

# GIS development and applications in Mongolia

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**Abstract:** Land is one of the essential sustainers of human life. Most human activities are conducted on a definite part of land, not only being conditioned by the features of the landscape but also utilizing some of the features. Establishing the routes of the historic events basing on Geographical Information System (GIS) is so core and give a chance to study history events within framework of geographic and historical science nowadays in particular, to pore over the historic events for geographic, to intensify some undiscovered activities, to consider the ground reliefs, geomorphological structures and locations of the rivers to conclude for space and so on. Old maps may contain valuable information about the past. By adding coordinates to such maps, they may be added as a feature layer to modern GIS data. This facilitates comparison of different map layers showing the geography at different times.

**Keywords:** Historical GIS, Mongolia, map

## 1. Introduction

Geographic Information System (GIS) is a software that combines an interactive map with a relational database. A more detailed description of the GIS is a system of hardware, software, data, processes, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating geospatial information about areas of the Earth. Advanced foreign countries have set up GIS since the 1970's. The GIS can be used to display many layers of information on one map, using a variety of colors, shapes and labels. The map is not just for looking at: it is an interactive database, made for asking and investigating questions by zooming in and out, seeking different locations, turning layers of data on and off and making queries to get specific information about a place.

## 2. Country background

### 2.1 History in brief

A large number of ethnicities have inhabited Mongolia since prehistoric times. Most of these people were nomads who, from time to time, formed great confederations that rose to prominence. Nomadic tribes that periodically plundered agriculturally based China from the west are recorded in Chinese history dating back more than 2000 years.

The first of these, the Xiongnu, were brought together to form a confederation by Modu Shanyu in 209 B.C. They defeated the Donghu, who had previously been the dominant power in eastern Mongolia. The Xiongnu became the greatest threat to China for the following three centuries; the Great Wall of China was built partly as defense against the Xiongnu.

The name Mongol comes from a small tribe whose leader, Genghis Khan, began a conquest that would eventually encompass an enormous empire stretching from Asia to Europe, as far west as the Black Sea and as far south as India and the Himalayas.

The Mongol Empire exploded out of the Inner Asian steppe in the beginning of the 13th century to rapidly become the largest land empire in human history.

Having conquered an enormous territory in Asia, the Mongols were able to guarantee the security and safety of travelers. There were some conflicts among the various Mongol Khanates, but recognition that trade and travel were important for all the Mongol domains meant that traders were generally not in danger during the 100 years or so of Mongol domination and rule over Eurasia. Another fact, which was marked in the world history was that Mongols had a benevolent attitude toward foreign religions, or at least a policy of benign neglect. The Mongols' receptiveness to foreigners was a critical factor in promoting cultural exchange and a truly "global" history. Their attitude of relative openness toward foreigners and foreign influence led to an extraordinary interchange of products, peoples, technology, and science throughout the Mongol domains.

After Genghis Khan's death, the empire was divided into four kingdoms, or "Khanates". But by the 14th century, the kingdom was in serious decline, with invasions from a resurgent China and internecine warfare.

The area accepted Manchu rule in 1689, but after the Chinese Revolution of 1911 and the fall of the Manchus in 1912, the northern Mongol princes expelled the Chinese officials and declared independence under the Khutukhtu, or "Living Buddha".

In 1924, after the death of the religious leader and king Bogd Khan, the Mongolian People's Republic was proclaimed and was backed by the Soviets. During the next several decades Mongolian People's Republic was aligned closely with the Soviet Union in the path to build communism in the country. The collapse of communism in the Soviet Union and Eastern Europe lead to a peaceful democratic revolution in Mongolia in 1990. This, in turn, allowed Mongolia to begin engaging in economic and diplomatic relations with the Western world. The nation finished its transition from a communist state to a multi-party democracy with the ratification of a new constitution in 1992.

Mongolia uses a unicameral parliamentary system in which the president has a symbolic role and the government chosen by the legislature exercises executive power. The legislative arm, the

State Great Khural, has one chamber with 76 seats and is chaired by the speaker of the house.

Mongolia is divided into 21 aimags (province), 331 soums (sub province) and the Capital city.

## 2.2 Geography

The country that is known primarily for Genghis Khan and impressive breeds of horses is also one of the world's least-densely populated: a mere 1.92 people occupy each square kilometer of this enormous landmass.

Mongolia is the world's nineteenth-largest country with the territory of 1,565,000 km<sup>2</sup>. The terrain in Mongolia consists primarily of mountains and rolling plateaus. Overall, the land slopes from the high Altai Mountains of the west and the north, to plains and depressions in the east and the south. Khuiten Orgil (4374m), the highest point, is located in western Mongolia, where the Mongolian, Russian and Chinese borders meet. The lowest point is 560 meters in the eastern Mongolian plain. The country's average elevation is 1580 m. Throughout the history, Mongols have followed praiseworthy tradition of showing deep respect to land and its resources by using land as main source of production as well as likening it with mother by regarding as "mother land".

Mongolia has an extreme continental climate with long and considerably cold winters and short summers, during which most of its annual precipitation falls. The country averages 257 cloudless days a year, and it is usually at the center of a region of high atmospheric pressure. Total population of Mongolia according to 2015 census is 3 million.

## 3. GIS development in Mongolia

The study of cartography and its related geographic disciplines underwent profound technological and conceptual advancements in the last half of the 20th century. These advancements, brought about by the advent of computers, the development of newer and faster mathematical and computational algorithms, and the birth of satellite imagery, contributed to paradigm changes that can be considered revolutionary. Technological and conceptual improvements have generated new forms of data, maps, and artifacts that differ radically from those typically archived in map libraries. In the future, these new artifacts and materials will form the basis for the study of modern cartography and as such, their collection and preservation present new challenges to the archivist and the map.

Since 1990, Mongolia's international cooperation on environmental issues has reached a high level. Projects with international organizations like GEF, UNDP, UNEP and WWF, and countries such as Germany, the Netherlands, Japan and the USA have been jointly implemented. Government agencies make use of GIS technologies for diverse purposes, including pasture land monitoring and disaster risk reduction planning from 1992. And there is a rising demand and need for spatial information which use drawings and maps in the fields including urban planning, resources, environment and

anti-disaster, the GIS based on computer technologies has steadily widened its range of application, and seen its importance growing.

Recently many organizations and individuals in Mongolia are using geographical information at different levels depending on their own capacities and purposes. GIS data producing is time consuming work requiring significant resources. Therefore data sharing is important to avoid data redundancy and work duplication saving time and expense. The easily accessed open data with appropriate information about data increases data using by other users for different purpose.

GIS technology is a tool for decision making and is widely used in different areas of the country. Networks and computers with access to international information systems are generally available in Mongolia. The policy documents and programs approved in previous years are still effective and being followed strongly use GIS, such as:

- E-Mongolia National Program approved by the Government of Mongolia in 2005;
- National program to establish unified information and registration system, approved by the Government of Mongolia in 2008;
- National program to ensure information security, approved by the Government of Mongolia in June, 2010;

The National Data Center is established by decree No. 183 on June 24, 2009. The National Data center has perspective to be recognized as a professional organization in international level by becoming basic center for collocation of national information database and information security and quality of service in information technology sector. The main mission is to provide operative, secure and accessible services for data and information of government organizations of Mongolia.

## 4. GIS application in historical study

The use of GIS for historical research is a very new field in Mongolia. It can be regarded as a subfield of historical geography and GIS. In response of the demands of interdisciplinary research applications to construct an integrated GIS-based application infrastructure within the spatial extent of Mongolia, in the timeframe of Mongolian history, and with the contents of Mongolian civilization. The target users of present historical GIS of Mongolia are primarily scholars, academic experts, and school teachers.

Land is one of the essential sustainers of human life. Most human activities are conducted on a definite part of land, not only being conditioned by the features of the landscape but also utilizing some of the features. The relationship between human activities and the landscape should be reflected on the historical maps.

Techniques used in historical GIS:

- Digitization and georeferencing of historical maps. Old maps may contain valuable information about the past. By adding coordinates to such maps, they may be added as a feature layer to modern GIS data. This facilitates comparison of different map layers showing the geography at different times. The maps may be further enhanced by

techniques such as rubbersheeting, which spatially warps the data to fit with more accurate modern maps.

- Reconstruction of past boundaries. By creating polygons of former administrative sub-divisions and borders, aggregate statistics can be compared through time.
- Georeferencing of historical microdata (such as census or parish records). This enables the use of spatial analysis to historical data.

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