Cartography in Modern Perspective

(Discussion Note)

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Abstract

Cartography compasses a number of specialized phases: the scale of the mapping, the method of projection, the symbolization of the data being mapped, the map design, and the preparation of the map for duplication. Though the rate of change of technology in cartography is accelerating, nowadays it is seen as the medium of conveying of spatial information by means of maps. The main objective of this paper is to discuss the changing trend of cartography with some practical examples.

Key words: visualization, cartography, spatial, GIS, changing technology.

Introduction

Cartography is the making and the study of maps in all respects. A map is the graphic representation of geographical settings. It is an important branch of graphics, and efficient way of manipulating, analyzing and expressing ideas, forms and relationships that occur in two and three dimensional space. Therefore, cartography involves many activities in producing the map including the skills of map-use; the collection, comparison and manipulation of data, the design and the preparation of maps, charts, plan and atlases (Robinson, 1997).

Changing Definition of Cartography

Cartography is derived from Greek word, "Carto" means a plane paper to write whereas, "Graphe" means to describe or draw the mathematically calculated or determined graphic lines. Therefore in general terms cartography is a scientific discipline of drawing maps and charts.

The meaning of "Cartography" changed fundamentally since 1960. According to Kraak and Ormeling (1996) the change in the definition is due to two factors: first, the fact that the subject has moved into the field of communication science and secondly, the advent of the computer.

The increasing use of computer especially in the field of map-making, gave rise to new definition of cartography. Cartography indicates the information transfer that is centered about a spatial data base which can be considered in itself a multifaceted model of geographic reality (Kraak & Ormeling, 1996).

Taylor (1994) defined cartography as "the organization, presentation, communication and utilization of geo-information in graphic, digital or tactile form. It includes all stages from data preparation to end use in the creation of maps and related spatial information products." In other words, it is a discipline involved in the science and art of map design and production. The "art" of map symbol and map layout, the graphic design of the map illustration and figures, generalization, drawing, color applying and printing the final product are the crucial issues of cartography. Therefore the science of cartography is involved in the scientific research of the fundamentals of the specific aspects of data acquisition, the interpretation and generalization of information collected from field surveys, photo images etc. The President of International Cartographic Association (ICA), expressed that" Cartography was quick to act on new technological developments presented by the use of computer and GIS technology. "The present technological possibilities introduced by developments in GIS were for years the stuff of cartographer's dreams. But cartography is for general use. The people are not creating maps nowadays, but giving only the general pictures, they are not accepting and following basic cartographic rules. Seldom do maps present huge amount of information. The importance of true visualization of geographic information remains one of the fundamental functions of cartography" (Konecny, 2004).

United Nations (1949) defined cartography as "the whole science of map making." This includes disciplines like photogrammetry, geodesy etc. but the core of the profession lies in the design, compilation and production of maps. The International Cartographic Association founded in 1959, defined cartography as the art, science and technology of making maps, together with the study of scientific documents and works of art, including interpretation analysis and map perception. This definition was accepted by the Council of the British Cartographic Society in 24th April 1964 (IESS, 1972).

Cartography is several thousand years old and has always been able to adapt itself to new developments. Since the mid-twentieth century the scope of the field has been greatly enlarged to include the study of maps as documents.

Historical Development of Cartography

The concept of scale reduction, direction and distance seem innate in man, and the earliest map that has survived is more than four thousand years old. Apparently map making is an inborn aptitude of mankind. Ancient maps such as charts made by the Marshall Islanders, Eskimo, American Indians, Egyptians, Chinese and Greeks have contributed a lot to the development of cartography. The oldest known map is a Babylonian map which was discovered during the excavating of the ruined city of Gasur, about 200 miles north of Babylon. It was exhibited in the Semitic Museum of Harvard University (Raisz, 1948).

Since ancient times, cartography has grown at uneven speeds. By the second century or almost 2000 year ago cartography reached a higher state of development because of the great work of Ptolemy. Claudius Ptolemy who lived and worked in Alexandria, Egypt, was probably the earliest real counterpart of the modern cartographer. Cartography is closely associated with geography. With the death of Ptolemy the geographic horizon including cartography that had been widened both physically and intellectually by the Greeks closed in again. The discipline developed at a very slow pace because of a lack of general access to manuscript maps (Preston, 1972).

Cartography faced downhill race when mysticism (spiritual belief and insight truth in god) and metaphysics (Philosophy of truth and knowledge, meditation) superseded science. Ptolemy's ideas of map-making came back during the Renaissance (i.e. 14th - 16th centuries). The rediscovery of Ptolemy's "Geographia" which was translated into Latin during 1405, contributed to the renaissance of cartography (Raisz, 1948). The appearance of the first printed maps through woodcut and engraving techniques marked the sign of the first true revolution in cartography. Ptolemy's works inspired the great geographers and explorers of the Great Age of Discovery (i.e. 14th- 15th centuries) to explore the unknown land (IESS, 1972). However, the foundation of the present system of cartography was largely laid down by the ancient Greeks. They recognized the spherical shape of the earth, with its poles, equator, and tropics and developed the latitude-longitude system and designed the first projection, and they calculated the size of the earth (Raisz, 1948). During the sixteenth century, cartography began to develop quite rapidly. The Dutch Cartography flourished in the late Sixteenth century. It played a pivotal role in the development of Cartography. Mapping land and sea was a well known skill in the Dutch Republic in the Golden Age. Mercator was the most influential map-maker of his day; he produced globes, instruments and maps of exceptional quality and produced a series of maps covering the whole world in collaboration with Theotrum Orbis Terrarum of 1570 and paved the way for the modern atlases. Dutch successes in map making and overseas trade stimulated demand for maps as a source of news. By 1648, all of Europe depended on Dutch maps and Dutch Cartography. They even continued their own strong tradition of mapmaking and had produced the first commercial cartographers (Schmidt, 2001). By the end of eighteenth century all modern classes of maps had been developed except the thematic maps which originated with the growth of science and social consciousness in the first half of the nineteenth century.

According to Richard W. Stephenson, a historian of cartography at the Library of Congress in Washington, a wide interest in maps began to develop just before the war. In the beginning of nineteenth century many wars broke out in different parts of the earth. It increased demand for war maps and introduced a kind of revolution in map making. Consequently, many war maps were produced in order to mobilize the army in the disputed areas. At the same time, commercial map makers seized upon cartographic techniques , such as panoramic "birds' eye views" to explain the course

of the war to fulfill the curiosity of the public. Then the newspaper also started to publish battle maps.

Reflecting the situation of those days, Stephenson (Wisdom, 1990) wrote in his introduction in a published book about the explosion of maps during the civil war of American History. There were more than 2300 civil war maps, charts and atlases in the Library of Congress including maps produced for the general public.

Until the 1960 a gentle progress was marked in cartography, which was profoundly changed by the rise of geography as a scholarly discipline. In the nineteenth century, combination of events introduced a second revolution in cartography. In twentieth century, this was further boosted with technical innovations such as stereo photography, aerial photography, reproduction of maps, offset printing machine, plastic materials for drawing and cartography reached a stage of higher development. In the contemporary periods, new technological developments, particularly in computers, significantly influenced the theory and practice of cartography. With the advent of digital technology and its application in Geographic Information System (GIS), the scope of cartography notably increased beyond the mere production and usage of paper maps. The organization management, analysis and exploitation of cartographic digital files have been more effective in different disciplines.

The map has been the central focus of the sciences of cartography because of two important functions: i) as a storage medium for information which humanity needs, and, ii) as a picture of the world that helps us to understand the spatial patterns, relationships, and complexity of the environment in which we live.

The application of computer in cartography has helped in preserving the basic elements of the science providing two distinct products i) to satisfy each of the former functions that maps alone once served: i.e. the digital database replacing the printed maps as the storage medium for geographic information, and, ii) cartographic visualizations on different media as served previously by printed maps (Robinson, 2002).

Cartography in Nepal

Nepal had begun to appear in European maps and atlases by the Seventeenth century. Their source material seemed to be the account of Jesuit Missionaries, particularly Johan Grueber, who visited Kathmandu in early 1662 (Gurung, 1981). Most of the maps concerning Nepal whether historical or modern were compiled and published outside the country were of British origin. The earliest reference of map-making in Nepalese history goes back to the first decade of the nineteenth century and the specimen of manuscript map of 1864 is preserved in the National Museum of Nepal (Gurung, 1981). According to Gurung (1981) the earliest map from ground survey

was drawn, by ensign general who accompanied William Kirkpatrick's mission to Nuwakot and Kathmandu in 1723. Similarly, the reliable map of Kathmandu was produced by Charles Crawford who was the first Resident' s escort in Kathmandu.

Most of the early maps arose out of the visits or expeditions. In this context Charles Crawford was the first to take note of the great height of mountains in Nepal. There are many sketch maps of different areas of Nepal produced by several explorers between 1871 to 1886. Maps on "Route Survey from" Nepal by Pundit Nain Singh (1865-66) was the result of extensive travels in the Himalayas and Tibet (Gurung, 1981). However, most of the scientific maps of Nepal were related to delineation of boundaries between British India and Nepal. They were drawn during the first half of the Nineteenth century. Maps giving detailed information about the physical and cultural features of the area of Nepal were prepared by the survey of India during the period between 1953 and 1963.

Several maps on different scales were published based on the survey of 1924-27 conducted by the survey of India. The best and most reliable and detailed topographical maps of Nepal are at the scale of 1:63,360 or one inch to a mile published during 1957-1963 and 1974. They cover the entire country except the area on the northern boundary. According to the Sino-Nepal Boundary Treaty and result of a joint survey, series of maps were prepared and completed between 1960 and 1979. A set of 57 maps covering the entire northern border of Nepal were prepared at the scale of 1:50,000 were based on the aerial photographs (Gurung, 1981).

Although the first comprehensive volume on the geography of Nepal consisting several maps was published in 1960 by P.P. Karan, and W. M. Jenkins. However, a separate volume on maps of Nepal, "Nepal in Maps" was published by the Statistics Department in 1966. Toni Hagen is also a well known name in Nepal not only for his expeditions and books on Nepal that were published between 1959 and 1969 but also for various thematic maps he included in those books. Latest edition (1998) of his book is available in the market. Mapping of his geological exploration and scientific findings inspired many researchers, geographers and individuals to explore more about Nepal in the following decades.

The formal official map making began with the birth of Topographical Survey Unit (TSU) in 1972. It was supported by United Nations Technical Assistance Programme (UNTAP). The unit was set up as an unit under His Majesty's Government Survey Department. Later it was upgraded to the branch in 1976. At that time it had a small cartographic unit from where the mapping was started from the available maps and field survey by ground method. At present, it has become an important section of Topographical Survey Branch . In this section the field verified maps are cartographically drawn in order to make them ready for printing. It has 63 skilled manpower and is equipped with not only traditional map-making equipment but

latest digital or computer technology. Therefore, map making technique in Nepal is gradually shifting from traditional to modern computer technology (Survey Department, 2002).

With the assistance of International Organization such as United Nations Development Programme (UNDP) infrastructure of the branch was developed. Similarly Land Resource Mapping Project (LRMP) was launched with the assistance of Canadian Government in 1977. Thus land capability maps, land system maps, land utilization maps, geological maps, climatological maps of Nepal based on existing one inch to a mile maps were produced at the scale of 1:50,000. Similarly with the assistance of Japanese Government, topographical base maps of Lumbini Zone was prepared at the scale of 1:25,000 in 1992.

A new series of topographical maps at the scale of 1:25000 and 1:50,000 was completed with the assistance of government of Finland in 2002. There are five hundred and ninety topo-sheets at the scale of 1:25000 covering the area of terai and middle hills whereas one hundred and sixteen sheets at the scale of 1:50,000 have covered the area of high hills and himalays.

With the assistances of Finland , Denmark and European Commission, census mapping project was started from 1999. The main aim was to prepare a digital data of all hard copy made so far (Pradhananga, 2002). The digital data (layers) of all Finida map (topo-sheets) are available in the Topographical Survey Branch.

A great deal of geo-data, in many countries is scattered across a diversity of public and private organizations. This scatter represents a stumbling block to greater use and better exploitation of geo-data. Recognizing the importance of sharing geo-data in improving internal working processes and services, government all over the world have come into action. Such operations go under the name of establishing a National Spatial Data Infrastructure (NSDI, 2003). In this context, in Nepal also maps of multidimensional themes based on digital data have been produced by all government or non-government agencies (organizations/institutions). They are based on the uncontrolled non-standardized construction of data bases. Enormous amount of money and time are already spent on the duplication of work. Therefore, to act as administrator of the national spatial data infrastructure, the survey department has initiated to establish the National Geographic Information Infrastructure (NGII), to integrate the existing data from various sources and disseminate the same to the users.

Map as a Means of Communication

Communication in general terms, is the transfer of knowledge, ideas, information from one person to another or to a group. People use maps to obtain information because a map is far more effective than any other source. In a very simple form,

map provides a bird's eye view of the earth and a representation of the earth's surface or part of the earth's surface. The exact duplication of the geographical setting, is impossible. The map maker asks the map reader to believe that a mosaic of points, lines and areas on a flat sheet of paper is equivalent to a multidimensional world in space and time (Moehrcke, 1974). A map can stimulate its reader to think in terms of a whole range of scale though the map itself is limited to one scale. According to Barbara (1978), "Map, like language, selects certain features and ignores others; and like language, maps are cultural expression of elements significant to society."

Maps are especially valuable, for most geographical facts can be represented on them. The primary function of a map in the widest sense is communication. People are drawn to maps because each person sees what he wants to see in them. As McCord (1971) says about maps, "Everything reveals. It is not necessary to read." With the advent of computer technology the definition of map has also changed with the time. Nowadays map is any concrete (real map or paper map or hard copy) or abstract (virtual maps which is the temporary map image projected on to the screen) image of the distribution and features that occur on or near the surface of the earth or other celestial bodies (ITC, 1997).

Maps are functionality matured and their application spread to all disciplines working with spatial data. Maps are no longer only the final products they used to be. Although originally associated with the wider field of geography, mapping is essential to many sciences. The International Cartographic Association (ICA) defines a map as "a symbolized image of geographical reality , representing selected features or characteristics, resulting from creative effort of its author's execution of choices and designed for use when spatial relationship are of primary relevance" (Konechy, 2004).

The map is of such value to the geographer that it has been called the "geographer's tool". It can be used for description of land in order to know its shape, to orient oneself and to locate objects, near by or far away. The maps can be used for measuring distance, finding the direction, computing the areas and volumes. Similarly, maps can be inventory of topography and natural resources in order to know their importance, to study their development and to decide about their exploitation

Now-a-days, the use of map is not limited to a geographer as the special shorthand but it has become the principal prerequisite for the development and planning to the modern world. There are many kinds of maps and they are useful in countless ways.

Classification of Map

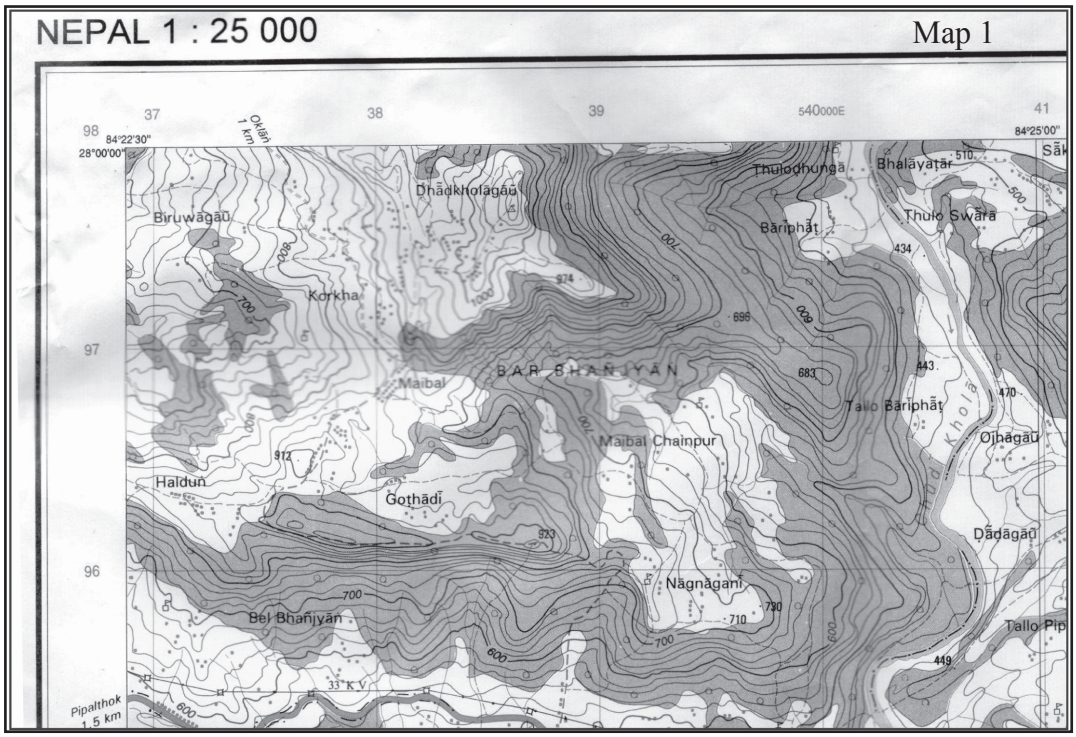
The variety of maps does not allow a strict classification, but in practice the uses made of maps and the methods involved in their preparation separate them into

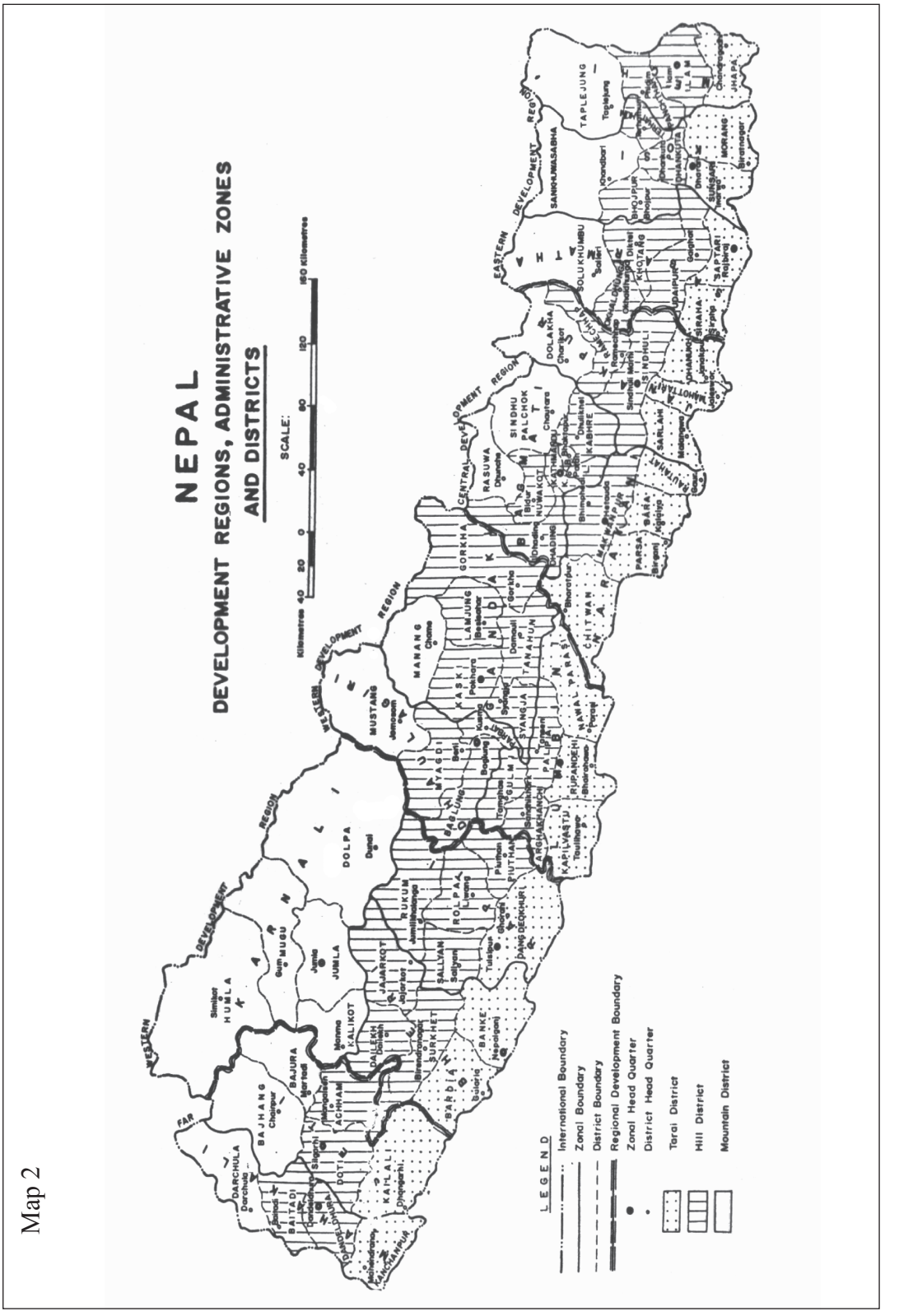
several general categories. Traditionally, the maps are classified into two groups (i) Topographic maps and (ii) Thematic maps.

In general, maps whether produced by traditional or modern digital methods are classified on the basis of their characteristic and nature. Robinson (2002) has classified maps according to their (i) scale, (ii) function and (iii) subject matter.

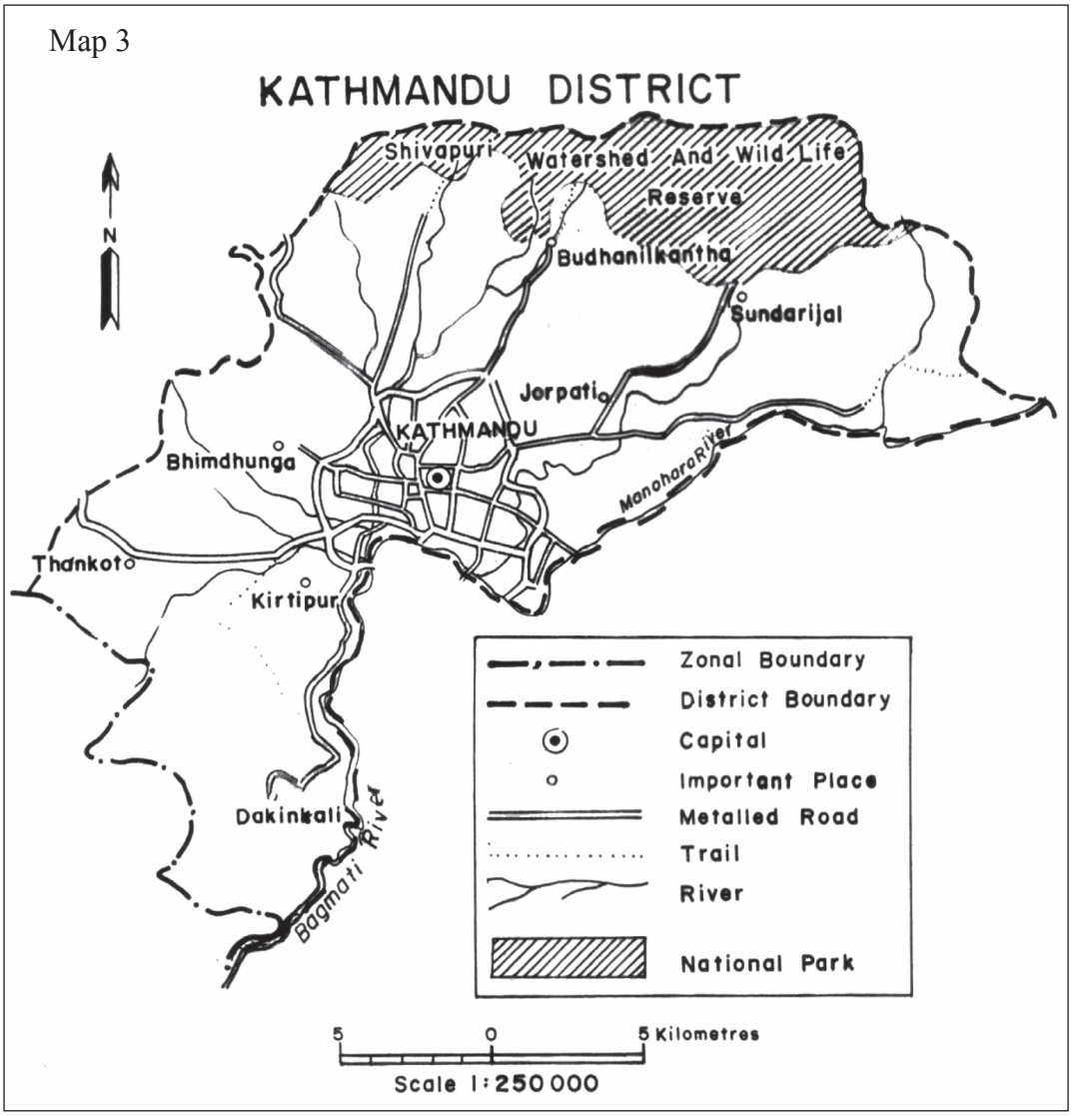
Class by Scale

Each map maker or cartographer must change the dimensions of the reality to serve the function of the map. Thus, the first problem of the map maker is to decide what is to be the relationship between the size of the map and the size of the area which it is to represent. The amount of detail shown on map depends upon what is termed the scale. The ratio between the dimensions of the map and those of reality is called the map scale. There are small scale maps and large scale maps. When a large area is shown in a small sheet of paper, it is described as being a small scale map (Map 2 & 3) whereas, if a map the size of the same sheet shows only a small part of reality (Map 1), it would be described as a large scale map. Almost all map maker and cartographers have agreed that a map with a reduction ratio of 1 to 50,000 or less are considered as the large scale map (for example 1/25000 or 1/10,000) and 1 to 500,000 or more (for example 1 to 30,000,000) are considered as small scale maps.




NEPAL
DEVELOPMENT REGIONS, ADMINISTRATIVE ZONES AND DISTRICTS
SCALE:
Kilometres 40 20 0 40 80 120 160 Kilometres
LEGEND
International Boundary
Zonal Boundary
District Boundary
Regional Development Boundary
Zonal Head Quarter
District Head Quarter
Tarai District
Hill District
Mountain District
WESTERN DEVELOPMENT REGION
CENTRAL DEVELOPMENT REGION
EASTERN DEVELOPMENT REGION
FAR WESTERN DEVELOPMENT REGION
DARCHULA
BAJHANG
BAJURA
HUMLA
MUGU
JUMLA
DOLPA
MUSTANG
MANANG
GORKHA
RASUWA
DOLAKHA
SINDHU PALCHOK
SANKHUWASABHA
TAPLEJUNG
MORANG
JHAPA

Map 2



Classed by Function

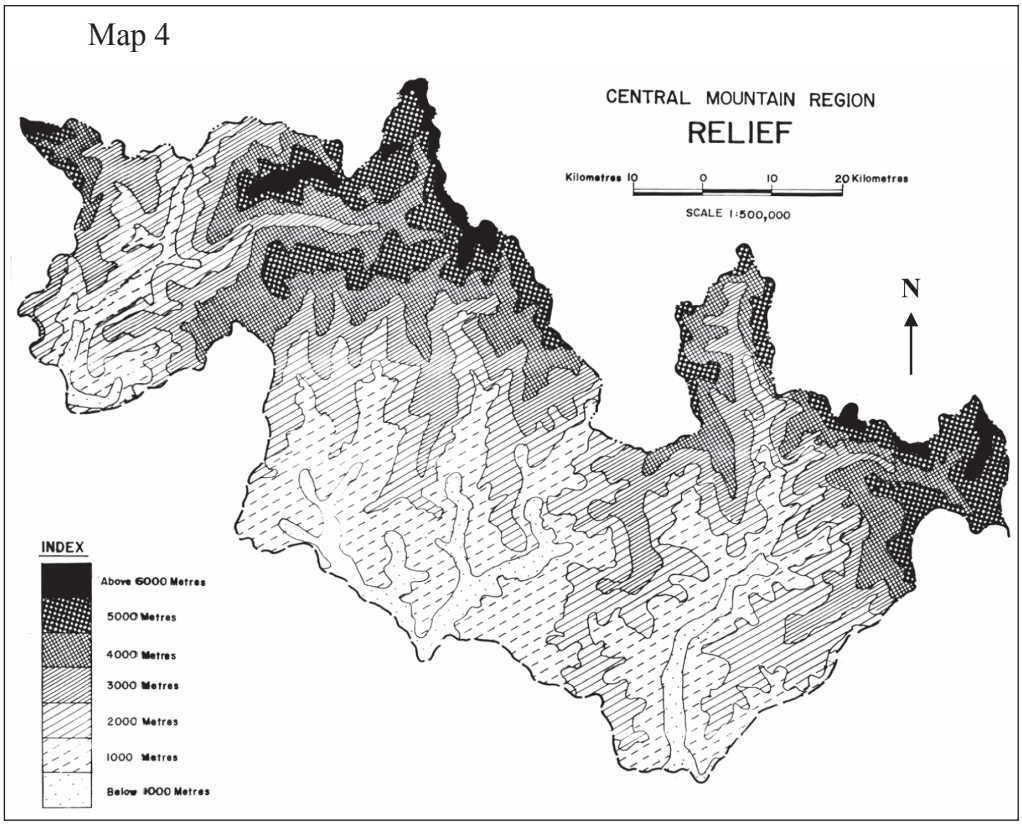
Although there are a range of maps from large scale to small scale with no clear divisions three main classes of maps can be distinguished on the basis of their function (a) general reference map, (b) thematic maps and (c) charts respectively.

General Map: Topographical maps are large sale general maps which show the locations of variety of different features such as contour lines from which elevation of a certain area can be presented or visualized water features by which the water bodies like river, lake ocean and sea can be identified, road network from which the transportation network can be analyzed or recognized. Similarly, a particular feature or location can be identified according to its X and Y coordinates and so on (Map 1).

Small scale general reference maps are of state, zone or district in atlases. Such maps show the similar features which are shown in the large scale maps. But the small scale maps are of reduced scale and generalized and simplified. They lack the detail and positional accuracy of the large scale maps.

Thematic Maps: The maps showing qualitative and quantitative information on specific features or concepts in relation to the necessary topographic details are called thematic maps or special purpose maps. Thematic maps represent the distribution of one particular phenomenon (Maps 4, 5 & 6).

Map 4

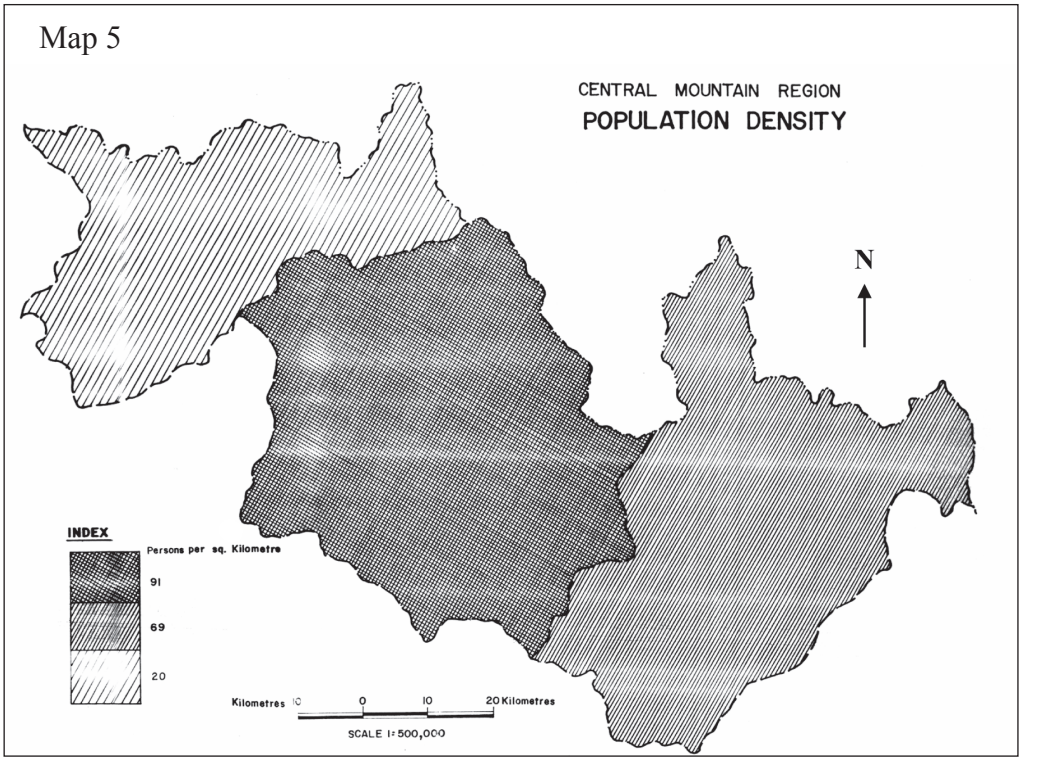


Charts : Maps especially designed to serve the needs of navigation, nautical and aeronautical are called charts. Nautical charts include sailing charts for navigation in open water, coastal charts for near shore navigation, harbor charts for use in harbor etc. Aeronautical charts are used for visual flying. Similarly road maps are also charts used for land navigation although they are not called as such.

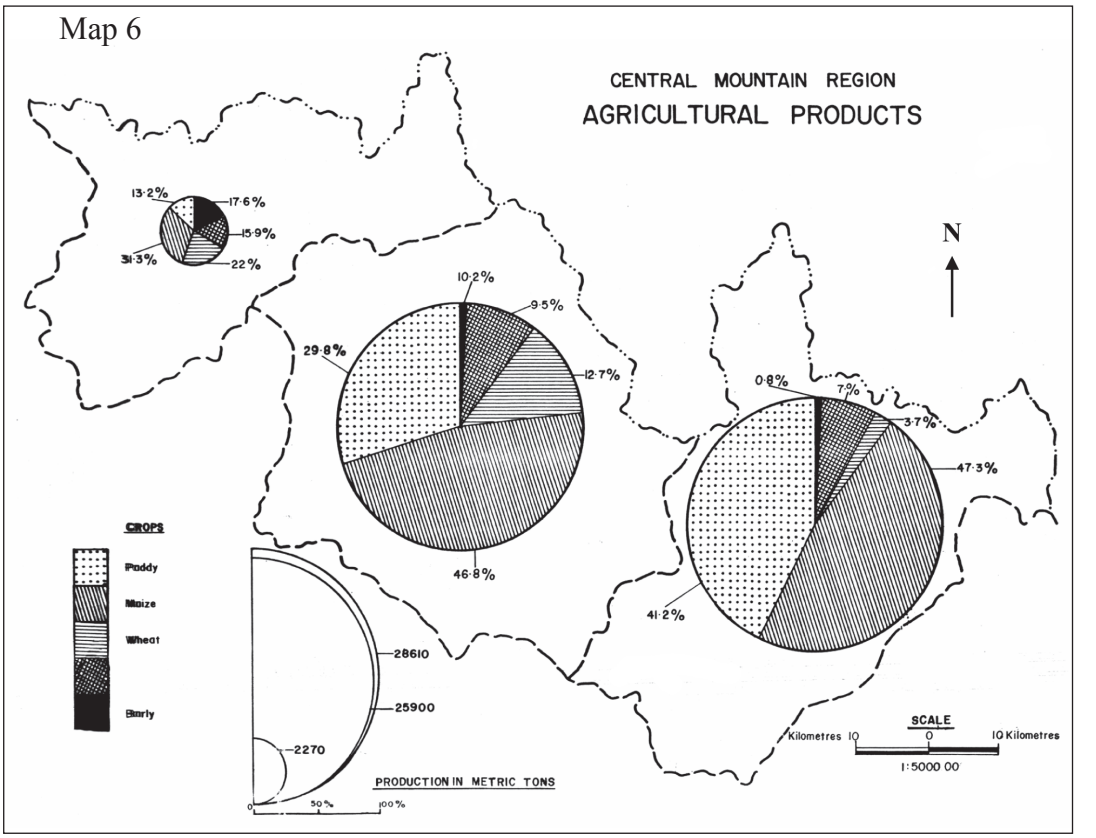
Classed by Subject Matter

There is no limit to the number of classes of maps that can be created by grouping them according to their dominant subject matter. Maps of several important categories may

Map 5


CENTRAL MOUNTAIN REGION
POPULATION DENSITY
N
INDEX
Persons per sq. Kilometre
91
69
20
Kilometres 10 0 10 20 Kilometres
SCALE 1:500,000

Map 6


CENTRAL MOUNTAIN REGION
AGRICULTURAL PRODUCTS
N
13·2%
17·6%
15·9%
31·3%
22%
10·2%
9·5%
29·8%
12·7%
46·8%
0·8%
7%
3·7%
47·3%
41·2%
CROPS
Paddy
Maize
Wheat
Barly
28610
25900
2270
PRODUCTION IN METRIC TONS
0 50% 100%
SCALE
Kilometres 10 0 10 Kilometres
1:5000 00

be recognized on the basis of their subject matter. One of the examples is cadastral maps which show the information on location of property - ownership lines , along with their length , breadth, and size of land parcels. The fact that cadastres are used to asses taxes and raise the revenue from the land. Apart from cadastral maps, there are planimetric and engineering maps which come under the class of subject matter.

According to Skelton (1972), "Maps have many functions and many faces and each of us sees them with different eyes". Therefore, there are unlimited variety of maps, climate, population, transportation, economic activities and so on without end.

Conclusion

The modern cartography has changed fundamentally since the nineteenth century. It has moved from "the whole science of map making" towards the field of communication science. Now-a-days, the use of map is not limited to a geographer as the special shorthand, but it has become the principal prerequisite for the development and planning of the modern world. Although the change in modern technology has accelerated cartography forward to an exciting future one should not overshadow the true concept, techniques and basic cartographic rules to create the real map but not only the general pictures. Cartography is for general use and the importance of true visualization of geographic information persist one of the fundamental functions of cartography.

References

Anson, R. W. and B. V. Gulsell, 1992: *Newsletter No. 19*, U.K: International Cartographic Association (ICA).

Barbara, N. A., 1978. Maps and the minds, Human Nature, U.K.: *The Geographical Review* 1(8):50-59.

Chhatkuli, R. R., 2003. Orthophoto Mapping: A Fundamental Data Layer for Urban GIS in NGII in Nepal. Kathmandu, *Nepalese Journal on Geo Informatics* No 2, Survey Department, HMG. May-June: 63-66.

Gurung, H. B, 1968. Nepal in Maps: Book Review. Kathmandu: *The Himalayan Review.* 21st International Geographical Congress, Social Issues.

Gurung, H. B. 1981. *Maps of Nepal: Inventory and Evaluation*, Kathmandu: New Era.

Hagen, Toni 1998. *Nepal, The Kingdom in the Himalaya*, Calcutta: Oxford Book & Stationary Co.

David L. Sills (ed). International Encyclopedia of the Social Science (IESS), England: Vol 2. The Macmillian Co. Lid.

ITC, 1997. *Introduction to GIS and Cartography*. The Netherlands.

Keats, M. J. & Ormeling, E. J., 1996. *Cartography: Visualization of Spatial Data*. England: Addison Wesley Lingham Ltd.

Konecny, Mila, 2004. Promoting Global Cartography, New York: GIM International Journal, Vol 18:7-9.

Kraak, M. J. and Ormeling, F. J., 1996. *Cartography: Visualization of Spatial Data*. Engliand: Addison Wesley Longman Ltd.

Mc Cord, Howard. 1971. *Listening to Maps: Poems Toward an Iconography of the West*, California: Kayak Books, INC.

Muehrcke, P. C. and Muchreke, J. O., 1974. Maps in literature. London: *The Geographical Review*, Vol. IXIV (3):317-338.

Pradhananga, T. B., 2003. Topographical Survey Branch with Remote Sensing. *Nepalese Journal on GeoInformatics,* No 2. Kathmandu: Survey Department, HMG.

Preston E. & Grofffrey, J. Martin, 1972. *All Possible World, A History of Geographical Ideas*. New York: John Wiley and Sons.

Raisz, Erwin, 1948: *General Cartography*. London: Mc Graw Hill Book Company.

Robinson, A. H., Sale, Randall D. & Morrison, Joel L., 2002. *Elements of Cartography.* 6th Edition, New York: John Willey & Sons.

Schmdt, Ariadn 2001. The Glories of Dutch Mapmaking in the 17th Century: Over the Horizon, The Netherlands: *Holland Horizon.* (4):22-25, The Dutch Ministry of Foreign Affairs with support from the Netherlands Board of Toursim (NBT) and the Netherlands Foreign Trade Agency (EVD).

Skelton R. A., 1972. *A Historical Survey*. USA: University of Chicago Press.

Stephenson, Richard W., 1990. Historical Development of Maps. USA: *National Geographic Magazine*, 177 (4):52-55.

Survey Department, 2000: *Brochure*. Kathmandu: Ministry of Land Reform and Management, HMG.

Taylor , D. R. Fraser, 1994. Perspectives on Visualization and Modern Cartography. UK*: Visualization in Modern Cartography*. Pergaman Elsevier Science Ltd: 333-334.