

Scheme for Enriching Authoritative Geospatial Information using Participatory Mapping Data in Indonesia

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SUMMARY

Following the enactment of the Act of Geospatial Information of Indonesia, all the aspect of geospatial information need to be reconsider, including participatory mapping (PM) activity and its organization (PMO). The Act also emphasized National Mapping Agency (NMA) to provide the majority of spatial data as an official reference for every mapping-related activity in Indonesia, regardless the fact that currently NMA experiencing the lack of resources. Based on these facts, the discourse to enrich authoritative spatial information using participatory mapping data came forward. However, the enrichment is not a straightforward task, since it has to comply with the Act. The status of PMO and its data have to be examined carefully, as well as for technical and non-technical aspect of collaboration need a proper investigation. To address this situation, a study on the Geospatial Information Act and its derivative conducted; it also supported with discussion and interview to related parties (academics, government, and PMOs) to understand the current condition and come to a practical solution for authoritative spatial data enrichment. The result of this research is important consideration towards spatial data collaboration between government and public organization that might exist under similar condition.

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1. INTRODUCTION

Participatory mapping (PM) in Indonesia developed mostly from the activity of non-governmental organizations (NGO) that took action to preserve and protect the legacy of natural resource and cultural diversity suppressed by the overexploitation and conflict under the New Order regime (A & Pramono 2009; Atok 2008). Later, many of these NGO transform to PM organization (PMO) and based its movement on this historical backgrounds. The late development shows diversion on the purpose of PM activities in Indonesia. As an example, a renowned community named “Navigasi.net” maps transportation network and Point of Interest for a navigation device. The existence of PMOs’ data become fruitful for certain parties, such as in filling the gap or provide spatial data that has not been mapped by the government. However, since the enactment of *Undang-undang Informasi Geospasial* (UUIG - Geospatial Information Act, “the Act”) in 2011, PM activities, PMO, and its data usage have to comply with the Act. Despite the fact that authoritative spatial data (ASD) provided by *Badan Informasi Geospasial* (National Mapping Agency of Indonesia – henceforth called as NMA) in many instances has not covered all of Indonesia region for certain resolution desired by users. Instead, many of NMA data are obsolete and irrelevant due to the low revisit period for an update.

According to the Act, essential spatial data for government and public can only be produced by NMA or by a certain government agency under coordination with the NMA. In reality, despite the demand for spatial data that rose over the years, the limitation of NMA resources in fulfilling the mandate need to be considered carefully. At this stage, the discourse to utilize PMO data for NMA once again emerge. The utilization is also can be deemed as a step to renew the relationship between NMA and PMO, as in the past PMO often positioned itself as an “opposition to government” in providing spatial data (A & Pramono 2009; Atok 2008). The revive attempt started with the recognition of ancestral map in 2012 (Takaka 2012), followed by government takes account of PMO data as an additional spatial information in the One Map Policy (Nirarta 2013). Afterward, PMOs implied government to include their data in decision and policy making. According to *Jaringan Kerja Pemetaan Partisipatif* (JKPP - Network for Participatory Mapping), PMOs own spatial data with promising quantity for NMA. Additionally, the majority data owned by PMO are up to date and contains invaluable information that can enrich and improve the details of ASD.

2. RELATED WORKS

The discourse of data collaboration between ASD and crowdsourced data have been long researched. It can be seen in the demonstration in the enrichment of transportation data (Shakeri et al. 2013), or integration of road vector data (Du et al. 2012) with ASD. Crowdsourced data usage in the government around the globe show a great potential (Haklay et al. 2014), it supports land

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administration (Mclaren 2012), wildfire event monitoring (Núñez-Redó et al. 2011), health sectors (Granell et al. 2014), etc. Indeed, the Canadian government has experienced the integration between volunteered geographic information with NMA data (Bégin 2012). Technical aspect of spatial data collaboration also researched extensively, including matching algorithm (Du et al. 2012), metadata update (Kalantari et al. 2014), cartography aspect (Engler et al. 2014; Plantin 2014), quality of the crowdsourced data (Koukoletsos 2012) or evaluation of its accuracy (Brown et al. 2015). Many types of research conducted to facilitate data collaboration with different approaches, such as application modularity (Sheppard 2012), data collection (Brunette et al. 2013), sensor processing of crowdsourced data (Lauer et al. 2013) and data cleaning (Qian et al. 2009). Another determinant factor for spatial data and collaboration also investigated, including the legal aspect of crowdsourced data (Scassa 2013), policy (Simorangkir & Samosir 2011; Zeiss 2011), or institutional complexity (Harvey 2010).

Nevertheless, these related research are scarcely any comprehensive research that discusses the enrichment scheme for ASD using crowdsourced data under the influence of specific and strong regulation on the spatial data, as have been experienced by Indonesia starting from 2011. This unique situation is important and interesting since the adoption of the Act in national scope revamped all the aspects of spatial data. This paper will examine NMA and PMO in Indonesia perceiving the situation. At the same time try to look up how both parties offer a possible solution on complying with the Act, driven by its obligation, intention and vision on the spatial data sharing.

3. METHODS

Numbers of document studied to get a comprehensive understanding of the research topic. The primary document reviewed for this research purpose is the Act itself¹, which contains general regulation on every aspect of geospatial activities and products. At least 21 from 79 articles of the Act related to this research (see Table 1). Another important document studied for this research is derivative regulation concerning “*Mechanism of Participation for Each Person in National Geospatial Information Network.*” It specifies the public contribution to the existing NMA infrastructure. Unequivocally, any related policies, standards, and archives (e.g. One Map Policy, NMA Standards, etc.) also included into the list.

Table 1. Articles of the Act related to the research theme

Article nr. (#)	Topic	Remarks
20	Thematic Geospatial Information (T-GI) production	Forbid changing accuracy and produce T-GI larger than reference
22	Base GI (B-GI) established only by government	Type of B-GI: Coastal line, Hypsography, Waters, Land Cover, Toponyms, Boundary lines, Transportation & Utilities, Building & public facilities
23	TGI establishment	<i>Each person can produce TGI</i>
27	Geospatial data (GD) collection	GD standards and collection method
28	Permit on geospatial data collection	Criteria GD collection that requires permit from government

¹ Unofficial English translation available at the United Nation Committee of Experts on Global Geospatial Information Management website via this link: <http://bit.do/UUIG> (accessed 22 Sept 2016)

32	Geospatial data processing	GD processing location, resources, and permission
36	GI presentation	Must refer to data source and objective of GI utilization
45	Geospatial network establishment	Network for GI dissemination provided by government
46	Legal consequences of GI	Competent authority approval of GI
49	GI quality	Mandate to state quality of GI produced
50	Derivative product of GI	permission from GI owner for commercial purposes
52	TGI for disaster management	Mandatory TGI submission in case of disaster
54	Performer of GI	Each person can establish GI
55	Qualification of GI performer	Referring to #54
57	Capacity building activities	For producer and user of TGI
59	BGI modification and dissemination	Prohibition to publish altered BGI
60	TGI modification and dissemination	Prohibition to publish altered TGI
61	GI presentation and accuracy	GI presentation must correspond with the data accuracy
62	GI dissemination	Referring to #46
63	Administrative penalties	Referring to #20, 36, 46, 49, 50, and 55
67	Punishment for violation in GI	Referring to #61

Interviews also conducted to support the studied documents. Three groups of respondent participated; academics from four major universities, PMOs, and government organizations as shown in Table 2. The participants selected based on their active involvement, expertise and interest in participatory mapping or related activities. Regarding the participants from PMO, from the existing 22 candidates, only 13 responded and willing participated in the research.

Table 2. Type of Respondents

Respondent	Remarks
Government [5]	<u>National Mapping Agency</u> Subdivisions of: Standardization for Geospatial Information Establishment, Disaster and Climate Change, Large-Scale Topographic Mapping, Legal Affairs <u>Local Government</u> District of Indramayu, West Java
PMO [13] (Organization Name)	JKPP, AMAN-SS, YRBI, SLPP-Jambi, SLPP-Kalsel, LSDP SD INPERS, MITRA BENTALA, PADI Indonesia, SLPP-Kalteng, SandiFlorata, PPK, SLPP-SumBar, Navigasi.net.
Academics [6]	Geodesy & Geoinformatics of <i>Institut Teknologi Bandung</i> : 2 Geodetic Engineering of <i>Universitas Gadjah Mada</i> : 1 Faculty of Geography <i>Universitas Pendidikan Indonesia</i> 2 <i>Universitas Paramadina</i> : 1

The interview conducted in three methods: direct interview, online questionnaire, and hardcopy data filling. All the methods contain same questions, grouped into sub-topics and theme that inter-relate each other. Two participants (PMO and NMA) interviewed twice, held one year after the first to get the latest update and development on PM activities in Indonesia. For this research purpose, 79 questions concerning enrichment on spatial data inquired. The summary of interview question as shown in Table 3.

Table 3. Interview questions summary

Theme	Number of questions	Respondents
Identity	5	Governmental Organization (GO), PMO
Membership	7	GO, PMO

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Activities	4	GO, PMO
Organization Positioning	16	Academics, GO, PMO
Spatial Data	39	Academics, GO, PMO
Legal Aspects & spatial information	8	Academics, GO, PMO

4. FINDING AND RESULT

4.1 Spatial data and PMO

The interview revealed that PMOs own approximately 9 billion hectares of spatial data distributed over 804 locations. The map resolution varied from 1:10.000 to 1:100.000 and produced at least by 24 PMOs along with individual contributors (Figure 1). Most of the mapped areas are located in remote or hard to reach location. Regarding the raw data and product repository, formerly PMO documented and stored spatial data on a hardcopy medium, as the initial method for data acquisition for PM merely using compass and *Plane Table*. Today, almost all PMO use digital tools and media to produce and archives their data. Moreover, the latest development shows that majority of PMO perform data dissemination using the internet along with digital media (CD/USB/diskettes) and hardcopy map.

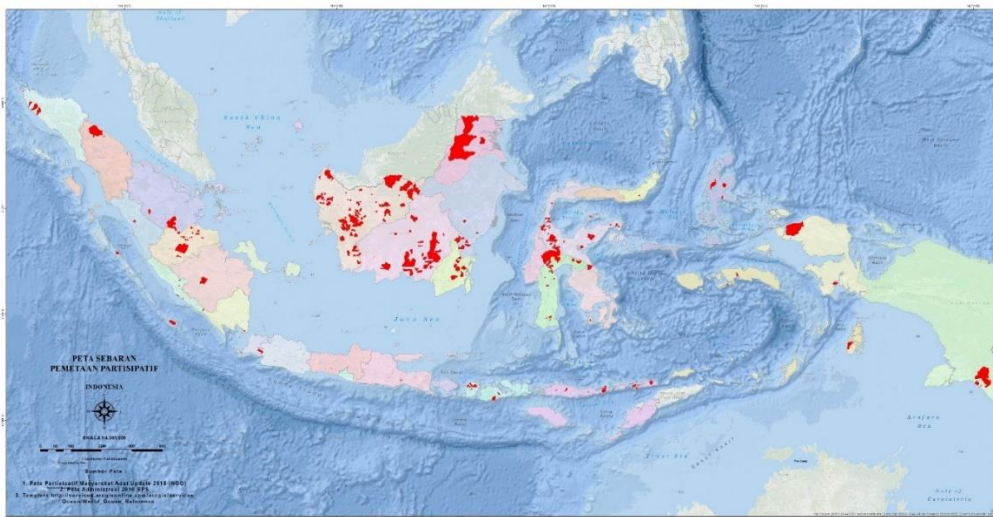


Figure 1. PM data held by PMO (red area) (Courtesy of JKPP)

On the matter of standards, only 38% of PMO persistently apply certain standard(s) for its data processing, and 31% do not own or apply any standard at all. Concerning data quality, less than half of PMOs applied quality control (QC), or quality assessment (QA) to the acquired spatial data, the rest of participants (54%) let the data processed without any quality check. Most of the PMOs that perform QC or QA concerned in the geometries of the data, the accuracy of thematic information, attribute and toponym data. On the post processing stage, a cartographic aspect also listed for the quality check. Internally, the majority of PMO (62%) recognized that its data partially more comprehensive (on attributes and details) compared to the ASD, while 15% convinced that their data more complete, the rest of PMO admitted that its data less complete compared to NMA.

However, PMO often quoted that its data represents more factual and original information than that of NMA. PMO found that ASD is decent in geometry but lack on the attributes detail.

4.2 PMO's comprehension on the ASD enrichment

PMO expected the collaboration could accommodate locals' knowledge, underpinning the facts that many of mapped objects own more information than just point, line, and area that depicted on the map. Historical background, ancestral connection, and function of the mapped object are invaluable data to consider at the time of a map compilation. PMO also believed that the collaboration could lead to more transparent process from NMA on the spatial data production. Transparency is important to create good interaction between NMA (as government representative) and PMO (as the representation of the citizen) to perform cross verification on the geospatial information produced by both parties, as well as to minimize the gap between government and NGO data. Frequently, additional data that came from external source provide help in the map compilation process.

Furthermore, PMO also urged NMA to apply the mandate from the Act to endorse intensive collaboration, not only to PMO but also to society and intra-government. This endorsement is expected to gain more massive spatial data collection and dissemination and believed will help NMA to fulfill its obligation in providing spatial data. However, detail execution on the process to include PM data to the ASD still not clear. PMO also questioned the procedure to gain consensus of collaborated spatial data, and the implementation of QC and QA. Additionally, the majority of respondents (other than governmental organization - GO) expecting NMA to put more trust on PMO in sharing and exchanging spatial data, as NMA is perceived has an unfavorable suspicion towards PMO regarding its motive on PM activity.

PMOs emphasized that ASD enrichment should be more comprehensive, by allowing the enrichment of a thematic data rather than only for the topographic data. Moreover, PMO also has a concern for non-spatial data such as audio, video, and writing that acted as additional information that can function as a supplement to describe a spatial data. History, culture and ancestral description of particular object supposed can improve the understanding of the data acquired as well to preserve indigenous information that might be valuable for later purposes.

4.3 PMO data utilization by the government

Numbers of PMO apply some limitation or restriction to its data access. Certain PMO requested "equal trading" to NMA. It means that to access PMO data fully; NMA must share all its data without any restriction. Unrestricted either in the data types (all topographic data, thematic data, imageries and aerial photo) and its access (perpetual and no speed limit). The objectives of equal trading are to promote openness and fairness between NMA and PMO. Certain concern also expressed, that the source of data enrichment for ASD should be stated. Clear and detailed disclaimer of data (usage limitation, quality, source, liability) must be present, either in the map legend (for hardcopy map) or metadata (for digital file). Moreover, several PMO requested certain (written) agreement between PMO and NMA to provide sufficient information and clarify the enriched data status in detail. A simple memorandum of understanding (MoU) might sufficient to provide legal base and prevent an affliction for both parties should the conflict appear in the future.

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Numbers of PMO required its data documented and stored properly; another requested the data has to be presented in the original detail, no generalization allowed to pertain authenticity. On PMO data quality, some only allowed its data to be included as a source for ASD enrichment if the data has passed its internal QC/QA or has passed a certain standard in the acquisition and processing. Some of PMO is only willing to share if the data has mutual benefit for NMA, PMO, citizen/society or person(s) that contributed the data. Another point stated by PMO is facilitation for data enrichment. In this matters, parallel to the aforementioned “openness and fairness” request, PMO inquired NMA to provide its ASD to be used for PM activities, mostly as a reference in data acquisition stage. In this regards, PMO placed NMA to fulfill its role as a spatial data producer. However, PMO insisted that should NMA cannot provide decent data, the government must allow alternative spatial data source from another provider (e.g. Bing map) as a reference to perform PM activity.

4.4 NMA version of ASD enhancement

Principally, NMA will accept PMO data after meet certain conditions. First, the enriched authoritative spatial data (eASD) is viable to execute when PMO follows certain (mapping) standards. Unfortunately, PMO is experiencing difficulties to reach NMA standard. In this regards NMA has lower the specification (this is also applies to another government institution (GO) that cannot afford to deliver a product using NMA highest standard). Alternatively, PMO could create separate standards document that only applies for PMOs. For this reason, PMO expects to create joint committee with NMA. Second, aside from the fact that NMA has built decent National Spatial Data Infrastructure (NSDI) as a clearinghouse for GOs, at the moment is not functioned for eASD yet. Instead, NMA provides a separate web application for participatory mapping². Nevertheless, not all the themes from PMO will be accommodated in the NSDI, since PMO has diverse products of maps and NMA might not be interested, either to save NSDI resources or to prevent unwanted data. For this matter, NMA has the same vision with PMO to establish joint committee to manage the eASD. Contrary to PMO intentions, NMA has no interest for long-term joint committee; it tends for a temporary one, seeing that the intensive workload of joint committee only exists at the beginning of eASD establishment, afterward only a few of maintenance and update.

Despite full government and PMO support, NMA unlikely to perform ASD enrichment shortly. NMA pointed that the collaboration should pass a meticulous examination before execution due to the complexity of PMO data treatment. NMA mostly concern about data quality, it mentioned that the quality control and assessment of PMO might be not sufficient and could result in further trouble if the data adopted for eASD. Another subject emerged was certain NMA spokesperson likely in doubt on the true intention of PMO in performing its activities or PM data production. The suspicion is likely on the possibility fostered PM activities (financially) by certain person/group that have vested interest (e.g. to extend a territory, land takeover, etc.).

4.5 Technical aspect on ASD enrichment

Numbers of technical aspects become a concern for ASD enrichment. First, regarding the cartographic representation of eASD either for hardcopy and digital portrayal. In the hard copy

² Can be accessed via <http://petakita.ina-sdi.or.id/pempar/>

display, the majority of PMO intended detailed notes on the map attribution, such as “*data on tile(s) XY originated from PMO ABC.*” Another option to identify data origin is to separate symbol usage in the portrayal. Other prefers to use general note on the map attribution (e.g. “*this eASD map composed from ASD with PMO data of XYZ and PQR*”). The complete preferences depicted in Figure 2. In the digital map portrayal, the representation of the eASD encountering a different situation. Considering digital portrayal of the map is dynamic on its POI (point of interest) window and styles, the respondent opinion on the information of data origin converged into two option. One option is to utilize metadata to cite data source and status or any information that correlate with the PMO data. The other option is to specify different symbol as in the hardcopy representation. However, the latter option only preferred if the data quality of PMO and NMA data is not equal. Second, concerning the digital file of eASD, certain PMO requested for NMA to separating feature codification (for a file that store object’s information in database e.g. shapefile *.SHP format) or different layer³ naming between data that originated from NMA or PMO. Another technical point to consider is the storage media for the eASD. The majority of PMOs are expecting the full facilitation from NMA, including storage for the contributed spatial data and the dissemination media of the eASD. The facilitation requests based on the assumption that NMA is the main actor of geospatial information. Thus it is proper to provide common storage and publishing tool for any PMO data collected and utilized by the government via NMA.

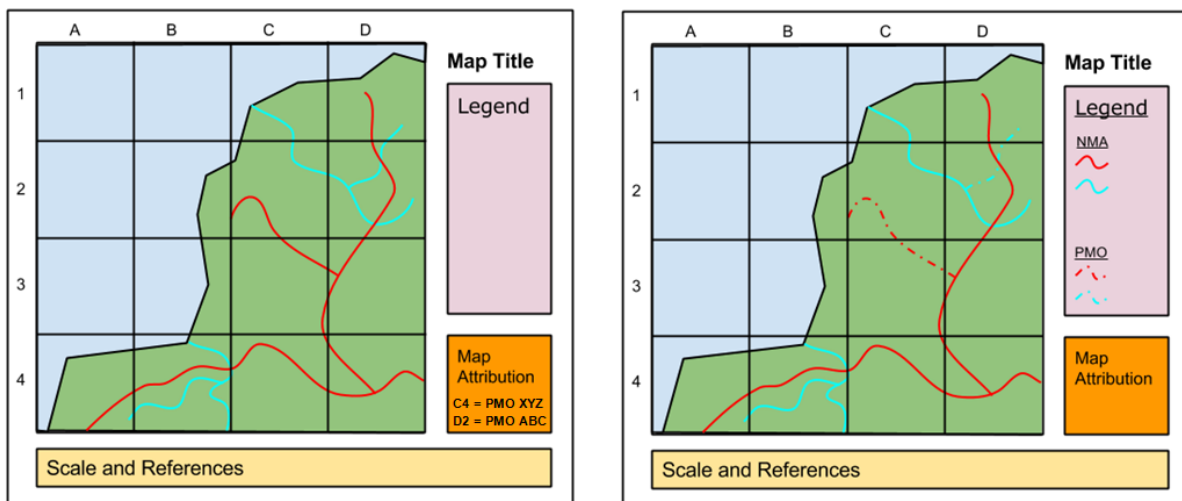


Figure 2. Cartographic representation options. Left: Detailed notes, Right: Different symbol usage

4.6 Non-technical aspect of ASD enrichment

The prior research on the inter-organization relationship between NMA and PMO showed no indication for the need of specific association between PMO to the government via certain GO (Ferdiansyah 2015). It assumed that NMA would act as one and the only required GO for PMO to fully comply with the Act. However, the later development of the crowdsourced map in the frame of One Map Policy intended that each PMO must find a suitable association in performing its activities. For example, PMO which has intention in forestry should coordinate with The Ministry

³ Layer here referring to the CAD (Computer-Aided Design) terminology

Environment and Forestry. Concerning the human resources, PMO aware the lack of understanding of its member towards the Act and the derivatives. Further, PMOs need the support from NMA to provide decent training concerning standards, technology, and trends in spatial data. Although NMA has realized training and dissemination concerning the Act, those activities depicted as "unpractical" and not devoted for PMO.

5. DISCUSSION

Based on the spatial data possession quantity, PMOs' activity and the distribution of PMO location it is reliable to assume that PM data is highly potential as an additional spatial information for the government. At least in its function as a compliment for the un-mapped area. Additionally, PM data provides a control and update resource for ASD. Nevertheless, the major concern in the data sourced from PMO is on its quality and storage. The majority of PMO admitted the importance of data quality, yet it appears the implementation encountered difficulty. The predicament on data quality in PMO side somehow understandable, since many PMO not specialized in mapping and act as a multi-function organization. The interview indicated that roughly 90% of the PMO are performing advocacy as an additional task to its participatory mapping activity.

On the data storage, despite the fact that majority of PMO have been using digital media to store its data, still, some of the PM product saved in the physical form. Some already converted to raster map by scanning, although there are lack –or none- of metadata about scanned map properties (scan resolution, scanning process/device, color depth, etc.). Many of digitally scanned map converted to vector via CAD or GIS software. Aside from geometric accuracy problem, many of earlier map invaluable provide a historical development in particular area (e.g. deforestation). In this case, the preservation becomes urgent since many of physical map originated from on-site mapping process could decay along with time. Another form of information that needs preservation is secondary data that complements geospatial data in the form of writing, audio or video documentary of corresponded mapping area.

The PM data completeness (compared to the ASD) appears to become the focal point of PMO's bargaining to the NMA. The majority status of PMO's "partial updated and complete" data gave a strong indication that many of ASD outdated and outperformed especially in the details. Many of POI, toponymy, and indigenous area were claimed: "better" or "more comprehensive" to that of ASD. Many of PM conducted by PMO initiated from the native that wanted to preserve its habitat and culture, contrary with the mapping performed by NMA that executed within limited time frame. Characteristically, the particular result of mapping performed by PMO contains the locality information, which claimed "more personal & comprehensive," out of pressure on merely to finish any occurring project.

The situation concerning the function of NMA as "establisher" is intricate. Bounded to the obligation as the focal institution on providing spatial data of Indonesia, notwithstanding encountered unbalanced and insufficient resources to perform mapping throughout the vast area and varying map themes. On the other hand, PMO as an object of the Act affected in a way to conform on performing its mapping-related activities, including its data product. Apparently, one of a

possible solution to compromise by both parties is to create a mutual partnership in spatial data production. This partnership should help both parties to converge with the Act.

There are benefits for PMO from the ASD enrichment process. First, PMO activities become recognized, whereas in the past PMO activities were overlooked by the government. It boosts PMO confidence on its data ownership and value, as PMOs believe their data contain additional information regarding locality, since the acquisition involving locals and include details that often unnoticed by the government. The enrichment process also maintains PMO function as an independent source of check and balance for any ASD produced by any government institution. In this case, NMA also being supported in its role as spatial data producer by benefiting additional information from the PM data, this supplementary data in the eASD later could be approved as official NMA data. However, certain criterion and process could be applied to assure the quality data consistency. Moreover, ASD enrichment could benefit PMO in term of QA & QC in the context that under supervision from NMA PMO becomes accustomed to maintaining its data quality.

Collaboration data from both parties will result in consequences regarding data publishing and ownership. eASD at least will be portrayed in digital form (as a digital map, i.e. online map & file-based map) and probably being printed. In this regard, the status of eASD ownership must be clear, whether eASD fully owned by NMA or each data still owned by the respective PMO. In the case of eASD is fully owned by NMA, it need to be clarified whether PMO automatically transfers its ownership on the data parallel at the time of data submission to the NMA, or there must be a periodical/incidentals separate ownership submission from PMO to NMA. Moreover, should there exist data conflict that resulting data alteration, it must be clear who will be responsible for correcting the eASD. Although it has stated that every data published via NSDI is fully under NMA responsibility, the option to disperse NMA burden on the data maintenance with PMO might become a way to put a subtle sense of responsibility to PMO.

Initial interview in mid-2014 showed that the most urgent dataset to be fulfilled by NMA is the data for the topographic map. However, after the installment of elected Government at the end of 2014, there is a new target for NMA to fulfill. The new focus is to produce Village Map; this new task is deviating (if not shifting) previous NMA mission to provide topographic map, and presumably add the burden to NMA. Indeed, from PMO point of view the additional task for NMA to produce Village Map widening the possibility for its thematic data contribution.

Last but not least an interesting finding emerge from the interview process, from the 22 initial planned PMO to interview only 13 agree and willing to contribute. The majority 11 PMO that did not intend and reluctant for interviewed located on Eastern of Indonesia, only one PMO from the eastern area were willing to contribute (named: *YLPM Bangwita*). The spatial distribution of PMO location and its contribution shown in Figure 3.

The rejection and hesitance those “east” PMO is intriguing since the situation of the “eastern area”⁴ have been very dynamic after the regional autonomy became an issue (Mappamiring 2006; Erb et

⁴ Eastern area here refers to “Indonesia Timur” stated in GBHN 1993 (Broad Outlines of National Policy) consisted of Sulawesi, Maluku, Papua and Nusa Tenggara region

al. 2013). This situation affected NGO – Government interaction, especially in the context of land ownership and its benefit (Atok 2008). The condition tends to place PMO in uneasy stand concerning a certain topic. A subject interview on funding, partnership and PMO-NGO interaction might become sensitive material for those PMOs. Some of the government respondents showed concern for PMO regarding its activities in some location, where PMO intention and purpose in PM activities might contain vested interest that only benefits certain party rather than helping locals and indigenous people to retain their aboriginal status.

Respondent Region (West - East)

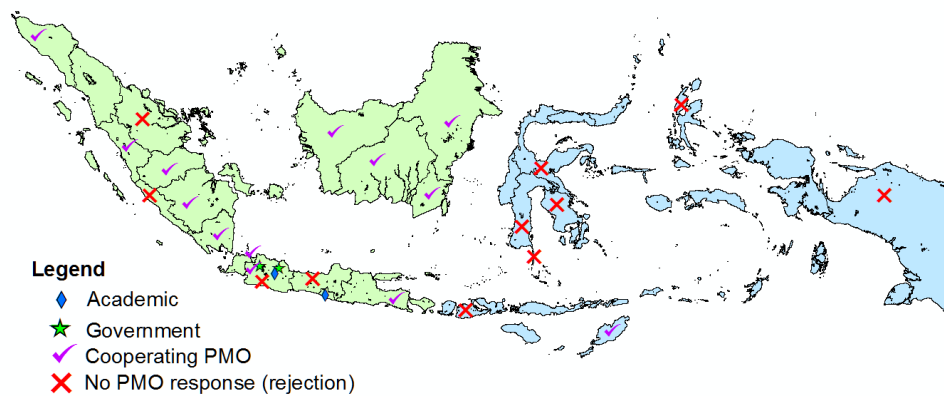


Figure 3. Respondent location distribution

6. SUMMARY

Considering numbers of relevant aspects that support the collaboration between PMOs and NMA in Indonesia, ASD enrichment is viable for execution. The mutualism can be simplified on how PMO can comply with The Act with help from NMA (creating standards, assessment, training, and infrastructure) and put its activities under the legal term of the Act. On the other side, NMA can take the benefit from PMO on its PM data, lending PM data that could fill the NMA data gap with certain extra information give leverage to NMA to make the map more accurate and intimate with the citizen and communities. Practically, both of NMA and PMOs have the overall vision on the technical matters. Few iteration on Focused Group Discussion between the parties should yield initial decent technical documents. On the legal matters, NMA appears to be very supportive. Proved by many of legal product that corresponds with the theme of PM activities has been published. The overall points of enrichment scheme for ASD using PM data summarized in the tables below:

Table 4 Non-technical aspect on ASD enrichment

Existing Situation	Notes & accomplishment	Future work, solution & recommendation
Human resources		
PMO need support for its members to comprehend on	Dissemination on the UIG has been held since 2011. Rare	More UIG dissemination that devoted for PMO and general audience

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the UIG.	dedicated for PMO, majority of the event addressed for GO	
Upgrade & update PMO members' skill on the most current trend on spatial data acquisition & processing	Initial training with NMA depicted in "ideal setting" (using high-end device & sophisticated method) rather than practical purpose (based on actual condition and available tools)	<ul style="list-style-type: none"> - Practical Training based on the condition, situation and limitation of PMO on work scope - Intensify the function of the existing mapping certification from the authorized accreditation institutions
Organization		
Specific association between PMO-GO based on PMO interest & specialization	Certain PMO has approached some GOs. To this date, none of official PMO-GO association has been made	PMO attach itself to suitable GO based on its interest. The respective GO will act as a hub to the NMA using the existing clearinghouse setting on NSDI.

Table 5 Technical Aspect on ASD enrichment

Existing Situation	Notes & accomplishment	Future work, solution & recommendation
Infrastructure for data dissemination		
No government facilitation for PMO to publish its data via NMA/GO	NMA has built NSDI since 2004 as a clearinghouse for entire GO. Upgraded on 2011 to fulfill NMA's function in the UIG	Optimizing the function of existing NSDI to disseminate eASD. NMA infrastructure will ensure stability and persistence of dissemination
Cartographical aspect of eASD		
The cartographic specification for PM data and eASD not exist	The document of map presentation only for Topographical map and certain thematic map	Details for eASD cartographic specification both for online and hardcopy should be present.
Tools (hardware) for data acquisition		
PMO using simple GPS or sketch	No existing cooperation regarding hardware between PMO and NMA	NMA provides SOP for PMO data acquisition on generally used devices
Tools (software or service) for data processing and storage		
PMO using outdated, pirated software	NMA create a <i>web service</i> for PM. The service is not fully available for access. Closed development, no possibility for copying, modification or further development	<ul style="list-style-type: none"> - Avoid to use commercial software for easier adoption by PMO - Create tools that can be deployed, using open source, and function as offline & online for storage and dissemination - Hold training on the Open Source Software (see point on organization)
Base map for PMO		
PMO using any available map as references to acquire data	NMA provides web page for free downloads NMA's maps (topographic & thematic) ⁵	Customizable NMA map for data acquisition device (e.g. for GPS), or NMA provides ready-to-use data in more generic format (e.g. GML, GeoJSON)
Map type		
Up to the end of 2015, NMA intentions is sole to complete topographical map	PMO demanded aside of topographic map; the collaboration must include thematic map	Considering the NMA's new task to produce Village Map, thematic data should automatically include the data collaboration
Non-spatial data		
No intentions from NMA to adopt any non-	PMO noted that many of objects falsely mapped as a consequence of	Considering the non-spatial data as an Additional information, it can help the

⁵ via <http://tanahair.indonesia.go.id/home> (last accessed 13 August 2016)

spatial data	NMA neglecting historical information from the locals	government comprehensively to understand the current status and history of mapped object. Non-spatial data is possible for addition to the map metadata
QA/QC on eASD		
QC and QA Sporadically performed by the few of PMO	NMA intended to maintain optimal quality for its ASD	PMO&NMA have to redefine the optimum standards of eASD that “acceptable” (easy to achieve for PMO as well as contain decent information for further adoption by the NMA)
Correction on eASD		
The derivative regulation mentions the correction performed by NMA	Considering the PMO data possession are excessive, it will add the burden for NMA to control	<ul style="list-style-type: none"> - NMA should consider sharing the burden on data correction with PMO - Mechanism of data correction between data owner and NMA must be standardized to avoid inconsistency - Metadata of each eASD have to carefully designed to accommodate all the possibilities on data development, include rapid correction and update

Table 6 Legal Standing on ASD enrichment

Existing Situation	Notes & accomplishment	Future work, solution & recommendation
Standards		
Standards for mapping exist only for PMO internal use. NMA standards apply as highest standard for mapping in Indonesia No shared/common standard produced for data collaboration between PMO and NMA	PMO expecting several standards on for PM that can help PM data automatically comply with UIG. Specification for eASD expected to consider PMO’s limitation on resource and applicable on the field (see human resources)	Standards on data format & structure Standards on s/w (preferences on the features, capabilities, etc.) Standard on members’ competence to perform PM (including manage & training)
Regulations		
PMO demands a firm standing base for their activities regarding PM.	UIG as the main legal standing already inking the admittance of participation on GI production. Strengthen by NMA regulation on mechanism Public participation on National Network of Geospatial Information	Legal standing for GO other than NMA should be established, especially in the case of PMO-GO association Derivative of UIG on the form of detailed Government Regulation concerning PM&PMO might be handy as a legal stand before each PMO-GO association available/established
Memorandum of Understanding (MoU)		
Certain PMO requires MoU to build mutual respect for every data exchange & utilization	MoU for data exchange is customary on every NMA collaboration with another GO Indonesian government has declared to respect ancestral domain map	NMA provides MoU template as a reference for PMO-GO collaboration to ensure compatibility with UIG

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7. RECOMMENDATIONS

There are several issues need to be investigated further by this research subject. The first issue is to gain additional understanding of the “east-west” PMO response phenomenon regarding this research topic in the respective area. To reveal what the origin and main cause, and see how it affects every aspect of PMO activities. Next issue is to perform further detail investigation on how PMO in Indonesia produces the data. Numbers of PMO insisted that many of its data contain more information and comprehensive compared to the governments. These claim must examined carefully, considering in some case, differences occurred regarding object/feature data properties, either between locals’ vs. locals’ or locals’ vs. government’s version.

Another topic for future research is the segregation on the quality of PM product in Indonesia. This recommendation emerges under certain fact that the current quality of PM products in Indonesia are not consistent between one to another. Only a few of PMO applied and adopted certain standard(s) on PM data acquisition and processing. Last but not least, as the consequences of the urgency of PM product segregation. The research of more practical QA and QC for PMO to use is needed. The term of “more practical” based on the fact that currently, a formal standard published by NMA tend to act as formal legal and theoretical document rather than technical one. The practical and easy-to-implement approach is needed to guide PM data acquisition and production.

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