



Original Research article

Availability Of Green Open Space For Oxygen Needs In Kadipaten Village, Wiradesa District, Pekalongan Regency

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ABSTRACT

Common problems that arise in Indonesia are increasing population density and increasing the size of urban areas which results in land conversion. Development in an area can have an impact on decreasing Green Open Space (GOS). Reduced vegetation or green open space reduces the environmental carrying capacity to absorb pollutant gases and provide oxygen. Oxygen is a very important component for humans and animals. The aim of this research is to look at the actual conditions of GOS in Kadipaten Village and estimate the current need for GOS to estimate oxygen needs. This research was conducted in Kadipaten Village, Wiradesa District, Pekalongan Regency. This type of research uses a quantitative descriptive approach from secondary and primary data. The area of Green Open Space (GOS) is known through digitization and interpretation of Pleiades 1B High Resolution Satellite Imagery (CSRT). The research results show that the Green Open Space (GOS) in Kadipaten Village is dominated by private rather than public green open space. The calculation results for the total oxygen needs of residents, motorized vehicles and animals are 5876.614 kg/day. In order for oxygen needs in Kadipaten Village to be met, the area of green open space that must be available is 116,081 Ha.

Keyword: Green Open Space; oxygen; Pekalongan Regency

1. INTRODUCTION

Regional structure planning is related to the spatial arrangement of an area. One of the important things in spatial planning is the availability of green open space (GOS). According to Kementerian ATR/BPN No. 14 tahun 2022 concerning the Provision and Utilization of Green Open Space, 30% of the area of an area is green open space. The 30% consists of at least 20% public GOS and 10% private GOS. A common problem that arises in Indonesia is the increase in population density and the size of urban areas which causes land conversion (Samsuri et al., 2021). Nor et. al. (2021), states that rapid urban development and increasing population density are the main causes of the process of changing green spaces in cities. According to Yuwono & Sari (2020), development in an area can also have an impact on decreasing green open space. In this context, the need for adequate green open space becomes increasingly important (Smith, 2020).

Many land conversions are caused by changes in land use for residential purposes. The land transferred can be empty land or vegetated land. The conversion of vegetated land into built-up land has an impact on environmental quality, especially air quality (Samsuri et al, 2021). According to Nawangsari & Mussadun (2018), the existence of a green open space has a significant influence on air quality. Reducing vegetation causes a reduction in the environment's carrying capacity to absorb pollutant gases and provide oxygen. Vegetation is an important component because it provides ecosystem services such as food and oxygen production, CO₂ absorption, and cooling through the evaporation process (Kroll et. al., 2021). In monitoring and evaluating regional planning as well as air and environmental monitoring activities, information related to needs oxygen becomes important.

Green Open Space (GOS) is an elongated/lane and/or clustered area whose use is more open, where plants grow, both naturally grown and deliberately planted. Based on ownership, GOS is divided into private GOS and public GOS. The existence of green open spaces takes into account water catchment function, ecological, economic, socio-cultural and aesthetic aspects. According to Ulfa & Fazriyas (2020), green open space is one solution to improve environmental quality because it combines natural and human systems. The area of green open space according to regulations is a minimum of 30% which is the minimum size for ecosystem balance in terms of hydrology, ecology, microclimate systems which can increase the availability of clean air and city aesthetics (Tontou et al., 2015). Currently, the significant decline in green open space both in quantity and quality is a problem that needs attention (Wahid et. al., 2021)

Oxygen can be available naturally through growing vegetation. Vegetation has the ability to produce oxygen. Oxygen is a very important component for humans and animals. Analysis of oxygen needs is important to estimate for the survival of humans and other living creatures and can be an instrument for monitoring air quality. Analysis of the oxygen demand approach can be calculated to estimate the presence of green open space using the Gerakis method (Putra, 2012). The aim of this research is to look at the actual conditions of green open space in Kadipaten Village and estimate the current need for green open space to estimate oxygen needs so that there is a balance between oxygen availability and demand. This balance is needed to improve air and environmental quality.

2. RESEARCH METHODS

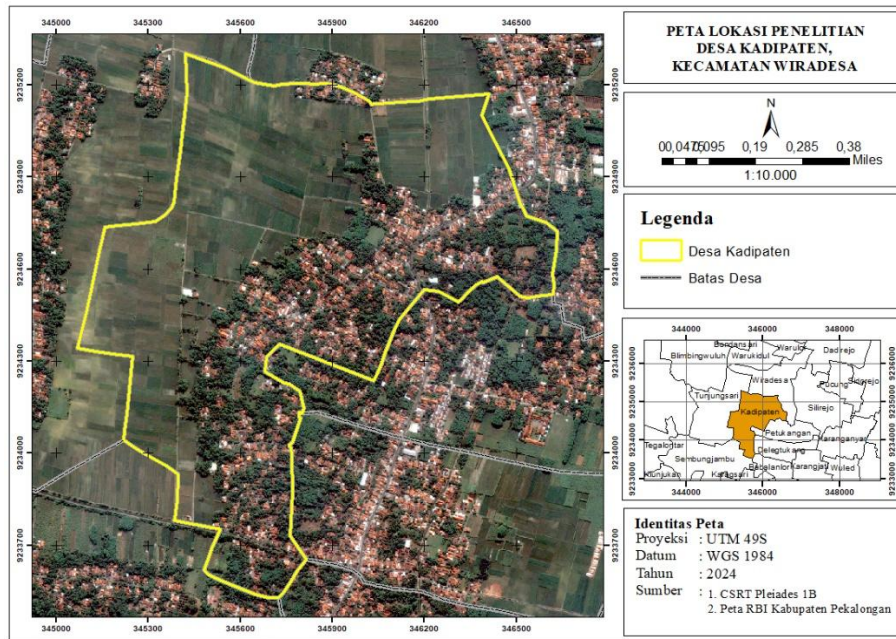


Figure 1. Research Location

The research was conducted in Kadipaten Village, Wiradesa District, Pekalongan Regency. This type of research uses a quantitative descriptive approach which aims to determine the availability of green open space and oxygen demand. Data collection techniques are carried out in 2 ways, namely primary and secondary. Primary data was obtained through direct observation at the research location. Meanwhile, secondary data is obtained from data from government agencies and other relevant sources. The area of green open space (GOS) is known through interpretation of Pleiades 1B High Resolution Satellite Imagery (CSRT) which is processed using the ARCGIS 10.8 software application. The data analysis technique begins with analyzing the availability of green open space by digitizing images to determine the distribution of green open space, then continues to identify the area of green open space. Second, oxygen requirements are calculated using the required data, namely the number of residents, motorized vehicles and livestock as components that require oxygen. In this research, industry and hotels were not included as oxygen consumers. The area of green open space was calculated for oxygen needs in Kadipaten Village using the Gerarkis formula by Muis 1988 in Nirmalasari (2013). The formula used is as follows:

$$Lt = \frac{(Pt + Kt + Tt)}{(54)(0,9375)}$$

Information :

- Lt : Area of green open space in year t (m²)
- Pt : Total oxygen requirement of the population per day in year t (grams/day)
- Kt : The amount of oxygen required by motor vehicles per day in year t (grams/day)

Tr : Total oxygen requirements of livestock in year t (grams/day)
 5 : A determination or constant that shows that 1 m² of vegetation land area produces 54 grams of plant dry weight per day (grams/day/m²)
 0.9375 : A determination or constant that shows that 1 gram of dry plant is equivalent with oxygen production of 0.9375 grams/day

Table 1. Total Oxygen Needs for Each Oxygen Consumer

Consumer	Category	Oxygen Requirements (kg/day)	Information
Man		0.864	
Vehicle	Passenger car	11.63	3 hours/day
	Bus	45.76	2 hours/day
	Load Car	22.88	2 hours/day
	Motorcycle	0.58	1 hour/day
Cattle	Buffalo and Cow	1,702	
	Goat	0.314	
	Poultry	0.167	

(Source: Putra (2012))

3. RESULTS AND DISCUSSION

Kadipaten Village is one of the villages in Wiradesa District, Pekalongan Regency. Currently, Kadipaten village continues to grow, both from a social and economic perspective. This development cannot be separated from changes in land use in the village. One of the functions of land that has changed a lot is green open space (GOS), both private GOS and public GOS. For this reason, mapping was carried out on the availability of green open space (GOS) in Kadipaten Village.

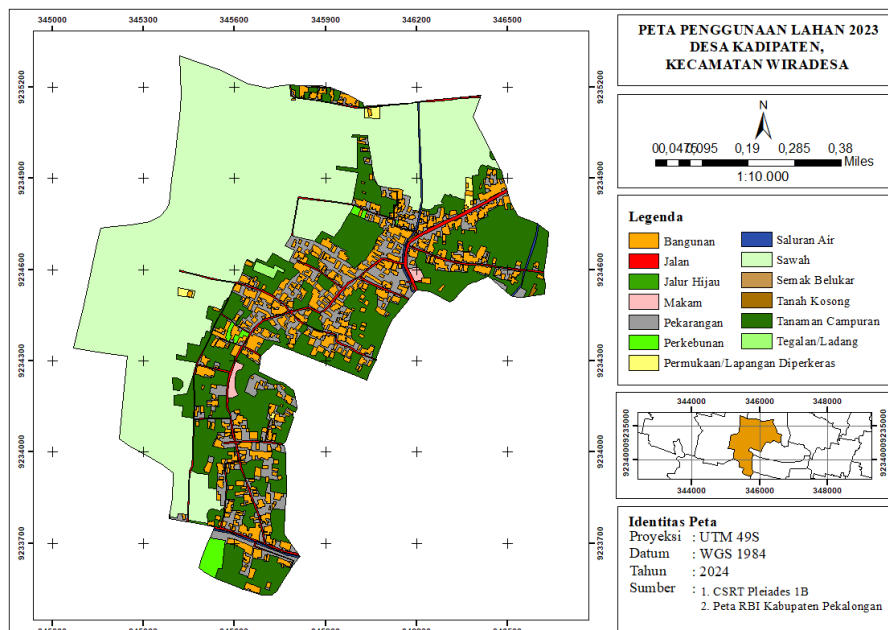


Figure 2. Map of Land Use in Kadipaten Village in 2023

(Source: author's)

The image above is Land Use in Kadipaten Village through CSRT Pleiades 1B digitization. The area of green open space and non green open space in Kadipaten Village from the digitization results is as follows:

Table 2. Land Use Area in Kadipaten Village

No.	Land Use	Area (Ha)	Percentage (%)
1.	Green open space		
	Vacant land	0.103	0.08
	Grave	0.402	0.3
	Green Line	0.046	0.03
	Shrubs	0.072	0.05
	Yard	13.25	9.92
	Mixed Plants	29.53	22.11
	Plantation	1.05	0.79
	Moorland/Field	0.268	0.2
2.	Non Green Open Space		
	Building	15.31	11.46
	Ricefield	69.35	51.93
	Road	3,076	2,3
	Hardened Surface/Field	0.481	0.36
3.	Water body	0.605	0.45
	Total	133,543	100

(Source: Author's)

The table above shows land use in Kadipaten Village in 2023. The area of green open space (GOS) in Kadipaten Village is 44,721 Ha, which is around 33.69%. Meanwhile, the area of non-green open space is around 88,217 Ha (66.06%) and the area of water bodies is 0.605 Ha (0.45%). Land use is dominated by rice fields followed by mixed crops and buildings. In this research, the land uses included in GOS are empty land, cemeteries, green belts, shrubs, yards, mixed crops, plantations, and moorlands/fields. Even though it is an open area, rice fields are not categorized as green open space. Rice field vegetation is seasonal vegetation so it does not provide oxygen (Setyanto, 2015).

The number of residents in Kadipaten Village experienced tendency to increase from year to year. One of these increases occurred in 2021, namely with a population of 3,579 which then increased to 3,660 in 2022. This increase in population will affect human oxygen needs which are necessary for human survival. According to BPS Pekalongan Regency (2022), the population in Kadipaten Village is 3,660 people, with 1,878 men and 1,762 women. This figure represents 5.8% of the population in Wiradesa District. According to Wahid et. al. (2021), the population will determine the expected area of GOS (Green Open Space) needed. With such a population, the estimated oxygen requirement for humans in Kadipaten Village is 3,110.4 kg/day.

Each vehicle has different oxygen requirements. According to Andrayani (2020), living creatures need oxygen to breathe, while vehicles need oxygen to help burn fossil materials to

become mechanical. The number of motorized vehicles in Kadipaten Village and the estimated oxygen demand (based on Putra, 2012) are as follows:

Table 3. Oxygen Requirements for Motor Vehicles

Transportation type	Number of vehicles	Total Oxygen Requirement
Passenger car	77	895.51
Bus	2	91.52
Load Car	15	343.2
Motorcycle	1195	693.1
Total		2023,33

description: obtained from the average number of vehicles in Pekalongan Regency 2022

Each livestock animal has different oxygen needs. This is based on differences in metabolism carried out by animals. The number of livestock in Kadipaten Village and the estimated oxygen requirements are as follows:

Table 4. Oxygen Requirements of Livestock Animals

Types of Farm Animals	Amount	Total Oxygen Requirement
Cow	15	25.53
Goat	54	16,956
Chickens (Breeds and Villages)	4,073	680,191
Duck	121	20,207
Total		742,884

description: obtained from the average livestock in Wiradesa District 2022

From the calculations above, it is known that the estimated oxygen requirement for humans in Kadipaten Village is 3,110.4 kg/day. Meanwhile, the estimated oxygen requirement for motorized vehicles is 2023.33 kg/day. Then the estimated oxygen requirement for livestock is 742,884 kg/day. Thus, the estimated amount of oxygen needed in Kadipaten Village is 5876.614 kg/day. In order for oxygen needs in Kadipaten Village to be met, the area of green open space that must be available is 116,081 Ha. From the results of land use calculations, the available green open space area is 44,721 Ha, so a green open space area of 71.36 Ha is still needed. However, the availability of green open space has met the provisions stipulated by Kementerian ATR/BPN No. 14 tahun 2020 (minimum 30%), namely 33.69%.

Green Open Space (GOS) is a major contributor to the sustainability of ecological and social functions. The availability of green open space has a direct relationship with oxygen production and carbon dioxide absorption. Vegetation can play a role in improving air quality by increasing the rate of particle deposition and/or absorption of pollutant gases (Kumar et. al., 2019). Socially, Green Open Spaces provide benefits to the community by improving health and providing a place to relax. Based on research by Zhang et. al. (2021), the community agrees that green open spaces act as a place for daily relaxation and recreation and recognize that green open space is an important means for human health, no matter how often they visit it. Green open space can improve public health through social-natural

interactions. However, green open space can still provide benefits to the community without depending on the frequency of direct visits. Green open space is beneficial for respiratory health because it improves air quality through urban trees (Eisenman et.al., 2019). Greening has the potential to produce broad health benefits such as reduced chronic disease, risk of stress, and offers a variety of ecosystem services (Kumar et. al., 2019). According to Asri et. al. (2021), by focusing more on providing an adequate green environment, a country can not only prevent environmental degradation but also address and improve economic stress and mental health burden. The existence of green open space is also an effective tool for cooling the surrounding air temperature. The reduction in green open space due to the increase in built-up areas has increased the intensity of the Urban Heat Island Effect (Khamchiangta and Dhakal, 2020)

Table 5. Public GOS and Private GOS

No.	Types of Green Open Space	Area (Ha)	Percentage (%)
1.	Private GOS		
	Yard	13.25	29.63
	Mixed Plants	29.53	66.03
	Plantation	1.05	2.35
	Moorland/Field	0.268	0.6
2.	Public Green Space		
	Grave	0.402	0.9
	Green Line	0.046	0.1
	Vacant land	0.103	0.23
	Shrubs	0.072	0.16

(Source: Author)

The vegetation found in Kadipaten Village includes banana trees, coconut, snake fruit, teak, mango, durian, sengon, rubber, etc. These trees are scattered in residents' yards, plantations and mixed plantings owned by residents. Other green open spaces found are cemeteries and green belts. Green open space in Kadipaten Village is dominated by private rather than public green open space. The percentage of private green open space is 98.61%. Meanwhile, public green open space is only 1.39%. This proportion is not in accordance with Kementerian ATR/BPN No. 14 Tahun 2022 Regulation.

Private green open space is open space that has the status of private or citizen ownership. Green open space in the Kadipaten Village is dominated by fruit tree vegetation, shade plants and aesthetic plants. According to Harjanti & Anggraini (2020), shade tree species serve an ecological function because they can create a cool microclimate in residential areas, fruit tree species serve an economic function because they can be directly consumed or traded, while flower plants in residents' yards have aesthetic function because it can provide beauty. However, this function can change at any time according to the interests of the land owner.

Public green open spaces are green open spaces that are public in nature and managed by the local government with the function of serving the needs of the community (society). For this reason, it needs to be re-managed in relation to the public green open space arrangements so that Kadipaten Village has green open space that can be used generally by the community and its function can clearly be maintained. According to Handy & Maulana (2020), the existence of Green Open Space is an important element in creating a comfortable and healthy urban environment. Apart from that, green open space can also function as a recreation area, sports facility, and/or as a play area. For this reason, public green open space is needed which can be utilized by the community in Kadipaten Village. The form of public green space that is needed can be in the form of planting trees on either side of the road as well as creating village parks, RTs or RWs which can be optimized with tree plants that provide optimal canopy cover for carbon absorption and oxygen production. According to Astell Burt & Xioqi (2019), green open spaces with tree canopies and good biodiversity are more attractive and can reduce heat compared to green open spaces with grass vegetation. In addition, when providing green open space it is necessary to accommodate native (local) plant species so that it can create a suitable environment for other animals to live in, for example birds (Harahap et. al., 2021). In research conducted by Hanson et. al. (2021), parks and public spaces are a source of inspiration for some people to own and maintain their private green open spaces, whether in the form of gardens or yards.

4. CONCLUSION

Land use in Kadipaten Village in 2023 consists of 44,721 Ha (33.69%) green open space (GOS), 88,217 Ha (66.06%) non-green open space, and 0.605 Ha (0.45%) water bodies. Land use is dominated by rice fields followed by mixed crops and buildings. Green open space in Kadipaten Village is dominated by private rather than public green open space. The percentage of private green open space is 98.61%. Meanwhile, public green open space is only 1.39%. The calculation results for the total oxygen needs of residents, motorized vehicles and animals are 5876.614 kg/day. In order for oxygen needs in Kadipaten Village to be met, the area of green open space that must be available is 116,081 Ha. From the results of land use calculations, the available green open space area is 44,721 Ha, so a green open space area of 71.36 Ha is still needed.

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