MONITORING AND ASSESSMENT OF TENURE INSTRUMENTS FOR LAND ADMINISTRATION AND MANAGEMENT

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ABSTRACT:

The Unified Map and Data Sharing or UMD-Sharing Project are tools and protocols for the preparation of a unified map for the various tenure instrument. It aims to provide NGAs and LGUs with guidelines on how to effectively utilize several tenure data from various NGA and LGU sources. With varying scales of data sources, in both spatial and textual dimensions, the project aims to explore these dimensions to create the Unified Map's spatial data model. In general, map is regarded as a basic tool in land administration and management (LAM) and a unified map's solution of harmonizing these disparate tenure instruments could mitigate conflicts. To implement the Unified Map and to show how data sharing is handled among the different organizations, including the LGUs, the project developed a QGIS plugin interface that can utilize a remote database repository.

1. INTRODUCTION

1.1 Background

Goal 15 of the Sustainable Development Goals (SDG) pertains to life on land. Specifically, it aims to protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, reverse land degradation, and stop biodiversity loss. It is circumstantial that all these challenges are land related. It is imperative that we acknowledge that man, specifically its activities on land, has a huge impact on the landscape and the environment. It is, therefore, necessary to regulate the use and behavior of man towards land. An important target in achieving these is addressing the challenge of land administration in a country, specifically land tenure.

Land tenure is one of the basic functions of land administration, invented by society, to regulate the use of land by allocating the necessary rights, responsibilities and restriction to certain individuals or groups. In the Philippines, while challenges from population increase, climate change and natural and man-made disasters are of primary considerations, it is cited that the insecurity of land tenure and property rights is the triggering, if not the primary, cause of these land-related challenges.

The Philippines has an overall strong framework on land tenure rights as indicated in the 1987 Constitution. There are four major tenure-related reforms since the 80s - CARP/ER, IPRA, UDHA & Fisheries Code, each seeking to create a more secure tenurial system and each implementing in their own independent capacity. However, these systems also lead to conflicting and fragmented policies creating overlaps in the mandates and functions of various land administration units (LAUs) - national government agencies (NGAs) and local government units (LGUs). These further leads to overlaps in land boundaries that defines land tenure. For instance, some instruments are issued by NGAs and others are issued by the LGUs, creating a complicated delineation of tenure. Furthermore, tenure rights can be further extended to other users to instruments such as rentals, lease, special permits, and contracts. Each land administration units also maintains their own land information systems (LIS), which are usually remote

and independent from each other. In short, there are many tenurial instruments and systems that require review and assessment. This research aims to codify and protect these unconsolidated information of tenure instruments.

1.2 Research Objectives and Significance

This research aims to assess and pose a GIS solution on the overlapping tenure instruments, by addressing key issues in mapping and GIS data creation and storage. Furthermore, consolidation of these data into a harmonized unified map that follows a single GIS standard would reduce many issues revolving the integrity of the dataset itself.

In addition to this, the research also aims to provide a solid mechanism for data sharing among the producers and consumers of data from various NGAs and LGUs. The Unified Map Tool integrates these two objectives in its design and development.

Upon completion, the UMD-Sharing Project will provide NGA and LGU capability to
1. Effectively use maps and information for various land administration and land management functions.
2. Adopt existing standards from well-defined protocols and guidelines.
3. Integrate maps and information from various data organizations.
4. Create maps with ease using tools that follow the domain and data model of the Unified Map system.
5. Enable interoperability and data sharing among NGA and LGU.

2. REVIEW OF RELATED LITERATURE

2.1 Maps in Land Administration and Management

Maps are basic tools for efficient and effective land administration and management. Recent initiatives of the government are to allow data sharing within and among NGAs and LGUs, empowering the communities with more facts used

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for critical decisions. To realize such initiatives, there are a few fundamental technical considerations that if not met would make such realizations a challenge. For the land administration and management (LAM) sector, particularly the tenure domain, these challenges exist and are primary subject of this research.

A related study, Review of Land-related Laws and Policies on Tenure (2019), mentions two of the technical problems in LAM. The first problem pertains to the fragmented nature of the land administration function in the country, manage by different land agencies and their executive department. Although it seems positive that this creates a check and balance among NGAs, it also creates confusion especially if the tenurial instruments and functions overlap with each other. The second problem, which is related to the former, is the lack of policy in data sharing among these executive departments. This exacerbates the former problem with the creation of their independent databases that are not compatible with each other. Although the culture of creating copies of digital information have been in practice in the country, the burden of cleaning and preprocessing were thrown to the consumers leading to ineffective utilization of the data.

2.2 Geographic and Land Information Systems

The design and creation of a Unified Map for land administration purposes is one of the milestones prioritized by the UM-DataShare project. This milestone is an answer to one of the many challenges in Philippine mapping and Land Information System implementations. As mentioned above, there is need for maps and spatial data for effective LAM. However, due to the overlapping and unconsolidated preparation of these data by the agencies mandated to provide them, their use for further analysis and consumption, particularly by LGU, is never an easy task. Devising a standard for a Unified Map that will consolidate and prepare maps from various agencies together with DENR LAMS is a big leap in supporting our LGU's LAM functions.

To achieve this, the UM-DataShare project needs to revisit and assess the existing LIS of the country, particularly from the DENR, Land Registration Authority (LRA), Department of Agricultural Reform (DAR), and the National Commission of Indigenous Peoples (NCIP). Each of these government institutions has established their own LIS independent from one another. Existing LAM standards such as ISO 19152 or the Land Administration Domain Model and some ISOs by ISO/TC 211 (Technical Committee for Geographic Information/Geomatics) are established approach in the design and implementation of LIS. These standards are the guiding principle in the implementation of the Unified Map.

3. METHODOLOGY

3.1 Preliminary Consultation and Assessment

Most data requests and inventory activities are conducted through the efforts of our DENR focal personnel and their GIS operators in each respective region. A requirement workshop was conducted with the stakeholders to gather expectations and needs.

It was in the data inventory activity that the researchers came to realize that not all datasets were GIS-ready. Some data were missing and/or issued by a different issuing agency. But some missing data were unavailable simply because the region doesn't have that kind of tenure instrument issued by the responsible agency. Although all data collected were currently digital, a quality assessment, both in terms of geometry and attributes are

needed. Map projection was a common problem. Another issue was the schema or attribute table was missing or was not originally specified in the dataset. In this case, the dataset is only representing the geometry of the features and not the information it conveys.

During the requirement workshop, many of these issues were expressed by the agencies and LGUs involved. Collectively, data models for these tenure instruments are going to be a priority in the project. The lack of dataset specification is the cause of many of these challenges. Combined with capacity building and training, it can be a viable solution to these problems.

3.2 The Unified Map Development

As stated in the research objectives, the creation of a Unified Map allows integrating land information from several NGA and LGU sources into a single GIS map instance. To achieve this, all spatial data considered must be prepared according to the standard and specification defined by the Project.

By using the Unified Map, each submitted or uploaded dataset becomes part of a spatial database and serves as an updating and maintenance module for the Unified Map Database Repository. GIS standards is a fundamental requirement in the Unified Map, due to the nature of the source data, which comes from several independent NGAs and LGUs. Adopting to this standard allows data layers (e.g. tenure instruments) to be integrated in a consistent land information managed and maintained by the Unified Map. The Unified Map GIS Standard and Specification follows the conceptual framework of the project as shown in the figure below.
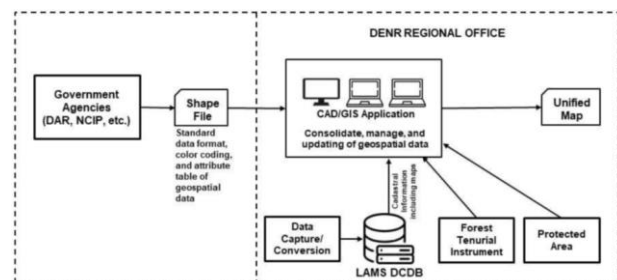

Figure 1. Conceptual framework of the research

3.2.1 The Unified Map GIS Standard and Specification. The primary objective of the research is the creation of a unified map that follows a GIS standard. Two important assumptions were established for the Unified Map GIS Standard and Specification. To transform tenure instrument to the target specification, the first assumption and the starting point of the Unified Map activities is the availability of existing tenure instrument layers. The minimum requirement for the "Source" submission is the ESRI shapefile format. Conversion to this format is the responsibility of the NGAs or LGUs producing the tenure instrument.

With the data sharing protocol among NGAs and LGUs handled within the Unified Map Tool, the more it necessitates the "Source" data to comply with this standard. In addition, future connections to existing spatial data infrastructures (SDIs) such as DENR One Control Map or NAMRIA Geoportal requires the source data to follow the Unified Map Standard and Specification.

The second assumption is the description of our "Target" output, which is the Unified Map Specification itself. This includes technical descriptions such as coordinate reference systems, database schema or attributes. Also included are the symbology, labels, and other mapping component. A metadata format was also included to support and describe the data created following the unified map data specification.

3.2.2 The Data Sharing Protocol. The second objective of the project is to improve access to relevant land information by making the Unified Map accessible to NGAs and LGUs for land administration and management purposes. This was implemented by creating a plugin software based on popular GIS software called Quantum GIS (or QGIS). QGIS is an open-source GIS software used by our NGAs and LGUs.

The main design requirement adopted in the development and implementation of the Unified Map is based on an open GIS principle. Open GIS is the full integration of geospatial data into mainstream information technology. This practically means, that the users have the means to access and share data over a GIS software without having to worry about format conversions or proprietary data types.

The design considerations for the Unified Map are as follows:
1. The unified map should be capable of handling spatial and non-spatial data.
2. The unified map should be implemented using robust and mature open source technology.
3. The unified map should be interoperable with standard interfaces.
4. The unified map should be extensible.
5. The unified map should be secure.

These considerations are the primary reason for choosing QGIS as the main GIS tool and its plugin system for extensibility. In addition to QGIS, postgreSQL and postGIS were also incorporated in the system to enable spatial data operations and security of the data. Both QGIS and postGIS are Open Geospatial Consortium (OGC) compliant technology.

4. RESULTS AND DISCUSSION

The Unified Map and Data Sharing Project (or simply Unified Map) are set of tools and protocols for the preparation of various tenure instruments. It aims to provide national government agency (NGA)'s regional units and local government units (LGU) with procedures on how to effectively access and utilize several tenure instrument data. Covering pilot sites for the 3 regions – Region 10 (Cagayan de Oro), Region 11 (Davao) and Region 13 (Butuan), it implements the two objectives discussed in the previous section, specifically, to create a standard GIS specification for the tenure instruments and to provide a prototype access for data sharing.

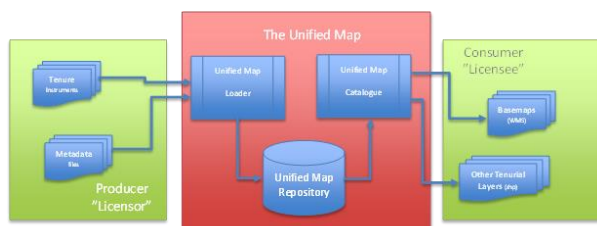The Unified Map Architecture is shown in the figure below:

Figure 2. Unified Map Components

This architecture enables the Unified Map and Data Sharing Tool to integrate a data delivery system for the project. The tool comprises of a client and a server component:
1. the client is the QGIS and the Unified Map Plugin comprising of a Loading and Catalogue Module.
2. the server is postGIS Database configuration.

The plugin client can be installed in a QGIS 3.22+ for all the identified user roles. The Unified Map Database Repository is a PostgreSQL with postGIS 3.x extension installed in an Amazon Web Services (AWS) Relational Database Services (RDS) instance.

The incorporation of a postGIS in the QGIS Plugin implementation allows the Unified Map Layers and its metadata to be stored in a designated database. Furthermore, being OGC-compliant allows the Unified Map to be interoperable to any succeeding GIS development utilizing the Unified Map data layers such as DENR One Control Map or NAMRIA geoportal, which also follows the OGC standards.

The development of the Unified Map tool provides important user functionalities for managing tenure instruments. The following discussion shows some of the important software components and user interface in the Unified Map Tools. Functionalities to upload and share data are incorporated into the tool.

4.1 The GIS in Unified Map

As stated in the conceptual framework, the creation of a Unified Map allows integrating land information from several NGA and LGU sources into a single GIS map instance. To achieve this, all spatial data considered in the Project must be prepared according to the standard and specification recommended by the Unified Map. See **Appendix** for a sample Unified Map Specification.

By using the Unified Map Tool, each submitted or uploaded dataset becomes part of a spatial database and serves as an updating and maintenance module for the Unified Map Repository. GIS standards is a fundamental requirement in the Unified Map Tool, due to the nature of the source data, which comes from several independent NGAs and LGUs. Adopting to this standard allows data layers (e.g. tenure instruments) to be integrated in a consistent land information managed and maintained by the Unified Map Tool.

The figure below shows the Welcome and Login page of the Unified Map. Licensor and Regular Users of tenure instrument data are given separate user credentials. It is necessary to have a minimal user control in this application to monitor the uploading and downloading of data.
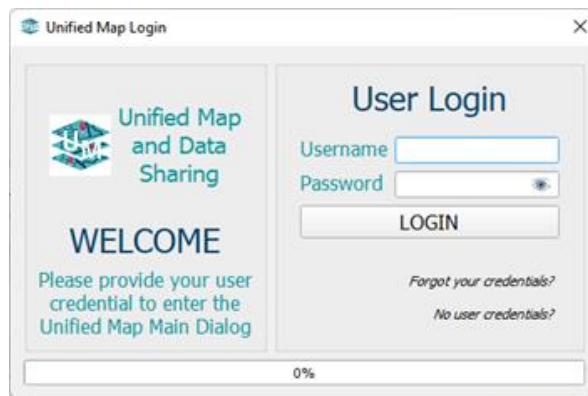

Figure 3. Welcome and Login Page

4.2. The Data Sharing in Unified Map

In its current version, the Unified Map has two data sharing modules: These modules facilitate the uploading and downloading of tenure instrument in its data sharing protocol.

1. Loading Module
2. Catalogue Module

4.2.1 Loading Module. The Loading Module is the main interface for uploading tenure instrument. Only the licensor (e.g. owner and uploader of tenure instruments) can upload data in the Unified Map Repository using this module. In this interface, the licensor selects an ESRI shapefile in its local repository to upload and to build its metadata entry. The metadata is strictly mandatory for licensors to upload their shapefiles in the Unified Map Repository. Data discovery in the catalogue module relies on the metadata entries, and so an incorrect metadata can make an uploaded tenure instrument data undiscoverable in the catalogue module.
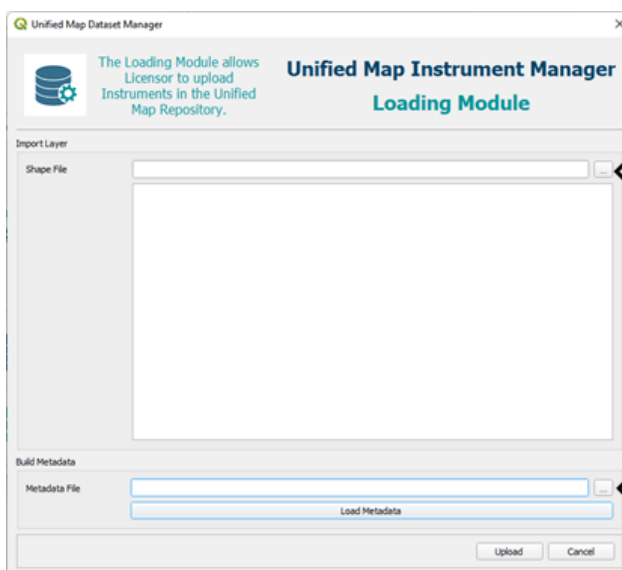

Figure 4. Loading Module

Metadata is necessary in a data sharing system. Metadata records the who, what, when, where, how, and why of a data resource. There are already existing standards in metadata as seen in this site https://www.fgdc.gov/metadata. Metadata information for the various tenure instruments were generated and stored in standard file formats. Unified Map metadata are organized in javascript object notation (JSON) format. The selection of json format is rooted from the fact that json follows a strong object-oriented pattern in structuring data content. QGIS python scripts and the PostgreSQL database also supports json files.

These metadata information is incorporated in the Unified Map Loading Module of the plugin. It helps bind the different configuration of the data layers. Figure 5 below shows the metadata builder in Unified Map.
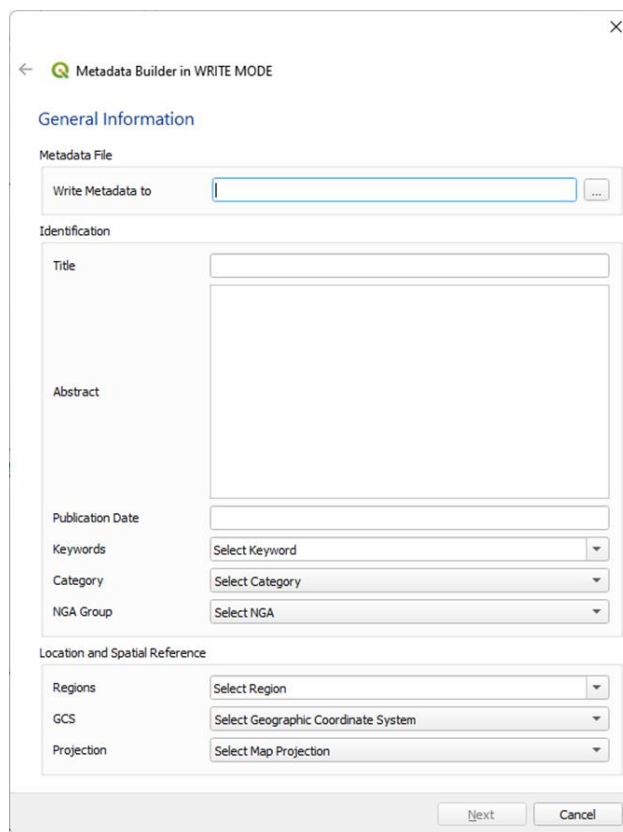

Figure 5. Metadata Builder

Figure 6 below shows a sample javascript object notation (json) file featuring the metadata entry in the Unified Map Repository.

```
{
    "title": "Region 11, National Integrated
Protected Areas (2022-11-03)",
    "abstract": "NIPAS is the classification and
administration of all designated protected areas
to maintain essential ecological processes and
life-sup- port systems, to preserve genetic
diversity, to ensure sustainable use of
resources found therein, and to maintain their
natural conditions to the greatest extent
possible.",
    "publicationDate": "2022-11-03",
    "keywords": "NIPAS",
    "category": "Biota",
    "group": "DENR",
    "regions": "Region 11",
    "gcs": "PRS 92",
    "projection": "PTM Zone 5",
    "status": "completed",
    "purpose": "For the creation of Unified Map
and Data Sharing Protocols",
    "dataQualityStatement": "Ground
Survey/Digitized Map",
    "restrictions": "Environmental Impact
Assessment and other\nProhibited Acts",
    "dataResource": "ESRI Shapefile",
    "dataName": "Region11-NIPAS_2022-11-03.shp",
    "attributes": [
        {
            "attribute": "Location",
            "label": "Location Name",
            "description": "Refers to the
location of the Protected Area",
            "displayOrder": "1"
        },
        {
```

```
        "attribute": "Region",
        "label": "the region",
        "description": "the region",
        "displayOrder": "2"
    }
  ]
}
```

Figure 6. Metadata in JSON format

The following are the essential metadata fields for the Unified Map Data Layers according to the json file.

1. Title – preferred naming convention "Location, Data Type (YYYY-MM-DD)".
2. Abstract – Provides additional information and enables users to better assess the data resource's fitness for use.
3. Publication Date - Date edited/updated (YYYY-MM-DD)
4. Keywords - Short, specific keywords, such as Tenure Type (e.g. MA)
5. Category – standard data group or category
6. Group – NGA or LGU group
7. Regions - Keyword identifies a location (Project site name, Province, City/Municipality)
8. GCS – the geographic coordinate system information of the data resource
9. Projection – Map Projection of the data resource
10. Status – the completion status of the data resource
11. Purpose - Summary of the intentions with which the resource(s) was developed
12. Data Quality Statement - General explanation of the data producer's knowledge about the lineage of a dataset. Must include stages of processing, software used and accuracy.
13. Restrictions - Limitation(s) placed upon the access or use of the data.
14. Attributes – list of attributes including descriptions and labels of the data layer.

4.2.2 Catalogue Module. The second module is the Catalogue Module. The Catalogue Module allows discovery and access to the Unified Map Repository. This is patterned on the publish-find-bind paradigm used in SDI and geoportals. Both licensee (i.e., regular user) and licensor (i.e., uploader user) can use this module.

Figure 7 below shows the user interface of the catalogue module and its data discovery interface. The metadata of each tenure instruments are also viewable in the catalogue module.
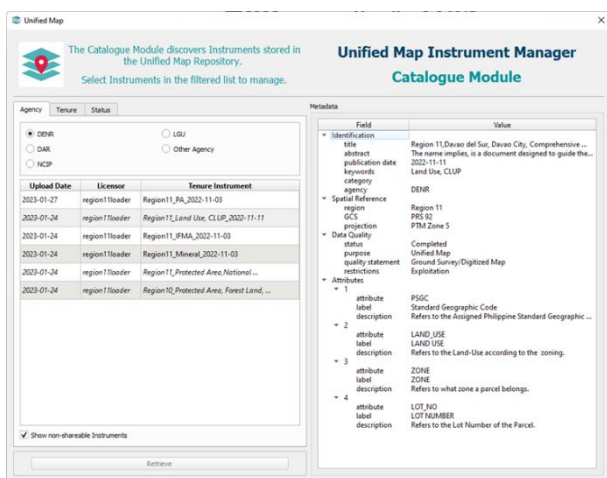

Figure 7. Catalogue and Data Discovery in Unified Map

The Unified Map Tool integrates both the unified map transformation and delivery system required for data sharing.

User credentials with secure database access ensures the integrity of the unified map layers in the repository. Licensor and licensee are provided basic information on the use of the data through the metadata entries. These are linked and stored for each layer. Ownership of the tenure instruments are retained to the licensor who has the sole responsibility for the layer's maintenance and updating.

5. SUMMARY AND CONCLUSION

Land administration and management can benefit from geographic and land information systems. Adopting to best practices in mapping and information technology will further improve and answer the challenges of land tenure. International mapping and GIS standards are the way forward to make data shareable.

However, in any GIS and Land Information System (LIS) project, the people component is a crucial part for its sustainability and proper working condition. Users should be knowledgeable of the features and workflow of the system. New software systems are usually met with resistance from users. This is normal as new products and software need time to integrate to existing workflow.

Furthermore, proper organizational and institutional setup should be established to sustain and maintain the existence and use of this technology. It becomes an abstract thinking if there is no established mechanism to implement any LIS. This starts with an LIS Office and its resources and people. Although not directly connected to the Unified Map project, this operational solution will benefit the NGA and LGU in the long term.

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APPENDIX

Tenure Instrument: Certificate of Ancestral Domain Title (CADT)

Involved Documents: Republic Act No. 8371

Data Format: vector shapefile

Abstract:

Certificate of Ancestral Domain Title. These are titles that were issued by the NCIP.

Keywords: Boundaries

Unified Map Schema:

FIELD NAME	TYPE	FIELD LENGTH	DESCRIPTION	DOMAIN	VALID VALUES
CADT_NO	Int	10	Refers to the CADT Number		239
DATE_APPROVED	Text	50	Refers to the the Date the CADT was Approved		January 17, 2019
AREA	Double	50	Refers to the AREA of each CADT	Range	67238.759000 00002
HOLDER	Text	100	Refers to the ethnic group holder		Manobo
PSGC	TEXT	10	Refers to the Assigned Philippine Standard Geographic Code		
SRVY_SYMBL	Text	50	Refers to the CADT Survey Symbol		
POPULATION	Text	50	Refers to the population inside the CADT		
STATUS	Text	254	Refers to the Status of the CADT		

Unified Map Topological Constraints:

CADT inside Municipal Boundary	CADT inside Barangay Boundary
CADT disjoint or touch Free Patent	CADT touch Free Patent
CADT inside Land Classification	CADT disjoint CBFMA
CADT disjoint SIFMA	CADT disjoint IFMA
CADT disjoint FLag	CADT disjoint Protected Areas
CADT disjoint PACBRMA	CADT disjoint CLOA
CADT overlap Mineral Agreement	CADT contians Mineral Agreement

Justification:

CADT is inside the Municipal Boundary, Barangay Boundary, and Land Classification. CADT should be disjoint or can only be touched to Free Patent, CBFMA, SIFMA, IFMA, FLag, PACBRMA, CLOA, and Protected Areas. CADT contains Mineral Agreement if there is a Free, Prior, and Informed consent for NCIP.

Sample Screenshots:

The figures below show the cases of the CADT (which appears to be the hollow polygon with brown outline) from other Tenurial Instruments.