

Assessment of GIS Capabilities of LGUs of the Province of La Union, Philippines: Basis for Action Plan

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The study determined the Geographic Information System (GIS) capabilities of the Local Government Units (LGUs) of La Union province in the Philippines. The GIS profile of the LGUs was assessed and the level of awareness, understanding, utilisation and expertise of GIS users on selected GIS concepts were determined. Constraints in the utilisation of a GIS was investigated to come up with a proposed GIS action plan. Using a descriptive research design, a constructed questionnaire was used in gathering data substantiated through key informant interviews. Data analysis was done using descriptive statistics. Results revealed that GIS users in the LGUs have moderate awareness and fair understanding on some GIS concepts. GIS is moderately utilised in the LGUs and GIS users have average level of expertise on such. LGUs operate GIS under minimal funding and technical support. Technical, financial and organisational constraints in GIS utilisation is evident such as limited GIS background of users, costly hardware and software and the absence of fulltime GIS specialists. Based on the results, projects such as capacity building, benchmarking and data collaboration were proposed to increase the GIS capacities of LGUs. Information dissemination was also done to extend the results to the LGUs.

1. Introduction

Geographic Information System (GIS) is recognised as a relatively new and valuable tool in decision making that is useful in a wide range of disciplines including agriculture, public health, natural resource management, and local governance (Tongco, 2011). Mapping land use/cover has been widely recognised by the scientific community (Yeo et al, 2017) to use it for understanding certain phenomena on the Earth, deriving biophysical information and used in planning and management of natural resources (Yeo et al, 2017). Ideally, agriculture, forestry, environment and natural resources management and conservation need state-of-the-art tools and procedures to effectively put into practice well-planned integrated and participatory strategies of all concerned sectors of the government and private entities. Such calls the use of GIS, global navigation system and remote sensing collectively termed as “GIS technology” (Reyes, 2009).

Though the art of GIS has been in existence since the 1960s, the science was restricted to skilled GIS professionals (Shamsi, 2005). Local governments especially in developed countries are now heavily using GIS in the management and administration as well as in planning and implementation of projects such as land use, emergency and disaster mitigation, boundary delineation, transportation, and public works (Tongco, 2011).

In the Philippines, the integrated use of remote sensing and GIS methods and technologies became fully mature in the 90s when most of the local researchers have taken advantage of the power of GIS (Reyes, 2009).

Since then, satellite data had been used in a wide range of applications for resource and environmental change detection, monitoring and management including forestry, geology, land use, pollution control, coastal zone and others. A lot of these applications however, had been directed more toward scientific and experimental pursuits rather than operational purposes (Reyes, 2009).

GIS initiatives in the country are apparently attuned to address impacts of disasters brought about by climate change. The Housing and Land Use Regulatory Board (HLURB) is mandated in terms of regulation of land use to ensure rational use of land and efficient shelter delivery in the country. One of the major functions of the

HLURB is to come up with guidelines on the preparation of Comprehensive Land Use Plans (CLUP) for LGUs as well to provide technical assistance to the LGUs planning. The CLUP is the instrument specified in the Local Government Code (RA 7160) as the means to identify the community's needs and translate them into achievable policies and plans, programs and projects. A CLUP prescribes the development pace, direction and strategies in a community as well as its role in provincial, regional and national development.

Designing the CLUP to lessen exposure to hazards and manage land and water resources is also a means of disaster risk reduction. The importance of land use planning as a strategic climate change adaptation tool is clearly stated in the Philippines' National Framework Strategy on Climate Change (NFSCC). Under the NFSCC, the integration of climate change and disaster risk reduction into local land use and development plans, based on an integrated ecosystems approach or 'ridge-to-reef' framework, is considered a major pillar of the country's adaptation plan (HLURB, 2013).

With some steps of advancements and achievements of GIS in the country (Philippines), it is still undeniable that GIS and all of its components and applications are not widely known to the people in the country. Based on a GIS literacy study conducted by Ulep (2000), from the total of 1,600 LGUs, about 1 % are in the operational stage, 4 % are in the developmental stage, 14 % are still in the planning stage, and the majority, 82 % have no GIS. These results suggest that for the past fifteen to sixteen years, most of the local governments are not utilising GIS.

In the province of La Union, little have known about the applications of GIS in its LGUs such as a tool for making maps relevant in land use planning and in Disaster Risk Reduction Management (DRRM) planning activities. As such, the assessment of the capabilities of LGUs in using a GIS was done to assist administrators in further improving the capacities of LGUs to handle GIS-related projects.

GIS, as one of the components of the CLUP, facilitates the analysis of geographic data needed in the formulation of hazard maps, land use maps and other thematic maps needed in local governance. Since the formulation or updating of local government's CLUPs is a very crucial undertaking done by the LGUs, the need to assess the utilisation of GIS should be taken into consideration.

2. Methodology

A descriptive design was employed in this study. Data were collected through the use of a questionnaire substantiated by key informant interviews. Reliability test using Cronbachs 's Alpha was employed to determine the internal consistency of the questionnaire.

There was a total of thirty-six respondents that were selected through total enumeration from all offices with GIS-related functions in the seventeen LGUs of the province. Most of the respondents are males, aged 35, engineering degree earners and who have worked in the Municipal/City Planning and Development Offices for about eight years with basic training background on GIS.

There are twenty towns of the province however, three do not utilise a GIS namely Balaoan, Bangar and Sudipen at the time of data collection therefore, eliminating them from the coverage of the study. The time of data collection was April to December 2016. Upon retrieval of the constructed questionnaires, the data were tabulated and analysed using descriptive statistics such as frequency counts, means, percentages and rankings. The Likert Scale was used in determining the corresponding statistical range and descriptive equivalents of variables that utilised rating scales.

3. Results and Discussions

3.1 GIS Profile of LGUs

Table 1 shows the GIS profile of LGUs. Results revealed that the primary source of GIS data in the LGUs are government agencies (69.44 %) while more than half (55.56 %) generate their own data. Agencies like the National Mapping and Resource Information Authority (NAMRIA) provide map data such as base maps and topographic maps to LGUs for mapping activities. Most of the LGUs rely on open source GIS desktop like Google earth (80.56 %) and Quantum GIS (69.44 %) mainly due to high cost of more sophisticated GIS software. These affects the availability of tools and functions of the system for more complex projects. Some however managed to use commercial desktop GIS like ArcGIS (52.78 %) and AutoCAD (38.89 %) but free or trial versions only. The establishment of a reliable and functional internet connection was not evident in some LGUs affecting the overall GIS data handling and management especially when working on online databases or datasets. The most common formats of GIS data used in their projects are Shapefiles and geodatabases. GIS updating is not definite mostly due to absence of continuing GIS projects in the LGUs. Aside from the application of GIS as a tool in land use planning and mapping, other applications are uncommon. Budget for GIS projects are not definite but provided by LGUs.

Table 1: GIS Profile of Local Government Units

Criteria	Frequency	Percentage (%)
1. Sources of Data		
a. Own agency	20	55.56
b. Government Agency/ies	25	69.44
c. Private Agency/ies	7	19.44
d. Web/Online Source/s	19	52.78
2. GIS Software/Package Used		
a. Commercial Desktop GIS		
a.1. ArcGIS	19	52.78
a.2. AutoCAD	14	38.89
a.3. ArcView	8	22.22
b. Open Source Desktop GIS		
b.1. Quantum GIS	25	69.44
b.2. Web Mapping Application/s	4	11.11
b.3. Google Earth	29	80.56
3. Internet Connection		
a. Personal	5	13.89
b. Provided by LGU	16	44.44
c. None	15	41.67
4. GIS Data Formats		
a. Geodatabase	15	41.67
b. Shapefile	23	63.89
c. CAD	8	22.22
d. Image	9	25.00
e. Raster	1	2.78
5. GIS Data Updating		
a. Immediately upon a change	6	16.67
b. At least monthly	3	8.33
c. Quarterly	1	2.78
d. Annually	5	2.78
e. Bi-annually	1	13.89
f. If Necessary	2	5.56
6. Budgetary Allotment for GIS Projects		
a. There is budgetary allotment for GIS projects.	12	33.33
b. There is no budgetary allotment for GIS projects.	7	19.44
c. There is no budget allocated but we plan to allot budget for this.	4	11.11

3.2 Level of Awareness and Understanding on Selected GIS Concepts

In this study, the awareness and understanding of respondents on selected GIS concepts was assessed with the aim of partly describing the knowledge of GIS users in the LGUs about GIS. Based on the results (Table 2), there is a moderate awareness of the respondents on GIS definition, elements and data; GIS-related sciences; and thematic mapping and spatial analyses but a relatively high awareness on map projections, coordinate and positioning systems, and georeferencing.

Table 2: Level of Awareness and Understanding of Respondents on Selected GIS Concepts

Criteria	Awareness		Understanding	
	Mean	DE	Mean	DE
1. GIS Definition, Elements and Data Structures and Types	3.32	MoA	3.14	F
2. GIS-related sciences (Geography, Cartography, Geodesy/Geodetics and Remote Sensing)	3.15	MoA	2.98	F
3. Map projections, Coordinate and Positioning Systems, and Georeferencing	3.57	MuA	3.28	F
4. Thematic mapping and spatial analyses	3.34	MoA	3.09	F
Grand Mean	3.27	MoA	3.12	F

Note: DE – Descriptive Equivalent; MuA – Much Aware; MoA – Moderately Aware; VG – Very Good; and F – Fair

Consistently, there is fair understanding of respondents on all the GIS concepts they evaluated. These results imply that knowledge about some GIS concepts by the respondents maybe limited reducing the maximisation of the technology. This further means that respondents need to broaden their understanding on some of the GIS concepts assessed.

Knowing and understanding GIS is essential in accomplishing GIS-related plans of the LGUs. For example, the choice or purchase of GIS software and hardware, types of training to avail, the type of workforce to hire and others. As such, it can be assumed that the LGUs are capable of integrating abovementioned activities in their future or present plans or activities as they are aware and understand the applications and need for GIS.

3.3 Extent of Utilisation of GIS in the LGUs and Level of Expertise of Respondents

Based on Table 3, there is a moderate extent of utilisation of GIS in the LGUs especially in map production; analysis of existing physical data; demographic data collection and analysis; transportation and public works; disaster preparedness and response; and environmental planning and management. On the other hand, there is an average level of expertise of respondents on map production; transportation and public works; and disaster preparedness and response, while below average expertise on the analysis of existing physical data; demographic data collection and analysis; and environmental planning and management. This would mean that GIS and its potentials are not fully utilised in the LGUs. It can be attributed to the profile of the respondents where most of them have basic GIS training backgrounds only.

Table 3: Extent of Utilisation of GIS in the LGUs and Level of Expertise of Respondents

Criteria	Extent of Utilisation		Level of Expertise	
	Mean	DE	Mean	DE
1. Map production	3.18	ME	2.69	A
2. Analysis of existing physical data	2.90	ME	2.53	BA
3. Demographic data collection/analysis	2.71	ME	2.41	BA
4. Transportation and Public works	3.07	ME	2.72	A
5. Disaster preparedness and response	3.34	ME	2.91	A
6. Environmental planning and management	2.82	ME	2.58	BA
Grand Mean	3.00	ME	2.63	A

Note: DE – Descriptive Equivalent; ME – Moderate Extent; A – Average; BA – Below Average

3.4 Perceived Constraints in the Utilisation of GIS by the Respondents

Reflected on Table 4 are the perceived constraints in the utilisation of GIS by respondents.

Table 4: Perceived Constraints in the Utilisation of GIS by the Respondents

Criteria	Frequency	Rank
A. User Constraints		
1. Limited/little background about GIS	9	5
2. Limited/little background about Mapping	11	1.5
3. Limited/little GIS trainings	9	5
4. Limited/little administrative support for GIS trainings	10	3
5. Limited/little technical support for GIS trainings	9	5
6. Limited/little time to work on GIS-based projects	11	1.5
7. Lack of interest to learn GIS	2	8
8. Lack of means to learn GIS	2	8
9. No GIS consultants/expert	2	8
B. Technological Constraints		
1. Difficulty/complexity of software	11	3
2. High cost of hardware and software	14	1
3. Computers are outdated and not capable of handling GIS	6	5
4. Lack of useful or usable data	13	2
5. Limited hardware	9	4
C. Institutional Constraints		
1. Little or no budgetary allotment for GIS projects	9	2.5
2. Less priority given to GIS projects	9	2.5
3. Lack of collaboration with other agencies/institutions	8	4
4. No full time GIS specialist/s	13	1

Based on the results, most of the respondents have little background on mapping and only have limited time to work on GIS-based projects. Some of the respondents also revealed that they lack knowledge and trainings on GIS and there is a little or no technical support for GIS trainings. This may be attributed to the fact that most of the respondents have basic background on GIS therefore it is expected that some would note such constraints. It can be supported by the statement of Bato, et al. (2011) that most LGUs do not currently have the technical capability to perform remote sensing and GIS, therefore, concerned national agencies should conduct regular trainings to LGU staff and should develop an easy-to-follow technical manual utilising free and open-source remote sensing and GIS software.

A small number of respondents revealed to have no means to learn GIS and that they cannot find GIS consultants or experts. As a result, they tend to lack interest to learn GIS because some resources in learning GIS, like computers and GIS software, may not be available.

The most pressing technological constraint to some of the respondents is the cost of hardware and software. Open source desktop GIS may not provide sufficient tools in complex spatial data analysis therefore the purchase of sophisticated GIS package is sometimes required. The acquisition of commercially offered GIS software can be a difficult problem to LGUs as they are limited to financial resources therefore, hindering the maximum use of GIS. It can also be noted that the difficulty of using a GIS software is a hindrance to few of the respondents. It may be attributed to the level of understanding of respondents to certain GIS concepts as they only have fair understanding therefore, some of them would not fully understand the actual applications of a GIS software. Hardware-related problems like the use of outdated computers and limited hardware were also found out which may be associated to the income class of the LGUs where most of them are 3rd to 5th class municipalities, therefore, the acquisition of GIS-related hardware may not be too practical for them.

The most notable problem in the LGUs in terms of institutional aspects is the absence or lack of full time GIS users/specialists. Evidently, three LGUs in La Union do not have full time GIS users mainly because personnel handling their GIS resigned or affiliated to other non-government organisations. Some of the respondents stated that there is little or no support to GIS-related projects and less priority is given to such. Based on interviews, GIS is not quite a priority in some LGUs as they are focused on much imperative priorities in their localities such as public health and safety, infrastructure projects and agricultural projects. It may also be associated to the lack of collaboration between the LGUs and other institutions as noted by some of the respondents.

3.5 Action Plan

Based on the findings of the study, an action plan was proposed to address the constraints and difficulties of the LGUs in the utilisation of a GIS (Table 5).

Table 5: Proposed Action Plan

Project/Activity	Objectives	Expected Outcomes
1. Capability Building (Seminar cum Workshops) on the:		
a. Introduction to GIS, Global Navigation Systems and Remote Sensing	•To increase the understanding of LGUs on the concepts	<ul style="list-style-type: none"> •Participants should be able to explain the components of global navigation systems •Participants should be able to operate a GPS hardware
b. Georeferencing	•To enable LGU personnel to apply georeferencing techniques and to increase their understanding on how coordinating systems work	<ul style="list-style-type: none"> •Participants should be able to understand the concept of georeferencing •Participants should be able to employ several types of georeferencing techniques
c. Thematic Mapping, Spatial Analysis and Topology	•To provide knowledge on basic and common map editing tasks and spatial analysis tools.	•Participants should be able to produce reliable and basic maps
d. Vulnerability and Risk Assessment Using GIS	•To supply LGU personnel with adequate information on vulnerability and risk assessment using GIS	•Participants should be able to create vulnerability maps
2. Benchmarking on GIS utilisation of LGUs	•To enable LGUs adopt best practices LGUs in terms of GIS utilisation	•Participants should be able to assess LGUs and benchmark GIS best practices
3. GIS Data Collaboration	•To enable data sharing and collaboration between LGUs	•A networking and sharing of GIS data between the LGUs

As seen on Table 5, the conduct of capability building is proposed to increase the capacities of LGU personnel in handling a GIS in terms of introduction to GIS technologies (GIS, global navigation systems and remote sensing); georeferencing; thematic mapping, spatial analysis and topology; and vulnerability and risk assessment using GIS. A benchmarking activity for GIS utilisation in LGUs is also proposed so that LGUs with low extent of utilisation can have actual learning experiences. Lastly, GIS data collaboration is proposed to enable data sharing and possible collaboration of GIS projects between LGUs.

4. Summary and Conclusion

In the seventeen LGUs of the Province of La Union that utilises a GIS, users are capable to handle GIS-related projects utilising non-sophisticated open-source desktop GISs. Mostly have moderate awareness and fair understanding on some GIS concepts and they do not fully utilise the system as affected mainly by their limited background on mapping and limited time to work on GIS-related projects. It is also due to the high cost of hardware and software and the absence of fulltime GIS specialists. The proposed action plan may help the LGUs to mainstream GIS in their planning activities especially in terms of addressing spatial-related problems or issues. As part of extending the results of the study, the outputs of the research were disseminated to the provincial LGU on behalf of all the Municipal/City LGUs.

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