

Geo-spatial Metadata Information System to Support State Land Administration in Colombo

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Key words: NSDI, Metadata, Land Administration, Colombo

SUMMARY

Sri Lanka, being a developing country in south Asian region has recorded a growth in land tenure and related land administrative proceedings by following the regulations issued since the colonial times. Having established the Survey Department in 1800, surveys related to land administration have been carried out for more than two centuries and a large number of statutory survey plans has been archived. These old survey records are not only very important but also play a vital role in present land administrative issues.

Since 1977, the country has been exposed to open economy. This trend has made the country rapidly urbanized resulting in conflicts of geo-spatial data floods. Organizations dealing with urban land administration possess various types of spatial datasets used in different project levels in different time frames. These have been archived digitally or as manuscripts without proper documentation of relevant meta information. Hence, the organizations which owned geo-spatial data have failed to present geo data to their clients to suit for the requested purposes. The city planners of many institutions are in conflict in seeking relevant information for initiating their projects. Especially, Non Governmental Organizations (NGO) involved in infrastructure developing Programmes need geospatial data to suit with their applications. Lack of Geo-spatial Meta Information System supported by National Spatial Data Infrastructure (NSDI) results in a critical drawback in implementation of land related developing tasks.

Most of the spatial-data saving organizations are in a privileged position with state-of-the-art systems for scanning the survey records and archive as electronic documents. Even though, this procedure is very much helpful in reducing the mass storages of hard copy archives, it does not facilitate the users with required Meta information to reduce the time-consuming tasks.

Hence, this technical paper - “Geo-spatial Metadata information system to support state land administration in Colombo” – elaborates issues involved. It also discusses the growth of land tenure and the key role which is being played by the Survey Department in land administration of the country.

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1. INTRODUCTION

Sri Lanka is a tropical country surrounded by Indian Ocean situated at latitude 7 degrees and longitude 80 degrees. The total area of the island is 65,610 sq km and the total population is 20 millions. Sri Lanka has a well-documented history over 2500 years of Civilization. But some ruins found in mountainous areas give evidence of civilization over 5000 years BC.

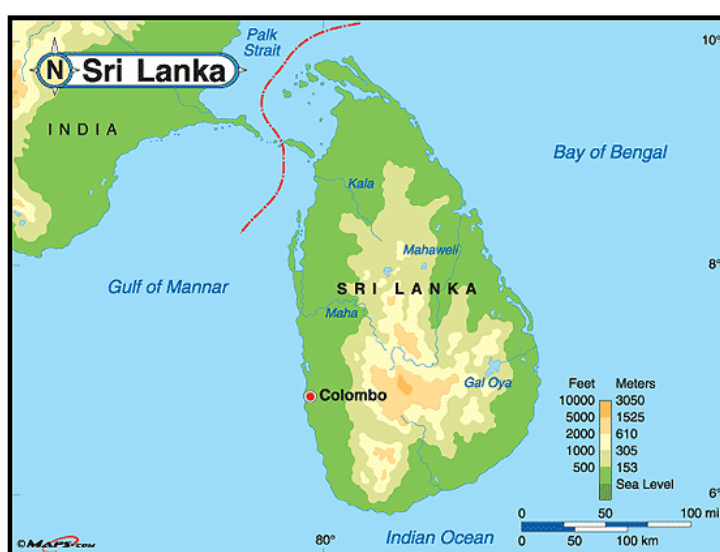


Figure-1 Sri Lanka & her Territory

The country has been ruled by a number of kings from time to time choosing various cities as their kingdoms. Archeological ruins found in many sites prove the sustainability and incredible technology used in irrigation schemes for agriculture.

Since the beginning of 16th century, Maritime Provinces have been gradually captured and colonized by Portuguese, Dutch and finally British. The country since then had been dominated by European administrative proceedings.

Since the country was exposed to open economy in 1977, the urban land resources have been shrinking rapidly due to irregular urbanisation. The demand of lands for agriculture, housing & industry has been increasing correspondingly. Requirements for urban land have led to misuse and degradation of lands in many areas.

Being a rapidly urbanising country in south Asian region, Sri Lanka is facing a complex situation because of geo-spatial data floods. With availability of sophisticated data capturing

equipment in the market, many organizations are engaged in collecting geo-spatial data at small scale level for their project requirements. However, land administrative surveys have been carried out by the Survey Department (**SD**), since its establishment in year-1800. Most of the professionals involved in projects for developments, first visit the SD for investigation to ascertain suitable lands for their projects. Hence, SD is facing a difficult situation in providing such information in time. There are many reasons for the delay in delivering the information. At the same time, there is a critical drawback in adopting the old surveys to the new jobs.

Hence, practice of National Spatial Data Infrastructure (NSDI) is found to be vital in urban land administration of the country by formation of Meta information inventory for the available land records in the state organizations.

2. HISTORICAL OVERVIEW OF LAND ADMINISTRATION IN SRI LANKA

2.1 Growth of Land tenure

The political history of Sri Lanka has influenced the cultural and the characteristic changes of its Land tenure and its Legal concepts to a great extent. Since 500 BC, the documented history of the country, land had been owned by the Kings, and the people had been benefited with the right to cultivate for the communal needs. Land had been allocated to the religious places (Temples) and to the king's subordinate rulers through legal documents called "Sannasa" and later, land records had been maintained in registers called "Lekam-mitiyas".

With the conquest of the Maritime lands by the **Portuguese** in **1505 A.D.** a new chapter of European influence dawned on the island. Almost all the Maritime Provinces had been ruled by the Portuguese for about 150 years. They introduced a land record called "Thombu Register" and commenced converting "Lekam-mitiyas" in to "Thombu registers".

The defeat of the Portuguese in **1656 A.D.**, at the hands of the **Dutch** provides the historical reasons for the introduction of the **Roman-Dutch Law** which has now, after three centuries, become established as the Common Law of Sri Lanka. Dutch continued conversion of "Lekam-mitiyas" in to "Thombu registers" in Maritime Provinces. Some of these "Thombo" documents can still be found in Sri Lanka National Archives and extracts of the same are issued on the request of public for reference purposes for legal rights prevailed in former Kandian provinces.

The conquest of the Maritime Provinces by the **British in 1796 A.D.** did bring the Dutch rule to an end, but not the Roman-Dutch Law. Later in 1815, British extended their rule until they captured the up-country; the last kingdom of Sri Lanka. Since then, Whole Island was dominated by the British as a colony and it was named "**Ceylon**" until it gained independence in 1948. The period of British colonization can be treated as a new era for land tenure in Sri Lanka with many significant doctrines of land administration. Ambiguous ownership, a result created in the former Kandyan provinces, appears to be responsible for neglect of land record

maintenance when the system of Lekam-mitiyas converted to Thombo registers. However this was not extended beyond the Maritime Provinces by the Portuguese and the Dutch.

British commenced procedural rules for land ownership records and issue of Title plans with the establishment of Survey Department (SD) in year 1800. Issue of Title plans for commercially valuable lands was mandated for the purpose of property transaction. Since then a number of land related administrative ordinances had been passed in many stages, which are considered as current land regulations in Sri Lanka. Hence, SD had played a leading role in land administrative doctrines by providing spatial data observing punctuality at all the times.

2.2 Land Administrative Survey Plans issued by the SD

The Survey Department, since its origin commenced preparation of Title plans and various other types of survey plans at different time frames as needed for land administration of the country. Table-1 shows a complete list of survey plans prepared by the SD and found in SD archives.

Category of TP	Numbers used	Purpose	Period Issue
Title Plan	1 to 432299	property Transaction &	1800 to 1934
Title Plan (T)	T 1 to T 29259	Commercial purpose	1934 to 1942
Acquisition Title Plans	TP1 to TP2669	For land Acquisition	1892 to 1912
Mining Right Title Plans	TP1 to TP154	Mining right purpose	1915 to 1940
Crown Title Plans	TP1 to TP154	For Crown lands	1937 to 1938
Preliminary Plans	1 to 82250	For issue of grants on	1859 to 1932
Preliminary plans (A)	A1 to A18376	settlement purpose,	1932 to 1965
District Preliminary Plans	District Based (eg; Colombo Co 8955)	Land acquisition, Vesting & alienation purpose,	1965 till now
Village Plans (VP)	Province Based	Less populated village	1859 to 1958
Final Village plans (FVP)	8891 Nos of plans issued	areas, Settlement purpose	
Topographical Preliminary Plans (Topo PP)	Province Based 319 Nos of plans issued	Very low populated & remote areas, Settlement purpose.	1917 to 1954
Irrigation Survey preliminary plans (ISPP)	Province Based 135 Nos of plans issued	Irrigation Scheme areas, For Settlement purpose.	1916 to 1986
Forest Survey preliminary plans (FSPP)	18 to 141	Settlements in forestry areas	Prior to 1980
Town Survey preliminary plans (TSPP)		Settlement in town vicinity	

Table-1 List of Land Administrative Survey Plans Prepared by the SD

The land administrative survey plans have been archived in hard copy format in survey department offices at district level and also in Colombo as duplicate copies. Hence, recently,

SD introduced procedural regulations to maintain digital records scanning all the valuable records. However, the absence of tracking system for relevant meta information of those scanned records, would result a critical draw back for the SD archives.

3. IMPACT OF GEO-SPATIAL META INFORMATION ON STATE LANDS IN COLOMBO AND THE ROLE OF THE SURVEY DEPARTMENT

Survey Department is mandated to perform its annual work plan which is amended every year in accordance with national requirements. SD is responsible to provide all the geo-information for national requirements in printed or digital format. Hence SD is functioning in two different drives; National mapping division and Land administrative surveys division. While the National mapping division functions as the central station in head office, Colombo, the Land administrative surveys are decentralized at district levels and they are more bureaucratic and need to follow up time-consuming proceedings.

Recently, SD launched a Land Titling programme in collaboration with relevant organizations and emphasized the need of digital archives in order to facilitate the requirements of general public with Land Information system (LIS). Hence, in addition to maintain archives of all the digitally captured survey data, a methodology has been introduced to scan the old survey plans to preserve as image files.

In order to facilitate Geographical Information infrastructure (GII) in the country, several conference level discussions have been conducted by the GIS community with the sponsorship of international organizations. Even though SD has concentrated its activities on GII concept for mapping sectors, land administrative survey divisions of the SD still have to take a leading role in this concept.

Land administrative plans, prepared by the SD covering the island have been archived in hard copy format in relevant District Survey offices. As the most competitive and highly build-up area in the country, the capital city of Colombo is covered with variety of land administrative survey plans out of which mostly preliminary plans are crucial for discussions on state lands.

In order to make a quick reference to the old survey plans, location based key diagrams are being maintained at the scale of 1-inch to 16-chain hard copies. These diagrams are called 16-chain RD. They have been manually updated incorporating new surveys carried out in the areas by land surveyors.

Location of new surveys in traditional plans drawn in arbitrary coordinates is rather difficult even for a professional surveyor. The only search key available to locate survey plans is the 16 chain record diagram (16-chain RD) drawn on scale of 16 chains to an inch (i.e. 1:12,672). This diagram shows the perimeter of each survey with relevant plan numbers. 16-chain RD has been amended when new surveys carried out in the area. These diagrams are very crowded now and it is difficult to find space for new entries. Further, these diagrams are only a key to the professional surveyors and they do not provide adequate meta information, which supports to trace the relevant survey records. Therefore availability of geo-spatial data and non-

availability of relevant meta information make rather difficult situation for the internal and external clients of the SD.

4 APPROACH TO GEO-SPATIAL META-INFO SYSTEM

Since armed with Master graduation in Geoinformatics at the “Institute of Aerospace Survey & Earth Sciences (ITC) – The Netherlands” I was keen to analyze the practical problems faced in meeting the urgent requests of SD’s clients for geo-spatial data. My experience in the mapping division and Land administrative survey divisions of the SD triggered me to develop at least a simple structural methodology for a Geo-spatial Meta information system enabling to provide information quickly to SD clients.

In 2008, an excellent opportunity presented before me to attend a training course at international level on “Urban land Administration” sponsored by the “Swedish International Development Agency “SIDA” held in Sweden. At this training course participants were given project assignments to complete within six months. Hence, as two Sri Lankan participants; I and one, Mr. Premathilake, Engineer, Road Development Authority of Sri Lanka could attend to a joint project proposal “Geo-spatial Meta info system for state land administration in Colombo”. Subsequently, we analyzed the project objectives as internal and external clients of the SD in order to accomplish the project goals.

4.1 Problem Definition and Change model

Most sporadically located survey plans completed in the past had been carried out on arbitrary coordinates systems without connecting to national grid coordinates. Hence, fixing of these old survey plans on to new surveys is quite complicated and is in need of extra data for fixing the boundaries. The land surveyors engaged in new surveys should go through the location key diagrams (16-chain RD) to get an idea as to which data is most appropriate in locating the new work.

The only location based key diagrams available in urbanized Colombo, are the “16 Chain RD” as hard copies and they are over crowded, difficult to read and hard to amend due to poor paper quality. Hence it is imperative to find an alternative solution to replace these “16 chain RD”.

Analyzing the As-Is situation of land administrative surveys, and studying most updated topographic maps in digital format could explore the possibility to accomplish a user-friendly meta-info inventory system based on location of any survey plan. Since, it is the responsibility of the field surveyors to maintain the location based key diagram; 16-Chain RD, it is timely to introduce a digital approach to prevailing system incorporating the Metric topographical map sheets.

Hence, we considered the importance of maintaining a record in digital form as a replacement for these 16-chain RDs for which relevant meta information could be linked through user-friendly search mechanism. Also it is necessary to explore the possibility of using 1:10,000 digital map as the key location diagram as they are readily available in the Survey

Department itself. Figure-2 shows an overlay of 16 chain RD index and 1:10,000 grid index on Colombo district map.

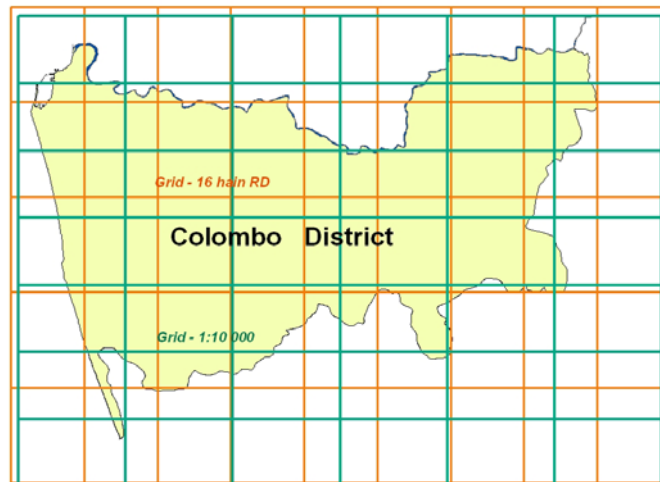


Figure-2 An overlay of 1:10,000 & 16-Chain RD Grids on Map Sheet

The scale “16 Chains to an Inch” refers to “1:12,672” which is shown in red grid lines in the diagram and “1:10,000” grids are in thick green lines. Hence, it appears that 1:10,000 scaled metric sheets are comparatively larger and seems to be a better tool for location key diagram for land administrative survey plans.

Considering the “As-Is” situation, the System architecture was designed to elaborate the “To-Be” situation with the description of the activities and their directions as shown in figure-3.

Definition of Activities

Hard Copy Key Diagrams

Manually updated location diagrams at scale of 16 chains to an inch are named as Hard Copy key diagrams and also mentioned as “16 Chain RD”. These diagrams are scanned in order to trace the respective locations of land administrative survey plans.

Land Administrative Survey plans

Mostly the Preliminary plans, which are considered as the plans prepared for the state lands in Colombo district. These survey plans are at A3 size and being scanned in order to archive in Image Database. Image DB consists of both the survey plans and relevant tenement information as scanned text pages.

Geo-Referencing and Vector Conversion

The scanned key diagrams are firstly geo-referenced with use of the grid coordinates shown in each sheet corners. The grid coordinates shown on the sheet edges are imperial coordinates and they should be converted to metric coordinates at the time of geo-referencing. On-screen

digitizing has been adopted for vector conversion of each of the location boundaries of individual preliminary plan drawn in the 16-chain RD.

Corrections and Topology Creations

Extracted location based boundary lines are then corrected for overshoots & undershoots and followed for topology creation as polygon entities and saved as shape files. These polygon shape files are named in respective survey plan numbers.

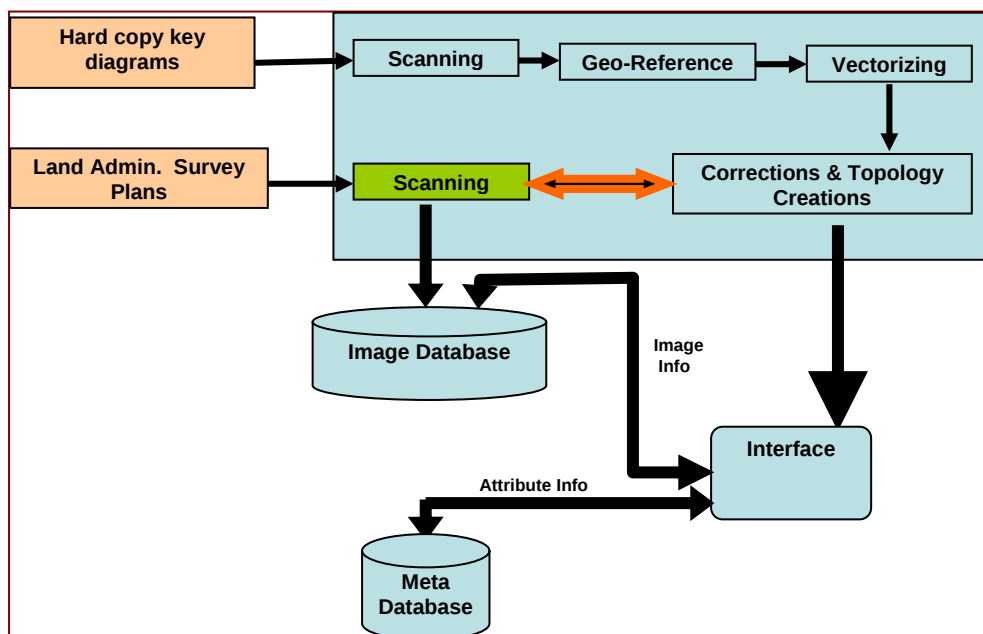


Figure-3 System Architecture

4.2 Image Database

Land administrative survey plans completed in the past are very important documents for on-going statutory surveys. All the new surveys carried out by the surveyors should be referred to old surveys graphically and also they should be described in tenement records. Hence, these old survey plans have been scanned and archived in Image DB assigning the respective survey plan number for each of them.

At the time of digitizing the key diagrams, the relevant image file should be displayed on screen for comparison and corrective precautions should be taken in tracing the boundary of each survey plan.

4.3 Meta Database and its Content

Meta database consists all the descriptive information appeared in each survey plan and the attributes are extracted from the survey plans and connected tenement pages. Even though, there are many accepted standards for metadata content in GIS applications, in this effort, we

used our own definitions for its content in order to define a simple set of attributes which could be easily handled by the internal and external users. Definitions of Metadata attributes were considered in categorizing in to groups as tabulated in Table-2.

<u>Metadata Group</u>	<u>Attribute Name</u>
Identification Info	Plan Number <i>(key attribute)</i> Request Number <i>(key attribute)</i>
General Info	Purpose of Survey Client Reference Number Client Date Client organization
Location Info	District Divisional Secretary Division Village Land name
Spatial Domain	North Bound coordinate East Bound coordinate South Bound coordinate West Bound coordinate
Quantity Parameters	Extent – Hectares No. of Allotments
Technical Info	Coordinate system Data compilation method Coverage of old data
Completion Notes	Surveyor name Supervisor Name Date of Completion

Table-2 Group of Metadata Attributes

4.4 Designing of Interface

The main task of the proposed system was to design the interface linking all graphics and descriptive data in order to display, query and update the necessary information. Following criteria was taken in to consideration in designing the interface;

Software constraints

It has been considered to develop friendly tools for the interface with Visual Basic programming taking the ESRI “Map object” as bridging software tool in order to display the graphic data in Shape files. The system can be executed in Windows without any other basic software needs.

User Interactive View port

Need to facilitate the users with graphic display of selected records (i.e. Polygon shape files of perimeter of survey plans) as overlay on location map.

Updating Facility

Interface should support the user to enter new records and any amendments to the metadata attributes and image files.

Query Facility

There should be a facility to query on Database attributes depending on users' interest and making reports as applicable.

The system interface was designed to satisfy the above requirements as shown in figure-4.

The screenshot shows the 'Survey Metadata' application window. It has a menu bar with 'File', 'Records', 'View', and 'Exit'. The main area is divided into several sections:

- Basic Info:** Requisition Number (CO/LM/78/3), Purpose of Survey (Misc Surveys), Method of Survey (Conventional), Shp. File Location (C:\SutMet\VP-SHF\CO-5064.s).
- Time of Survey:** Starting Year (1979), Starting Month (January), Completion Year (1979), Completion Month (January).
- Plan Number(s):** PP Number (CO-5064), FVP Number, FSPP Number, Cad Map Number, Suppl. Number, Sheet Number, Zone Number.
- Grid Map reference:** Path (C:\SutMet\Grid-SHF\6808.shp).
- Client:** Organization, File Number.
- Quantity Parameters:** Extent(Ha) (0.0633), Number of Lots (2), Number of Allots (2).
- Old Work Coverage:** Conversion of old Data (Manual Compilation), Old Work Coverage (Preliminary Plan).
- Location Info:** District (Colombo), DS Division (Colombo), Village (Colombo Fort, Ward No.2), Land Name (Assmt. No51 & 51/2, Lotu).
- Work Done By:** Supervisor (S.Kalutantiri -Asst.SS), Surveyor (M.K.Dayaratne).
- Location Coordinates:** Coordinate System (Arbitrary), Minimum East (97409.89), Minimum North (192444.73), Maximum East (97459.5), Maximum North (192491.5).
- Records:** A table with columns: Survey_Method, Data_Conversion_Method, Old_Covg, Coord_System, Surveyor_Name, Supervisor_Name. It lists several records with 'Conventional' survey methods and 'Manual Compilation' data conversion methods.
- Map:** A small map of Sri Lanka showing the location of the survey area.

At the bottom, there is a status bar showing 'Ready' and 'Record 1 of 48'.

Figure-4 System Interface

4.5 Working with the New System.

4.5.1 Data Collection

The continuous on-going process for scanning the survey plans has now been completed almost 9,000 survey plans and archived as “jpeg” images. Hence, those image files could easily be used for digitizing purpose. Hard copy key diagrams (16-chain RD) of Colombo metro area were firstly scanned, geo-referenced and then converted in to metric grid coordinates. Tracing the perimeters of identical survey plans was then followed with comparison with the scanned images of the same. Characteristic Meta information was then entered into MS Access Database with proper clarification of hard copy files.

4.5.2 User Satisfaction

Initially, the SD surveyors were advised to use the system in order to identify the drawbacks for further improvements. Hence, all the surveyors accepted the proposed system and expressed their satisfaction providing important comments for future developments. The surveyors also agreed to assist in data extraction on volunteer basis as the system will be useful for them in reduction of job processing time.

4.5.3 Future Developments.

- Geo-referencing of all the scanned survey plans (image files) into National Grid coordinates and link to 1:10,000 location key map as an overlay enabling display through the interface.
- Improving the system for web access in order to provide on-line Meta information to external users.
- Providing access to the system to field surveyors enabling updating facility from their field offices.

5. CONCLUDING REMARKS

- Meta information system for state lands in urbanized Colombo is an essential component towards sustainability of land related development projects.
- Traditional key diagrams maintained for location of land administrative survey plans should be replaced with digital location maps linked to a Meta data inventory tracking system.
- Process of scanning and archiving the old survey plans and maintain as electronic archives has become a fashion for most of the spatial data saving organizations in developing countries.
- Spatial data saving organizations are in disarray to follow the international metadata standards due to bureaucracy and procedural approach.

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BIOGRAPHICAL NOTES

- Present Post: **Senior Superintendent of Surveys** – Survey Department of Sri Lanka.
Responsible for Land Surveys and related regulations in Colombo district
- Overseas Experience: - **Tunnel Surveyor**, Underground Tunneling Project, Saudi Arabia (1993-1994) All Related Surveys in underground Tunneling project.
- **Professional Surveyor**, Cadastral Survey Directorate, Bahrain (2005-2006) Cadastral Data Manipulation and Architectural Modeling for “e-Service” & “Correspondence Management System of the Survey Directorate”
- Local Experience: -Land Surveys related with Major Irrigation Scheme, Mahaweli Project in Sri Lanka.
-Superintendent of Map Publication, Survey department of Sri Lanka.
- Publications: -Need of Geo-spatial Metadata for GIS community in Sri Lanka GISSL, Sri Lanka. 2004.
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