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TODARMAL ENDOWMENT LECTURE

THE ROLE OF MAPS IN BUILDING A STRONGER NATION

By

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Distinguished members of INCA, my dear young and budding cartographers committed to have a large vision for new dimensions and application of Indian and International cartography, my colleagues, students, friends

Ladies and Gentlemen it is a great honour for me to be addressing such an august audience for the Todar Mal Lecture series which is a prestigious event by itself with the INCA International Congress every year.

Todar Mal joined the service of Emperor Akbar. He was appointed “Diwan” of the Province of Gujarat. He was promoted to the post of “Wazir” and was one of the Navratna’s of Emperor Akbar’s Court.

Raja Todar Mal is credited with systematising the land revenue system. He rationalised the land tax rates and introduced the concept of compensation for crop damage. Todar Mal was not only a brilliant Administrator but also a good soldier and a General. What has immortalised Todar Mal was the revenue assessment and land survey system, which he pioneered. After the fall of **Mughal** dynasty, the system he introduced still remained and was subsequently followed by both the Marathas and the British. The present lecture is in commemoration of Raja Todar Mal's contribution to the land revenue and land survey and the foundation which he laid for cadastral surveys.

Maps were created and used by Raja Todar Mal and his team, but as you all know today, the utility of maps has become essential in all developmental works and indispensable in almost all spheres of our modern life especially if you are an urban dweller. All your daily home requirements are delivered at your doorsteps, you speed post any document, you book an Uber or Ola, you need to access the easier traffic route, you can track all your queries on your VERY SMARTPHONES. Life has become so simple, fast and easy .You hardly need to step out of your home.

Allow me to quote **Gilbert H. Grosvenor, who has been Editor of National Geographic (1903- 1954):**

"A map is the greatest of all epic poems. Its lines and colors show the realization of great dreams."

It has been often stated and it is a true appreciation of the cartography professionals that a number of astronauts, and in fact, everyone who saw the photography from space, were somehow amazed when reality turned out to be true to the maps.

Peter Greenaway, a Welsh film director has very aptly said:

“I’ve always been fascinated by maps and cartography. A map tells you where you’ve been, where you are, and where you’re going — in a sense it’s three tenses in one.”

Ladies and Gentlemen I agree that most of you here will perhaps share the opinion that all this is possible because of the internet...yes very true but there is another partner to this success story and that is GIS...Geographical Information Systems which is a very refined and precise form of mapping. From rudimentary marking of routes, highways, locations i.e. railway stations , post offices, hospitals, schools, agricultural areas, religious locations, administrative bungalows GIS offers a lot more in terms of details and is updated easily within least time thereby being cost effective. We have experienced Remote Sensing and GIS in its most basic form, i.e., our eyes and our brain respectively, however GIS as an alternate and faster mode for communicating is incomplete without technology most precisely Geospatial Technology. Remote Sensing is a process while GIS is the product of such a process.

Since the early days in cartography, people realized that to be successful they would need information and data from sources beyond their immediate workgroups. People recognized the need for data sharing. Modern cartography emphasizes on participation, sharing and collaboration. It is no more confined within experts in this domain rather it encourages involvement of common people. Geospatially-oriented social media communications have emerged as a valuable information resource to support crisis management.

Cartography is no more confined in paper maps. It has shifted to the cloud (large clusters of computer servers with a variety of software installed on them). Fast and affordable computing network enables all of us to have access to rich collections of information. Every layer has a URL that makes it searchable and easily usable. Data from different sources can be combined into a web map and can be published as an app which can be shared with anyone. This new era of cartography has much wider audience and influence on common people.

The ability to fly personal missions has whole new ways to implement cartography to a new range of problems—assessing traffic conditions; law and order problems; monitoring wildlife habitat; responding to emergencies and disasters and monitoring agricultural fields.

Little more than a decade ago the whole world was amazed to see their familiar places in continuous and multi scale imageries provided online by Google and other mapping companies. People everywhere began to experience some of what cartographers already knew. We immediately zoomed in on our neighbourhoods and located our home. Subsequently, we focused beyond that first local exploration to see anywhere in the world. Almost overnight cartography became personal and everyone with access to a computer and internet became a cartographer.

Geospatial Technology has totally engulfed every aspect of our lives and this has brought down distances, improved communication speed greatly, increased accountability and alertness and is helping individuals to store massive quantity of data virtually.

The evolving or advancing technologies of Geographic Information Systems (GIS), combining the use of satellite imaging and digital data, have made these tasks easier by replacing laborious cartographic handwork with a capacity to superimpose maps of various elements showing how these elements may be related.

Jack Dangermond of Environmental Systems Research Institute (Esri) conveyed the potential of GIS as follows:

“Knowing where things are, and why, is essential to rational decision making.”

“The application of GIS is limited only by the imagination of those who use it”.

In fact, this statement applies to any technology and more so to any computational technology. A variety of “unintended usages” emerge after adoption of a technology.

With passage of time, the cartography has enriched itself by interfacing with various emerging computing technologies. Briefly speaking, modern Cartography is dealing with Big data i.e. high-volume, and high-variety information which need cost-effective, innovative forms of information processing for enhanced insight and decision-making. There are multiple areas where geospatial technology has applied Big Data for enhanced analysis. For illustration, one may think of Climate modeling and analysis, Location analytics, Retail and E-commerce, Intelligence gathering, Terrorist financing, Aviation industry, Disease surveillance, Disaster response, Political campaigns and elections, Banking, Insurance and so on.

Geospatial technology has been further supplemented by advancement in sensor technologies. Imagery enables us to see

beyond what our human eyes perceive, providing new perspectives of the Earth. Satellites have sensors that can measure non visible information, such as infrared energy, across the electromagnetic energy spectrum that enables us to map and analyze beyond the visible. Active sensors such as lidar, radar, and sonar emit pulses of energy and then monitor the return of energy. As the return energy arrives at the sensor, the intensity and time of the return signals are used to determine the precise shape and location of the object. Active sensors work perfectly well at night and provide a new perspective of the earth. Hyperspectral sensors use a broad swath of the electromagnetic spectrum, but unlike multispectral sensors, the hyperspectral systems provide many more spectral bands, enabling identification of detailed spectral signatures. Hyperspectral images can be used to identify and map specific plants and minerals.

Ladies and Gentlemen Now the point to be pondered upon is, as to how our country has progressed from the mapping of landholdings for revenue collection since the time of Sher Shah Suri by Raja Todar Mal who rose to fame later when he joined Emperor Akbar's court as his revenue minister in 1560 A.D. I shall share with you further that even though now in India land marking system has adopted an electronic format based upon GIS the system the concept of patwaris still remain. Thus Raja Todar Mal overhauled the whole concept of ownership of landholdings and introduced standard weights and measurements which was followed throughout Akbar's kingdom and is referred to and consulted even today. In other words, we can hardly over-estimate the professional relevance of Raja Todar Mal and cartography, even in modern times.

Now to the present times.....Geospatial technology is no longer a domain out of the reach of the common man..as I have discussed at the beginning. Now the requirement is in diverse fields, and so cartography requires more precision and ease of use. Learning Cartography has been always associated with geography but that pathway has now diversified ... everyone wants to know where they are, what facilities and amenities are available within reach. Indian Universities have never realized the need for training students for professional cartography.....yet it has such a wide demand now within our country as well as abroad. Maps so far have been meticulously and authentically produced by Survey of India and the National Atlas and Thematic Mapping Organisation. Both the organisations have contributed at a steady pace to the mapping of Indian states, presenting cartographically different facets of national and regional socio economic realities and characteristics.

Cartography has diverse demand especially in a country like India with population approaching 130 crore. It is evident that requirement from cartography has to address a more diverse field comprising transportation, agriculture, medical, weather report, disaster management, navigation, drainage network enhancement for transportation and irrigation, crude oil pipes running overland, fishing, route monitoring...the list is endless.

The most pertinent question here Ladies and Gentlemen is whether we been successful in creating professionals to address the requirements of the nation? I am afraid we are in the process of creating such professionals and probably another fifty years is required to suitably build up such a workforce who can provide their services to fields of agriculture & crop health, land-use land-cover,

weather, geology, archaeology, disaster management, urban sprawl, traffic route relay and management, to name a few.

Cartography has never gained its due ground I PERSONALLY feel, because

- i) Foremost, it has been treated as a mere tool to illustrate demarcation of space on paper and pointing of locations of some feature based on a particular theme
- ii) Secondly, educational institutions have always associated its recognition with geography and never as an independent discipline which has usage in other fields also.
- iii) There is also dearth of institutions in India which are devoted to this discipline.

Now my proposition is..... if it is to be treated as a technique which helps us to describe and illustrate the concept of area or regions then why can it not be taught as subject in our technical institutes which will create a strong cartographic professionals who can provide service to the required fields. At present, professionals that we have, are sent to train at our various institutes like IIRS, NATMO or SOI for a certain duration where a general training for a certain period given and a certificate at the completion of the course. This offers limited scope for adaptation of the knowledge for multiple usage.

The drawing of a parallel between cartography and architecture is instructive. Each lies in the field of the practical arts; each is older than history; and each, since its beginnings, has been more or less under the control of its consumers.” ~ Arthur H. Robinson, The Look of Maps

In other words, a good cartographer is both a scientist and an artist. He must have a thorough knowledge of his subject, must be intelligent enough to make a right selection of the features to represent, should make artistic judgment to effectively use lines and colours, and is also expected to be aware of the tricks of effective visual communication. In fact, much like archaeology, architecture and medicine, art and science are inseparable in cartography.

In modern time, research on earth studies has become more focused, on the impact of natural processes upon those regions which are anthropogenetically important. The need for awareness and the expertise required to tackle problems like drought, floods, soil loss, land degradation and desertification , gullying in tropical lands are gradually gaining priority among the researchers and policy planners today. Nations have set up task forces to delineate and map, discuss among its experts, use latest techniques like Geospatial Techniques (remote sensing, GIS and GPS) to monitor the problem areas and finally arrive at suitable methods to address these problems. So the requirement in terms of cartographic professionals in the coming times is going to be intense.

THE BEGINNING OF CARTOGRAPHY IN INDIA

Cartography evolved since man started to settle down along the fertile river banks and settlements started to sprawl over the adjoining floodplains. Kingdoms were established and the need arose to delineate the extent. Natural features like rivers, mountains, hills or deserts were considered boundaries and taken as expanse of a particular kingdom. Then, there arose the need to

maintain records, collect revenues, gift or receive land as tokens of appreciation. Thus, the requirement for cartography in ancient and medieval India was of three types:

- i) Conquest
- ii) Rule and
- iii) Administration comprising a. revenue collection,
b. describing and estimation of cultivable and fallow land,
c. estimation of boundaries for moving military resources and trade .

Maps served as a function of measure, as means of enquiry and as a method of examination for the above functions. It is to be noted that all these exercises did not arise at the same time and gradually evolved over time and as requirements developed. Trade routes already existed over land and through sea routes.

The arrival of the Mughals in 1526 A.D. gradually progressed towards an organized system of administration. The demise of Babur in **1530 A.D. and the subsequent defeat of his son and successor Humayun at the hands of Sher Shah Suri** led to the establishment of Sher Shah Suri's empire. It is considered that Sher Shah Suri's system of administration and land reforms led to successful management of the Mughal **Empire** later under the able administration of Emperor Akbar. Raja Todar Mal was inducted by Akbar into his court as one of his nine gems (Nav Ratans) as the former had already gained experience in land reforms and revenue collection under Sher Shah Suri.

Of the few points that I would like to emphasize on Raja Todar Mal's system of land surveys was his foresight. **In place of the practice of measuring land with the help of hemp rope called *Jarib*, bamboo**

rods called *Tanab*- joined with the help of iron rings were introduced for land measurement. This innovation was introduced keeping in mind the interest of the peasants and also to check the corrupt practices of the land surveyors since the *Jarib* of rope could to contract or expand according to seasonal variations. Moreover, dishonest officials could have manipulated the *Jarib*. But the *Tanab* of bamboo and joined by iron rings could not be manipulated.)

The 18th century under the British rule in India took cartography to another level. The necessity for organized cartography arose in colonial India chiefly due to the expansion of British kingdom and establishment of dominion. Three major types of surveys were carried out in British India:

- i) Topographical
- ii) Trigonometrical
- iii) Revenue

Surveying and mapping were important part for administration of newly acquired unknown territories and India was surveyed and mapped at village as well as country level. The first detailed map of India was by a French geographer D'Anville titled 'Memoirs' published in French in 1752 which was based on travel routes and rough chart of coasts. The map of Hindoostan by James Rennell in 1788 was based on survey method and distances to be measured were chained and observations were taken for latitudes and longitudes at certain stations.

The laying of railway lines in the 19th century was yet another reason as it facilitated topographical surveys and record keeping in the form of topographical maps. Thus before mapping was necessary for

revenue and military purposes i.e.to delineate the extent of kingdoms. Now it was required for transport and communication purposes also .Railway lines gradually connected the whole of India together with the main cities being recognized as important railway stations.

Ladies and Gentlemen Before closing, I shall quote two succinct and insightful statements.

First quote is by the author **Terry Pratchett** in his novel **:*The Last Continent*** :

“Geography is just physics slowed down, with a couple of trees stuck in it.”

In other words, what we map in Geography is not an isolated interplay of the physics inspired theories, rather nothing gets depicted unless it is intermediated by the animate world including the vegetation.

The second quote is a statement by **Professor Nicholas Chrisman, of Geomatic Sciences of Université Laval**, a public research university in Quebec City, Canada applauding maturity of the theories developed in map making in precisely few words:

“Geographers never get lost. They just do accidental field work.”

Until Cartographers get an independent identity, we the geographers will continue to take credit of this field and our theories would suffice the art and science of map making. The Todar Mal series is a testimony of interdisciplinary nature of Cartography and I am thankful to the organizers of this 37th edition of INCA Congress for

providing me an opportunity to highlight the past, present and future of Cartography in evolution of India.

The foundation of map-making in India was laid during the Vedic period when the expressions of astronomical truths and cosmological revelations were made. The expressions were crystallised into 'sidhantas' or laws in classical treaties of Arya Bhatta, Varahamihira and Bhaskara, and others. Ancient Indian scholars divided the known world into seven 'dwipas' (Fig. 1). Mahabharata conceived a round world surrounded by water (Fig. 2). [From NCERT Book chapter, Introduction to Maps]

Todarmal pioneered land



Fig.1: Seven Dwipas

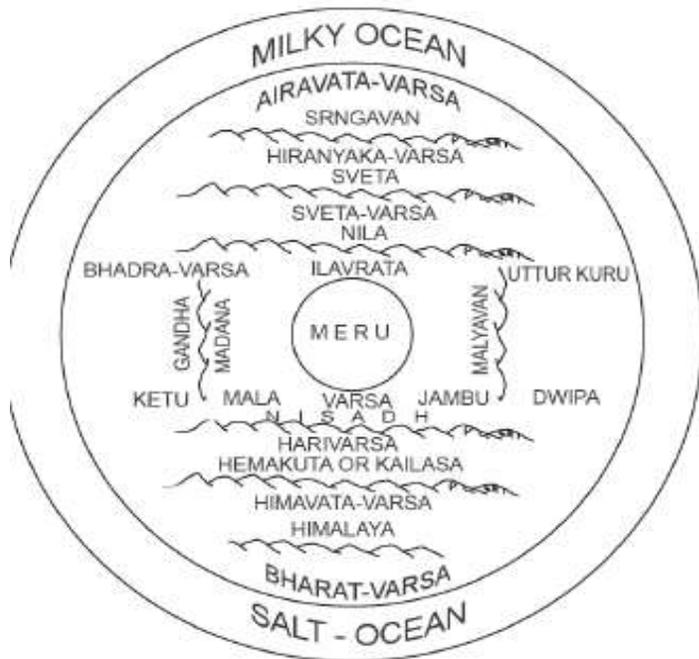


Fig.2: Round world in Mahabharata

Ladies and gentlemen, I finish now by reminding you all that cartography has a cognate role together with Geospatial Technology (remote sensing, GIS and GPS) in **building a stronger nation** and the immediate imminent need of the hour is to develop **a institute** that shall endeavor in creating professionals trained to use cartography for creating products which will cover all fields that are crucial to **nation building**.

It may be apt to end with a famous quote of Tagore –

“You can’t cross the sea merely by standing and staring at the water.”

Hence, we **need to act and act together!**

Thank you.