

THE CONSERVATION DEVELOPMENT OF THE UPPER AREA OF GUNUNGPATI DISTRICT IN SEMARANG CITY

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Abstract: The upstream area of Semarang City is earmarked for development that often ignores conservation. The research objective is to evaluate changes in land use and develop conservation plans to create green open spaces. Exploratory methods are used to collect data and develop suitable conservation activities. The research looked at land use change in Gunungpati district between 2017 and 2021, which shows that this region has an important role in maintaining environmental balance because it is located in the highlands. Conservation analysis is applied to assess land use change. The research results show that conservation has not been implemented optimally to create a green area. Vegetation cover in Gunungpati District is still adequate, at around 42% but is facing the threat of environmental degradation due to population growth. One of the main causes of environmental degradation in this area is the increase in population caused by urbanisation, resulting in rapid changes in land use. Development in Gunungpati district has not been fully sustainable. Green spaces must be planned in conservation development based on three aspects – utilisation, preservation, and protection.

Keywords: Upper area, land use change, green city, conservation.

Introduction

As the capital of Central Java Province, Semarang is the centre of regional development. Semarang City is growing very dynamically in line with its population and economy (Hidayati *et al.*, 2018). Semarang has hinterlands involving the “Kedungsepur zone” (Kendal, Demak, Ungaran, and Purwodadi), which has grown to become a “region-based urbanisation, which is a rural-urban area”. The upper area of Semarang City is mountainous and earmarked for development. In general, development and land use in Semarang tend to be uncontrolled which brings negative impacts on the environment such as increased occurrences of floods and the degradation of the land carrying capacity resulting in landslides in the upper area of Semarang. Urban development that is environmentally friendly contributes greatly to the reduction of the impacts of climate change and maintains the conservation function of upper Semarang.

The Regional Spatial Plan (RSP) – a document that controls the development of the city – has not been effective as development in upper Semarang often violates its provisions and even ignores conservation activities. Disharmony between development plans in the RSP and its actual implementation must be avoided, to realise efficiency and effectiveness in the use of limited land and resources (Nugroho & Sugiri, 2009; Dewi *et al.*, 2020; Setyowati *et al.*, 2021b).

Literature Review

Based on the Semarang RSP 2011-2031, the sub-districts of the upper area of the city are as follows: (1) Tembalang district (4,420 Ha) is categorised as BWK VI, the main function: Education; (2) Banyumanik district (2,509 Ha) is categorised as BWK VII, the main function:

Military office; (3) Gunungpati district (5,399 Ha) is categorised as BWK VIII, the main function: Education (Istandia, 2020). These areas are protected. Furthermore, more than 40% of these sub-districts comprise sloped areas and function as water catchments. Some of these water catchment areas are being rehabilitated after deforestation.

Private green space plans include open yards and office yards, shops and business districts. In addition, public green spaces include (1) parks and urban forests; (2) roads and pathways; and (3) open spaces for certain functions. Areas designated as urban forests are Kreo Cave in Gunungpati district and Tinjomoyo in Banyumanik district. The urban forest area can be used for research and development of science, education, supporting cultivation, natural tourism and recreation, as well as cultural preservation in the form of conservation and non-convertible forest (Setyowati *et al.*, 2021b; Wicaksono *et al.*, 2022). Conservation of natural resources, for example, forests is highly dependent on the participation of local communities around the forest (Sumarmi *et al.*, 2020).

The development of urban areas always results in environmental degradation. Environmental problems must be addressed with sustainable management because of their enormous ecological impacts, which not only impact the in-situ environment but also the wider environment (Acuto *et al.*, 2018; Zinkernagel *et al.*, 2018). The role of green open spaces in balancing environmental ecosystems and supporting ecology is very important (Sholihah & Astuti, 2021), especially in urban areas (Utama *et al.*, 2018). The existence of green open spaces in urban areas will increase oxygen production and absorb carbon dioxide, provide a habitat for wild animals such as butterflies and birds and maintain the quality of groundwater (Subianto *et al.*, 2019).

Urban green spaces have paramount importance for a big city such as Semarang. They provide space for social interaction and physical activities such as exercise and play,

both of which have an impact on physical health and psychological well-being. Factors in day-to-day life that significantly affect health status, are referred to as “determinants of health”. Problems in urban areas arise due to unhealthy lifestyles, stressful jobs, and the emergence of disease due to the impact of pollution. Sustainable urban development can be achieved by paying attention to the link between community health and welfare (Hasyim & Dale, 2021; Tonne *et al.*, 2021; Thompson & Kent, 2022). The main features of the Healthy City project include a political commitment to high levels of collaboration among the cross-sectoral community (Capolongo *et al.*, 2020; Tran *et al.*, 2020).

Based on the importance of this role, many urban designers, especially in America, initiated community garden programs and developed them innovatively to reduce environmental injustice, especially those that affect poor citizens. These programs involve the participation of communities in reforming the green space so that they improve the health of urban communities, both physically and psychologically. One of the sub-districts in Semarang City has complied with Semarang City Regional Regulation No. 7 of 2010 concerning evaluating the suitability of green open spaces. South Semarang district has 65% green open space, which is 113,940 Ha of the 175,829 Ha that has been planned (Andari *et al.*, 2020). Meanwhile, environmental justice has also been taken into consideration as ecosystem services are deemed to be a part of public services that should benefit all groups of citizens on an equal basis (Brilhante *et al.*, 2018).

The strategy is to revitalise the urban space to be greener by avoiding problematic spaces such as parks under the highway. Another strategy is to replant abandoned infrastructure such as unused railroads to obtain a green open space. The trees in green spaces produce more oxygen and shield people from dust and air pollution from motor vehicle fumes in large cities.

Less green open space in urban areas will reduce the connection between humans and nature (Dipeolu & Ibem, 2022). The green open space in big cities such as Jakarta, Surabaya, Bandung and Medan has decreased from 35% of their areas to less than 10%. Only 9% of Jakarta is green space, which is only 7.08 m² of green open space per capita. In comparison, this is significantly lower than in Stockholm City (80 m²/capita), New York, Berlin (approximately 30 m²/capita), and Paris (approximately 15 m²/capita). The growth and development of cities raise environmental problems, especially for cities that have strong connections to Jakarta such as Depok City. The environmental performance of Depok in all categories averages 50.2%. Performance falls short in six categories, energy and CO₂, land use and building, waste, sanitation, air quality and environmental governance (Kirmanto *et al.*, 2012; Endangsih, 2020).

There are eight criteria for the Green City concept: (1) Development must be in line with the regulations, including disaster mitigation, spatial planning, and the protection and management of the environment, (2) the zero waste concept (integrated waste management, nothing is wasted), (3) the zero run-off concept (the water must be absorbed into the soil, the concept of eco-drainage), (4) green infrastructure (pedestrian and bicycle lanes are available), (5) green transportation (mass transit use, environmentally friendly renewable fuel, encourage the use of transport instead of a motor vehicle-walking, biking, wagon/buggy/carriage/rickshaw etc.), (6) green open space covers 30% of the city area (20% public green open space, 10% private green open space), (7) green building, and (8) community participation & green community (Fuady, 2021).

Xue, Gou and Lau (2017) argue that the concept of green open space is one of the solutions to urban development planning and design that can reduce the impact of environmental damage and maintain the survival of the city's environmental ecosystem. It is feared that the dense development of

cities in Asia will create an imbalance between residents and limited green open space. It was found that the level of green space cover and density of green plants were significantly related to outdoor microclimatic conditions and usage behaviour, such as visiting patterns, sensations, and healing evaluations of green open spaces in dense urban contexts.

The Green City is a city that is "in balance with nature", where all forms of nature, from living organisms to their habitats are significant components of the urban form and part of green infrastructure (Breuste, 2020). The results of climate study through the urban forest zone in Bandung Regency and the degradation of environmental quality in Depok City revealed that the vegetated area has low air temperature. In Malang City, the tendency of the built-up area to increase along with population growth and development expansion indicates that the city will surpass the region's holding capacity sooner than it should. Such conditions create an uncomfortable living environment (Subadyo, *et al.*, 2019; Endangsih, 2020). On the other hand, open areas without vegetation have higher air temperatures. In addition to being able to reduce air temperature, vegetation can also increase humidity so the environment is more comfortable (Panara *et al.*, 2023). Urban forests can provide major benefits to microclimate control, engineering and aesthetics aspects.

The Green City Development Program is one of the concrete steps taken by the central government together with the provincial government and the district government in fulfilling the provisions of the environment law, especially related to the fulfilment of urban green open space, to answer the challenges of climate change in Indonesia. The Green City Development Program is an innovation for the realisation of community-based urban green open spaces (Xue, Gou & Lau, 2017; Yin *et al.*, 2022).

Since the industrial revolution of the 18th century, the human ability to develop and utilise natural resources has continued to improve. As a result, serious environmental problems have

emerged such as land damage and biodiversity, emissions and pollution, increased energy consumption, and so on (Kowarik *et al.*, 2020). In this era, the quality of the environment continues to decline. The increasing number of populations causes humans to face big problems now and in the future. Humans use natural resources and the environment more intensively and expansively, while the earth's carrying capacity to provide for humans' livelihoods is very limited. A crisis of spiritualism in humans makes the environment increasingly neglected as development is not balanced with the preservation of the surrounding environment, threatening future generations (Desi *et al.*, 2021).

Development is correlated to environmental damage but connotes physical development and economic improvement. Development often only focuses on economic growth and investment. Development based on industrialisation is accompanied by economic and ecological disasters (Zeng *et al.*, 2020; Shi *et al.*, 2020). Environmental development and damage move people to improve it by carrying out various conservation activities (Bennett *et al.*, 2017; Setyowati *et al.*, 2020). Conservation development combines land development with natural resource protection. Conservation development prioritises the protection of natural resources, open spaces and agricultural land.

Conservation is an effort by humans to preserve nature. The scope of conservation is not just about nature and includes cultural heritage and the built environment, archaeological monuments, important historical buildings, landscapes, ecology, existing resources, and wildlife conservation. Conservation efforts carried out by humans to preserve or protect

nature include protection, preservation, maintenance, and utilisation activities.

Conservation development efforts carried out on the Semarang State University campus apply conservation development strategies including (1) Biodiversity management; (2) management of internal transportation; (3) energy management; (4) management of green buildings; (5) waste and water management; and (6) management of cultural conservation. The six conservation programs are expected to cover all aspects of life, both physically and non-physically, human resources and culture (Prihanto, 2017; Setyowati *et al.*, 2020).

In particular, development in the Gunungpati district has resulted in changes in land use. Changes in land use will affect the biophysical conditions of the watershed such as topography, slopes, soil fertility, and land area, leading to environmental damage. Humans as watershed residents carry out activities continuously, their role will be to make the environment better or worse. Humans can carry out conservation activities that can improve the environment. Conservation efforts include protection, preservation, maintenance and utilisation activities. It is hoped that a clean, beautiful and comfortable living environment with green open spaces will be created sustainably as in the scheme presented in Figure 1.

Material and Methods

This research is not to provide conclusive results, but rather to explore a research problem to find something new in the form of symptom groupings (Swedberg, 2020). This research aims to deepen knowledge related to a particular matter in more detail, logically and objectively.

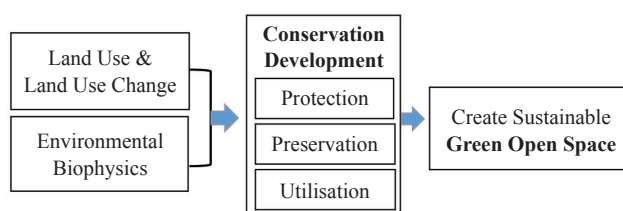


Figure 1: Theoretical framework of upper area conservation development

The exploratory method is carried out based on specific observable facts, and then, mapping and categorisation are carried out. In this research, quantitative methods were also used, data taken from remote sensing images were analysed quantitatively with a spatial approach using a Geographic Information System (GIS).

The research object is the Gunungpati Regency area, Central Java, Indonesia (Figure 2). Several villages were used as detailed research observations. Data collection methods to develop conservation activities consist of observation, image interpretation and interviews.

Research materials include digital data from SPOT 7 satellite imagery for 2017 and 2021 with field inspections in 2021; Gunungpati District Administrative Map; secondary data in the form of land use data and population data collected from the Central Statistics Agency. The survey tools used in this research were: Interpretation tables and writing tools, Global Position System (GPS), digital cameras, interview guides, and questionnaire instruments.

Data analysis for land use mapping used SPOT 7 satellite imagery with digital interpretation. The implementation of digital image interpretation used ArcGIS software to process image data so that the types of land use can be determined using pixel values. The pixel

values that have been interpreted are validated by checking in the field. Analysis of changes in land use area is calculated from changes in increase or decrease in land use area in 2017 and 2021.

Results and Discussion

Existing land use in 12 villages in Gunungpati district of Semarang are described by the visual interpretation of the image data source recorded on SPOT 7 in 2017 and 2021. It is divided into two recording scenes: Scene 1408-543 and scene 1408-544.

The results of visual interpretation in 2017 were classified into 12 land-use classes. The dominant land use in the study area is residential buildings and vegetation cover or green open space. The widest residential building was in Tembalang district with an area of 1,285.41 Ha (29.08% of the total area). On the other hand, the smallest residential area is in Gunungpati district with an area of 874.79 Ha (16.20% of the total area). The residential area with the largest percentage is in Banyumanik district with 38.07% because the area is in a strategic location due to the presence of several public buildings such as the university, industry, hospital, cluster area, and several other important buildings.

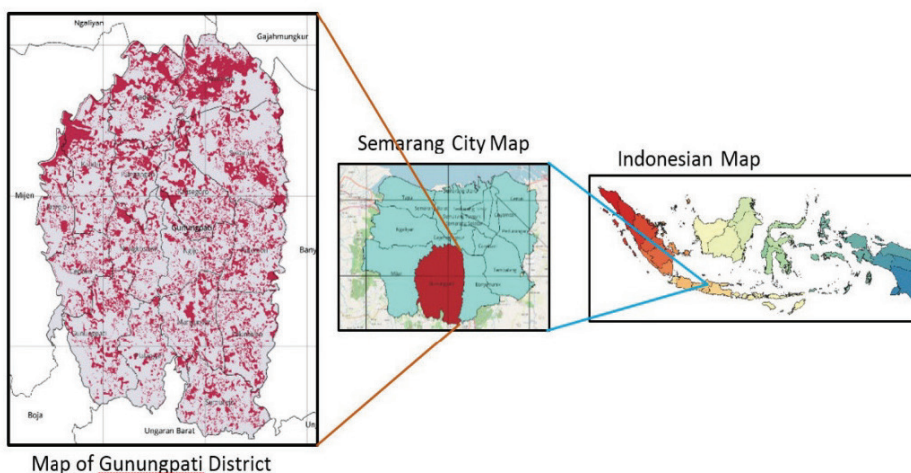


Figure 2: The research location is Gunungpati district, Semarang City, Central Java

The residential areas in the Banyumanik district and Tembalang district have two dominant patterns, elongated along the road and clustered in densely populated residential areas and boarding houses. Meanwhile, the pattern of the residential area in the Gunungpati district is more elongated along the road. However, some houses are clustered in several areas such as Sekaran Village.

Based on the results, the widest vegetation cover is in the Gunungpati district with 2,474, 98 hectares or about 48.27% of the total area (Figure 3). The vegetation cover and the green space in the other districts are almost similar to that of Gunungpati with a percentage of area below 30%. The vegetation or green space in Gunungpati district is still maintained because most of the area is a protected area with a fairly steep slope, construction of buildings is difficult. The vegetation in this area is the main support of green open space in Semarang with the district of Mijen as a balancer of the microclimate and oxygen source of the population. The area of Green Open Space in Mijen district is dominated by conservation and park-type green open spaces (Baldwin & Beazley, 2019; Hadriani *et al.*, 2021). Green open space is one way to create a comfortable microclimate for the community (Setyowati, 2021a).

Tembalang and Banyumanik districts have a relatively low area of vegetation cover/

green open space at only 17.69% and 24.93%, respectively. In general, vegetation/green open space in both districts consists of urban forests, parks, green space road boundaries and gardens with elongated patterns. According to Law 26 of 2007 on Spatial planning, it can be concluded that vegetation cover/green space areas that meet minimum standards were found in the Gunungpati district. On the other hand, two other districts still have not met the minimum standard. In general, Semarang has experienced a reduction in the area of green open space, the decline in green open space as a catchment area in the city of Semarang has resulted in a decrease in the groundwater table from -4.808 m above ground level in 2016 to -5.687 m above ground level in 2019 (Nepomnyashchikh *et al.*, 2019). The following graph presents a comparison of the area of dominant land use at the sites (Figure 3).

According to the map in Figure 4, the dominant land use in Gunungpati is the vegetation cover and green open space, with the widest area located in Patemon village with 167.58 hectares and Gunungpati with 163.03 hectares. Vegetation cover at the location is dominated by foreside *bagus* and mixed plantations whose spatial patterns are clustered in areas with relatively steep slopes. These areas are categorised as protected areas based on the Spatial Plan of Semarang.

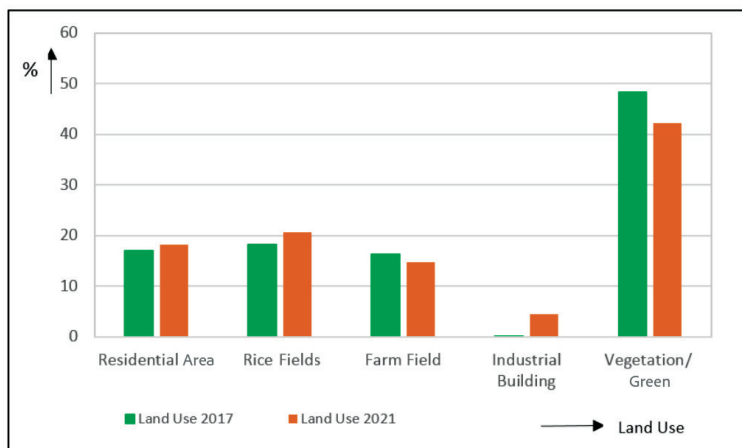


Figure 3: Percentage of land use area in Gunungpati district in 2017-2021

Source: Visual interpretation

Protected areas act as a counterweight to natural ecosystems, ensuring water availability, biodiversity, climatic conditions, regional aesthetics, health, and community welfare (Zhildikbaeva et al., 2018; Saputra et al., 2022). If protected area management is to be effective, it requires global-level cooperation through international organisations such as the International Union for Conservation of Nature (Baldwin & Beazley, 2019). Sustainability can be maintained by involving the community in maintaining the preservation of protected areas. One way is to apply the concept of forest management to the community (Kusmana & Melyanti, 2017).

The largest residential area is located in Sekaran with 88.36 Ha, Sukorejo Village with 86.21 Ha and Gunungpati Village with 83.53 Ha. The development of Sekaran, Sukorejo and Patemon villages are strongly influenced by the Universitas Negeri Semarang (UNNES) campus in the area. In general, the residential building and construction are in the form of a boarding house and business places around the campus area. Sukorejo Village is dominated by residential buildings with a more regular pattern. The rapid growth of building establishments around the Universitas Negeri Semarang campus has resulted in a reduction in vegetation in the area.

Agricultural land in Sukorejo Village takes up to 126.50 Ha and 97.90 Ha in Sekaran Village. The farms in both regions are mostly located in areas with relatively steep slopes. Rice fields are still quite dominant, especially in Gunungpati Village with an area of 135.75 Ha (Figure 4). Wide rice fields are a valuable ecological asset and must be maintained. Aside from being a source of food, paddy fields are also a form of city-scale green open space (Zhildikbaeva et al., 2018). Preservation of green open spaces in the form of rice fields can also be done by imitating the *subak* concept in Bali. *Subak* is a traditional farmer organisation in Bali which is engaged in managing irrigation water with a socio-religious nature based on the *Trihithakarana Philosophy*. *Trihithakarana* means that there are three causes

of happiness if there is a harmonious relationship between humans and God, fellow humans, and nature (Dewi et al., 2018; Setyowati, 2021a). *Trihithakarana* needs to be adapted to the local beliefs of Gunungpati district.

The upper areas of Semarang such as Gunungpati district, Tembalang district and Mijen district experience very rapid urban growth for the presence of social economic activities such as the establishment of campuses. The UIN Walisongo campus and the BSB Satellite City attract economic activity which ultimately also affects land use, building planning, traffic circulation and parking, pedestrian ways, marking, open space, and supporting activities in bus corridors (Dzakiya et al., 2019). As a result of the growth in business activities, population growth has also increased due to inward migration. According to data from the Central Bureau of Statistics (2022), the population growth in the Gunungpati district is above average the population growth rate of Semarang (1.66% per year). The population growth rate of Gunungpati was 3.43% and 3.64% per year with a population of 109,820 and 69,789 people, respectively. This growth increases the volume of waste, which has reached 4,556.68 m³ per day but only 81.71% of it is transported to the Final Disposal Site. The rate of population growth will also result in physical changes, especially in residential land (Putra et al., 2021). In addition, there are 43 slums in Semarang and 52 urban villages on the riverbank (Central Bureau of Statistics, 2022).

The results of the preliminary research indicated that the growth of Semarang City affected the land use. The result is in line with Giyarsih's (2010) studies in the Yogyakarta-Surakarta corridor, that the higher the physical accessibility, the higher the degree of regional transformation. According to the Central Bureau of Statistics (2022), of the 38,965 hectares in Semarang, there are 273 hectares of critical land, 689 hectares of land are quite critical, and 5,806 hectares are potentially critical. To preserve biodiversity and restore land structure, it is necessary to regulate diverse

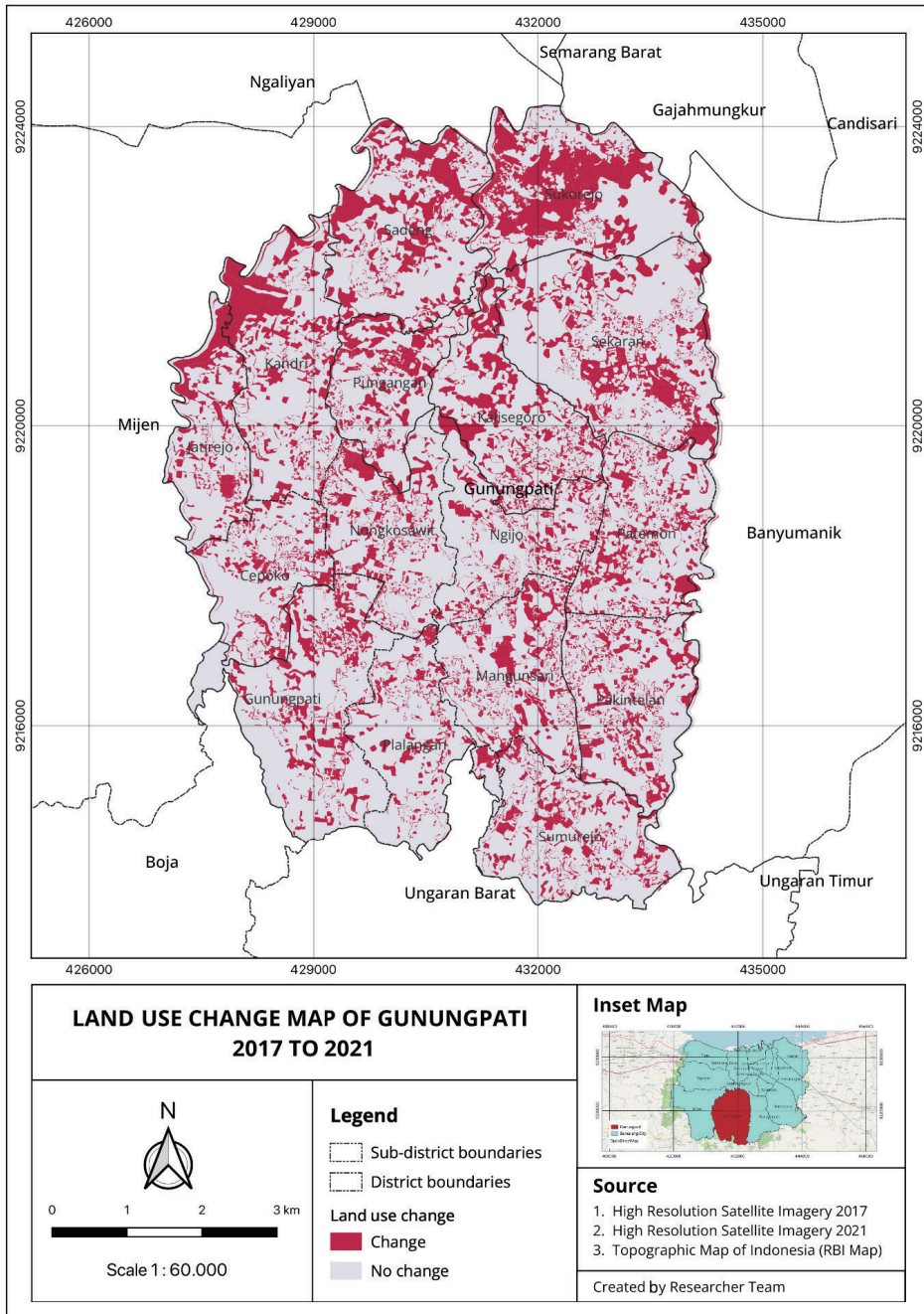


Figure 4: Land use change of Gunungpati district 2017 until 2021

land uses. These models are commonly used in scenario-based assessments to project future developments of biodiversity and ecosystem conditions (Alkemade *et al.*, 2022). Land use

changes resulted in environmental damage. As a consequence, various disasters occur. The Central Bureau of Statistics (2022) recorded 129 landslides in 2022 (approximately

14.25% in Central Java) and 11 floods in 2022 (approximately 14.84% occurred in Central Java). Furthermore, there are many environmental cases throughout the year, including the number of toxic hazardous substances (B3) of about 6,056.77 tonnes per year, fly ash of 116.80 tonnes per year, and bottom ash of 24.20 tonnes per year. Environmental crises are a consequence of many large and medium-scale industries. There are 328 industries with 98.032 workers. This number is the largest compared to other cities in Central Java.

Conclusions

Land use in Gunungpati shows that it still maintains green open spaces by statutory provisions, namely at least 30% of the total land area. Gunungpati Regency has experienced changes in land use that are developing rapidly, especially for residential buildings which are mainly developed around the Semarang State University campus. The results of the study show that the vegetation cover or green open space is 42%. Therefore, it still meets green space regulations. In general, green open space is dominated by mixed forest and garden types with clustered spatial patterns. Green open spaces are located in areas with relatively steep slopes which are protected areas by the Semarang City Spatial Plan. Conservation development is applied by making changes to land use by paying attention to aspects of protection, preservation and land use (utilisation).

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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