. GIS can be used to study the land and its characteristics in detail so that optimal use of resources can be made (GIS (Geographic Information System), 2022).

A Geographic Information System (GIS) is a Suitability Mapping instrument that has an advantage in Suitability Analysis. Hence this is the tool to be used in the study as it satisfies the study's objectives through its features in the most effective way.

Digital Elevation Model

The Digital elevation model (DEM) is a geographically referenced model of the Earth's land surface. It is used for mapping, surveying, land management, and other applications. It is utilized in civil engineering, earth sciences, disaster management, urban planning, and other fields. It has been widely used for various activities related to topographic mappings, such as contour lines, drainage patterns, buildings, other structures, and others. It is also used extensively in terrain modeling applications such as modeling the ground displacements caused by explosions or landslides, evaluating the geologic hazards to aviation safety, planning and carrying out mining operations, designing structural foundations, and building levees and other flood protection systems. It depicts a continuous topographic elevation surface through a grid of cells. A feature's elevation (Z) at each cell's position is shown (X and Y). Because they only provided information on the elevation of geological (ground) features like valleys, mountains, and landslides, to mention a few, digital elevation models are a "bare earth" portrayal. They do not have any information on the elevation of any above-ground items, including vegetation or structures (What is a Digital Elevation Model (DEM)? 2022).

In this study, DEM depicts a continuous topographic elevation surface through a grid of cells. A feature's elevation (Z) at each cell's position is shown (X and Y). Because the only provide information on the elevation of geological (ground) features like valleys, mountains, and landslides, to mention a few, digital elevation models are a "bare earth" portrayal. The data using DEM will be used to identify the elevation in the province of Oriental Mindoro to be used in the Suitability Analysis for slope criteria of 0-3%.

Land Use and Land Cover (LULC)

Land Use and Land Cover (LULC) data are essential for many purposes, such as mapping, inventorying, and planning. However, ac urate and up-to-date LULC data can be difficult to find or collect. Even though the terms land use and land cover are frequently used synonymously, their true meanings are considerably different. The Government of Canada differentiated the two, where the term "land cover" refers to the material that covers the surface of the ground, such as vegetation, urban infrastructure, water, bare soil, or another material. For the purpose of resource management, planning, and global monitoring studies, it is crucial to identify, delineate, and map the land cover. The baseline from which monitoring operations (change detection) can be carried out is established by identifying the land cover, which also supplies the ground cover data for baseline thematic maps.

Meanwhile, land use" describes a piece of land's function, such as agriculture, wildlife habitat, or recreation. Since time information is needed to determine the current quantity of land in what sort of use and to identify the land use changes from year to year, land use applications entail both baseline mapping and subsequent monitoring. This information will be used to create strategies that balance development demands, competing uses, and conservation. The loss or disruption of fertile land, urban sprawl, and forest depletion are issues driving land use studies (Land Cover & Land Use, 2015).

Land Use and Land Cover are needed data for determining Land use in a particular place or location. In this study, these data will be utilized in Suitability Analysis for Land use where there should be a cultivation production area as stated in the criteria presented by WMO.

Road Network

According to Facao and Papa (2022), since the road network map, whose edges are determined by the roads connecting two reference points, is already defined by the adjacency relation of the graph, road networks place a new restriction on it. The goal of further research is to discover the best locations for different purposes on a specific road network instance so that they can arrive at the scene of an incident where the purpose is identified as quickly as possible.

Road network data is essential for urban planners, transportation engineers, and city administrators to support intelligent planning decisions. Many roads in urban areas have been created over the years and are no longer up-to-date with modern traffic management techniques or design standards. It is common practice for cities to periodically perform road audits to capture and update road network information. This information is often collected in the form of Geographic Information Systems (GIS) files that provide information about the road width, elevation, number of lanes, traffic volumes, etc. City planners can then use this information to identify areas where improvements can be made to improve the safety and efficiency of the city's road network (Kerekes, 2018).

The edges or boundaries of a road network map are determined by the roads that are linked with two reference points, and it is often represented using a GIS tool. In this case, it can be used for the suitability analysis of the weather station for accessibility criteria to locate the best location for developing and installing the Arduino-based Weather Station.

Location of Research-based Institution

The choice of agro-meteorological stations, whether primary, ordinary, auxiliary, or for purposes, will differ from nation to nation, but there may be some general recommendations. All Agrometeorological stations should be situated in areas with active agricultural, forestry, pastoral, or other kinds of production, according to the first factor to be considered. In this regard, the following locations will frequently be appropriate for major (and typical) stations: 1) agricultural, horticultural, animal husbandry, forestry, hydrobiology, and soil science experimental stations or research facilities; 2) colleges that are connected to agriculture; 3) important areas for farming and animal husbandry; 4) areas for forestry; 5) National parks and reserves (Guide to Agricultural Meteorological Practices, 2010).

For security purposes, the weather station must be situated on any government property for a clean and smooth operation to occur. The information mentioned above serves as the basis for the study as one of the criteria for Suitability Analysis for developing the Arduino-based Weather Station.

Mesoscale and Microscale

WMO (2012) established guidelines in classifying the scales for the instrumentation of hydrometeorological devices. Under representativeness, which is defined as the degree where it accurately describe the value of the variable needed for a particular function. In addition, the quality is not fixed but results from joint appraisal of instrumentation, measurement interval and exposure against the requirements of some application. Hence, shorter-range weather forecasts require more frequent observations from a denser network across a smaller area in order to catch any small-scale phenomena and their rapid development. Forecasting scales are closely tied to the timescales of the phenomena. Horizontal meteorological scales can be categorized as follows, with a factor of two uncertainty, using a variety of sources: (a) Microscale (less than 100 m) for agricultural meteorology, for example, evaporation; (b) Toposcale or local scale (100-3 km), for example, air pollution, tornadoes; (c) Mesoscale (3-100 km), for example, thunderstorms, sea and mountain breeze.

In the study, microscale will be used for agricultural meteorology with maximum radius of influence of 100 m, while in terms of Disaster Risk Reduction and Management (DRRM), mesoscale was used with 3-100 km radius of influence chosen. According to the suitability analysis criteria, the distance from the existing weather stations should be 9 km, hence, 9 km radius of influence will be used in this study.

(9) METHODOLOGY

This project is divided into 3 parts which are: 1) Suitability Analysis using GIS Mapping; 2) Development of an Arduino-based Automatic Weather Station; 3) Evaluation of Hydrologic Response Modelling at Mag-asawang Tubig Watershed.

Suitability Analysis

After the approval of the project, the cooperating agency in coordination with the proponent will facilitate the procurement of equipment for the development of the Arduino-based synoptic weather station. At the same time, the team will coordinate with different agencies to request the data/shapefiles, vector files needed for Suitability Analysis:

1. NAMRIA – DEM, Land Cover
2. BSWM – Land Use
3. DPWH – Road Networks
4. PAGASA – Weather data
5. DOST – List of Hydrometeorological Devices installed, Government institutions.
6. DENR/PENRO – LULC, DEM IFSAR, Soil Map
7. LGU (Calapan, Naujan, Victoria) – Streamflow data, Soil Map, Land Use

After granting the request, the team will conduct the Suitability analysis using QGIS to locate the most suitable places to install the Arduino-based Weather Station.

Development of an Arduino-based Automatic Weather Station

Upon the delivery of the materials needed after the procurement process, the project team will start the development of the Arduino-based Weather Station in the selected locations. 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 PDRRMO staff.

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 PDRRMO-Oriental Mindoro, and the proponent will be assigned and therefore compose the Project Management Team (PMT) which will oversee and administer the implementation of the project. Near real-time hydrologic and microclimate data will be recorded by the device and transmitted to (2) 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. Project MOSES (Monitoring and Observation of Site-specific E-weather Stations) will be established to monitor and regulate the accurate, integrated, and receptive atmospheric conditions of Mag-asawang Tubig using the data transmitted in the Arduino-based Weather Station. The impact of the project would be assessed based on its objectives and would be reported after the second year.

Evaluation of Hydrologic Response Modelling at Mag-asawang Tubig Watershed

After the successful installation and operation of the weather station, the project team will continue to study and evaluate the hydrologic response of Mag-asawang Tubig Watershed using the data transmitted from the developed Arduino-based Weather Station.

(10) TECHNOLOGY ROADMAP (if applicable) Refer to **Annex A**

(11) EXPECTED OUTPUTS (6Ps)

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. Three servers located at MinSU-Main Campus, PDRRMO 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, and PDRRMO-Oriental Mindoro.

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.

(12) POTENTIAL 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.

(13) POTENTIAL IMPACTS (2Is)

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 susceptible 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.

(14) TARGET BENEFICIARIES

The target beneficiaries for this project are the following:

1. Oriental Mindoro Province and its residents
2. PDRRMO and MDRRMO
3. Farmers and Fishers near Mag-asawang Tubig watershed
4. Residents of municipalities around Mag-asawang Tubig watershed
5. Mindoro State University

(15) SUSTAINABILITY PLAN (if applicable)

The collaborative efforts among DOST-MIMAROPA, PDRRMO-Oriental Mindoro, 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.

(16) GENDER AND DEVELOPMENT (GAD) SCORE (refer to the attached GAD checklist)

Refer to **Annex B**

(17) LIMITATIONS OF THE PROJECT

1. Mesoscale station for DRRM purposes, there is radius of influence for its effectivity.
2. Microscale station for Agrometeorological purposes, it is only effective in 100 m distance for agricultural activities
3. Devices used are digital

4. Only 2 stations will be established
5. The stations are limited to be constructed at government institutions only, particularly at SUC.
6. Data acquired are effective at Mag-Asawang Tubig Watershed area in Oriental Mindoro only

(18) LIST OF RISKS AND ASSUMPTIONS RISK MANAGEMENT PLAN (List possible risks and assumptions in attaining target outputs or objectives.)

Risk	Assumptions
Delayed acquisition of necessary materials	Conduct day-to-day follow up for the purchase request/order
Disruption of scheduled activities due to weather disturbances in MinSU (Orographic Precipitation)	Develop catch-up plans such as request to render service of the personnels
Shortage for salaries of the Contract of Service	Request for realignment of budget and addendum
Interruption in the implementation of the program of works due to unavailability of needed equipment and devices	Request Render of Service during Weekends and Holidays to deliver necessary output in time

(19) LITERATURE CITED

Aalst, M. V. (2006). The impacts of climate change on the risk of natural disasters. *Disasters, 30 (1),* 5-18.

Agri-Infohub. (2023, January 10). *AGRI-PROFILE: ORIENTAL MINDORO.* Retrieved from Agri Info Hub: http://www.orminagri.com/orientalmindoro

Ahmad, D., Kanth, R., Parvaze, S., & Mahdi, S. S. (2017, December). *Measurement of Atmospheric Pressure.* Retrieved from Research Gate: https://www.researchgate.net/publication/321535663_Measurement_of_Atmospheric_Pressure

Air Quality Measurements Series: Wind Speed and Direction. (2021, October 21). Retrieved from clarity: https://www.clarity.io/blog/air-quality-measurements-series-wind-speed-and-direction

Alejo, L. A. (2018). Suitability analysis for optimum network of agrometeorological stations: A case study of Visayas Region, Philippines. *Journal of Agrometeorology*, 3.

Amorim, A. M., Gonçalves, A. B., Nunes, L. M., & Sousa, A. J. (2011). Optimizing the location of weather monitoring stations using estimation uncertainty. *International Journal on Climatology*, 941-952.

Arnfield, A. J. (2016). *climate classification.* Retrieved from Britannica: https://www.britannica.com/topic/classification-1703397#ref1106608

Arsenault, R., & Brissette, F. (2014). Determining the OptimalSpatial Distribution of Weather Station Networks forHydrological Modeling Purposes Using RCM Datasets:An Experime ntal Approach. *Journal for Hydrometerology*, 517–526.

Banholzer, S., & J. Kossin, S. D. (2014). The impact of climate change on natural disasters. *Reducing Disaster: Early Warning Systems for Climate Change, Springer*, 21-49.

Bayer, A., Iersel, M. v., & Chappell, M. (2017, June). *What is a Weather Station and Can it Benefit Ornamental Growers?* Retrieved from Center for Agriculture, Food, and the Environment: https://ag.umass.edu/landscape/fact-sheets/what-is-weather-station-can-it-benefit-ornamental-growers

Borzenkova, I. I. (2019). TYPES AND CHARACTERISTICS OF PRECIPITATION. *HYDROLOGICAL CYCLE*.

Boustan, L., Kahn, M., Rhode, P., & Yanguas, M. (2020). The effect of natural disasters on economic activity in us counties: a century of data. *J. Urban Economy 118*.

Briceño, N. B., López, R. S., J. O., Oliva-Cruz, M., Fernández, D. G., Mur, R. E., . . . Barboza, E. (2021). Site Selection for a Network of Weather Stations Using AHP and Near Analysis in a GIS Environment in Amazonas, NW Peru. *Climate 9(12)*, 169.

Brooks, M. S., Sims, A. P., Frazier, A. N., Boyles, R. P., Syed, A., & Raman, S. (2011). Climate-Based Decision Support Toolsfor Agriculture. in "Challenges and Opportunities inAgrometeorology. *Springer*, 245–256.

Brown, T. (2022, August 10). *Cloud Cover.* Retrieved from National Geographic: https://education.nationalgeographic.org/resource/cloud-cover

Cundiff, J. (2021, August 2). *The Relationship Between Temperature and Relative Humidity.* Retrieved from Energy Management: https://fm.okstate.edu/energyservices/energymanagement/blog/temp-humidity.html

DENR. (n.d.). *Alag-Baco, Butas, Catuiran-Bucayao, Mag-Asawang Tubig and Pula Cluster 3 River Basin.* Retrieved from River Basin Control Office: https://riverbasin.denr.gov.ph/river/cluster3

Erd, M., Schaeffe, F., M. K., & Reindl, L. (2016). Event monitoring in emergency scenarios using energy efficient wireless sensor nodes for the disaster information management. *International Journal for Disaster Risk Reduction, 16*, 33-42.

Finger, R., & Lehmann, N. (2012). Modeling the sensitivity of outdoor recreation activities to climate change. *Climate Research Volume 51*, 229-236.

Fuka, D. R., Walter, M., MacAlister, C., Degaetano, A., Steenhuis, T., & Easton, Z. (2013). Using theClimate Forecast System Reanalysis as Weather InputData for Wat ershed Models. *Hydrologic Processes 28(22)*, 5613–5623.

Gaur, A. (2022, December 1). *temperature.* Retrieved from Britannica: https://www.britannica.com/science/temperature

Gaur, A. (2022, September 2). *humidity.* Retrieved from Britannica: https://www.britannica.com/science/humidity

Gaur, A. (2022, September 29). *wind.* Retrieved from Britannica: https://www.britannica.com/science/wind

Graham, S. (1999, March 1). *Clouds and Radiation.* Retrieved from NASA Earth Observatory: https://earthobservatory.nasa.gov/features/Clouds#:~:text=Low%2C%20thick%20clouds%20primarily%20reflect,the%20surface%20of%20the%20Earth.

Gubler, S., Hunziker, S., Begert, M., Croci Maspoli, M., Konzelmann, T., Brönnimann, S., . . . Rosas, G. (2017). The Influence of Station Densityon Climate Data Homogenization. *International Journal on Climatology 37(13)*, 4670–4683.

Guedes, E., de Lima, P., & de Oliveira, M. (2016). Neural Networks for Time Series Rainfall Forecasting: A Case Study in Manaus, Amazonas. In *Proceedings of the XIII Encontro Nacional de Inteligencia Artificial e Computacional* (pp. 337–348). Recife, Brazil: SBC ENIAC.

Kumar, S., Tiwari, P., & Zymbler, M. (2019). *Internet of Things is a revolutionary approach for future technology enhancement: a review.* Retrieved from Springer Open: https://journalofbigdata.springeropen.com/articles/10.1186/s40537-019-0268-2

Latest Automated Weather Stations. (2022). Retrieved from DOST-PAGASA: https://bagong.pagasa.dost.gov.ph/automated-weather-station/

Li, X., Yan, D., Wang, K., Weng, B., Qin, T., & Liu, S. (2019, August 10). *Flood Risk Assessment of Global Watersheds Based on Multiple Machine Learning Models.* Retrieved from MDPI: https://www.mdpi.com/2073-4441/11/8/1654

Lotha, G. (2019, December 18). *hygrometer.* Retrieved from Britannica: https://www.britannica.com/science/hygrometer

Mag Asawang Tubig Riverside Resilience. (2021, December 20). *Green-Gray Partnership Project V*.

Meteorological Models. (2021). Retrieved from National Geographic: https://www.nationalgeographic.org/activity/meteorological-models/#:~:text=Six%20key%20variables%20contribute%20to,thermometer%2C%20barometer%2C%20and%20anemometer.

Nowak, D. J. (2021). *Regulating Ecosystem Services – Forests and Climate Regulation.* Retrieved from Science Direct: https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/air-temperature

PAGASA. (2020). *Field Station Categories.* Retrieved from PAGASA: https://www.pagasa.dost.gov.ph/information/field-station-categories

PAGASA. (2023). *Latest Automated Weather Stations.* Retrieved from PAGASA: https://bagong.pagasa.dost.gov.ph/automated-weather-station/

Patel, K. K., & Patel, S. M. (2016). Internet of Things-IOT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges. *IJESC*.

Perez, C. C., & Zardi, D. (2023). *An Introduction to Meteorological Applications.* Royal Meteorological Society.

Philippines. (2017, June). Retrieved from Landlinks: https://www.land-links.org/country-profile/philippines/#:~:text=The%20Philippines%20is%20an%20archipelago,1%2C830%20square%20kilometers%20of%20water.

Pielke, R. S. (2014). Land and Sea Breezes. *Elsevier*.

Rafferty, J. P. (2022, March 17). *microclimate.* Retrieved from Britannica: https://www.britannica.com/science/microclimate

Ramis, C., Romero, R., & Alonso, S. (2019). Relative Humidity. Palma de Mallorca, Spain.

Rana, A. (2012). Role of Remote Sensing and GIS in Agrometeorology. In *NRDMS-DST Sponsored Summer Training Programme On GEOSPATIAL TECHNOLOGIES AND APPLICATIONS* (pp. 205-219). H.P. India.

Reyes, D. D. (n.d.). *Ensuring the Accuracy and Quality of Data from DOST-ASTI's Automated Weather Stations.* Retrieved from ASTI.DOST.GOV: https://asti.dost.gov.ph/communications/angsurian/2018/volume-1/issue-1/ensuring-the-accuracy-and-quality-of-data-from-dost-astis-automated-weather-stations/

Rinoza, J. (2021, October 14). *Philippines: Death Toll Rises from Floods, Landslides in Storm's Wake.* Retrieved from Benar News: https://www.benarnews.org/english/news/philippine/update-storm-10142021123322.html

Rodriguez, E. (2022, November 25). *pressure.* Retrieved from Britannica: https://www.britannica.com/science/pressure

Sawant, S., Durbha, S., & Jagarlapudi, A. (2017). Interoperable agro-meteorological observation and analysis platform for precision agriculture: a case study in citrus crop water requirement estimation. *Computer and Electronics in Agriculture Volume 8*, 175-187.

Sener, E., Terzi, O., Sener, S., & Kucukkara, R. (2012). Modeling of water temperature based on GIS and ANN techniques: Case study of Lake Eğirdir (Turkey). *Ekoloji 21(83*, 44-52.

Solar Energy Technologies Office. (2021). *Solar Radiation Basics.* Retrieved from Energy Efficiency and Renewable Energy: https://www.energy.gov/eere/solar/solar-radiation-basics#:~:text=Solar%20radiation%2C%20often%20called%20the,using%20a%20variety%20of%20technologies.

Takahashi, G., Suzuki, T., & Kawamura, M. (2011). Detection of outliers in meteorological observation data. *Journal of Quality*, 393-405.

The climate in the Philippines. (n.d.). Retrieved from World data.info: https://www.worlddata.info/asia/philippines/climate.php

The Global Green Growth Institute. (2021, December). Climate Vulnerability and Risk Information System (CVRIS) for Agricultural Value Chain in Oriental Mindoro. South Korea.

Thoai, T. Q., Ranola, R. D., & Camacho, L. D. (2018, December). *The Importance of Weather Forecasts and Meteorological Information in Adaptation to Climate Change in Agricultural Production: Some Preliminary Findings.* Retrieved from Research Gate: https://www.researchgate.net/publication/329424992_The_Importance_of_Weather_Forecasts_and_Meteorological_Information_in_Adaptation_to_Climate_Change_in_Agricultural_Production_Some_Preliminary_Findings

Types of Precipitation. (2022, March 19). Retrieved from National Geographic: https://education.nationalgeographic.org/resource/types-precipitation

UGC Berkeley. (2018). *Temperature.* Retrieved from Understanding Global Change: https://ugc.berkeley.edu/background-content/temperature/

UP-TCAGP. (2015). DREAM Flood Forecasting and Flood Hazard Mapping for Mag-asawang Tubig River Basin, Disaster Risk and Exposure Assessment for Mitigation (DREAM) Program. *DOST Grants-in-Aid Program*, 94.

Vuille, M., Francou, B., Wagnon, P., Juen, I., Kaser, G., Mark, B. G., & nd Bradley, R. S. (2008). Climate Change andTropical Andean Glaciers: Past, Present and Future. *Eart-Science Revolution 89(3-4)*, 79–96.

What Is a Wind Direction Instrument and How Does It Work? (2021, June 8). Retrieved from Maximum Weather Instruments: https://www.maximum-inc.com/what-are-wind-speed-direction-instruments-and-how-do-they-work/

What is Humidity ? Its Types and Effect on Temperature. (2022, August 10). Retrieved from Turito: https://www.turito.com/blog/physics/humidity

What are the trade winds? (2022, October 1). Retrieved from National Ocean Service: https://oceanservice.noaa.gov/facts/tradewinds.html

WMO. (1993). Siting and exposure of meteorological instruments. In J. E. Ehinger, *Instruments and Observing Methods Report No. 55.* Lausanne, Switzerland: CIMO.

WMO. (2010). *Guide to Agricultural Meteorological Practices.* Geneva, Switzerland: World Meterological Organization.

WMO. (2012). APPLICATIONS OF METEOROLOGY TO AGRICULTURE. In *Guide to Agricultural Meteorological Practices (GAMP).* World Meteorological Organization.

WMO. (2021). *Guide to Instruments and Methods of Observation (WMO-No. 8).*

Woesik, F. V. (2021, September 9). *A 'Third Way' to Combat Climate Change: Microclimates.* Retrieved from The Water Channel: https://thewaterchannel.tv/thewaterblog/a-third-way-to-combat-climate-change-microclimates/#:~:text=This%20concept%20of%20microclimate%20management,next%20to%20mitigation%20and%20adaptation.

Yildirim, V., Nisanci, R., Colak, E. H., & Yildiz, O. (2016). A GIS-based siting technique for automatic weather stations in Trabzon, Turkey. *Weather 71 (2)*, 43-49.

(20) PERSONNEL REQUIREMENT

Position	Percent Time Devoted to the Project	Responsibilities
Project Leader	**20%**	Overall in charge of the project
Project Members (2)	**20%**	▪ Assist in the processing of materials ▪ Contribute ideas for the improvement of the project ▪ Assist in submitting documents ▪ Perform activities related to the project
Research Assistants (2)	**100%**	▪ Processes the procurement of supplies below Php 50,000.00 and procurement of needed equipment in EO. ▪ Prepares the requisition and documentation of procured supplies and equipment's. ▪ Conducts regular documentation and reporting of the project in-progress. ▪ Collection and analysis of research data ▪ Use of GIS software to create and manipulate vector files, automate routine process, and develop and manage workflows ▪ Assess the Impact of Land Use and Land Cover of the study area ▪ Performs Hydrologic Modeling ▪ Analyze Historical Atmospheric data sets

		▪ Assist in writing technical reports and paper ▪ Contribute ideas during meetings and reviews ▪ Perform other tasks that may be assigned from time to time by the project leader in relation to the conduct of the research
Computer Programmer	**100%**	▪ Develop and write computer programs to perform specific tasks related to project goals ▪ Create workflow diagrams and charts to demonstrate the functionality of programs before coding ▪ Run software tests to spot and resolve bugs and inconsistencies ▪ Write code for software patches and bug fixes ▪ Work with team members to find creative, innovative solutions to problems ▪ Collaborate with other departments to understand their needs and devise ways to accommodate them with software ▪ Perform regular audits to identify software inefficiencies and mastermind ways to improve workflow ▪ Assist in data analysis and write up pf research results. ▪ Assist in conducting surveys. ▪ Assist in focus group discussion and key informant interviews. ▪ Write and continually update documentation for all programs for internal and external reference ▪ Carry out filed work activities for data gathering and interview. ▪ Report and discuss progress of project with the Project Leader and Members. ▪ Submit progress reports to the Project Team. ▪ Attend trainings, meetings, data consolidation and Validation, seminars, and other activities to be conducted by the Team ▪ Facilitate preparation of requirements of project proposals and ▪ Perform other duties that may be assigned by the supervisor.
Utility Worker - Electrician	**100%**	▪ Assists in the design, modification, and fabrication of PCB layout,

		monitoring instruments and data transmissions system ▪ Performs repair and maintenance of electronic components that may be assigned for testing and performance evaluation ▪ Knowledge in using specific equipment in electronics including multimeter, SMD Hot air Rework station SET, soldering iron and other devices ▪ Ensures the sensor compliance with voltage requirements and able to develop power supply at different voltage and current output ▪ Assists in the installation of monitoring system, provides alternative source of energy using solar and wind power in hybrid set-up and can simulate AC and DC connections. ▪ Analytical thinking and problem-solving skills related to electronics ▪ Contribute ideas during meetings and reviews ▪ Perform other functions as may be assigned from time to time

(21) BUDGET BY IMPLEMENTING AGENCY

IMPLEMENTING AGENCY	PS	MOOE	EO	Total
Year 1	**749,600.00**	**140,849.96**	**1,873,707.62**	**2,764,157.58**
Year 2				
TOTAL				**2,764,157.58**

(22) OTHER ONGOING PROJECTS BEING HANDLED BY THE PROJECT LEADER: 0
(number)

Title of the Project	Funding Agency	Involvement in the Project
N/A	**N/A**	**N/A**

(23) OTHER SUPPORTING DOCUMENTS
N/A

I hereby certify the truth of the foregoing and have no pending financial and/or technical obligations from the DOST and its attached Agencies. I further certify that the programs/projects being handled is within the prescribed number as stipulated in the DOST-GIA Guidelines. Any willful omission/false statement shall be a basis of disapproval and cancellation of the project.

	SUBMITTED BY (Project Leader)	ENDORSED BY (Head of the Agency)
Signature		
Printed Name	**Engr. CHRISTIAN B. HERNANDEZ**	**JESSE M. PINE**

Designation/Title	**PROJECT LEADER**	**PROVINCIAL S&T DIRECTOR**
Date		

Note: See guidelines/definitions at the back.

ANNEX A
TECHNOLOGY ROADMAP

ANNEX B
GAD CHECKLIST

Element and item/question (col.1)	Done? (col. 2) No (2a)	Partly (2b)	Yes (2c)	Score for an item/ element * (col. 3)	Results or comments (col. 4)
1.0 Involvement of women and men (max score: 2; 1 for each item)				**2**	
1.1 *Participation of women and men in beneficiary groups in problem identification (possible scores: 0, 0.5, 1.0)*			1		
1.2 *Participation of women and men in beneficiary groups in project design (possible scores: 0, 0.5, 1.0)*			1		
2.0 Collection of sex-disaggregated data and gender-related information (possible scores: 0, 1.0, 2.0)		**1**		**1**	
3.0 Conduct of gender analysis and identification of gender issues (max score: 2; 1 for each item)				**1.5**	
3.1 *Analysis of gender gaps and inequalities related to gender roles, perspectives and needs, or access to and control of resources (possible scores: 0, 0.5, 1.0)*		0.5			
3.2 *Analysis of constraints and opportunities related to women and men's participation in the project (possible scores: 0, 0.5, 1.0)*			1		
4.0 Gender equality goals, outcomes, and outputs (possible scores: 0, 1.0, 2.0) Does the project have clearly stated gender equality goals, objectives, outcomes, or outputs?			**2**	**2**	
5.0 Matching of strategies with gender issues (possible scores: 0, 1.0, 2.0) *Do the strategies and activities match the gender issues and gender equality goals identified?*			2	2	
6.0 Gender analysis of likely impacts of the project (max score: 2; for each item or question, 0.67)				***1.67***	
6.1 *Are women and girl children among the direct or indirect beneficiaries? (possible scores: 0, 0.33, 0.67)*			0.67		
6.2 *Has the project considered its long-term impact on women's socioeconomic status and empowerment? (possible scores: 0, 0.33, 0.67)*			0.67		
6.3 *Has the project included strategies for avoiding or minimizing negative impact on women's status and welfare? (possible scores: 0, 0.33, 0.67)*		0.33			

7.0 Monitoring targets and indicators (possible scores: 0, 1.0, 2.0) *Does the project include gender equality targets and indicators to measure gender equality outputs and outcomes?*		**1**		**1**	
8.0 Sex-disaggregated database requirement (possible scores: 0, 1.0, 2.0) *Does the project M&E system require sex-disaggregated data to be collected?*		1		1	
9.0 Resources (max score: 2; for each question, 1)				**2**	
9.1 Is the project's budget allotment sufficient for gender equality promotion or integration? OR, will the project tap counterpart funds from LGUs/partners for its GAD efforts? (possible scores: 0, 0.5, 1.0)			1		
9.2 Does the project have the expertise to promote gender equality and women's empowerment? OR, is the project committed to investing project staff time in building capacities within the project to integrate GAD or promote gender equality? (possible scores: 0, 0.5, 1.0)			1		
10.0 Relationship with the agency's GAD efforts (max score: 2; for each question or item, 0.67)				**1.67**	
10.1 Will the project build on or strengthen the agency/ NCRFW/ government's commitment to the empowerment of women? (possible scores: 0, 0.33, 0.67) *IF THE AGENCY HAS NO GAD PLAN: Will the project help in the formulation of the implementing agency's GAD plan?*			0.67		
10.2 Will the project build on the initiatives or actions of other organizations in the area? (possible scores: 0, 0.33, 0.67)			0.67		
10.3 Does the project have an exit plan that will ensure the sustainability of GAD efforts and benefits? (possible scores: 0, 0.33, 0.67)		0.33			
TOTAL GAD SCORE – PROJECT IDENTIFICATION AND DESIGN STAGES				**15.84**	**Gender-responsive**

ANNEX C
COUNTERPART FUNDING

C.1 ACKNOWLEDGEMENT RECEIPT

Mindoro State University
Victoria, Oriental Mindoro 5205 Philippines

E-mail: minsctmainop@gmail.com
Website: www.minscat.edu.ph
Phone: +63 977 846 72 28

ACKNOWLEDGMENT RECEIPT

This is to acknowledge receipt from DOST-MIMAROPA the partial release of funds amounting to **One Million Seventeen Thousand Four Hundred and 29/100 Pesos (P 1,017,400.29)** for the 2022 GIA Project: **Strengthening Weather Monitoring System Through Hydrologic Response Modeling in Mag-Asawang Tubig Watershed** with LDDAP-ADA No. **01101101-09-0784-2022** dated **September 30, 2022,** for the acquisition and expense of the following items as per approved LIB:

Particulars	Approved Amount (PhP)	Amount Disbursed (PhP)	Amount to be Disbursed (PhP)
Personal Services			
Honoraria			
1 Project Leader (PhP8,800/mo x12 mos.)	105,600.00		105,600.00
2 Project Staff Level 2 (PhP6,000/mo x12 mos.)	144,000.00		144,000.00
MOOE			
Semi-Expendable Machinery Expenses	12,500.00		12,500.00
1 Printer (L3110 Eco-Tank 3-in-1)			
1 Year Load Subscription 3mbps @ PhP 2,000.00 per mo	24,000.00		24,000.00
Dedicated Server 1 year Subscription + Domain Name (www.sample.com) @ 8,695.83 per mo	104,349.96		104,349.96
Equipment Outlay			
2 High-end Laptop 50YE i5 8gb 512 SSD RTX 3050 15.6" FHD IPS 144H	120,000.00		120,000.00
2 sets Arduino-based synoptic weather station	1,453,707.62	1,017,400.29	436,307.33
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
Total	**2,264,157.58**	**1,017,400.29**	**1,246,757.29**

Received by: Date Received:

DR. LEVY B. ARAGO, JR.
University President

Signed in the Presence of:

MARIA CRISTINA D. SISCAR, C.P.A
Acc

Sdg

CLARISE ... LOPEZ
ACCOUNTANT I

C.2 Disbursement Voucher

Region IV-B

DISBURSEMENT VOUCHER

Fund Cluster: 1 01 101

Date: 09-30-2022

DV No.: 2022-09-2339

Mode of Payment	☐ MDS Check ☐ Commercial Check ☐ LDDAP-ADA ☐ Others (Please specify)		
Payee	MINDORO STATE UNIVERSITY	TIN/Employee No.:	ORS/BURS No.: 2022-09-[illegible]
Address	Victoria, Oriental Mindoro		

Particulars	Responsibility Center	MFO/PAP	Amount
for partial release of funds for the DOST-MIMAROPA GIA project entitled "Strengthening Weather Monitoring System Through Hydrologic Response Modeling in [illegible] Watershed" in Oriental Mindoro.		A.III.a.2.a GIA-ORBM-Weather Monitoring System	1,017,400.29
Amount Due			1,017,400.29

A. Certified: Expenses/Cash Advance necessary, lawful and incurred under my direct supervision.

ZENAIDA [illegible] G. FORMENTO
Science Research Specialist II

B. Accounting Entry:

Account Title	UACS Code	Debit	Credit
Due from National Government Agencies	1 03 03 010 00	1,017,400.29	
Cash - Modified Disbursement System (MDS), Regular	1 01 04 040 00		1,017,400.29

C. Certified:

☐ Cash available

☐ Subject to Authority to Debit Account (when applicable)

☐ Supporting documents complete and amount claimed proper

D. Approved for Payment

One Million Seventeen Thousand Four Hundred Pesos and Twenty Nine Centavos

Signature	Sdg	Signature	Sdg
Printed Name	JEFFREY B. VARELA	Printed Name	[illegible]
Position	[illegible] Accountant	Position	Regional Director
Date		Date	

E. Receipt of Payment

Check/ADA No.: 22 01090784		Date: SEP 30 2022	Bank Name & Account Number:	JEV No.
Signature:		Date:	Printed Name:	Date
Official Receipt No. & Date/Other Documents				

[illegible]

DOST-MIMAROPA REGION
Cashiering Unit
Received Date: SEP 30 2022