

Visualization of Spatial Distribution of Village Development Index a Review Of Location Data in West Java Province

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ABSTRACTS

The spatial distribution of the Village Development Index (IDM) is the result of village development analysis for the purposes of mapping and assessing variations in the level of village development results in a region. The aim of the research is to analyze the spatial distribution of IDM, which is a comprehensive indicator that covers social, economic and environmental aspects in assessing village development progress. The methodology used in this research includes spatial analysis using a spatial data integration system with secondary data (statistical data). The combination of the internet of things (IoT) with WebGIS makes it possible to integrate data from various sources, in the form of spatial and non-spatial data into one easily accessible platform. This allows for more in-depth and accurate data analysis; and it is possible to disseminate information quickly and widely because it can be accessed by various stakeholders. That spatial distribution of the IDM can be used as an important tool in planning for a more inclusive and sustainable regional development. With WebGIS, data collected from IoT devices can be processed and analyzed to producing interactive maps and reports that will help in a better decision-making process, the research results can be accessed at <https://jabar-e.netlify.app>.

Keywords / Kata Kunci — *Sdistribution, Village, IDM, IoT, WebGIS*

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1. INTRODUCTION

Poverty is a condition where a person cannot fulfill basic needs such as food, clothing, medicine and shelter. Poverty is also one of the measures of social and economic conditions in assessing the success of government development in a region. Poverty is also a major problem for many countries in the world [1]. Spatial data can help village mapping specifically based on their location, and by understanding the geographical context the village locations, including topography, accessibility, and environmental conditions that can affect the development. Village development activities are changing as a result of the acknowledgment and delegation of power to village communities, which enable them to conduct their business independently. The goal of recognizing and allocating authority at the village level is to ensure that village customs, rights of origin, and community initiatives serve as the foundation for the implementation of village community development. In order to evaluate the village development's performance, the government measuring it using a composite index (Village Development Index/IDM) that is formed based on three indices, namely the Social Resilience Index, Economic Resilience Index and Ecological/Environmental Resilience Index [2]. Village production, distribution access,

trade access, financial institution access, trade openness, and economic institutions are the components of the IDM's economic resilience characteristics. The distribution of income and the flow of money within the community are directly tied to the economic resilience feature. Every part of the economic resilience dimension points to a growth in the village's development, which translates to an improvement in the local community's economy [3].

The study of the IDM is important because it provides an in-depth understanding of development progress at the village level and the factors that influence the quality of life of residents in rural areas. The IDM is closely linked to the Sustainable Development Goals (SDGs) issue. The IDM development study provides an overview of the progress towards achieving various SDGs targets at the village level. The use of spatial data in this study is intended to improve the quality of IDM information with the aim of providing deeper and more detailed insights into geographic, social, economic and environmental conditions at village level. Besides, it can help in monitoring development inequality between regions or villages. This is important to ensure that the development occurs evenly and does not leave the under-developed areas behind.

By conducting regular IDM development studies, integrated with spatial data, a more holistic understanding of the dynamics of development in rural areas can be obtained. This is an effort to support the achievement of the inclusive, sustainable, and oriented development towards improving the quality of life of the villagers. The use of spatial data can clearly show where poor villages are located, making it easier to determine which villages need more attention in poverty alleviation efforts. There are 8,412 sub-districts and 74,093 villages nationwide in Indonesia [4], and poverty conditions have a lot of impact on the level of rural areas. By examining each village's potential to improve the welfare of its residents, the rural development program offers a way to transform rural areas into more developed ones. The IDM, a composite index made up of the Social Resilience Index, Economic Resilience Index, and Ecological / Environmental Resilience Index, can be used to track the progress of the village [5]. These indices can be described as follows:

- The Social Resilience Index consists of the Social Capital Dimension (including indicators of social solidarity, tolerance, sense of security and social welfare); the Health Dimension (using indicators of health services, community empowerment, and health insurance); the Education Dimension (using indicators of access to primary and secondary education, access to non-formal education and access to knowledge); and the Settlement Dimension (using indicators of access to clean water, access to sanitation, access to electricity, and access to information and communication)
- The Economic Resilience Index uses indicators of the diversity of village community production, the availability of trade service centers, easy access to distribution / logistics, easy access to financial and credit institutions, economic institutions, and regional openness.
- The Environmental / Ecological Resilience Index consists of the Ecological Dimension using indicators of environmental quality and disaster-prone potential and disaster response.

The IDM serves as a reference in integrating, affirming, and synergizing development with the hope of realizing the conditions of a prosperous, just, and independent village community.

The West Java Province has 18 regencies with 9 cities, which are divided into 627 sub-district areas consisting of 5,322 villages and 645 sub of sub-district (Figure 1). Villages are at the vanguard of development, accounting for 75% of the Sustainable Development Goals (SDGs) to be achieved. In the West Java Province, 89% of the administrative areas are village-based, and 72% of the population resides in villages [6],

Therefore, the development of a just and successful society is of utmost importance to the government. Village development is a key component in creating a just and prosperous community. IDM is used to evaluate the village development's success, with the conception that to become an advanced and independent village, a sustainable development framework is needed where social, economic and ecological aspects become complementary forces and maintain the potential and ability of the village to prosper the lives of the population.

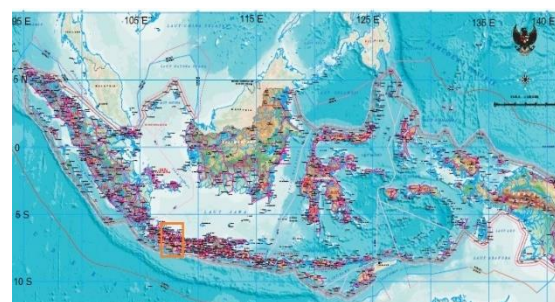


FIG 1. Research Area [8]

The objective of this research is the utilization of spatial data at improving of the quality of IDM information, by providing more in-depth and detailed insights into geographical, social, economic, and environmental conditions at the village level including topography, accessibility, and environmental conditions that may affect development. Certain trends or tendencies in the development of villages over time can be verified and validated with information from multiple sources. Tracking and identifying significant changes, and measuring the impact of development interventions can be implemented by providing a solid foundation for the village-level development analysis, optimizing the use of data for informed decision-making, and improving the effectiveness

of the development programs to achieve better outcomes for the villagers [7]. Spatial data allows the integration of various sources such as administrative maps and field survey data in building of a comprehensive picture of village conditions. This data integration improves the accuracy and sustainability of the information used in the analysis.

Data used in this study were obtained from various government agencies and websites. Spatial data (Indonesian Topographic Map/RBI) as the main data was obtained from the Geospatial Information Agency [8], especially the administrative area data. On the other hand, the Central Bureau of Statistics [6] provided statistical data related to development indices and village conditions in Indonesia. Data related to village development and development programs in rural areas were obtained from the Ministry of Villages, Development of Disadvantaged Regions and Transmigration (Kemendes PDTT). The background maps were obtained from the OpenStreetMaps (OSM) website, an organization providing world base maps for free.

The Ministry of Villages' and the BPS's tabular (non-spatial) data were combined with BIG's spatial data to form the foundation for the IDM's spatial distribution throughout the Province of West Java. After being categorized, the poverty data from BPS was included into spatial data and utilized to incorporate information on village development initiatives by granting village residents the legitimacy and power to independently oversee and manage their affairs. The IDM is based on three indices, namely the Social Resilience Index, Economic Resilience Index and Ecological / Environmental Resilience Index [9]. Village production, distribution access, trade access, financial institution access, economic institution access, and trade openness are all included in the economic resilience dimension, which makes up the IDM. Every facet of the economic resilience factor points to improved village development outcomes, which implies improved village community economics.

Techniques for the Geographic Information System (GIS) can make it easier to display spatial data on a province's development outcomes (IDM) and poverty distribution. Web Geographic Information System (WebGIS), an online-based Geographic Information System program that combines web design and web mapping, integrates GIS data for the goal of visualizing and disseminating. In order to represent the information system for the spatial distribution of IDM and the distribution of the poor, this study will make use of WebGIS. The first step in setting up this website is to create a Web Map Service (WMTS) or layers group using the GeoServer software, which has as its primary components Workspace, Stores, Layers, and Styles. The data that was utilized in this instance was processed.

WebGIS is a geographic information system application that is implemented and run using the internet network. WebGIS itself runs using the internet in a global network or local network on a device that has a web browser [19]. Several programming applications known as programming scripts including HTML and CSS, are required for WebGIS developments. WebGIS may be hosted on a local server, a web server that runs locally on a desktop PC known as localhost. To create a localhost, web server software like WAMP or XAMP, and map server software like GeoServer or ArcGIS Server should be installed in a local PC. This PC then becomes a localhost and WEBGIS applications can be installed into the PC and can be accessed locally on the PC or other PCs connected to the localhost network.

To view, examine and distribute map-based visual representations of geospatial data online, web mapping is necessary. Web mapping utilizes the interactive features of the web for GIS applications. On a single user screen, web mapping can also display thematic maps and multi-layer maps, known as earth maps. The ability to display information dynamically and interactively, such as hyperlinks, mouse coordinate positions, map properties, and map pan, is another benefit of web mapping [10].

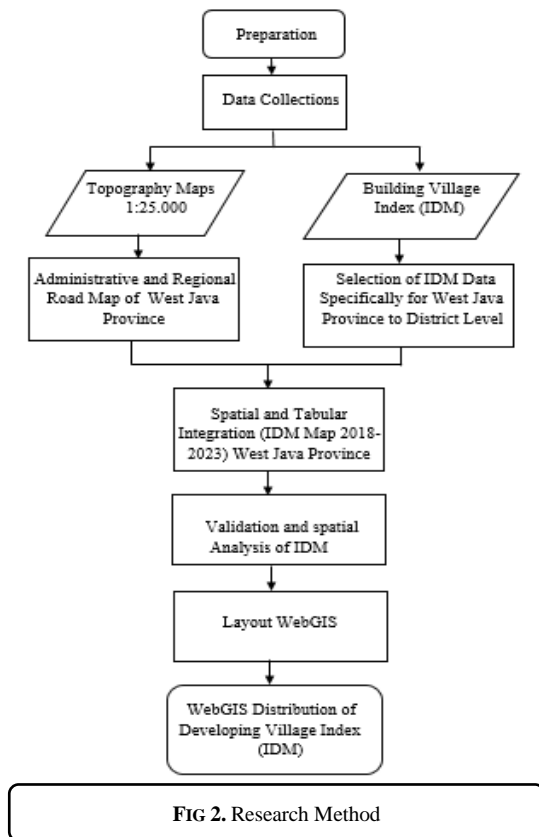
A WebGIS configuration has a server that functions as a mapserver that handles map requests from clients and sends them back. Users or clients do not need to use GIS software, they only need to use an internet browser such as Firefox, Google, or Chrome to access the GIS information on the server. For this research, due to funding issues, the online publication of the IDM information is implemented by hosting its WEBGIS application in the remote cloud computing company, Netlify, Inc

2. RESEARCH METHODOLOGY

Poor villages tend to face greater socioeconomic challenges, such as limited access to health services, education and basic infrastructures. These conditions can affect development outcomes, monitored using the IDM, due to low health, education and economic indicators in these villages. Easy-to-understand visualizations of spatial data, such as interactive maps or dashboards, present analysis results and enable better decision-making (Figure 2.). The implementation of the visualization preparation is carried out in the following stages:

- Convert shapefile format geospatial data to GeoJson format.
- Web page design: header, menu, footer map face and legend using Hyper Text Markup Language (HTML) and Cascading Style Sheet (CSS).
- Symbolization of point, line, area and label feature maps using OpenLayers software.
- Create layers of points, lines, areas, labels according to the predefined symbols, using OpenLayers software.
- Presentation of maps in web pages, using OpenLayers software.

- Upload the HTML, JavaScript, PNG image files to the Netlify internet server, and get a Uniform Resource Locator (URL) address.



Hyper Text Markup Language or what we usually call HTML is a collection of symbols or tags written in a file that aims to display pages on a web browser. These tags inform the browser to display the complete web page to the user [11]. Programming of HTML files called tags can be used in determining the appearance of HTML documents. HTML tags function as defining that the HTML file is a document, while the head of the HTML document itself is called the head element which is used to place the file identity. Unlike the head tag, the body tag is used to determine the content that you want to display on the web page [21].

Cascading Style Sheet (CSS) is a style language that regulates how HTML elements are displayed in the browser. CSS has a function to decorate web page content. CSS was added to HTML as a solution to the problem of mixing content creation codes with display management codes [12]. The CSS is also a document that aims to change the standard web page format into a web form that has a more beautiful and attractive quality. Impressions on HTML elements in a web need to meet graphic rules, therefore styling is needed in CSS in terms of layout, font, and color usage. The use of CSS can save work time because it can organize layouts on several web pages at one time [10].

JavaScript is one of the web-based and object-oriented programming languages or often called OOP (Object Oriented Programming). An object is considered to have different methods, properties, and events. For example, when clicking a button, a warning message will appear, or when the cursor crosses a link, a message will appear [12]. The web-based application page system and its appearance can be enhanced by using JavaScript.

WAMPServer is a web server that works on a localhost basis that is made independently and installed on the Windows operating system. WAMP stands for Windows and the principal components of the package: Apache, MySQL and PHP. W is for Windows. A is for Apache, which is the server software responsible for displaying a page. M is for MySQL, refers to the database management system on the server that serves to store all relevant information, for example, site content, user profiles and others. P is for PHP, which is a scripting language or programming language that can manipulate the information created in the database and generate dynamic web page content every time requested by the browser. Other programs can also be included in the package, such as phpMyAdmin which provides a graphical usage interface for the MySQL database manager or the alternative Python programming language or Perl [13].

3. RESULTS AND DISCUSSION

Under keeping with the development initiatives under the agenda of the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), the National Long-Term Development Plan (RPJPN 2005–2025) prioritizes programs aimed at reducing poverty. Although the number of impoverished individuals is still very significant, this initiative has succeeded in lowering the percentage of the population living in poverty. The cultural norms of Indonesian society continue to provide numerous obstacles to current efforts to reduce poverty. The goal of development is the wellbeing of society through an ongoing process involving the social, economic, and environmental spheres.

The province of West Java comprises 5,322 villages and 18 regencies, along with 9 cities. Villages account for 75% of the accomplishment of the Sustainable Development Goals (SDGs), making them the primary entity in the execution of development programs. In the province of West Java, 72% of the population resides in villages, and 89% of the administration is a village government. [14]. Since the village is the most crucial component of development achievement, there should be more focus on building a just and successful society there. In order to move towards developed and independent villages, a sustainable development framework where social, economic,

and ecological aspects become complementary forces that complement each other and maintain the potential and ability of the village to prosper the lives of its residents is needed. This is how the success of development in villages is measured using indicators developed in the IDM. Poverty continues to be the main issue in the village. As a result, the non-spatial data in the IDM book combined with the topographic map is crucial.

Village development and community empowerment policies and activities aim to produce equity and justice, by strengthening local and cultural values, and being environmentally friendly in managing the potential of natural resources in a good and sustainable manner. The IDM monitors or watches the development of village independence based on the implementation of the Village Law with the support of village funds and village assistants. The IDM provides direction in conducting policy interventions with the correlation of appropriate development interventions from the government based on community involvement and or participation that correlates with the characteristics of the village area. The results achieved in this research activity are presented spatially using a topographic map of West Java Province area integrated with IDM data as attribute data.

Social, economic, and environmental resilience factors are the fundamental elements of the assessment used to determine the state of a village, with the classifications being Independent Village, Advanced Village, Developing Village, and Underdeveloped Village. As stated by Kemendesa PDTT [5], the level of village development is grouped into five IDM categories, namely:

- Very Advanced Village (Independent Village): This village is able to develop for the betterment of its citizens' welfare and standard of living. With an IDM rating higher than 0.8155, it possesses sustainable ecological, social, and economic resilience.
- An advanced village is one that is able to manage its potential social, economic and ecological resources to improve the welfare of the village community. It has a good quality of human life and is able to overcome poverty. An advanced village is one that has an IDM within the index value limit of $0.7072 \leq 0.8155$.
- Developing villages are villages that have social, economic and ecological resources but have not optimized their management. Developing villages have an IDM of $0.5989 \leq 0.7072$.
- Underdeveloped villages are villages that are less than optimal in managing their potential social, economic, and ecological resources, resulting in poverty in various forms. Disadvantaged villages have an IDM of $0.4907 \leq 0.5989$.
- Very Underdeveloped Villages, are villages that experience poverty in various forms and are also vulnerable to social conflict, economic shocks and natural disasters. The IDM of a disadvantaged village is less than 0.4907.

The West Java Province includes 5,322 villages total. Of those, 48 are classified as extremely underdeveloped, 37 as independent, 695 as developed, and 4,542 as developing. Eight districts and nineteen cities have established IDM strata, according to the integration of tabular data (non-spatial data) into spatial data at the district and city levels (Figure 3). Policies and initiatives aimed at empowering rural people and promoting sustainable development are moving quickly forward (<https://jabar-e.netlify.app>). The Province of West Java's IDM status increased over the 2019 period, with 11 districts and cities having advanced IDM stratum. As a result, the advanced IDM stratum controlled West Java Province status in 2022, and there were 9 (nine) districts/cities have independent IDM stratum (Figure 4). And in 2023, the Province status was dominated by the Independent IDM stratum [5].



FIG 3. Spatial Information of Village Development Index 2018



FIG 4. Spatial Information of Village Development Index 2019

Financial development in West Java Area is still overwhelmed by the lodging advancement division (Figure 5.), which suggests that financial development is around urban zones and or financial development centers [15].

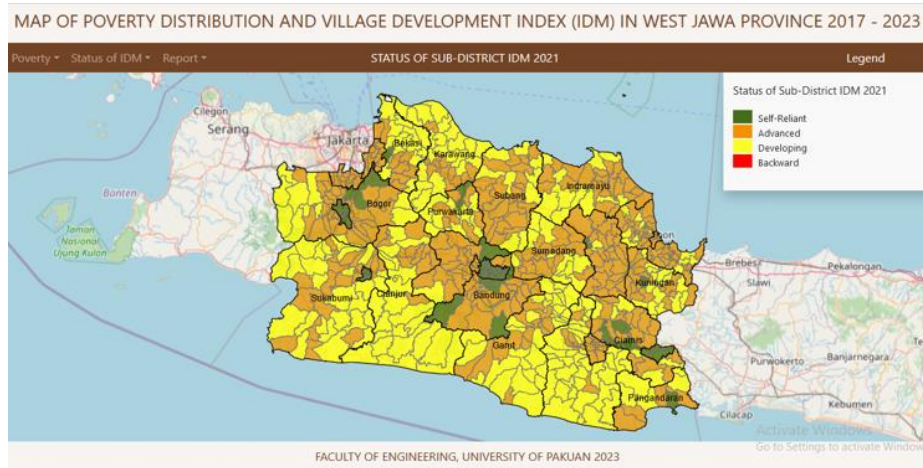


FIG 5. Spatial Information of Village Development Index per Sub-district Area 2021

The wellbeing, instruction and obtaining control or standard of living segments have a negative impact on the destitution rate. Government help within the frame of the Common Assignment Finance (DAU) and coordinate assistance to the destitute features a noteworthy impact on decreasing the destitution rate [16]. Spatial analysis reveals that villages with low transportation accessibility and far from education and health facilities have a tendency to have lower IDM values.

There are several factors that cause a village to have a low development index, including the location of the village in an area that is difficult to access, making it difficult to access resources, infrastructure, and basic services such as education and health. Limited resources, both human and natural, will make it difficult to develop infrastructure and provide basic services to its population. Limited access to quality education and health services can also affect the welfare and ability of the population to improve their standard of living. Villages that are highly dependent on primary sectors such as agriculture or mining are particularly vulnerable to commodity price fluctuations or environmental changes, which can hamper their economic growth. These are examples of factors that can lead to a low development index in a village. The conditions and causes may vary depending on the local context and specific factors affecting the village [17].

Visualization of IDM data using WebGIS (Web-based Geographic Information System) has several significant benefits in the context of village development index data, including that stakeholders can see spatial patterns of IDM, making it possible to understand the spatial distribution of development levels across villages and regions and assisting in the identification of villages that require greater attention (Figure 6. and Figure 7.). This information can be used to set priorities in resource allocation and plan development programs accordingly, and can quickly identify villages that have a low development index. WebGIS can also be used as a tool to increase community involvement in the development process. This visualization can also improve efficiency, transparency, and participation in efforts to improve the welfare of village communities. By allowing easier access to information on the village development index, communities can be more actively involved in planning and implementing development programs that impact their lives [18].

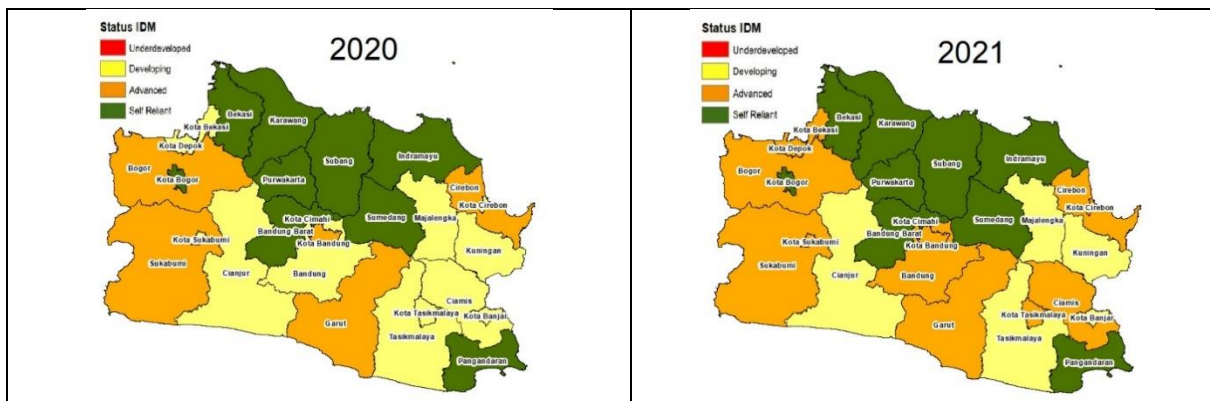


FIG 6. Spatial Information of Village Development Index 2020-2021

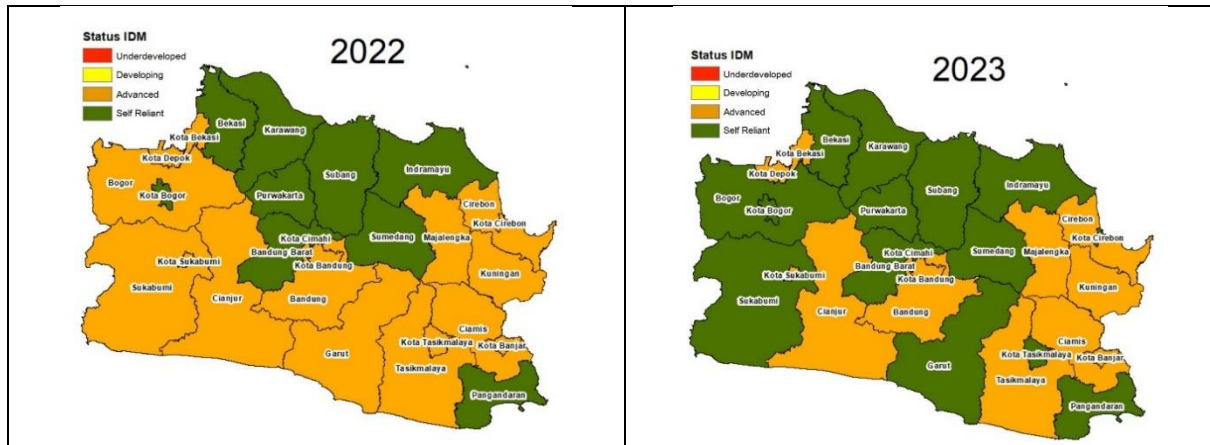


FIG 7. Spatial Information of Village Development Index 2022-2023

4. CONCLUSIONS

The results show that there is a significant variation in the level of village development across West Java Province, with a concentration of independent and developed villages near economic centers and major infrastructure networks. Factors such as transportation accessibility, education availability and health facilities, and local government policy support play an important role in improving IDM. Spatial analysis reveals that villages with low transportation accessibility and far from education and health facilities tend to have lower IDM scores.

Overall, IoT and WebGIS can serve as important tools for more inclusive and sustainable regional development planning. It can significantly contribute to the dissemination of IDM spatial information by improving the quality, speed and reach of available data, and supporting better and faster decision-making. This will require policy interventions that focus more on improving accessibility and providing basic facilities

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