GENEALOGICAL AGGREGATION AND ANCESTRAL DOMAIN MANAGEMENT: A WEB-BASED GIS IMPLEMENTATION IN A DEVELOPING COUNTRY

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ABSTRACT: The nascency of emerging technologies brought significant impact to different walks of life, and most prone to vulnerability and repress the marginalized society, especially in developing countries at large. This study's domain focuses on the Indigenous Peoples (IP) of the Philippines in a select geographic region. According to the country's Republic Act number 8371 (RA 8371) or commonly known as the "Indigenous Peoples' Rights Act of 1997 (IPRA)", is to preserve and protect the cultural diversity, solidarity, rights, welfare, and ownership of ancestral lands exhibited to the indigenous community. There have been reports on cases and incidents of land disputes, miscalculation of boundaries, and inconsistencies of terrestrial data throughout times. In some extant literature, challenges such as inaccuracy and loss of genealogical records have been accounted for, which must be kept preserving their ancestral origin. To address the issues presented herein, we conducted an assessment in the case of the Caraga region. First, we gathered data through available permitted documents from the National Commission's office on Indigenous Peoples (NCIP), the sole agency in IPRA law implementation. Second, we interviewed key personnel of the agency and triangulated them with the documents presented. Third, we analyzed the data and presented the recommendatory solutions to the agency. The recommendation encompasses digitized spatial data banking and building a demographic profile among IPs. Thus, Genealogical aggregation and ancestral domain management system.
The system was built using the web 2.0 architecture integrating therein other technological platforms such as GIS, Google map, database infrastructure, and other mapping tools. Genealogical aggregation starts from profiling each IP and aggregates with other profiles to produce a genealogical record or its ancestral origin. In contrast, ancestral domain management enables the user to manage the platform like uploading shapefiles and updating maps overlayered in the google maps, which renders a visual representation of ancestral land. In conclusion, upon implementing this study, it provides a convenient way of accessing information, producing accurate and timely records, and printable maps, thereby expediting the IPRA law's goals in preserving and conserving the indigenous group.

1. INTRODUCTION

Today, the trend of using technology, especially information and communication technology (ICT), has had a significant impact on almost everyone in society and causes most companies to optimize their ability to obtain advantages, access, and productivity at work or in business (Vaitis et al., 2018). In a developing world, such as the Philippines, several organizations are involved in day-to-day operations to leverage ICT's power. The National Commission on Indigenous Peoples (NCIP), whose mandate is to protect and preserve the sanctity of indigenous peoples (IP) and their ancestral domain lands as reflected on the Republic Act number 8371 (RA 8371), is one of these (NCIP, 2010). As the IP community in the Caraga region, southern Philippines, began from a few members to thousands today, it is of good hope that through the use of a web-based platform, the agency can manage to plan how to preserve the genealogy of these tribes by establishing a record of their origins and their ancestral domain lands (Pitogo, 2019).
The genealogy includes families of the roots of those six (6) separate tribes in the area, collectively

preserved in hard files and cabinets for filing. In the tedious part of the organization to search and present information, and a chance of lost pages, torn parts and worst, destroyed, the challenges of these hard-keeping records could arise (Baker, 2015).
This calls on the department to use ICT through the integration of the Geographic Information System (GIS) for easier input, entry, retrieval and presentation of reports, and easier management of its ancestral lands. The development of a web-based platform to allow the agency to aggregate genealogical records of family members and their tribes' history and background. In addition, a mapping feature built into the framework will now assist in efficient zoning, referencing and potential settlement of ancestral land disputes (Cuijuan et al., 2018).
The system's implementation follows an iterative technique in which multiple users and their functions are directly involved in the process. Upon proper implementation and management of the system, this will provide an easier job among the employees of the agency and would provide other line agencies or organizations who want to use the information with fast and comprehensive information. And most of all, to the IP community, to provide them with the highest services they deserve.

2. REVIEW OF RELATED LITERATURE

2.1 Genealogical Aggregation

For millions of people around the world, genealogy have becoming a hobby or pastime for some, studying the origin of a family and their kin (Veale, 2006). It became a vibrant activity when an individual able to find their relatives and track down their heritage chain's missing link (Baker, 2015). It is fortunately tedious for some inexperienced genealogists to utilize tools for efficient work. The emerging software use for genealogic activities able to aid those researchers in their field. Some software can assist users to manage and arrange profiles and sorting of family trees, and some could run in different platforms (Cuijuan et al., 2018).
HuMo-gen is a PHP and MySQL-based web-based genealogy software that can be run on almost a regular web server platform of your choice. HuMo-gen is now available in a variety of languages including English and is still being actively developed, initially produced by the Netherlands developer Huub Mons in 1999 (Shankar et al., 2019). It allows storing of various characteristics based on the records for each member of a family and can include individual file of each kin. Another module as part of the system includes reporting mechanism, such as ancestors and its relation to descendants presented online, with an interesting feature of ancient RSS feed (Gobakis et al., 2017). Gramps is a Python-based desktop application for the management of genealogical data. It was originally referred to as "Genealogical Research and Analysis Management System." It was programmed in a Linux environment, but today it runs on other operating systems like Windows and Mac. The system uses its own style of openness to an XML format. It has also features that can store media files and events management module with an aid of a dashboard (Picone & Lo Piccolo, 2015). Another software called PHPGed View and webtrees also exists in the aid of genealogical works. These programs are also built using PHP and MySQL architecture, that allow them to run in most web services. Though the features are good enough to manage genealogy, it was not further improved since developers moved into different research (Baker, 2015). These technologies enable researchers to reproduce the genealogical aggregation of the local IP community and to strengthen existing structures such as ease of handling and other features. It helps them to develop this technology for genealogical activities in a web-based platform.

2.2 Web-based Geographic Information System (GIS)

Geographic Information Systems (GIS) are now flourishing as a robust technology with advanced tools for manipulating, storing, visualizing, and analyzing spatial data. As an evolving framework born in the early 1970s, GIS has been a catalyst for geographical phenomena that support geography as a discipline worthy of study (Dragićević, 2004). Although recent and trend-setting Internet technology, GIS has shaped its landscape from a centralized and exclusive user-oriented operation towards a more open, enhanced, and adaptive approach to other emerging technologies, such as web and mobile architecture (Javid, 2019; Matias et al., 2020). The web application allows GIS to be

operationalized in web architecture, typically referred to as web-based GIS applications (Cropf & Benton, 2019). The open use of GIS has been expanded by web-based GIS in different form of research agenda, such as retrieval and distribution of spatial data, visualization and simulation (Pacot & Marcos, 2019). The GIS and internet combination offer great possibilities such as interactive access to, data integration and transmission of geospatial information (Karnatak, 2016; Sunaryo et al., 2019). Web-based GIS has been applied in varied researches. Kulawiak & Chybicki (2018) applied GIS in tracking the shallow sea depth level in the Baltic sea, giving a more recent data on the seal level, while Bhatia et al. (2018) produced a web-based GIS program to provide interactive maps using open-source platforms. Another application that web-based GIS has been utilized can be seen in the works of Singh et al. (2016) they developed a platform for citizen's participation for reporting collection of garbage and solid wastes that exudes convenient mapping mechanism and reliable solid waste monitoring and management (Alesheikh et al., 2018).

Presenting the opportunities that a web-based GIS can provide convenience, ease of visualization for decision-making (Valcik, 2019), the researchers were profound to developed similar functionalities yet explicit on the organization that needs it, in which, ancestral domain lands needs to be digitized and analyzed.

3. METHODOLOGY

In designing and improving the applications, the researchers used the Iterative Life Cycle model. An iterative model of the life cycle does not try to start with a complete specification of requirements. Instead, development starts with only part of the program being defined and implemented, which is then checked to identify more specifications and users may provide input before progressing to the next stage, as shown in the figure below.

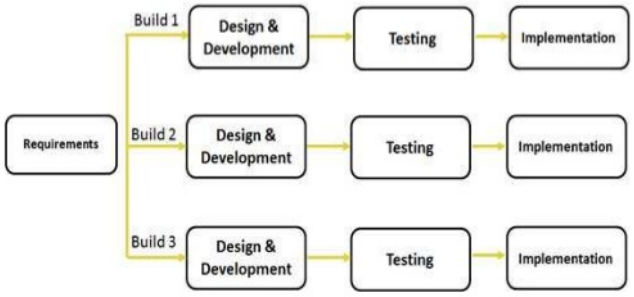

Figure 1. Iterative Model

3.1 Requirements

The researchers conducted the necessary data prior to building the application. Accordingly, there are six (6) different tribes that inhibited in the ancestral domain lands covered in the Caraga region. Each difference tribe has its unique customary and norms, but the genealogy of their origins will always have similar structure such as the chieftain as the head of the tribe. Details of each tribe has been curated and aggregated. Includes also is the software and hardware specifications for the development of the application.

3.2 Design and Development

For the design and development phase, open-source platforms such as PHP and MySQL are the backbone of the program with an integration of GIS tool for the mapping of ancestral domain lands. The framework also utilizes web applications and plugins to upload mapping data in a Geojson format that can be presented as a web-map application. Geojson is a format which is designed to contain simple geographic features on the basis of the JavaScript Object Notation (JSON) and which is made of shapefiles using third party software like QGIS.

In addition, the system architecture is designed to represent the user level and access to the entire application as presented in the following figure.

Figure 2. System Architecture

The figure shows how the system can be accessed by publics and NCIP officials. Different users have different user functions and levels, and all data from the rendering interface comes from a web server with databases on it.

3.3 Testing

Alpha and beta testing is done during this process to ensure that the application meets the user's expectations and needs entirely. The hardware requirements and the server setup are adequately handled and designed before system implementation. The potential device users within the NCIP agency were also subjected to random monitoring (Kotusev et al., 2015).

3.4 Implementation

The platform is implemented in the NCIP Regional Office 13 with its own web server and database management as scheduled after it has been tested and accepted by the end users. A required IT support is needed to maintain and manage the infrastructure as well.

4. RESULTS AND DISCUSSION

The following figures depict how the origins of all the IP community in the entire region is genealogically aggregated. Also, visual maps are featured for management of shape files and other spatial data.

Figure 3. IP Profiling

The figure shows the six tribes listed under the management of Region 13. Based on the records, different tribes may have several members, or the community may have inhabited different areas in the region.

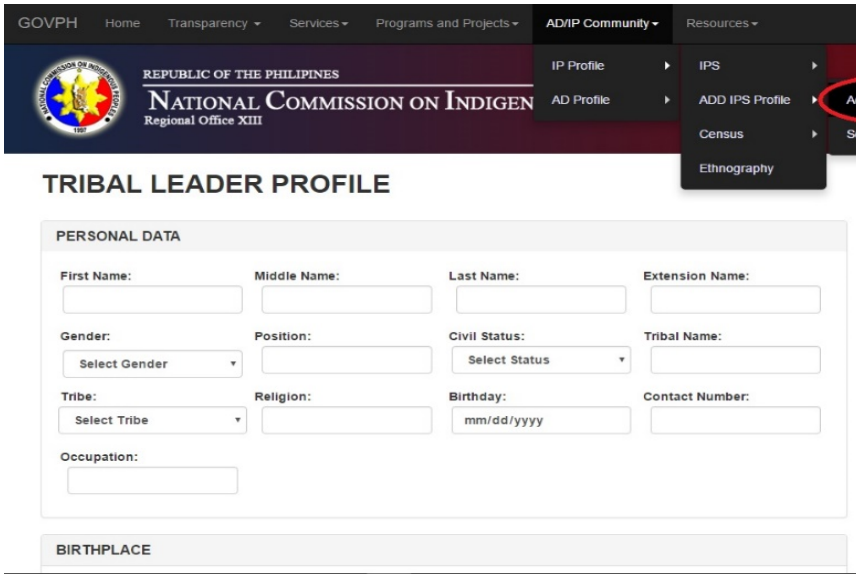

Figure 4. Tribal Leader Profiling

In this module, the management and profiling of each tribal leaders are recorded and stored.

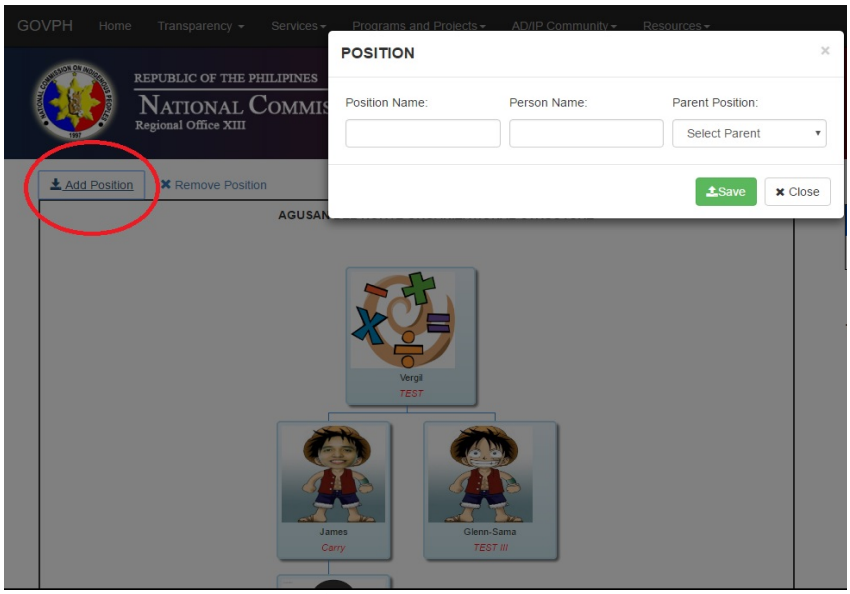

Figure 5. IP Community Leader Profiling

In this module, IP members who are appointed / selected to take office are coordinated and controlled.

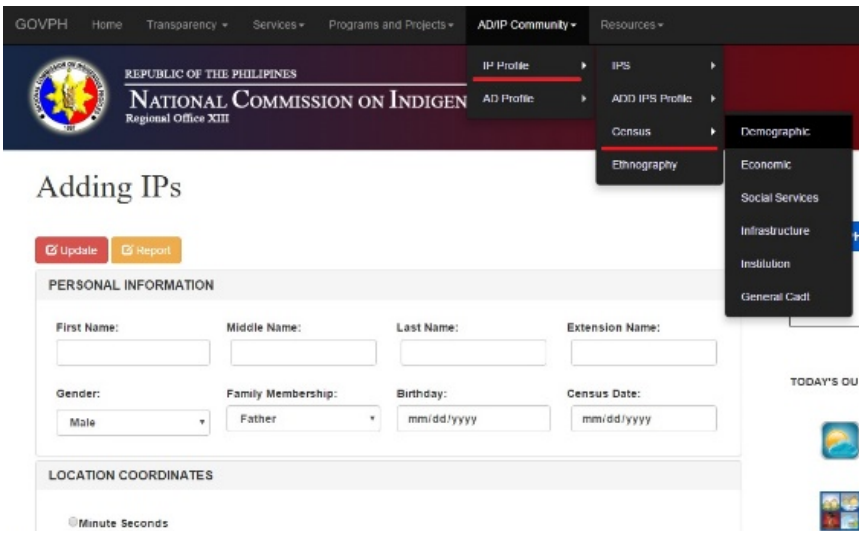

Figure 6. Genealogy of IP member

This is the module that defines and adds each IP member to the program. The said member is tagged

in which tribes he belongs and his ancestral origin. All detailed information about the member is also encoded in the listing. The genealogy of each member shall be determined on the basis of their tribe and tribal leaders.

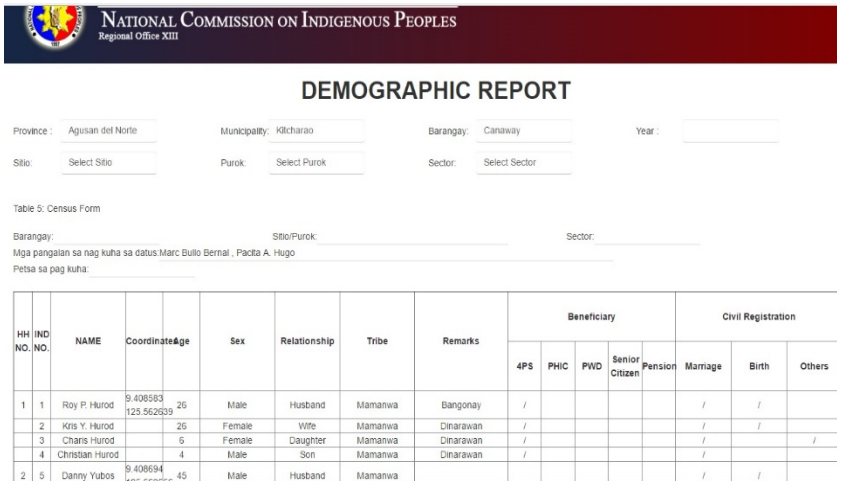

Figure 7. Demographic report

The sample report provided from the system is shown in the figure. The Demographic Report is just one of the many potential reports provided by the system, including economic, social and educational information for each tribe or tribe within a locality. The dynamics of this module enables the user to choose predefined data for presentation.

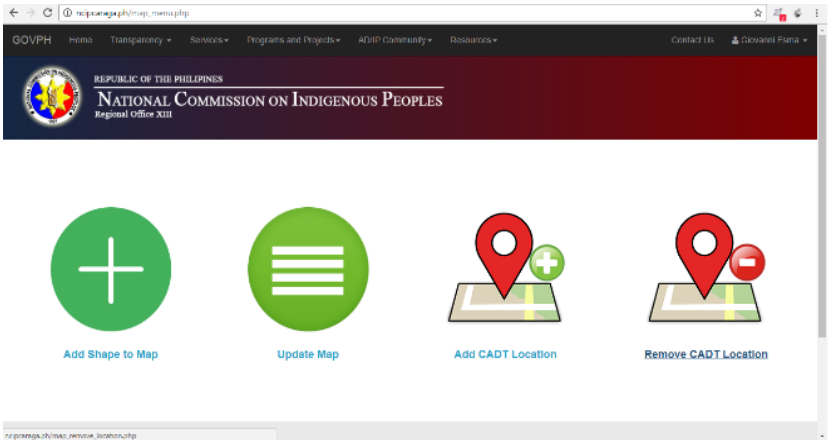

Figure 8. Manage Map

This is a map page that allows the admin account user to add shape to the map, update shape and other information, add location to the map, and remove location to the map. The shapefile and map updates are done in this module.

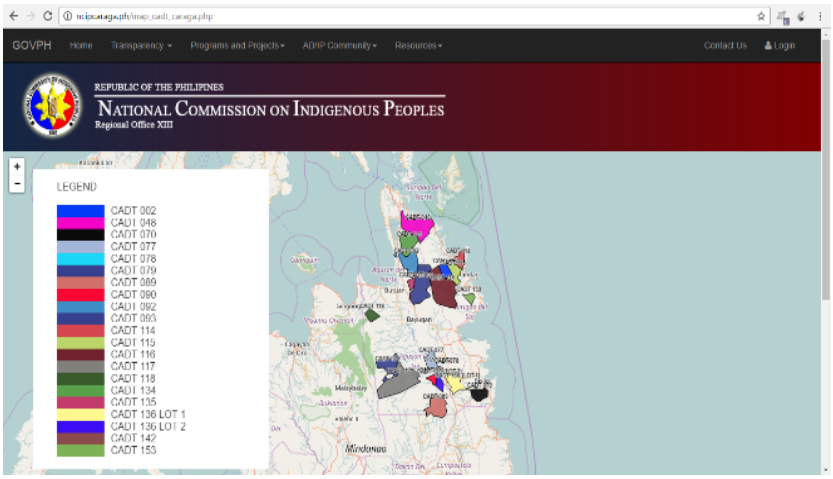

Figure 9. Caraga CADT Map

Figure 9 shows the CADT map of the Caraga region. Showing all the shapes with the corresponding color to the legend to mark the name of the CADT. With the support of the Google Map API, the shapefile is overlaid on the Google Map.

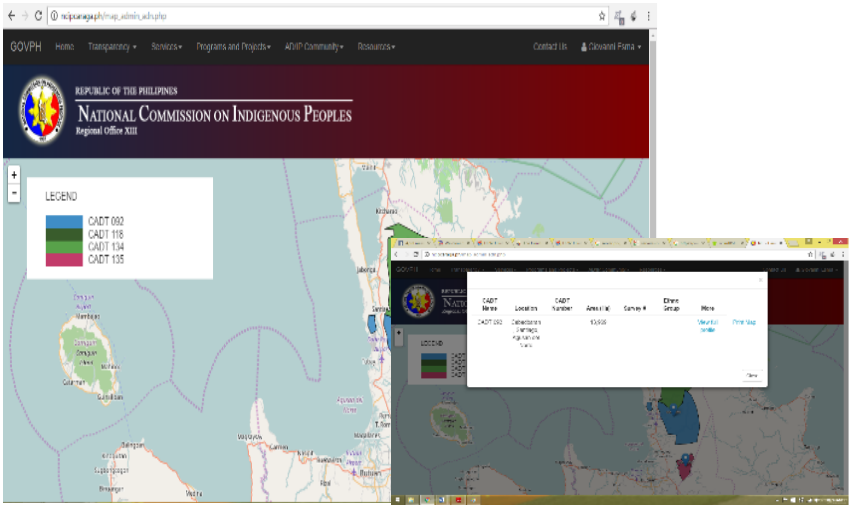

Figure 10. Agusan del Norte map

The figure shows the map of Agusan del Norte with its respective CADTs. Each CADT has a marker on it, and it can be clicked. Whenever the user hits the marker, a modal will be created showing the specifics of the CADT and two (2) links for the printable map and the complete CADT profile in pdf or document form.

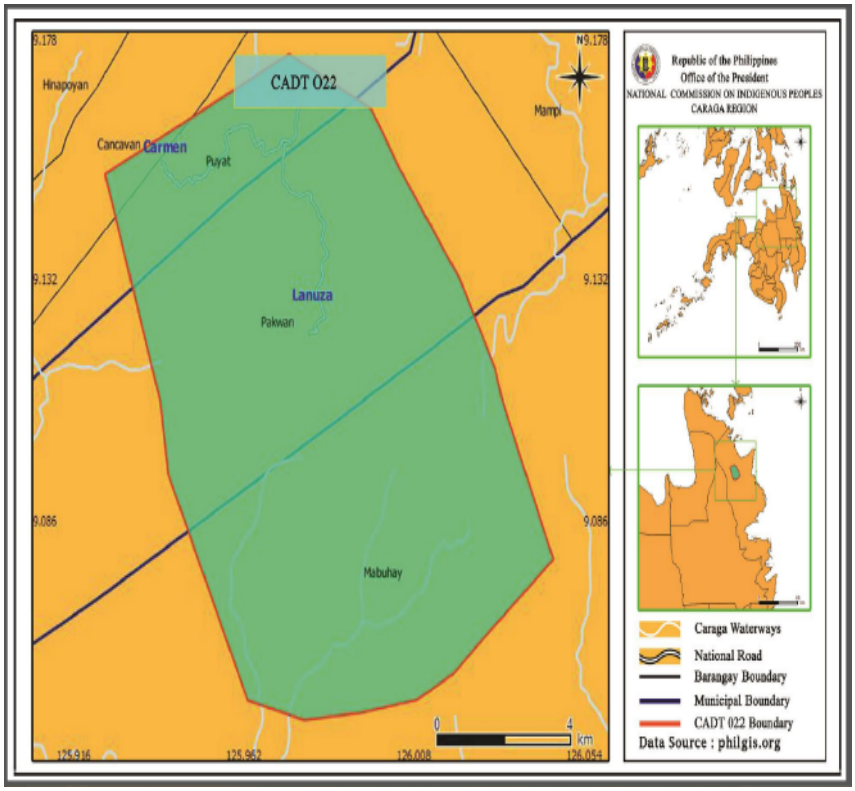

Figure 11. Printable map of CADT 022

The figure shows the printable CADT 022 map which is in pdf format and can be downloaded from the link given by the application. The figure shows the position chart of the CADT and the barangays where the CADT is located.

5. CONCLUSIONS

The program has been tested and implemented in the NCIP 13 Regional Office. On the basis of the program 's accessibility, it is able to support the normal day-to-day work of an employee impacted by this digitization. As regards the aggregation of origin records between tribes, a system capable of preserving the genealogy of the IP community within the area in which the problem raised by this research has been resolved, such as potential loss of hard files or damage to storage cabinets.

The Web-based GIS integration as a comprehensive NCIP framework has been a critical tool for the Agency to provide an effective, fast and timely reporting system. This was also an aid in the settlement of land disputes between ancestral domain lands in which the application with maps may refer to the exact position of the domain (Barik, 2019).

It also shows that the respondents consider that the program is useful and offers a user-friendly interface and that accurate information is being given. With this recent creation of CADT mapping, Indigenous People in Caraga now have an effective and convenient way to locate their ancestral lands and territories. The agency has a more natural way to visualize data maps than hard-print materials as a result of this research. This further concludes that the project greatly improved the processing and verification of domain lands between IPs.

6. FUTURE WORKS

The research presented is still at its early stage of implementation and is early to say that the method is worthy of adoption by all other agencies. However, it is recommended that this application be continually improved and expanded to meet the Agency 's needs. The integrated ICT tools may not be as robust as they currently are but may deliver state-of-the-art framework enhancements in the future (Ernst et al., 2019).

The following is suggested by the researchers to help develop the system.

1. Allows the framework to better handle the data of indigenous peoples by having more modules and functionalities;
2. The GPS functionality should be amplified as an integrative method to locate the precise location

and points on the map;
3. Add a map for the number of Indigenous People (IPs) for decision-making and other visual information on land title;
4. Increase as more complex imaging and visually-aid charts; and
5. Security steps should be taken when the application is implemented and used, in particular in the web infrastructure where the transmission of data is unpredictable (Barber & MacLellan, 2019).

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