



Examining the features of a geographic map

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Abstract

Geographical maps are instruments utilized to depict natural and anthropogenic features on the Earth's surface. The principal attributes of a map include scale, orientation, symbols and signs, geographic grid (longitude and latitude), boundary delineations, elevation representation, sources of information, map accuracy, and map classification. These attributes assist users in accurately interpreting maps and employing them for various purposes such as navigation and geographic analyses. The objective of the present study is to examine and analyze the fundamental components and essential characteristics of a standardized geographic map, thereby providing criteria for assessing the quality and efficacy of maps for end-users. The research methodology employed is descriptive-analytical, leveraging library resources, sample maps, and cartographic standards to scrutinize key features such as title, scale, orientation, symbols and signs, geographic coordinates, map type, accuracy, and currency. The findings indicate that the presence of an appropriate scale, standardized symbols, precise orientation, and up-to-date information constitute four pivotal elements in enhancing the functional efficiency of maps. Furthermore, the selection of the map type in accordance with its intended application (e.g., political, physical, or climatic) plays a significant role in the accurate transmission of information. Consequently, attention to the foundational attributes of geographic maps is imperative for their effective preparation and utilization. A map devoid of an accurate title, valid scale, or comprehensible symbols is not only rendered impractical but may also mislead users. Hence, adherence to cartographic design principles and the employment of advanced mapping technologies such as Geographic Information Systems (GIS) can substantially improve the precision and quality of maps.

Keywords: Map, geography, Symbols, latitude and longitude.

Introduction

Geographical maps are considered fundamental tools for understanding and analyzing the natural and human characteristics of the Earth's surface. Through the use of signs, symbols, and scales, these maps present complex geographical information in a simple and comprehensible form. In today's world, maps are not only used for navigation and route finding, but they also have extensive applications in various fields such as urban planning, natural resource management, weather forecasting, and scientific and educational studies.

Various features, including scale, orientation, symbols and signs, and the accuracy of maps, enable these tools to convey precise geographical information about the Earth's surface to users. In this regard, examining the characteristics of a geographical map contributes to a better understanding of how maps can be used in different applications.

The main research question is: What are the main characteristics of a geographical map, and how do they influence its accuracy and effectiveness?

The Sub-Research Questions are:

1. Which elements are of greater importance in the design of a geographical map?
2. How does map scale affect the level of accuracy and the practical application of a map?
3. What is the role of conventional signs and symbols in improving the understanding of map information?

The significance of research on the characteristics of geographical maps stems from the fact that maps are fundamental tools for understanding and analyzing geographical information. This research can have valuable impacts in several areas, including improving the accuracy and efficiency of maps, increasing awareness of the principles and characteristics of cartography, enhancing the use of geographical maps in education and research, supporting decision-making in various sectors through geographical maps, and contributing to the development of digital maps and practical and scientific Geographic Information Systems (GIS) applications.

This research not only contributes to a more accurate and scientific understanding of maps, but it can also serve as an important step toward improving spatial analysis skills, enhancing educational methods, and ensuring more precise utilization of geographical data at individual, academic, and professional levels. The importance of this subject will become even greater in a future that is increasingly dependent on spatial and geographical data.

Literature Review

The literature review in the field of geographical maps refers to the extensive studies that have been conducted from the past up to the present in various disciplines such as geography, geology, urban planning, and other related fields. Since ancient times, maps have been used as important tools for representing geographical features across different regions and countries.

1. **Historical Developments in Cartography:** In ancient times, early geographical maps were mostly prepared in a simple and conceptual manner to represent regions of the Earth. For example, maps produced by ancient civilizations such as Greece and Roman Empire were designed using geometric and empirical principles. These maps were primarily used for navigation and maritime travel.
2. **Modern Cartography:** In recent centuries, with the advancement of modern technologies, cartography has reached a new level of accuracy and complexity. During this period, the use

of tools such as the Global Positioning System (GPS) and Geographic Information Systems (GIS) significantly improved the accuracy of maps. These developments enabled maps to be used not only for navigation purposes, but also for analyzing various geographical and environmental data.

3. **Research on the Characteristics of Geographical Maps:** Numerous studies have been conducted on the characteristics of maps. These studies include the examination of map scales, the use of signs and symbols, methods for representing natural and human features, and the impact of accuracy in maps. Research findings indicate that the quality of information and the way it is presented through maps can greatly influence geographical decision-making and different planning processes.
4. **Digital Maps and Their Applications:** With the expansion of the internet and digital technologies, geographical maps have become digital and interactive. Geographic Information Systems (GIS) and modern cartographic software enable users to easily analyze geographical information and utilize it for various purposes. Research in this field mainly focuses on how these technologies are used and on the new features of digital maps.

In conclusion, the literature review in this field demonstrates that with technological advancements and the increasing application of maps in everyday life, understanding the characteristics and various dimensions of geographical maps has become essential for their effective utilization.

Research Methodology

This research is descriptive–analytical in nature and focuses on examining the characteristics and design principles of geographical maps. The study employs a library-based research method and relies on the review of secondary sources for data and information collection.

Results and findings

Concept of a geographical map

A geographical map is a symbolic and scaled representation of a part or the entirety of the Earth's surface that illustrates its natural and human features on a flat surface, such as paper or a digital screen. A geographical map refers to a tool designed to represent the geographical characteristics of the Earth's surface. These characteristics may include natural features such as mountains, rivers, and large water bodies (oceans, lakes, gulfs, and ponds), as well as human features such as cities, roads, and political boundaries (Arian, 2016, p. 45).

Maps are generally divided into two categories: physical maps, which display natural features, and political maps, which illustrate political boundaries and administrative divisions. A geographical map, as a visual representation of the Earth and its features, serves as an important tool for conveying spatial information (Abbasi, 2016, p. 45).

A map must have an accurate scale so that the relationship between distances on the map and actual distances on the Earth is correctly maintained. Map scales are represented in two forms: numerical (fractional) and graphical (linear), and the choice of scale depends on the purpose of the map (Kazemi, 2019, p. 123).

Main characteristics of maps

The characteristics of maps are the elements that help users correctly interpret the geographical information presented on a map. Some of the most important characteristics of maps include the following:

- **Map scale:** Map scale indicates the relationship between distances on the map and actual distances on the Earth's surface. Scale plays a significant role in the accuracy of maps. Large-scale maps display more details, whereas small-scale maps present fewer details (Sadeghi, 2018, p. 72).

Map scale is divided into three types: fractional scale, linear scale, and verbal or statement scale. All three scales can be used simultaneously in calculating and determining the actual distance on the ground. For example, two points on a map may first be measured linearly, then calculated using the fractional scale, and finally expressed verbally.

Fractional Scale:

Graphic or Linear Scale: $\frac{1}{50000}$



- **Colors:** One of the important components in reading maps is the color of different sections and the degree of color saturation. In general, most maps consist of three primary colors: brown, green, and blue. However, depending on the mapped features, other colors such as red, black, white, and purple may also be used.

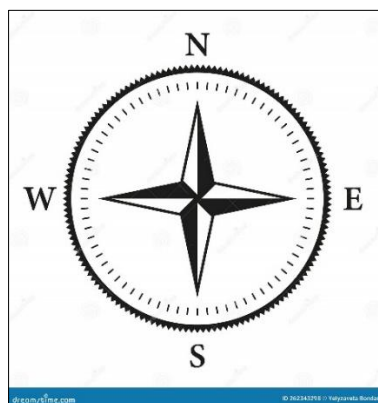
The meaning of each of these colors is as follows:

1. Brown: Contour lines and elevation figures.
2. Green: Vegetation cover.
3. Blue: Water bodies.
4. Black: Artificial (man-made) features.
5. Red: Main and secondary roads, as well as political boundaries.
6. White: Non-water and non-vegetated areas such as deserts, sand, rocks, and similar features.
7. Purple: Revisions made using aerial photographs and awaiting confirmation (purple is no longer used in modern topographic maps).

Generalization (Summarization): Generalization or summarization refers to a series of activities carried out according to specific principles and standards to systematically reduce geographic information. As the map scale becomes smaller, the available map space decreases. Since it is impossible to display all features and details of the Earth's surface within the limited space of a map, ground features must be selected according to the scale. This process is unavoidable in the preparation of any type of map, and regardless of the advancement of technology and human knowledge, its importance continues to increase.

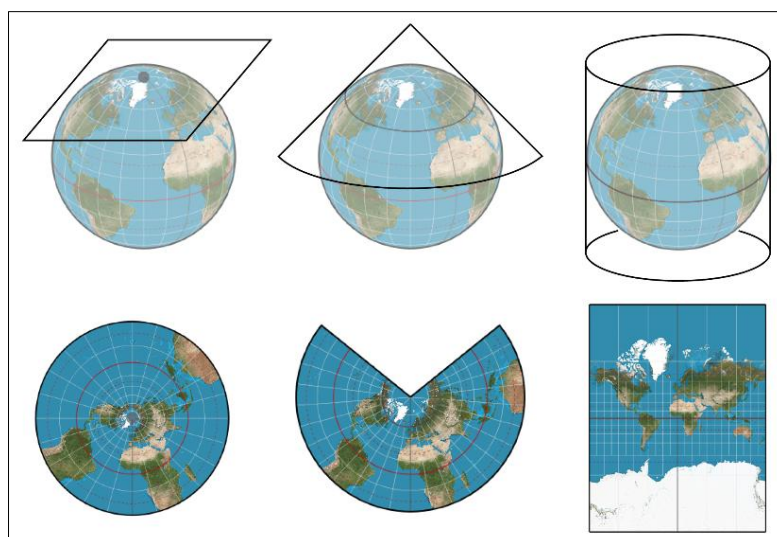
Generalization refers to the process of moving from lower levels of information classification to higher levels of information. At lower levels, more detailed information is accessible, whereas as one moves to higher levels, the amount of detail decreases and more generalized information becomes available (google.com/search?q, 2023, p. 1).

- **Map symbols and signs:** Every map uses specific symbols and signs to represent the geographical features of the mapped area. These symbols are usually explained in a section of the map known as the map legend, enabling users to understand what each sign represents (Beigi, 2015, p. 89). These symbols may include representations for mountains, rivers, cities, and political boundaries.
- **Orientation:** One of the essential features of maps is the presence of an orientation symbol, which is generally placed at the top or bottom of the map. This symbol helps users correctly identify directions such as north, south, east, and west (Karami, 2017, p. 54).



- **Map projection system:** Maps generally represent the relative dimensions and positions of phenomena. One of the main objectives of cartography is to use a projection system capable of transferring the three-dimensional characteristics of the Earth's curved surface (length, width, and height) onto a flat surface. However, this transformation inevitably causes distortions in direction, distance, area, and shape. The process of transferring the Earth's three-dimensional curved surface onto a two-dimensional flat surface is known as the "map projection system."

This system must be selected for all maps. In addition, every map has a basic coordinate system known as a planar coordinate network. In cartography, the three-dimensional surface of the Earth is transformed into a two-dimensional representation through specific methods. This process requires projecting the spherical surface of the Earth onto a flat surface, which inevitably results in changes in direction, distance, shape, and area. A projection system refers to the framework and rules used to transform the curved surface into a flat surface in a way that achieves the greatest possible accuracy and usefulness. In simpler terms, a projection system is the process of transferring the Earth's three-dimensional surface onto a two-dimensional medium such as paper, plastic, fabric, or other materials (Rastgoo, 2015, p. 8).

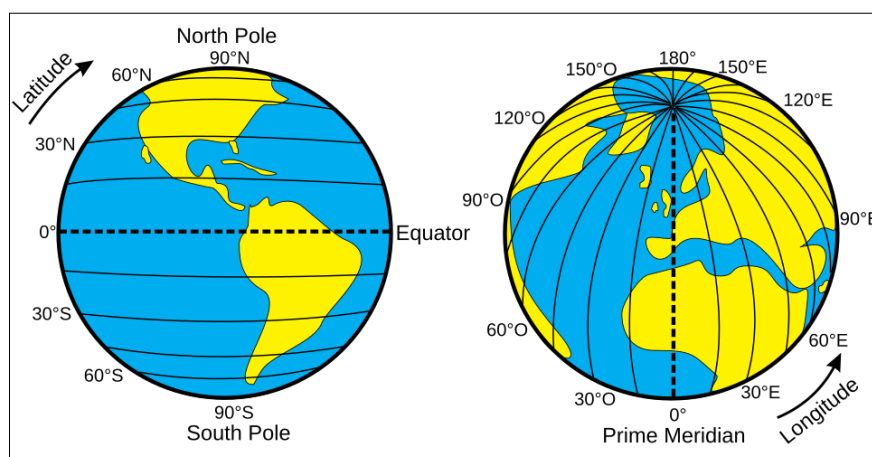


- **Map legend:** The map legend should be selected according to the map scale and the features represented on the map, and it is usually placed on the right side of the map sheet. The legend helps readers correctly interpret the map and understand the meaning and function of each symbol used on it (Rastgoo, 2015, p. 40).
- **Latitude and longitude:** Latitude and longitude indicate the position of any point on the Earth's surface. Longitude is the angular distance between meridians, while latitude is the angular distance between the Equator and the parallels or between the vertical line at a location and the Equatorial plane.

Longitude represents the east–west geographical coordinate used in cartography and navigation. It identifies a location based on its distance from the Prime Meridian and is expressed as an angle ranging from 0° to $+180^\circ$ or -180° . By convention, positive values generally indicate locations east of the Prime Meridian.

Latitude refers to the north–south position of a geographical location on the Earth and is widely used in cartography, surveying, and navigation. Latitude lines are parallel circles drawn around the Earth. These lines help determine climatic zones across the Earth's surface (Nami, 2012, p. 66).

Generic Road Map Legend	
	Highway
	U.S. route
	State route
	Major street
	Street or road
	Railroad
	Ferry
	Interstate route
	U.S. route
	State route
	State capital
	Cities over 1,500,001
	Cities 1,000,001 to 1,500,000
	Cities 700,000 to 1,000,000
	State boundary
	County boundary
	Public airport
	Commercial airport
	Military airport
	Point of interest
	Elevation point



Digital maps and Geographic Information Systems (GIS)

With the advancement of technology and the digitalization of cartographic tools, digital maps and Geographic Information Systems (GIS) have gained increasing importance. These systems assist in the analysis and processing of geographical data and provide more accurate and up-to-date representations of temporal and spatial changes. Furthermore, GIS systems make it possible to integrate and analyze different types of data simultaneously (Nikkhah, 2019, p. 123).

Digital maps possess unique capabilities such as more accurate boundary representation, rapid updating, and interactive data handling. These features have led to the extensive use of

digital maps in various fields, including urban planning, city development, the identification of recreational and educational locations, and environmental analysis (Javaheri, 2018, p. 94).

The findings of this research indicate that digital maps and Geographic Information Systems (GIS) offer greater advantages compared to traditional paper maps. These maps are capable of presenting geographical information with much higher accuracy and provide the possibility of simultaneously analyzing and processing different types of geographical data (Nikkhah, 2019, p. 123). For example, in analyses related to environmental changes or geographical forecasting, the use of digital maps and GIS enables more advanced and precise analyses that cannot easily be achieved through paper maps (Javaheri, 2018, p. 95). In addition, GIS systems allow maps to be continuously updated and supplemented with new information.

The analysis of the findings also demonstrated that digital maps and Geographic Information Systems (GIS) have several advantages over traditional maps. These advantages include higher accuracy, rapid updating of information, and the capability to analyze multiple datasets simultaneously. In particular, in environmental analysis and urban planning, digital maps and GIS provide opportunities for more complex analyses that are not easily achievable with paper maps (Nikkhah, 2019, p. 123).

In the field of disaster and natural hazard management, these maps serve as key tools for predicting and responding to unexpected events. For instance, during critical situations such as floods or earthquakes, access to updated digital maps enables crisis managers to plan and implement necessary measures with greater speed and precision. These features are especially important in remote areas or in situations where access to other resources is limited.

Overall, this analysis demonstrates that digital maps and Geographic Information Systems (GIS), as advanced technological tools, play a vital role in improving accuracy, efficiency, and the speed of decision-making in various fields.

The Impact of map characteristics on their accuracy and effectiveness

One of the most important characteristics affecting the accuracy and effectiveness of maps is map scale. In large-scale maps, a greater amount of detail can be represented, whereas in small-scale maps, the accuracy decreases and only the main features are illustrated (Arian, 2016, p. 48).

In addition, the accuracy and regular updating of information are also considered essential factors in the effectiveness of maps. Outdated maps that have not been updated may provide incorrect information and negatively influence decision-making processes (Sadeghi, 2018, p. 75).

Education and better use of maps

One of the major challenges in the use of maps is users' limited awareness of how to interpret the different characteristics of geographical maps. Proper training in understanding symbols, scales, and conventional signs used in maps can contribute to the more effective use of maps. In addition, training in the use of Geographic Information Systems (GIS) and digital maps enables users to benefit more effectively from the advanced capabilities of these systems (Karami, 2017, p. 60).

Main characteristics of maps and their impact on accuracy and application

Based on the conducted studies, it was found that map scale is one of the key characteristics of a geographical map and has a significant impact on its accuracy and application. In large-scale

maps, such as urban maps, the accuracy of information is higher, and both natural and human features are represented more precisely (Arian, 2016, p. 47). In contrast, in small-scale maps, such as national or continental maps, the level of accuracy is lower, and only the major geographical features, such as country borders and large cities, are displayed (Sadeghi, 2018, p. 73).

These findings indicate that selecting an appropriate scale in map design, according to the area and purpose of the map, is of particular importance and has a major influence on the accuracy and usefulness of maps.

Specifically, in urban maps, large scales contribute to more precise analysis of features and support decision-making related to infrastructure and urban development. On the other hand, small-scale maps, such as national maps, provide less environmental detail but are more suitable for presenting key geographical features and broader spatial scales. These findings demonstrate that choosing the appropriate map scale largely depends on the specific needs and intended application of the map.

Furthermore, appropriate color usage has been recognized as one of the key factors in improving map readability. Colors should be selected carefully and distinctly according to the type of data so that spatial differences can be clearly represented (Mohammadi, 2017, p. 58).

Finally, the use of maps with suitable scales for each geographical application can contribute to greater accuracy and more effective decision-making. For example, in urban planning, where greater detail is required, the use of large-scale maps is essential, whereas for national or continental maps, small-scale maps are generally sufficient.

The impact of map symbols and signs on user interpretation

The results showed that the proper and standardized design of internationally accepted map symbols and conventional signs has a significant effect on users' understanding and interpretation of geographical information. An examination of different geographical maps indicates that maps using clear and standardized symbols are much easier for users to understand and interpret (Beigi, 2015, p. 92). In contrast, maps that use non-standard or complex symbols create considerable difficulties for users, reducing the accuracy of information interpretation.

The analysis of the data further demonstrates that the use of standardized symbols and signs in maps plays a major role in the correct understanding and interpretation of maps. In maps where symbols are designed clearly and according to recognized standards, users can interpret information more easily and achieve more accurate results (Beigi, 2015, p. 92). On the other hand, maps containing complicated or non-standard symbols are not only unfamiliar, difficult, and confusing for users, but may also lead to incorrect interpretations and inappropriate decision-making.

These findings highlight the importance of education and standardization in the use of map symbols and signs. Particularly in specialized applications such as environmental cartography and urban planning, the use of standardized symbols can contribute to more accurate interpretation and more effective decision-making.

The application of maps in urban planning and management

Maps are fundamental tools in urban planning and natural resource management within countries. In urban planning, maps are used to analyze locations, identify suitable areas for

construction, determine transportation routes, and recognize high-risk zones. In addition, in natural resource management, maps assist in analyzing ecosystem conditions and planning for the conservation of natural resources (Beigi, 2015, p. 94).

This research revealed that maps are key instruments in urban planning and management. For example, in urban planning, the use of maps for identifying suitable construction areas, developing infrastructure, and recognizing vulnerable locations is of great importance (Karami, 2017, p. 58). Furthermore, in management processes, especially through digital maps and Geographic Information Systems (GIS), maps play a significant role in analyzing critical situations, simulating different scenarios, and providing appropriate solutions. These findings demonstrate that the continuous updating and high accuracy of maps are particularly important in these fields.

Comparison between paper maps and digital maps

The results of the research showed that digital maps have many advantages over paper maps. Among these advantages are the ability to rapidly modify and update maps, greater interaction with data, and access to more extensive information through Geographic Information Systems (GIS) (Arian, 2016, p. 53). In addition, digital maps allow the simultaneous analysis of different geographical datasets, which is not possible with paper maps. Nevertheless, paper maps are still useful in areas such as elementary education and in situations where access to digital technologies is limited (Sadeghi, 2018, p. 76).

The analysis further showed that digital maps possess several advantages compared to paper maps. Digital maps can easily be updated and supplemented with new data, a feature that is especially essential in research and planning activities (Arian, 2016, p. 53). In contrast, paper maps have many limitations, including the inability to be continuously updated and the possibility that their accuracy may decrease over time.

However, the findings also demonstrated that paper maps could still be effective in certain situations, such as primary education and in regions with limited access to digital technologies. This indicates that both types of maps—paper and digital—can be useful within their own specific contexts, and neither can completely replace the other.

Maps in environmental research

The use of geographical maps in environmental research is also of particular importance. These maps enable researchers to obtain accurate information about environmental changes, the distribution of different species of living organisms, and climatic variations. The findings of this research indicate that the use of digital maps and Geographic Information Systems (GIS), especially for time-based data analysis, can contribute to better prediction of changes and the development of more effective solutions (Javaheri, 2018, p. 98).

The analyses derived from examining the applications of maps in urban planning and crisis management demonstrated that maps are essential tools in these fields. Maps help urban planners identify suitable locations for infrastructure development as well as high-risk or vulnerable areas (Karami, 2017, p. 58). In crisis management, the use of maps for simulating different scenarios and evaluating risks caused by natural disasters contributes to faster and more accurate decision-making.

This analysis shows that although the use of maps in planning and crisis management is common, their importance becomes even greater in real and emergency situations. This is

especially significant in regions affected by natural disasters, where maps can play a key role in reducing damages and improving rapid response measures.

The analysis of the findings further demonstrated that different map characteristics, including scale, symbols, signs, and map type, have considerable effects on their accuracy, applicability, and effectiveness. Digital maps and Geographic Information Systems (GIS), in particular, provide capabilities that paper maps cannot offer. On the other hand, the correct understanding and use of map symbols and signs also play a fundamental role in accurate interpretation and effective decision-making. Therefore, the use of maps, especially in planning and environmental research, should be carried out with careful consideration of their characteristics in order to achieve better outcomes.

Finally, the findings of this research indicate that different map characteristics, such as scale, symbols, signs, and the type of map (paper or digital), have significant impacts on their accuracy, application, and efficiency. Furthermore, digital maps and Geographic Information Systems (GIS) provide more advanced capabilities for analyzing geographical data and have wide-ranging applications in various planning fields and environmental research

Conclusion

The findings of this research demonstrate that maps, as key tools in various geographical fields such as urban planning, disaster management, research, and education, play a highly significant role. The examination of different map characteristics and their applications in this study—particularly features such as scale, map type (paper or digital), symbols and signs, and their specific applications—highlights the importance of maps in geographical decision-making.

One of the key findings of this research is the emphasis on the importance of map scale. Larger scales are essential for analyzing detailed information at local levels, while smaller scales are more suitable for providing a general overview of broader environments. This can contribute to improved decision-making in various areas such as urban planning and natural resource management.

Furthermore, the use of digital maps and Geographic Information Systems (GIS) offers many advantages over paper maps. These maps are especially more practical and effective in complex analyses, scenario simulations, and rapid information updates. These technologies allow users to analyze data more accurately and utilize them effectively in emergency situations or for predicting environmental changes.

This research also showed that the proper use of standardized symbols and signs in maps has a significant impact on the accurate interpretation of geographical information. The standardization of symbols and signs enables users, particularly in large-scale or complex projects, to understand and utilize information more easily and effectively.

Overall, this research emphasizes that maps, whether in paper or digital form, should be carefully selected and properly utilized in order to enhance effective decision-making, natural resource management, and urban and environmental planning.

Recommendations

1. **Standardization and Improvement of Map Symbols and Signs:** Considering the key role of symbols and signs in the correct understanding of maps, it is recommended that all maps use standardized and internationally recognized symbols and signs.

2. **Increasing the Use of Digital Maps and GIS Systems:** It is recommended that greater use be made of digital maps and Geographic Information Systems (GIS) in various fields such as urban planning, natural resource management, environmental studies, and scientific research.
3. **Education and Capacity Building for Map Users:** Conducting educational courses and specialized workshops on the proper use and interpretation of maps, especially digital maps and GIS, can be highly beneficial for users.
4. **Continuous Updating and Maintenance of Maps:** It is essential that maps, particularly digital maps and Geographic Information Systems (GIS), be updated and maintained regularly to ensure the accuracy and reliability of geographical information.
5. **Supporting the Use of Paper Maps in Remote Areas:** In regions where access to digital technologies or the internet is limited, the use of paper maps as a complementary tool should continue to be maintained.

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