Increasing Availability, Quality, and Accessibility of Common and Fundamental Operational Datasets to Support Disaster Risk Reduction and Emergency Management in the Philippines

Green Paper [1] (v1.2: 29th May 2014)

Ebener, S. [2], Castro, F. [3], Dimailig, L.A. [3]

I. RATIONALE

The need for accurate and up-to-date data to support disaster risk reduction and emergency management has long been recognized. Despite this recognition, efforts aiming at ensuring for these data to be available, of sufficient quality, and easily accessible to all stakeholders at the time of a crisis remain limited and fragmented.

As a consequence of the above, the data used at the time of a crisis is often incomplete, out-of-date, of low quality, incompatible among sources, and/or not officially provided by the Government. In addition to that, a lot of efforts are put together by different institutions and organizations to come up with data, especially geospatial data, they will be using during the different phases of a crisis (response, recovery and rehabilitation); sometime leading to duplication of efforts.

Finally, once the crisis is over, not much of the data collected in the field get integrated back into the information system of the Government; and only limited efforts are being provided to support the government in improving, maintaining, and/or updating these data in preparation to the next crisis, leading therefore to a similar data gap crisis after crisis.

Trying to address these, the Inter-Agency Standing Committee (IASC), which is the primary mechanism for inter-agency coordination of humanitarian assistance followed by nine (9) UN agencies and nine (9) standing invitees, came up in 2010 with the concepts of Common Operational Datasets (CODs) and Fundamental Operations Datasets (FODs) defining them as follow [a]:

- CODs are predictable, core sets of data needed to support operations and decision-making for all actors in a humanitarian response;
- FODs are datasets required to support multiple cluster/sector operations and complement CODs.

In theory, CODs are meant to be proactively identified and maintained prior to an emergency as part of data preparedness measures, while FODs are meant to be made available as soon as

[1] Green Papers are consultation documents produced by the Government. The aim of this document is to allow people, both inside and outside the government, to debate the subject and give feedback on its suggestions.
[2] Gaia GeoSystems - Strengthening Information Infrastructure for Emergency Management (SIIEM) project
[3] Department of Social Welfare and Development – Information and Communication Technology Management Service

possible after the onset of an emergency. However many FODs could be developed during preparedness such as: education facilities, health facilities, government buildings, etc., as their locations and attributes will likely be required during the response.

In reality, however, the system is mainly reactive; CODs and FODs are being identified and improved during the crisis itself, and oftentimes, independently between government agencies and by humanitarian organizations; with the international body under the leadership of the UN Office of Coordination for Humanitarian Affairs (OCHA).

From an outside perspective, the main reasons for the system to be mainly reactive, is the large number of countries susceptible to experience crisis and the large number of resources that would be needed in order for these data to be generated and maintained for each of these countries, if this was to be coordinated externally to the government.

There was therefore a need for complementary framework that would aim at directly supporting the government of these countries to make a set of key datasets (CODs and FODs) available to all the stakeholders at the time of a crisis.

The Strengthening Information Infrastructure for Emergency Management (SIIEM) project [b] therefore proposed such framework through the implementation of the following four principles:

1. Countries should be in a position to generate and maintain the layers of information necessary to support disaster risk reduction and emergency management;
2. The international community (sensu lato) should support countries in reaching principle 1;
3. The open data policy should be used as much as possible. When this is not possible, agreements allowing access to this data should be signed between the government and all the actors involved in emergency preparedness, disaster risk reduction, as well as, emergency response, recovery and reconstruction activities;
4. Data collected during the crisis by the international community should be integrated back into the government information system.

By illustrating the current situation in the Philippines when it comes to the implementation of these principles in relation to the concepts of CODs and FODs, in the context of the response to Typhoon Yolanda (Haiyan), this paper seeks to engage all stakeholders involved in the disaster risk reduction and management and/or the production and maintenance of these data (e.g. Government, Donors, UN, NGOs, Open Data Community) in a constructive discussion, aiming at identifying and implementing sustainable solution to address the gaps.

II. CURRENT SITUATION IN THE PHILIPPINES: EXAMPLES OF RESPONSE TO TYPHOON YOLANDA

While CODs and FODs cover a large number of datasets, this paper focuses on the following geospatial datasets, as they are not only among those mainly used in the context of a response to a crisis, but also under the mandate of different governmental agencies. They also allowed illustrating the main issues related to data availability, quality, and accessibility observed during the response to Typhoon Yolanda:

1. Administrative boundaries (down to the lowest level of desegregation)
2. Key infrastructure locations (evacuation centers and health facilities)
3. Road networks (national and local)

The following sections describe the observations made in relation to the availability, quality, and accessibility of these layers at the time of the response to Typhoon Yolanda starting 8th November 2013. These observations are being shared to illustrate the type of data issues encountered during a crisis and therefore support the discussion described in the rationale of this paper.

The quality of the geospatial dataset has been assessed in terms of completeness and accuracy. In addition to that, the availability and use of a unique identifier for the first two (2) layers mentioned above represents a key component to ensure data compatibility among sources.

A. Administrative Boundaries

The Philippines is administratively structured according to four levels, namely (from the highest to the lowest) Regions, Provinces, Municipalities/Cities, and Barangays.

Other types of subdivision also exist like legislative districts; but they can all be recomposed based on delimitation of Municipalities/Cities, or in some cases, Barangays. The observations reported here are therefore related to these two particular levels.

The following Barangay administrative boundaries layers were available at the time Typhoon Yolanda hit the Philippines:

- The layer currently under development Province by Province by the National Statistics Office (NSO). Still in the process of being cleaned; this layer was only accessible upon written authorization, and could take time even between government entities.
- The layer freely available from the Global Administrative Areas (GADM) website [c]. Reported as coming from the Ministry of Agriculture of the Philippines, this layer actually corresponds to a modified version of the map created by NSO for the 2000 census.

At a later stage, an additional layer with a different delineation of Barangay boundaries for Tacloban City has also been identified. While made accessible to the international community involved in the response, this layer has not been extensively used as being not being endorsed by the local government.

Finally, another Municipality/City boundaries layer was also made available upon request from the National Mapping and Resource Information Authority (NAMRIA).

In view of this, OCHA decided to use the map which came from the GADM website as the administrative boundaries COD for the response to Typhoon Yolanda after performing some changes on it as described later in this section. It is important to note that the geometry, location name, and Philippines Standard Geographic Code (PSGC) are all required in the administrative boundary layer.

The level of completeness for these layers over Regions affected by Typhoon Yolanda (Regions IV-B, VI, VII, and VIII) has been assessed using official list of Provinces, Municipalities/Cities, and Barangays provided by the National Statistical Coordination Board (NSCB) as part of the PSGC. Table 1 shows the number of divisions observed at all levels in these Regions at the time of the event.

Region	Number of Provinces	Number of Municipalities/Cities	Number of Barangays
IV-B (MIMAROPA)	5	73	1,458
VI (Western Visayas)	6	133	4,051
VII (Central Visayas)	4	132	3,003
VIII (Eastern Visayas)	6	143	4,390
TOTAL	**21**	**481**	**12,902**

Table 1 Number of Provinces, Municipalities/Cities, and Barangays observed in the Regions most affected by Typhoon Yolanda at the time of the event

In comparison, Tables 2a and 2b provide the number of divisions observed for the layers available from NAMRIA and the GADM (both original form and operated OCHA) at the time of the event. Differences compared with the PSGC list (Table 1) are reported in grey.

Region	Number of Provinces	Number of Municipalities/Cities
IV-B (MIMAROPA)	5	71
VI (Western Visayas)	6	133
VII (Central Visayas)	4	132
VIII (Eastern Visayas)	6	143
TOTAL	**21**	**479**

Table 2a Number of administrative divisions observed at the Municipality/City level from NAMRIA

Region	Number of Provinces	Number of Municipalities/ Cities	Number of Barangays (original file)	Number of Barangays (file shared by OCHA)
IV-B	5	72	1,459	1,455
VI	6	133	4,034	4,034
VII	4	132	3,003	3,001
VIII	6	143	4,388	4,387
TOTAL	**21**	**480**	**12,884**	**12,877**

Table 2b Number of administrative divisions observed at the Barangay level from GADM

The layer from NSO was compared with the PSGC list at the provincial level because it does not cover all affected areas (Table 3).

Region	Province	Number of	PSGC	NSO
VI	Negros Occidental	Municipalities/Cities	32	32
		Barangays	662	662
VIII	Biliran	Municipalities/Cities	8	8
		Barangays	132	132
	Eastern Samar	Municipalities/Cities	23	23
		Barangays	597	597
	Leyte	Municipalities/Cities	43	43
		Barangays	1,641	1,641
	Northern Samar	Municipalities/Cities	24	24
		Barangays	569	390
	Southern Leyte	Municipalities/Cities	19	19
		Barangays	500	500

Table 3 Comparison between the number of Municipalities and Barangays reported in the PSGC list and those contained in the Barangay level layer from NSO for the Provinces that were completed at the time of the event

Finally, regarding the additional layer identified for Tacloban City, the PSGC reports a total of 138 Barangays, while the layer itself was containing 136 Barangays.

As shown in Tables 1, 2a, 2b, and 3, none of the administrative boundaries layers available at the time of the crisis were matching the reality on the ground when it comes to the Barangay level. Even the changes operated by OCHA on the GADM dataset did not allow reaching the match.

While the difference observed when compared with the PSGC list is not very high when considering the GADM layer (29 Barangays), the gap observed in Northern Samar in the NSO layer is significant (179 Barangays), and indicates the need for a complete and up-to-date Barangay level map to be available in support of the disaster risk reduction and emergency management in the country. To further illustrate this, the country was counting 42,028

Barangays at the end of 2013 as per PSGC list, while the GADM layer contains the delimitation of 41,880 Barangays, thus a difference of 148.

At the Municipality/City level, the gap is smaller and only located in Region IV-B. For reference, the missing municipalities in NAMRIA's layer were Cagayancillo (PSGC: 175308000) and Kalayaan (PSGC: 175321000), and Kalayaan only in the GADM layer.

Like in the Barangay level, significant gaps were also observed in other Regions of the country, especially in the Autonomous Region of Muslim Mindanao (ARMM). As an indication, the map from NAMRIA misses the delimitation of 21 Municipalities in this Region (mainly in the province of Maguindanao). In the GADM layer, this gap is smaller (6 Municipalities).

While it is understood that without precise field survey, evaluating the accuracy of an administrative boundary will be difficult, it is still possible to perform the following:

1. Overlay the different layers to visually estimate the difference between one another; and
2. See how different layers match the coastline.

In performing the above procedures, potential editing issues (holes, overlap between polygons, etc.) were also observed. Overlaying the three Barangay boundaries layers available for Tacloban City (Figure 1) is a very good illustration of the differences that can exist between sources at the same level of desegregation.

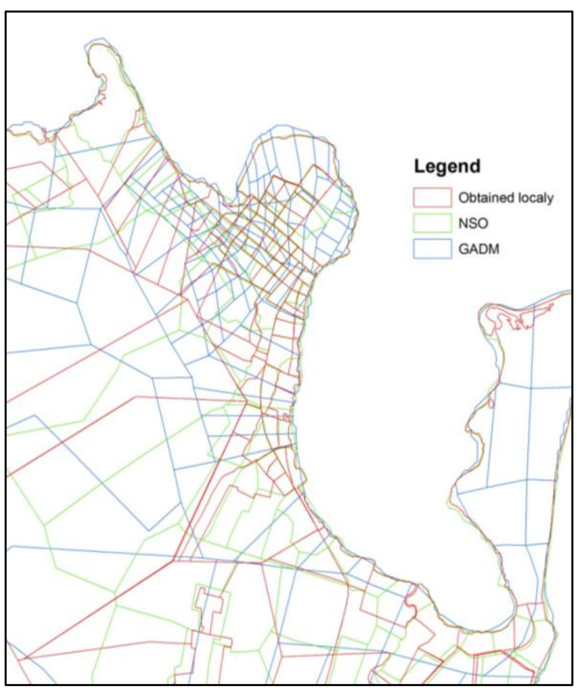

Figure 1 Barangay boundaries for Tacloban City as reported in three different layers: NSO, GADM, and the one obtained locally during the response to Typhoon Yolanda

Such important differences between sources are not only confusing when responding to a crisis, but might also lead to crucial errors during the response, recovery and/or rehabilitation operations.

Still using the example of Tacloban City, we can also observe important difference between sources at the Municipality level (Figure 2).

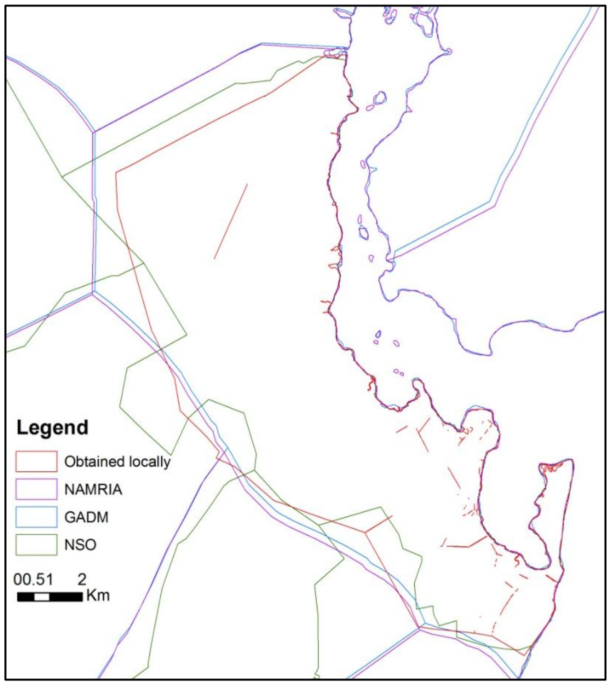

Figure 2 Municipality boundaries for Tacloban City as reported in four different layers: NAMRIA, NSO, GADM, and the one obtained locally during the response to Typhoon Yolanda

Even if part of these differences could be explained by difference in scale used to generate the layers; these gaps remain significant, reaching up to few kilometers depending on the source considered, and could therefore lead to some inconsistencies when combined with GPS collected points for example.

What can also be observed in Figure 2 are editing errors in the layers obtained locally. These errors, appearing as lines within the boundaries of the city, are due to holes between Barangay level polygons. Such errors, as well as overlap between polygons, have actually been observed in all sources considered, except the GADM dataset.

The comparison with the coastline was performed using the Landsat ETM+ (Enhanced Thematic Mapper Plus) mosaic scenes available through the Earth Science Data Interface (ESDI) at the Global Land Cover Facility [d], as their positional accuracy of 75 meters was sufficient for this exercise.

Looking at the regions affected by Typhoon Yolanda, the major issue that this analysis revealed was that part of the islands forming the municipality of San Vicente in Northern Samar were missing in NAMRIA's layer. Apart from that, the difference, and some time shift, observed between the coastline on the Landsat ETM+ scenes and the different layers could be explained either by the accuracy of the scenes, the difference in interpretation of what forms the coastline (inclusion of mangroves for example), or the scale at which the layers have been generated.

Looking outside the affected regions, other issues nevertheless appeared on the layer from NAMRIA; as for example, the shift observed at the level of Simunul Municipality in Tawi-Tawi Province (Figure 3).

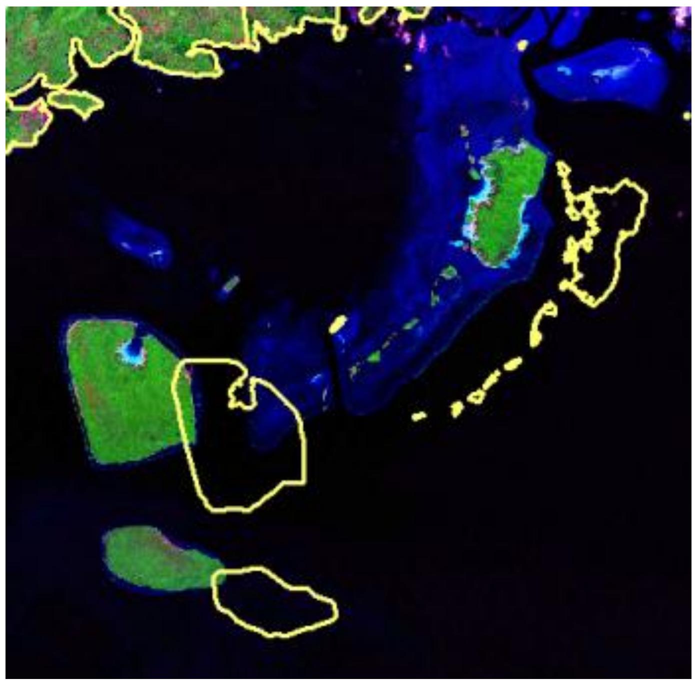

Figure 3 Shift between the coastline and administrative boundaries layer from NAMRIA at the level of Simunul Municipality (Tawi-Tawi)

Another major issue is the unique identifier, PSGC. It was checked in each of the layers considered, and findings include:

- Not integrated in the layers from NAMRIA, GADM, and the layer locally identified for Tacloban City; and
- Partially integrated in NSO's layer as part of a specific coding scheme (ppmmbbbnnnnnn) with: ppmmbbb corresponding the Province, Municipality, and Barangay part of the PSGC code and nnnnnn, a sequence for NSO use only.

In addition to that:

- The attribute table for the layer generated by NSO was for the moment not containing the name nor a code for the Region, Province, and Municipality/City

levels, only the Barangay name was included in addition to the above mentioned code;
- The spelling used for the Regions, Provinces, and Municipalities in the layer from NAMRIA was not always following the spelling used in the PSGC; and
- Neither the Region's name nor code were included in the original GADM dataset.

All of these required for OCHA to integrate under the PSGC in the GADM dataset in the middle of the crisis in order to facilitate the work of the different agencies involved in the response operations. Further, the PSGC had to be integrated under three different forms in order to allow for its use:
- As text in order to keep the "0" appearing at the beginning of its sequence for Regions 1 to 9;
- As number for institutions that stored the PSGC under that format, therefore without the "0" at the beginning of the sequence; and
- As text, but with the "PH" prefix in front of the sequence as a way to partially address the problems generated by the "0".

All of the above confirms the need for unique, complete, and up-to-date Barangay administrative boundaries layer to be generated and maintained. This layer should also contain the PSGC. In addition to that, and because of the regular changes observed in the administrative structure of the country, this layer should be updated on a regular basis to account for these changes.

Generating and maintaining such a layer for the whole country will be costly. Being able to bare this cost will not only require looking at reducing duplication of efforts among institutions, but also the identification of new resources.

B. Key Infrastructure Locations

a. Evacuation Centers

Evacuation centers are one of the most vital infrastructures during crises. Thus, information on its locations are of great importance. This paper focuses on the experiences and observations made by the Department of Social Welfare and Development (DSWD).

Most often, but not always, evacuation centers consist of public buildings and spaces, especially schools. But, there are cases in which privately-owned properties are used; thus, the lack of direct administration from any governmental entity. In effect, there is difficulty in capturing comprehensive reportorial requirements.

Further, evacuation centers are identified by Local Government Units (LGU) of affected areas, down to the local Barangay chieftain. And in reality, these shelters are not fixed; meaning, an evacuation center might be used for only a single limited time. In addition to that, an established protocol, including unique identifiers, for archiving reported evacuation centers does not exist. These indicate the difficulty of creating a database of all evacuation centers at this time.

Internally to DSWD, the reporting of evacuation centers starts from the Social Workers and/or Municipal Links in each Municipality/City in the country, it is then passed to the provincial offices for consolidation, then to the regional offices, and finally, to the central office. This procedure takes a lot of time; and thus, negatively affects the accuracy and validity of information. But with the newly created Disaster Risk Reduction Monitoring Information System (DRRMIS), a multi-modal and multi-module disaster information system, DSWD expects a real-time reporting procedure once it is fully operational.

Also, the current reporting system does not include the location of evacuation centers, other than the Municipality/City where it was reported. Thus, there is great difficulty in locating these evacuation centers. In geolocating shelters, DSWD employs crowd-sourcing from various volunteers and in various media. Most volunteer mappers, such as OSM and Google Mappers, help by locating evacuation centers using a single web platform, which in most cases is a Google Map. Others, especially the locals, help DSWD mappers in the field by visually validating shelters using satellite imageries from Google Earth. On December 2013, there is a total of 1,239 reported evacuation centers used during the response to Typhoon Yolanda; however, only 164, or 13% of these are geolocated.

In conclusion, although availability and accessibility of captured geospatial information is not an issue for DSWD; availability of comprehensive, accurate, and up-to-date information remains to be a major bottleneck.

b. Health Facilities

The main health facilities in the Philippines are (from the highest to the lowest level of care provision): Hospitals (public and private), Rural Health Units (RHU), and Barangay Health Stations (BHS). Other types of health facilities are not covered in the context of this paper.

In August 2012, the Department of Health (DOH), with the support of the World Health Organization (WHO), engaged itself in a process aiming at converting the existing National Health Facility Database (NHFD) into the National Health Facility Registry

(NHFR) with the objective for this registry to become the unique, complete, up-to-date, and georeferenced list of health facilities for the Philippines.

At the time of the crisis, the data publicly available from NHFR website [e] was limited and an important volume of information coming from different sources was still not integrated into it and the DOH. In addition to that, accessibility to the rest of the dataset, including the coordinates of the facilities, was not granted to the international community.

The only health facility location database available at that time was therefore the one collected for the DOH by NAMRIA back in 2000. This dataset was not only out-of-date, but also not matching the content of the NHFR, especially in regards to the unique identifier used by the DOH. The latitude/longitude information in this dataset had also not been fully checked.

A compromise could nevertheless be found with the DOH and the content of the NHFR finally released to the international community under the form of a Google spreadsheet at the beginning of December 2013 under the conditions that access was requested in writing to the DOH and guarantying that the dataset would only be used for the purpose of supporting the response operations.

This dataset, being the official list of health facilities from the government, has then been recognized as the FOD, and therefore posted as such on OCHA's website in place of the dataset collected by NAMRIA back in 2000. The following fields were included in this dataset:

- Official DOH unique identifier;
- The DOH Surveillance in Post Extreme Emergencies and Disasters (SPEED) code when available;
- The official name of the health facility;
- The health facility type;
- The name and code of the Region, Province, Municipality/City, and Barangay in which the health facility is located as per the PSGC; and
- The geographic coordinate (latitude/longitude) of the health facility with an indication of the source and level of precision.

A separated worksheet containing the PSGC for the affected Region was also included to facilitate the work of the health sector in the field.

At the time it got released to the international community, this dataset was counting 1,520 health facilities covering Regions IV-B, VI, VII, and VIII.

Thanks to DOH's Knowledge Management and Information Technology Service (KMITS)'s efforts and WHO's support, all the information available have been integrated into the database and cleaned as much as possible to reach 6,924 health facilities by January 1st, 2014 (Table 4).

Despite all the work done, gaps were still remaining, especially in regards to the name of the Municipality and Barangay in which several facilities were located. It was also not possible to guaranty that all health facilities were included in the database. In addition to that, other lists of health facilities were still being used in the field, generating confusion, as well as, data compatibility issues.

	Region IV-B	Region VI	Region VII	Region VIII
Government Hospital	45	73	62	60
Private Hospital	29	25	50	29
Rural Health Unit	85	152	173	163
Barangay Health Station	773	2,001	2,155	1,049
TOTAL	**932**	**2,251**	**2,440**	**1,301**

Table 4 Distribution of the health facilities in the DOH Google Drive by January 1st, 2014

When it comes to accuracy, the large number of health facilities in the country and the limited resources at disposal, did not allow for the DOH to collect a precise location for each of them. To illustrate this, Table 5 present the qualitative precision level observed for the facilities located in the most affected regions.

Precision Level	Region IV-B	Region VI	Region VII	Region VIII	All 4 Regions
High	19.6%	5.1%	49.8%	28.1%	**27.1%**
Low	64.3%	74.1%	43.2%	56.2%	**58.5%**
Unknown	12.4%	14.8%	5.1%	7.3%	**9.7%**
No coordinate	3.6%	6.0%	1.9%	8.5%	**4.7%**

Table 5 Precision level distribution for the health facility coordinate over the most affected regions

In Table 5:

- A high precision level corresponds to location that have either been collected using a GPS device and an established protocol or precisely located in Google Map, also using a defined protocol;
- A low precision level corresponds either to locations that have been identified with Google Map but for which the facility could not clearly be identified on the satellite image or to the use of the Barangay centroid as the location for the health facility; and

- An unknown precision level corresponds to any other locations that have not been documented in terms of the approach that has been used to collect it.

When looking at this table, it is important to first precise that all the points finally stored in the database have been checked in order to remove coordinates that would fall outside the right municipality of in the sea.

As we can see in Table 5, only 27.1% of all the coordinates are presenting a high level of precisions. At the scale of the affected regions, this represents around 5,000 facilities for which high precision location needs to be obtained. At the scale of the country, this gap reaches around 16,000 health facilities.

Apart from that, each health facility included in the NHFR gets a unique identifier. Referred as the DOH code, this identifier is meant to be used by all stakeholders to ensure data compatibility among sources.

In reality, different coding scheme are still existing and being used within the health sector, and this both internally and externally to DOH. This issue, as well as, the capacity for DOH to be able to answer any request aiming at adding new facilities in the NHFR was therefore to be addressed.

In view of the above, and recognizing the importance of the NHFR, not only for emergency management, but also for any other health related interventions in the country, DOH has started the second phase of the project aiming at filling the gaps, validating the information contained in the registry, as well as, putting in place the necessary institutional framework and technical capacity to ensure the sustainability of the registry in the long run.

The amount of work that remains to be performed is very big as illustrated by the statistics reported in Table 6 for 2013 and the beginning of 2014, and obtaining a unique, complete, up-to-date health facility registry for the whole country for the involvement and support of all health sectors and beyond to cover all institutions involved and interested in locating health facilities.

Number of	2013	2014
Records at the beginning of the year	22,811	20,902
Duplicates removed	2,763	288
New facilities added	854	1,222
Edits performed	16,466	1,095

Table 6 Selected statistics for the NHFR updating and cleaning process

Among those, we can mention for the need to integrate the coordinates collected in the field during the response to Typhoon Yolanda into the NHFR. While this process has already started with WHO, coordinates might also have been collected by other institutions.

Beyond the health sector, there is also a need to ensure that institutions interested in health facility location for their own activities do collaborate with DOH to avoid duplication of efforts and therefore fill the gap faster. An example of this would be the collaboration between the Department of Science and Technology (DOST) and the OpenStreet Map (OSM) Mapping Initiative in the context of Nationwide Operational Assessment of Hazards (Project NOAH), as this activity does not involve DOH at this stage, while aiming at mapping all hospitals in the country in its first phase (http://maning.github.io/noah_osm_mapping/).

C. Road Network

The road network in the Philippines can be classified into (from the highest to the lowest level) [f]: Highways, Expressways, National Roads, Provincial Roads, City and Municipality Roads, and Barangay Roads.

Three layers were available at the time of the crisis, namely:

- The dataset available upon request from the Department of Public Works and Highways (DPWH) which contains the national roads for the country [g];
- The dataset reported as having been developed by NAMRIA in 2008. Made available to the international community through OCHA's website [h], this dataset is actually composed of two sets of layers that seems to have been generated at two different scales:
    - A layer covering the whole country; and
    - Two additional layers covering the Provinces of Eastern Samar and Leyte in Region VIII; and
- The dataset being developed and publicly shared by OSM Philippines [i]. Downloadable for the whole country at once from Geofabrik's website [j].

Among these layers, it is important to mention the huge amount of work that has been performed by over 1,700 volunteers to perform 4.5 million edits in the OSM database during the response to Typhoon Yolanda. The OSM database, which is considered here, is therefore the one downloaded from the Geofabrik website on January 29th, 2014.

Trying to look at completeness among different road networks layers is not as straightforward as doing with health facilities; and because a road registry does not exist. And if such registry exists, it would be difficult to maintain and populate in a way that could allow to check if all existing roads are indeed captured in a given GIS layer.

What has therefore been done here is to overlay the above mentioned layers on top of each other and derive the following visual observations out of this exercise:

- None of these layers contain the complete road segments reported in others; meaning that each layer contains a part of the information that would lead to having the most complete road network possible;
- At the same time, an important overlap exist between the different layers; indicating that duplication of efforts exists among the institutions behind these layers; and
- An important number of disconnect exist in the layers from OSM and NAMRIA.

Overlaying these layers on top of the Landsat ETM+ scene just confirmed these observations to the extent that not all roads are necessarily visible on these images due to their resolution, and the fact that they have been captured back in 2000 (Figure 4).

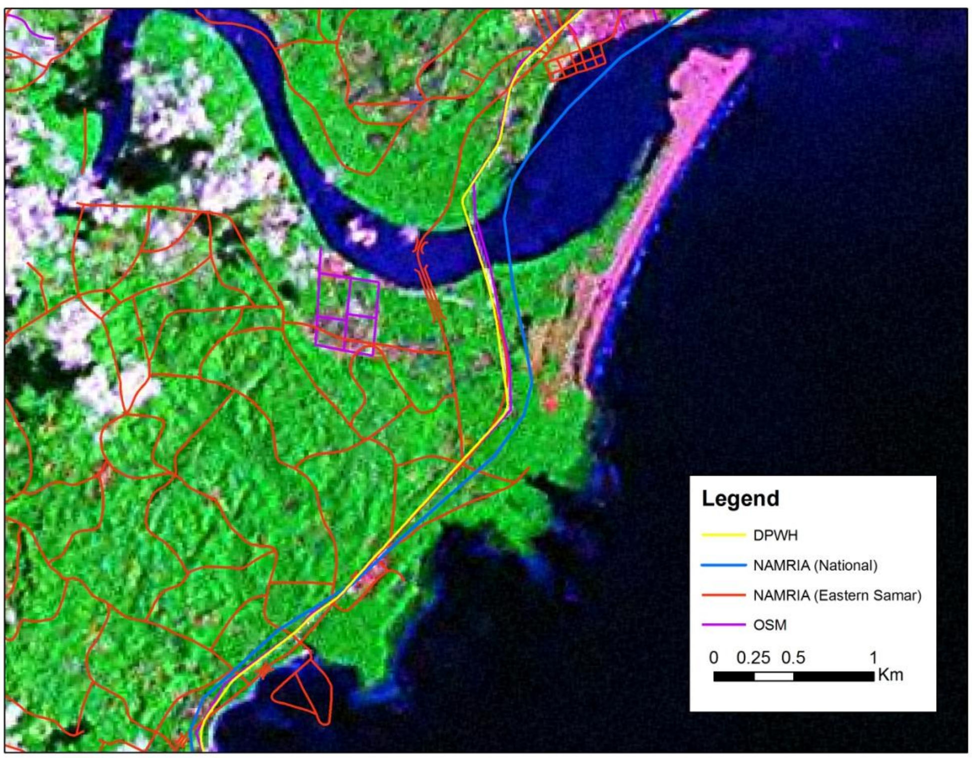

Figure 4 Overlay of road networks layers considered in this paper on top of the Landsat ETM+ scene mosaic

In conclusion, a complete road network down to the lowest level of desegregation (Barangay roads) is not currently available in the country.

Looking at the accuracy between these layers is an even more difficult exercise; complicated by the fact that the projection information was missing for the two layers covering the Provinces of Eastern Samar and Leyte. The other complication roots from the fact that these layers seem to have been generated at different scale and through different methods.

While the OSM dataset is well documented in terms of the method used, the same information would have been useful for the layers coming from DPWH and NAMRIA, emphasizing therefore the importance of metadata.

The layer from OSM, being extracted directly from satellite images and the close match existing between OSM and DPWH datasets on most segments seems to indicate that the latter might have been generated using the same approach. If this is indeed the case, this could represent a good basis for looking at the possibility of merging these two datasets together. The layer from NAMRIA could eventually also be integrated if the question of projection and scale be addressed. Before that, the differences in road classification used in each of the layers considered here will also have to be addressed as illustrated in Table 7.

DPWH	OSM (road type only)	NAMRIA (National)	NAMRIA (Provincial)
National arterial	living_street	All weather, hard surface road	Bridges
National secondary	motorway	All weather, light surface road	Pier
	primary	Cart track, trail	Road Main
	residential	Fair or Dry weather, loose surface road	Road Sec
	road	First and Second Class	Trail
	secondary	Narrow Gauge Railroad	
	tertiary	Normal Gauge Railroad	
	track	Railroad	
	trunk	Road Under Construction	
		Third Class	
		Track or Trail	

Table 7 Road classification used in the different layers considered in this paper

The situation observed here is very similar to the one mentioned earlier for the administrative boundaries layers, in the sense that the observations reported here confirm the need for a unique, complete, and up-to-date road network layer to be generated and maintained. Duplication of efforts could potentially be reduced through improved collaboration, not only between governmental institutions, but also between them and the Open Data Community, and the labor force they represent through their volunteers.

III. CONCLUSION AND POINTS FOR DISCUSSION

The review presented here is not meant to be comprehensive, but to illustrate the current situation when it comes to the availability, quality, and accessibility of common operational datasets to support disaster risk reduction and emergency management in the Philippines.

As such, it is most likely that the previous sections have neither captured all the sources available for the considered layers nor covered all potential data related issues faced during the response to Typhoon Yolanda. For example, the question of compatibility between layers has not been discussed here while critical not only in the response but also in emergency preparedness and disaster risk reduction context.

At the same time, while some of the aspects have been introduced when looking at administrative boundaries, there are other issues linked to the structure of the PSGC that would need to be addressed in order for this coding scheme to become more information management friendly and therefore be used by a larger number of institutions. Layers specific to disaster risk reduction, like hazard distribution maps, have also not been covered here while data quality and duplication of efforts issues are also observed.

Despite these limitations, the examples described here are first confirming the availability of key geospatial data in the Philippines. This being said, these data are not necessarily easily accessible and agreements have to be made during the crisis itself. Going through this process is taking time while time is at the essence during the response, especially during the first few weeks.

Once these data are accessible, they are not automatically documented. This, as well as the proliferation of sources, is generating confusion; which is also something we want to avoid during the response to a crisis.

Finally, the quality of the data in terms of completeness and accuracy remains limited and could definitively be improved if the necessary guidelines and standards were defined and agreed upon among all the institutions in charge of generating and maintaining these data.

All of this would of course require resources, but a lot could certainly already be done if the mandate of each institution was to be more clearly defined, if duplication of efforts within and among institutions would be reduced, if conflicts between data sharing policies were to be addressed, and if workforce such as the Open Data community was to be leveraged.

All of this leads to a set of questions that it would be important answering:

1. How can the Open Data Philippines program, and more specifically, the 2014-2016 implementation plan [k] help in solving some of the data accessibility issues?;

2. How can the international community help the Government in addressing some of these issues, starting by filling some of the data gaps and support its maintenance?;
3. How to ensure that the response to a crisis is actually directly contributing to strengthening the country information system and improve data, in order to be better prepared at the time of the next crisis?;
4. How can we leverage the Philippine GeoPortal Initiative to also provide all institutions with the necessary standards and guidance to ensure data compatibility among sources and improve data quality?; and
5. What other bottlenecks to data availability, quality, and accessibility are present in the country and how could we address them?

Trying to answer these questions, a first workshop has been jointly organized by DSWD and the SIIEM project in February 2014. While the outcomes of this meeting have already provided some possible answers to these questions, there is a need to expand the discussion to all the stakeholders involved in disaster risk reduction and emergency management and/or in the production and maintenance of these common operational datasets, and to identify and implement sustainable solutions to address these bottlenecks and gaps.

This discussion is very timely in a country such as the Philippines, being considered as the 3rd most risk-prone country in the world according to the 2012 World Risk Report [l], and the solutions to be identified could present a major asset for the Government and the international community at the time of responding to the next crisis.

IV. REFERENCES

[a] IASC (2010): IASC Guidelines Common Operational Datasets (CODs) in Disaster Preparedness and Response: https://www.humanitarianresponse.info/applications/data/document/iasc-guidelines-cods-disaster-preparedness-and-response [Accessed April 26, 2014]

[b] SIIEM project website: http://eoe.aag.org/siiem-project/ [Accessed April 30, 2014]

[c] Global Administrative Areas (GADM) website: http://www.gadm.org [Accessed April 26, 2014]

[d] Earth Science Data Interface (ESDI) at the Global Land Cover Facility http://glcfapp.glcf.umd.edu:8080/esdi/index.jsp [Accessed April 26, 2014]

[e] National Health Facility Registry (NHFR) website: http://uhmis2.doh.gov.ph/doh_facility/rfacilitieslist.php [Accessed April 26, 2014]

[f] Transportation in the Philippines from Wikipedia: http://en.wikipedia.org/wiki/Transportation_in_the_Philippines#Land_transportation [Accessed April 30, 2014]

[g] Road data for the Philippines on DPWH's website: http://www.dpwh.gov.ph/infrastructure/Road%20Data/2012%20Road%20Data%20for%20Ipad/index.htm [Accessed April 30, 2014]

[h] NAMRIA's 2008 road dataset through OCHA's website: https://cod.humanitarianresponse.info/dataset/philippines-roads-0 [Accessed April 30, 2014]

[i] OpenStreetMap Philippines: http://openstreetmap.org.ph/ [Accessed April 30, 2014]

[j] Geofrabrik website to download the OSM dataset for Asia: http://download.geofabrik.de/asia.html [Accessed April 30, 2014]

[k] Open Data Philippines action plan 2014-2016: http://www.gov.ph/downloads/2014/01jan/Open-Data-Philippines-Action-Plan-2014-2016.pdf [Accessed April 30, 2014]

[l] United Nation University, the Nature Conservancy (2012): World risk report 2012: http://www.ehs.unu.edu/file/get/10487.pdf [Accessed April 30, 2014]