Information, Education, and Communication Campaign in the Philippines: Capacitating Academic Institutions and Government Agencies using Geographic Information System, Radar Remote Sensing, and Artificial Intelligence

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ABSTRACT: Artificial Intelligence (AI) and Remote Sensing (RS) have emerged as powerful tools with diverse applications in various fields as well as research domains, including environmental monitoring, disaster risk management, agriculture, and even aquaculture. In the Philippines, harnessing the potential of these technologies has been crucial for sustainable development and scientific-based decision-making. This paper presents an overview of collaborative efforts among academic institutions and government agencies in the Philippines initiated by the Department of Science and Technology's Advanced Science and Technology Institute (DOST-ASTI) to promote education, capacity building, and technology proliferation through Basic AI and Radar RS Training Series.

The initiative stems from recognizing the pressing need to equip professionals, researchers, and students with the knowledge and skills required to harness earth observation data using AI, GIS, and Radar RS effectively. Several State Universities and Colleges, Higher Education Institutes, and Government Agencies across the archipelago have committed their infrastructure and manpower for this initiative. With multidisciplinary collaborations and continuous knowledge-sharing activities, these institutions and agencies are fostering a new generation of skilled professionals who can lead the way in integrating emerging technology into the realm of earth observation, leveraging AI and Radar RS for other research and development domains.

With the national development goals in line, policymakers prioritize funding for research and educational initiatives, hence DOST-ASTI with the researchers of the Synthetic Aperture Radar and Automatic Identification System for Innovative Terrestrial Monitoring and Maritime Surveillance (SARwAIS) Project is able to expand its reach, covering the major islands in the country. Additionally, academic and governmental collaboration enables the development of joint research projects that address agency and institution-specific challenges, fostering technology transfer and knowledge dissemination.

This paper highlights success stories and challenges faced during the implementation of these capacity-building initiatives, shedding light on strategies to enhance their impact and effectiveness in a tailored manner. Evaluation metrics are employed to assess the outcomes and gauge the R&D potential of earth observation data using AI, GIS, and Radar RS.

Overall, the collaborative efforts in Basic AI and Radar RS Information, Education, and Communication campaign in the Philippines exemplify a dynamic model for other nations seeking to harness these transformative technologies in academic and national government levels. Through continuous refinement and inclusive engagement with communities, DOST-ASTI remains to be the country's hub for partnerships and collaborations using R&D in the field of space science and technology and other emerging technologies.

1. INTRODUCTION

Artificial Intelligence (AI) and Remote Sensing (RS) have emerged as transformative technologies with multifaceted applications across diverse domains. In the Philippines, harnessing the full potential of AI and RS has proven essential and vital for research, sustainable development, and informed policymaking especially when integrated to resource

monitoring using earth observation data. Numerous projects and services were funded to conduct research and development efforts in these fields.

This paper sheds light on the concerted efforts of academic institutions and government agencies in the Philippines, led by the Department of Science and Technology's Advanced Science and Technology Institute (DOST-ASTI), to promote education, capacity-building, and technology proliferation through the Basic AI and Radar RS Training Series.

One of the pioneering projects of the Philippines' Department of Science and Technology in the AI and RS domains was the Remote Sensing and Data Science: DATOS Help Desk or the DATOS Project, continued by The Synthetic Aperture Radar and Automatic Identification System for Innovative Terrestrial Monitoring and Maritime Surveillance (SARwAIS) Project.

The SARwAIS Project is a directed research and development initiative with funding from the Department of Science and Technology's Grants-in-Aid Program. Housed in the Advanced Science and Technology Institute (DOST-ASTI), the SARwAIS Project focuses on terrestrial monitoring and maritime surveillance on high-priority areas through simultaneous radar image and automatic identification system (AIS) data acquisition through the NovaSAR-1 satellite developed by UK-based company Surrey Satellite Technology, Ltd (SSTL).

The conduct of Basic Artificial Intelligence and Radar Remote Sensing originally with State Universities and Colleges and Higher Education Institutes (SUCs/HEIs) around the Philippines is a response to the objective of DOST-ASTI's SARwAIS Project to further expand the use of Remote Sensing and Artificial Intelligence in processing earth observation data and automating the detection of features from satellite images, especially NovaSAR-1, through capacity building activities.

Recognizing the urgent need to equip professionals, researchers, and students with the knowledge and skills necessary for harnessing earth observation data effectively, this initiative seeks to bridge the gap. Collaborating with State Universities and Colleges, Higher Education Institutes, and Government Agencies across the archipelago, the program leverages existing infrastructure and human resources. Through multidisciplinary collaborations and continuous knowledge-sharing activities, these institutions and agencies are nurturing a new generation of skilled professionals poised to integrate cutting-edge technology into the realm of earth observation. This, in turn, facilitates the utilization of AI and Radar RS across various research and development domains.

According to WHO/UNICEF, the greatest challenge to information education and communication is perhaps to give individuals and communities the capacity to improve their capability and own environments as well. Therefore, the SARAIS team has meticulously ensured that the projects' Information, Education, and Communication (IEC) campaigns are customized to meet the specific needs of the communities they serve. A central tenet of these efforts is the recognition of the importance of collaboration and partnerships among various agencies and institutions, underscoring their vital role in achieving the technology proliferation and adaptation objectives of the project.

In the past, there have been cases where national government agencies were not coordinated or familiar with each other's programs. It is possible that an agency may not even be aware that other agencies have the same concerns; each agency acts without regard to the involvement of others, which duplicates effort and resources used. Complex problems stemming from these information asymmetries thus call for the expertise and resources of different agencies to come together—inclusive innovation being a case in point (de la Peña, 2022).

The crafting of Filipinnovation, as a use case of Information, Education, and Communication campaigns, emerged as a solution to rectify a conspicuous gap characterized by limited resource sharing and a lack of convergence in mandates and activities among various agencies and institutions in the Philippines. Filipinnovation provides a framework for collaboration among government agencies, academic institutions, industry, and civil society organizations.

This way, the SARwAIS project recognizes the need for building stronger community resilience through persistent and constant information, education, and communication campaign using the internet and social media, continuous personal visits to local communities (Cadiz, 2018), as well as capacitating stakeholders, policymakers, and academic leaders; providing them an avenue to exchange knowledge and solutions like that of the training series offered by DOST-ASTI.

The capacity-building efforts encompass various components, including curriculum development, hands-on exercises, workshops, and knowledge-sharing seminars. AI-related topics cover the basics of machine learning algorithms, data analytics, and object detection, while Radar RS training imparts knowledge about radar data acquisition, processing, pre-processing, and interpretation techniques using the DOST-ASTI developed technologies and infrastructure. Participants are exposed to real-world applications (e.g., flood impact and landcover mapping), thereby ensuring practical relevance.

To facilitate effective learning and technology adoption, partnerships with industry experts from the government and international organizations are also forged to provide access to cutting-edge satellite data and resources, software tools, and other datasets.

2. METHODOLOGY

The Basic AI and Radar RS Training Series, initiated in 2019, attracted diverse sets of participants from State Universities and Colleges (SUCs), Government Agencies, and Higher Education Institutions around the country. This inclusive gathering of academic and governmental institutions, participated by students, officers, officials, lecturers, professors, and even agency heads, marked a significant commitment to advancing knowledge and expertise in the fields of Artificial Intelligence (AI) and Remote Sensing (RS) within the Philippines.

2.1 The Team

The Team comprises of dedicated professionals with distinct expertise collaboratively contributes to the Basic AI and Radar Remote Sensing Training Series' accomplishments. This part delineates the collective roles of these individuals, highlighting their pivotal contributions to the program's execution.

1. One (1) Geographic Information Systems Expert - drawing upon extensive experience in GIS applications, particularly in the domains of land-use planning and environmental assessment, this expert ensures the comprehensive coverage of spatial data analysis;

2. One (1) Remote Sensing Expert - An adept Remote Sensing Expert complements the team's capabilities, bringing expertise in satellite imagery analysis and fieldwork experience. The role of this expert is pivotal in guiding participants in the interpretation of spaceborne imagery and elucidating the practical utility of Earth observation data. The Remote Sensing Expert's role bridges the divide between high-resolution satellite imagery and real-world applications, thereby ensuring the practicality of the training program.

3. One (1) Statistics and AI Expert – the expert in Statistics and Artificial Intelligence lends profound analytical insight to the program. Instruction in AI and statistical analysis equips participants with the essential tools for harnessing data effectively, extending from image classification to predictive modeling. This expert's presence substantiates the program with a comprehensive understanding of both the methodologies and rationales underpinning AI applications in RS.

4. One (1) Information Officer and Project Manager - manages communication, coordination, and project oversight. These responsibilities encompass orchestrating logistics and ensuring the seamless flow of information among team members, participants, and partnering institutions. The Information Officer and Project Manager's effective communication and stakeholders' engagement is instrumental in streamlining the operational aspects of the training series; and

5. One (1) Administrative Officer – whose responsibility spans from resource organization to participant registration management. Guiding the technical team and project manager, s/he ensures the smooth operational execution of the training series. The team members represent the first point of contact for participants, providing ongoing support and guidance throughout the program.

The team members (domain experts and dedicated professionals), each adept in their respective capacities, establish a comprehensive and transformative learning environment for participants engaging in the Basic AI and Radar RS Training Series.

In navigating the complexities of technology, geospatial science, and data analysis, the team works with common objective: the empowerment of individuals and institutions to leverage AI and RS technologies for the advancement of space science and technology assets and applications in the Philippines.

2.2 Program of Instruction

Practical learning is a cornerstone of the initiative. Participants engage in hands-on exercises that immerse them in AI and Radar RS applications. These exercises ensure that theoretical knowledge is translated into practical skills, and the training series was guided by a program of instruction or POI. The POI is also adjusted, i.e., some topics may be added or omitted, so that it will fit with the needs or requirements of the participating institution. Table 2 shows a sample POI used by the SARwAIS team.

Table 2. General program of instructions used by the SARwAIS team when conducting the Basic AI and Radar RS Training

Topic / Learning Activities	Schedule	Scope of Instruction	Methodology
Introduction to Remote Sensing	Day 1 *(8 hours)*	Overview of DOST-ASTI Infrastructures Training Proper - Introduction to DOST-COARE - Introduction to Remote Sensing (RS) - Introduction to Synthetic Aperture Radar (SAR)	Discussion
Pre-processing and Analysis of Satellite Products	Day 2 *(8 hours)*	- Working with Sentinel and NovaSAR Data - Introduction to QGIS and SNAP - Preprocessing SAR Products - Graph Builder and Batch Processing - Generation of Indices	Discussion / Laboratory Exercises
Introduction to Interferometry Processing in SARPROZ Software	Day 3 *(8 hours)*	- Overview on SARPROZ Software - Single-pair interferometry - PSInSAR	Discussion / Laboratory Exercises
Introduction to Statistics and AI, and Training Data Preparation and Modeling	Day 4 *(8 hours)*	- Basics on Inferential and Geospatial Statistics - Introduction to Artificial Intelligence (AI) - Dataset, Software Installations & COARE Environment - Training Data Preparation - Model Training using QGIS AI Plugin©	Discussion / Laboratory Exercises
Model Assessment and Optimization, and Discussion of Outputs	Day 5 *(8 hours)*	- Model Prediction using QGIS AI Plugin© - Model Retraining and Optimization - Presentation of Outputs - Lessons Overview - Suggestions and Recommendations - Closing Ceremony	Discussion / Laboratory Exercises

In general, the team provides first a general overview about DOST-ASTI and its services. This is followed by lectures discussing the basic concepts of RS, SAR, QGIS, and AI. Afterwards, the participants are provided with hands on exercises to help them understand and appreciate the concepts discussed during the lectures. One of these exercises include the use of the QGIS plug-ins for the development of AI models. These plug-ins were developed by the team using Python scripts to expedite and simplify the training and prediction of models, as well as to make the process easier for non-technical users. Figure 1 shows the typical user interface of the QGIS plug-in being introduced to the participants. Using these plug-ins, the participants can experience the general processes done in AI model development without the need for coding or modifying scripts. Whenever possible, these exercises are also tailored such that they can be applicable to the participating institution's mandates.

Training Data Generation Plugin (A)

U-Net Training Plugin (B)

U-Net Prediction Plugin (C)

YOLO Training Plugin (D)

YOLO Prediction Plugin (E)

Figure 1. The user interface of the different QGIS plug-ins for AI model development. These plug-ins include a) Training Data Generation, b) U-Net Model Training, c) U-Net Model Prediction, d) YOLO Training, and e) YOLO Prediction.

In navigating the complexities of technology, geospatial science, and data analysis, the team works with common objective: the empowerment of individuals and institutions to leverage AI and RS technologies for the advancement of space science and technology assets and applications in the Philippines.

2.3 The Participants

Throughout the past four years that the Basic AI and Radar RS Training Series has been conducted, the team was able to their knowledge and expertise to several participating institutions. Table 1 lists the institutions that participated in the Basic AI and Radar RS Training Series of the SARwAIS team.

Table 1. List of SUCs/HEIs/Government Agencies that participated in the The Basic AI and Radar RS Training Series conducted by the SARwAIS Team

YEAR	AGENCY/SCHOOL
2019	Sugar Regulatory Administration
	National Mapping and Resource Agency
	Bataan Peninsula State University
	Catanduanes State University
	Southern Luzon State University
	Pangasinan State University
	University of the Philippines Cebu
	University of San Carlos (CenGES)
	Central Mindanao University
2020	Philippine Statistics Authority
	Central Bicol University of Agriculture

	Caraga State University
	University of the Philippines Mindanao
	Mindanao State University- Iligan Institute of Technology
	Visayas State University
	Bohol Island State University
	Cebu Institute of Technology
	Libmanan Water District
2021	Bulacan State University
	Philippine Statistics Authority (AI4CAF)
	DOST Region XI
	Laguna Lake Development Authority
	Armed Forces of the Philippines
	Philippine Navy
2022	National Coast Watch Center
	Philippine Coast Guard
	Maritime Research Information Center
	Bureau of Fisheries and Aquatic Resources
	DOST Region XI
	Sugar Regulatory Administration
	Georisk Team (DOST-PHIVOLCS)
	Mariano Marcos State University
	Mindanao State University- Iligan Institute of Technology
	BLISST Program (UP Baguio, University of Cordilleras, MGB CAR)
	Caraga State University
	Jose Memorial University
	University of Science and Technology of the Souther Philippines
2023	Indiana Aerospace University
	Technological University of the Philippines- Visayas
	Aklan State Univeristy
	Rizal technological University
	Department of Transportation (Railways)
	ACER Program (DOST-PHIVOLCS)

3. CONCLUSIONS

The significance of the Basic Artificial Intelligence and Radar Remote Sensing Training Series extends beyond technical expertise. Since its inception in 2019, the program has been steadfast in its commitment to disseminating the technological advancements and knowledge cultivated through the SARwAIS Project. This strategic approach recognizes that the effective utilization of cutting-edge technology for disaster management and resource monitoring necessitates widespread adoption and comprehension. By fostering broader awareness and understanding, this initiative significantly augments the Philippines' capabilities in assessing hazards and managing its precious resources.

An Information Education Campaign (IEC) is an integral part of this endeavour. It aims to disseminate the acquired expertise and encourage the broader community, including government agencies, local government units, and

stakeholders, to embrace earth observation data and SAR technology. By raising awareness and building capacity at all levels, the IEC empowers a collective response to the nation's pressing hazard assessment needs.

The collaborative efforts spearheaded by DOST-ASTI in the Philippines, under the Basic AI and Radar RS Training Series, underscore the Department of Science and Technology's commitment to fostering education, capacity building, and technology proliferation. By equipping professionals and researchers with the knowledge and skills needed to harness AI and RS effectively, the Philippines is poised to make significant strides in sustainable development and evidence-based decision-making, thus ensuring a brighter and more resilient future for its people.

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