Optimization of Space Data Development and Distribution and Capacity Building in the Philippines through the PhilSA Integrated Network for Space Enabled Actions towards Sustainability (PINAS) Project

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Abstract

The Philippine Space Agency (PhilSA) implemented the PhilSA Integrated Network for Space Enabled Actions towards Sustainability (PINAS) to establish an active network of institutions and citizen scientists that will work together to utilize space data and information in support of the sustainable development agenda. The project was conceptualized to address the inherent challenge in gathering feedback, disseminating space data and information, and conducting capacity building initiatives in an archipelagic nation. The project will be conducted in three (3) phases, Phase 1: Network Building, Phase 2: Capacity Building, and Phase 3: Build Up and Expansion. This paper highlights the initial activities and preliminary assessment of the PINAS Project. The results of the initial activities illustrate the potential of the project in optimizing data products and its distribution processes, and in strengthening local capacity to use space data and information. This contributes to the development of effective capacity building initiatives and efficient space data optimization and data-sharing workflows in the country.

1. Introduction

According to the United Nations Office for Outer Space Affairs (UNOOSA), information provided through space technology is essential in monitoring the progress of the Sustainable Development Goals (SDGs) and as a basis of strategic policy making (UNOOSA, 2018). UNOOSA introduced these contributions of space technology to the attainment of the SDGs as the SPACE4SDGs (UNOOSA, 2018).

PhilSA, as the Philippines' central government agency addressing all national activities related to space science & technology, produces thousands of satellite maps for varying applications as part of the SPACE4SDGs. In 2022 alone, the agency produced nearly 15,000 satellite images and maps which were distributed to National Government Agencies (NGAs), Local Government Units (LGUs), Civil Society Organizations (CSOs) and Research and Development Institutions (RDIs) as inputs for their research activities, policymaking, and action implementation. (PhilSA, 2022)

Despite the availability of images hosted in government agencies, many LGUs claimed they were unable to utilize the space-derived data produced by the agency. The LGUs cite the lack of awareness on the availability and satellite image request process as the main barrier in utilizing PhilSA space data. .

It was also recorded that in some cases, potential end users were not able to utilize the data provided to them because it was not optimized to support their needs. The Philippines, as an archipelagic nation, is composed of 82 provinces. With this, it was expected that agencies from different areas will have varying activities, environmental concerns, and priority space technology applications. This information must be gathered for PhilSA to develop products and distribution workflows capable of supporting the needs of the end users.

Concerns on requesting institutions' absorptive capacity to utilize distributed data were also recorded. This pertains

to insufficient resources and lack of technical knowledge to conduct research, create policies, and implement actions in response to the space data.

To address the concerns of the potential end users, the PhilSA Integrated Network for Space-Enabled Actions towards Sustainability (PINAS) Project was implemented. PINAS was envisioned to be an active network of institutions and citizen scientists that will work together and utilize space data and information in support of the sustainable development agenda. The network consists of NGAs, LGUs, RDIs, CSOs, private institutions, and citizen scientists from various regions and provinces in the country. This project was conceptualized to optimize the development, distribution, and utilization of the PhilSA satellite maps and data products.

2. Implementation of PINAS Project Activities

2.1. PINAS Objective

The PINAS network was established to identify the needed data products and training programs of various sectors from different regions and provinces in the country. Further, the project aims to:

- Objective 1: Provide an overview of the LGU and NGA capabilities and needs on Space Science Technology and Applications (SSTA).
- Objective 2: Establish a network with diverse, responsive and cooperative members that will ensure sustained knowledge sharing throughout the country.
- Objective 3: Develop, document and disseminate data processing workflows for the commonly needed data products by LGUs and select NGAs.
- Objective 4: Capacitate the LGUs in collection of ground data and field measurements.
- Objective 5: Ensure that sufficient support is provided towards decision-making, policy formulation, and action implementation in

resource management, sustainable development and disaster response and mitigation.

2.2 PINAS Methodology

The PINAS project was divided into three (3) phases: Phase 1 Network Building, Phase 2 Capacity Building, and Phase 3 Build Up and Expansion.

2.2.1. Phase 1. Network Building

The network building phase focuses on the call for network member registration and the conduct of introductory workshops in identified provinces.

I. Introductory Workshop

Conduct of trainings in different provinces proved to foster broader awareness and understanding on the effective utilization of satellite data (Cadiz et al,.2023). With this, introductory workshops are held in different provinces in the country in coordination with partner universities or government entities. Invited participants are LGUs, regional offices of NGAs, universities, and CSOs with programs and policies related to the SDGs. The workshop features the following capacity building and needs assessment components:

A. Lecture (Capacity Building)

The lectures focused on providing the participants with background knowledge and information about the PINAS Network and its relevance to their programs. The main topics discussed during the lecture includes the following:

- Overview of the mandate, programs, and value creation framework of the Philippine Space Agency
- Presentation of PhilSA space data products and applications (DATOS)
- Utilization of Earth Observation as basis for action implementation and policymaking
- Introduction and Call for Registration to the PINAS Network

Additional topics and technological demonstrations are added to the lectures depending on the province, workshop partners, and resource availability.

B. Fieldwork (Capacity Building)

Ground truthing through fieldwork is an essential part in validating PhilSA data products. With this, the introductory workshop aims to capacitate the PINAS workshop participants in conducting field measurements through the ODK Collect application.

The ODK Collect Application is an open-source software platform in Android that serves as a data collection tool (Brunette & Hartung, 2023). It allows the end users to collect field data in rural areas, where internet connectivity is limited.

This workshop component includes discussion, demonstration, and practice of field data collection.
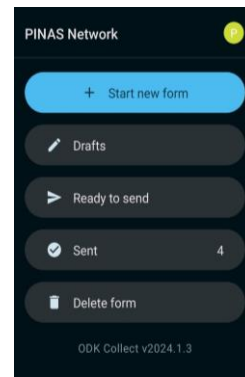

Figure 1: Interface of the PINAS Network Form

The figure above is a sample interface of the PINAS Network form in the ODK Collect application. PINAS workshop participants are encouraged to download the ODK Collect application to gather and submit field data as part of the workshop activity.

Point locations gathered will automatically be uploaded to the PhilSA servers once the users connect to the internet along with the environmental information and physical observations. The map with validated ODK collect data points during the practice field data collection will be presented to the workshop participants. The network form will remain open after the workshop to allow the participants to continuously submit field data.

Network members are also encouraged to download the ODK Collect application and contribute to map validation initiatives through continuous submission of field data.

The utilization of ODK Collect application and conduct of fieldworks will be revisited during Phase 2 of PINAS for collaboration with LGUs in conducting field measurements.

C. Workshop Inputs (Needs Assessment)

The introductory workshop is designed not only to disseminate information but also to gather feedback from the participants. Input from the Environmental Concerns Mapping Activity of the PINAS Workshop will be used as basis for initial needs assessment on priority space data applications and areas of interest of the workshop participants. During the activity, the participants are tasked to discuss and map environmental concerns encountered within their area.

Figure 2: Sample Workshop Map Inputs from Participants in Ilocos

Figure 2 is an example of a workshop map input. Each sticker has a corresponding input code to a workshop input form.

Figure 3: Sample Workshop Input Form from a
Participant in Ilocos

Above is a submitted workshop input form by a participant from Ilocos, wherein, he indicated landslides and mountain erosion as an environmental concern. The input code "1" is also in one of the stickers on the workshop maps to visualize the location of the areas of concern. In addition, the workshop input forms contain information on the problems encountered within the area, proposed solutions, and proposed partners of the participants.

The maps produced during this activity will be consolidated and digitized for distribution. This will serve as a reference in establishing subnetworks and developing data products.

II. Call for registration (Network Building)

Calls for registration to be a PINAS Network member were mostly conducted during the PINAS Introductory Workshops. However, it is noted that the registration form and PINAS information are publicly available in the PhilSA website since 2022. With this, interested members can register and contribute to the network even if PINAS is yet to conduct an introductory workshop in their region or province.

Partner agencies will be identified and invited to co-manage centralized activities for the subnetworks within their area. The information provided by the members in the registration and workshops will also be classified into various levels depending on their training needs, capabilities, and resources.

2.2.2. Phase 2 Capacity Building

The input from PINAS Phase 1 provides preliminary information on the needs, capabilities, and interest of potential end-users in contributing to the network to utilize space data. This will be used to devise training programs and optimize data products and distribution processes for Phase 2. The goal for Phase 2 is to elevate the level of the regional and provincial network members through development of specialized training modules and optimization of data products and distribution process.

I. Development of Training Modules

Participants will be classified based on their requested training and priority data applications. Training topics, duration, and approach may vary depending on the evaluated network needs and available PhilSA resources (financial, equipment, manpower).

II. Optimization of Data Products

Data products will also be optimized based on the common needs and priority space data applications of the network members within the region.

Part of the data optimization process includes the ground truthing activities to validate the maps produced by PhilSA. During the training in Phase 1, the ODK Collect application was introduced to the participants. In Phase 2, this application will be used to collaborate with network members for ground truthing activities and field measurements. This will further capacitate the network members in conducting field measurements for validation of distributed space data products.

III. Optimization of Data Distribution Process

Digitized environmental concerns maps which were produced during the workshops will be used to identify common areas of interest and environmental concerns. Workflows to streamline data distribution processes for top environmental concerns will be devised and implemented. A subnetwork will also be established for network members with similar areas of interest and environmental concerns for data and resource sharing purposes. Subnetwork members are encouraged to work together in providing input to improve PhilSA data and distribution process.

2.2.3. Phase 3 Build Up and Expansion

As a result of the capacity building initiatives in Phase 2, network members are expected to operationalize and institutionalize the optimized data products during Phase 3 – Build Up and Expansion.

The optimized data will be used to guide the network members in proposing, developing, and implementing projects, services, and policies related to their priority applications.

As subnetwork members were identified and encouraged to work together in Phase 2, they are also expected to continuously share data within the network for more efficient workflow in data distribution. Partnership and collaborations may be solidified through collaboration agreements, memorandum of agreements, memorandum of understandings, joint project proposals, and co-authorship on research activities.

As projects, services, and policies are implemented within existing network members, the network will continuously expand to other relevant LGUs, NGAs, RDIs, CSOs, private institutions, and citizen scientists. New network members will undergo Phase 1 to Phase 3 activities as a repeated cycle.

2.3. PINAS Ongoing Activities

The PINAS Project was launched in October 2022. As of April 2024, the project conducted the following activities in line with its objectives:

2.3.1. Objective 1

The project conducted seven (7) workshops in different provinces, including the two (2) workshops during the pre-implementation period. The workshops were in Iloilo (June 2022), Palawan (September 2022), Ilocos

(November 2022), Aklan (February 2023), Mindoro (June 2023), Davao (November 2023) and Zamboanga for Zamboanga, Basilan, Sulu, and Tawi-Tawi (March 2024).
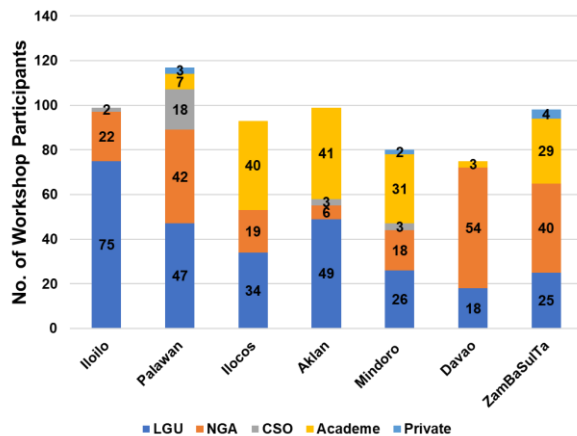

Figure 4. PINAS Workshop Participants

The figure above shows the number of workshop participants per sector in all the workshop locations. As of May 24, 2024, it was recorded that the introductory workshops reached 661 individuals, consisting of 274 LGUs, 201 NGAs, 26 CSOs, 151 Academe, and nine (9) private institutions. The largest overall attendance recorded was from Palawan with 117 participants, but highest recorded attendance of LGUs (75) is in Iloilo, NGAs (54) is in Davao, and Academe (41) is in Aklan.

The citizen science network was also introduced in August 2023 through an online webinar, which was attended by 90 participants. The webinar was conducted to provide opportunities for individuals to contribute to the PINAS Network.
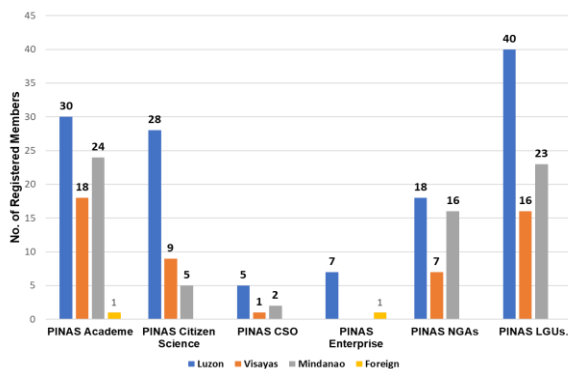

Figure 5. Registered Network Members of PINAS

It was observed that there are registered members who are not from provinces where the PINAS Introductory Workshops were conducted. With this, data was assessed and recorded based on the three (3) major islands in the Philippines - Luzon, Visayas, and Mindanao. Two (2) foreign stakeholders also registered to join the PINAS Network.

It was noted that as of April 2024, there are 251 registered network members. Most of the members came from LGUs (79). Most of the registered members from Luzon are from LGUs, while from Visayas and Mindanao are from the Academe.

The registered members are looped in on PhilSA updates and announcements of opportunities for capacity building activities, scholarship grants, and other relevant services and programs. A social media group for PINAS members will also be launched for members to communicate updates, requests, and feedback in relation to their activities supported by space science and technology applications (SSTA).

2.3.2. Objective 2

It is noted that there is still a need to continuously collect data to draw a more accurate overview of the needs and capabilities of the network members on SSTA. Consolidation of data from registration forms and workshop inputs is still being conducted for data needs, capacity building, and resource assessment.

I.   Data Needs Assessment

Data Application	No. of Registered Members who indicated need for this data application				
	Luzon	Visayas	Mindanao	Foreign	Total
Land cover	72	37	53	1	163
Infrastructure map	68	35	53	1	157
Elevation Map	73	33	49	0	155
Flood Hazard Map	73	37	51	1	162
Landslide hazard map	65	32	49	1	147
Land Use	71	32	54	1	158
Crop Maps	73	29	46	0	148
Disaster Damage Extent	80	39	52	1	172
Household footprints	71	32	51	0	154
None	9	2	3	0	14
This information is not available to me right now.	23	4	2	1	30
Other Applications	1	0	0	0	1

Table 1. Needed Data of Registered Members

Disaster damage extent, land cover, and flood hazard maps are the overall most needed data of the registered network members. The small gap in the registration options might signify that other applications are also in demand.

It is noted that for members in Luzon, Disaster Damage Extent is the highest recorded need while Elevation Map, Flood Hazard Map, and Crop Maps all tied as second most

needed data applications of the members. Members from Visayas also recorded Disaster Damage Extent as their most needed data followed by Flood Hazard Map and Land Cover. Different to the recorded need of Luzon and Visayas, the highest recorded need for Mindanao members is Land Use followed by Infrastructure Map and Land Cover. The difference in priority data applications is also being considered in optimization of data products and data distribution workflows.

Areas of interest and environmental concerns of workshop participants are also considered in the data needs assessment process. This information was gathered during the environmental mapping of the introductory workshop.
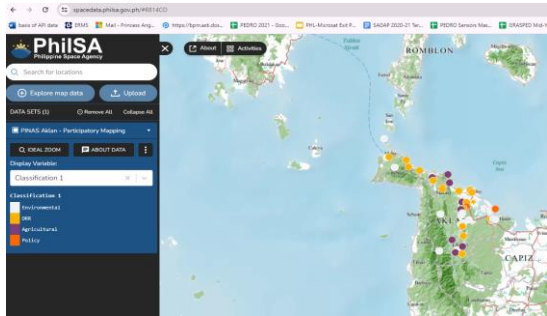

Figure 6: Digitized Environmental Concerns Map

This is a sample of the digitized map containing the consolidated inputs of the workshop participants, integrated in the PhilSA developed Space Data Dashboard. This can be used as reference in creating subnetworks within the province because this visualizes the areas with environmental concerns and agencies that have similar issues. It is noted that the digitization process and distribution for all workshop maps is still ongoing.

Figure 7: Digitized Environmental Concern in the Space Data Dashboard

The figure shows what the end users can see if they were to click on the plotted areas of concern in the digitized map. This provides detailed information to data users regarding areas of concern. Information can be used to foster collaboration among agencies with similar areas of interest or environmental concern.

The details of the needed data from the PINAS Network members and workshop participants are being considered in the planning for PhilSA procurement of satellite images. These may also be considered in planning of upcoming PhilSA satellite missions particularly if cases occur wherein identified needed data cannot be sufficiently addressed by existing satellite missions.

II. Capacity Building Assessment

To assess the training needs of the members, the registration form also includes preferred capacity-building topics and setup.

Requested Training Topics	No. of Registered Participants who indicated need for this Training Topic				
	Luzon	Visayas	Mindanao	Foreign	Total
Registered Member	**128**	**51**	**70**	**2**	**251**
GIS Mapping for Environmental Applications	97	42	60	2	201
Advanced Theoretical Training in RS and GIS	90	40	57	2	189
Advanced data processing Techniques	92	39	56	2	189
Hazard Mapping	95	37	56	2	190
Disaster Damage Assessment and Response using Space Imagery	92	43	55	2	192
Basic Theoretical Training in RS and GIS	104	40	54	1	199
Google Earth Engine Training	94	40	54	2	190
Programming Applications in GIS	94	37	52	1	184
Field Data Collection Techniques	93	40	50	2	185
Accuracy Assessment of Space-Derived Data Products	93	40	50	2	185
How to Download Open Access Satellite Images	83	41	45	1	170

Table 2. Requested Training Topics of Registered Members

Based on inputs of 251 members, the most preferred training topic of registered members is Geographic Information System (GIS) Mapping for Environmental

Applications. This is closely followed by topics on Basic Theoretical Training in Remote Sensing (RS) and GIS and Disaster Damage Assessment and Response using Space Imagery. Face-to-face is the overall preferred training method of the members.

The difference of requested topics for Luzon, Visayas, and Mindanao were also considered to see if capacity building needs will vary based on the location of members.

It was observed that there is a difference in the most preferred training topics per location: Basic Theoretical Training in RS and GIS for Luzon, Disaster Damage Assessment and Response for Visayas, and GIS Mapping for Environmental Applications for Mindanao. Despite the difference, it was noted that GIS Mapping is part of the top two preferred topics in all three (3) locations. Lastly, advanced theoretical training and data processing techniques ranked higher than basic theoretical training for members in Mindanao area.

Training Setup	No. Of Registered Members who indicated preference for this training setup				
	Luzon	Visayas	Mindanao	Foreign	Total
Registered Member	128	51	70	2	251
Self-paced and online via Massive Open Online Course	58	22	26	0	106
Online via Zoom or Microsoft Teams	63	28	32	1	124
Hybrid (Online for theoretical, Face-to-face for hands-on)	65	32	38	2	137
Face-to-face in your area	65	29	45	1	140
Face-to-face in NCR	48	10	19	0	77

Table 3. Preferred Training Setup of Registered Members

The majority of the registered members preferred the face-to-face training setup. This will require the PINAS resource speakers and trainers to travel to the network members' area. Following closely to this is the conduct of a hybrid training setup wherein theories and foundational knowledge will be taught online and hands-on workshops will be conducted physically.

The preference of the participants will be considered in the planning of training activities to account for financial, manpower, and timeline constraints.

2.3.3. Objective 3

The PINAS Project is still consolidating and devising data processing workflows for the commonly needed products. However, PINAS distributes satellite data packages with available maps to interested workshop participants. During the workshops, 7,000 maps were distributed through the PINAS data packages. Below is the breakdown of the number of distributed maps per province:

Province	No. Of Maps Distributed	No. Of Agency Recipients
Iloilo	Not Applicable	Not Applicable
Ilocos	342	20
Palawan	1221	29
Aklan	758	22
Mindoro	592	16
Davao	1938	20
ZamBaSulTa	2149	31

Table 4. No. of Distributed Maps in Introductory Workshops

It is noted that the PINAS project was not able to distribute data packages in Iloilo. The number of maps distributed in the area varies depending on the available maps. ZamBaSulTa and Davao, the most recent workshops, recorded a significantly higher number of distributed maps.

2.3.4. Objective 4

The PINAS project capacitates the members institutions in the collection of ground data, field measurements, and geospatial analysis through the practice fieldwork during the workshop.

As of April 2024, PhilSA received a total of 1,922 data points through the ODK Collect App. Here is the breakdown of the data points collected.

Workshop	No. of Submitted Data Points
Iloilo	58
Palawan	385
Ilocos	180
Aklan	N/A
Mindoro	119
Davao	147
ZamBaSulTa	159

Other	932
Total	1980

Table 5. No. of Submitted Data Points through the ODK Collect Application

Submissions outside of the workshop dates either through citizen science or PhilSA fieldwork are higher than all workshop inputs. However, the number is still insufficient to complete validation of distributed maps.

It must also be noted that the PINAS Network was mobilized to contribute to the field validation of the 2023 PhilSA Mangrove Map in collaboration with the Department of Environment and Natural Resources (DENR). The validation of the Mangrove Map was successful with contributions from the network.

The PINAS team received ODK Collect Application user feedback which includes requests to optimize the application and to reflect data sources. There are also requests to provide a platform for members to visualize the updates on the collected data points.

2.3.5 Objective 5

The team expects to attain Project Objective 5 during Phase 3 of the project implementation.

As of August 2023, PhilSA, through the PINAS Network, already signed a collaboration agreement with Mindanao Development Authority (MinDA) on the utilization of space assets to promote socio-economic development in Mindanao.

Under this, MinDA collaborated with PINAS in conducting the Davao and ZamBaSulTa workshop. MinDA also devised a data buildup program which focuses on environmental concerns in different provinces in Mindanao. The activities under the partnership with MinDA provided opportunities for network expansion as PhilSA was introduced to more potential end-users.

In particular, PhilSA was introduced to the Regional Geographic Information Network (RGIN) of Region IX, which is a collaborative network of regional and provincial GIS centers. PhilSA conducted a training with them in Zamboanga City on May 2024. Afterwards, PhilSA received an invitation to be a member of RGIN IX in June 2024. Similarly, RGIN VI also reached out to PhilSA and is discussing another MOA for PhilSA to be a part of RGIN VI.

The PINAS team is attempting to replicate this partnership with other network members from different regions and provinces.

2.4 PINAS Preliminary Findings

Introductory workshops were conducted in seven (7) provinces (6 regions). With this, efforts to reach the other provinces and regions must be executed. Despite this, the network was already able to recruit a substantial number of active members who expressed interest in contributing to the data optimization and capacity building initiatives of the project.

It is also noted that difference in sectoral engagements per province or region is to be expected in conducting trainings and workshops. Example shows the highest number of overall workshop participants in Palawan, but higher turnouts of LGUs in Iloilo, NGAs in Davao, and Academes in Aklan. Potential cause of this difference is yet to be examined as schedule of workshop, number of LGUs, universities, and regional offices in an area, priority programs, and general interest in space data are just some of the major variables that might have affected this data.

Workshop Participants	Strongly Agree	Agree	Disagree	Strongly Disagree
Iloilo	N/A			
Palawan	N/A			
Ilocos	92	35	0	6
Aklan	103	36	0	12
Mindoro	74	28	1	0
Davao	56	20	0	0
ZamBaSulTa	51	19	1	0
TOTAL	376	138	2	18

Table 6. Satisfaction Survey on Usefulness of PINAS presented information

Despite this difference, it is noted that participants from all seven (7) PINAS Workshops generally appreciated the usefulness of PINAS. Most of the participants in all workshop sites, except for Iloilo and Palawan, indicated that they strongly agree that the information provided during the introductory workshop is useful to their agency and their work. It is noted that Iloilo and Palawan were not able to conduct a workshop assessment where the usefulness of the topics discussed were evaluated.

This shows general enthusiasm and participant appreciation of space data and its potential contribution to projects and policies once awareness is raised.

Initial data needs and capacity building assessment portray potential differences in priority space data applications and training topics per location of network members. These applications and topics must be considered in the planning the optimization, workflow development, and training initiatives.

Focusing on preferred training methods which are face-to-face and hybrid setups, it must be expected that trainings will require more resources and longer completion period.

In terms of initial data distribution, it was observed that are only a few supplemental data requests from agency recipients of the PINAS data packages. The team is yet to determine if this is because the recipients were unable to

utilize the provided data or if this is because the distributed data packages are already sufficient information.

Meanwhile, the low number of ODK Collect application data submissions show that there is a need to strategize a find a way to better encourage members to continuously submit data.

Lastly, the collaboration agreement with MinDA which eased the network expansion activities through joint workshop invitation and implementation, provided opportunities which led to more partnerships with RGIN and its network members. This portrays the importance of identifying main partners to co-manage the subnetwork and provide initial insights in the priority space data applications.

2.5 Future Activities

The PINAS Network will continuously conduct introductory workshops to various provinces in the country. This will allow the project to reach more institutions and individuals to expand its network. The additional workshops will also collect more datasets on priority data applications and capacity building needs assessment for different regions and provinces in the country.

Upon digitization of the environmental concerns map, technical consultations with registered members will be conducted. Based on the results, PhilSA space data will be optimized to the needs of the members. Data workflows for commonly needed products will also be devised to streamline the distribution process. Subnetworks for agencies and institutions with similar areas of interest will be established to facilitate data sharing and to encourage the participants to work together in research initiatives, policy making, and action implementation.

Training modules and timeline will be designed in consideration of the preferred setup and topics of the participants. Visualization of the ODK Collect Application validated data points will be improved to encourage members to continuously and actively participate in field data collection through the application.

Upon network building, optimization of data and distribution process, and capacity building activities, the project is expected to generate collaborative projects, programs, and research activities among the network members. This will be solidified through joint project proposals, collaboration agreements, MOAs, and MOUs.

3 Conclusion

The number of active members and their input illustrates the potential contributions of building a network in conducting needs assessment and capacity building initiatives in the country. This paper provides an insight into the ongoing establishment of an integrated network of institutions and individuals using space data and information in support of sustainable development. The preliminary findings from the ongoing activities of the project offer valuable input in the development of efficient space data optimization and data sharing workflows, and effective capacity building initiatives as part of the project's future activities.

In conclusion, PINAS was able to raise awareness and gather insights from network members through the introductory workshops and call for registration as part of its ongoing activities. It is important to continuously expand the network and gather more information to draw a more accurate needs and capabilities assessment. Additional activities and studies must be conducted to assess the effectiveness of the data optimization, data sharing, and capacity building initiatives to be implemented under the next phases of the project.

4 Acknowledgement

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