Managing Green Open Space to Reduce Carbon Emissions towards Sustainable City Areas (Case: *Kelurahan* Neglasari, Bandung City)

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Abstract. Community-based management of green open spaces to reduce carbon emissions in each environment plays an important role because people need quality life in sustainable cities and settlements, amidst the threat of climate change that is felt worldwide**.** This research aims to determine efforts to reduce carbon emissions in residential areas towards sustainable urban areas by exploring the management of green open spaces carried out by communities in these areas. The research was located in *Kelurahan* Neglasari, Cibeunying Kaler District, Bandung City, Indonesia. The research method used a qualitative approach, with data collected from field surveys, and in-depth interviews with *Kelurahan* Neglasari office officials and the community. The research results show that the reduction of carbon emissions carried out by the community is by allocating area land for green open space with an area of 8,007 Ha or 10.3% of the total area of 77.71 Ha and managing green open spaces; as well as establishing collaboration with relevant stakeholders. The main activities in community-based green open space management are integrated urban farming (*Buruan SAE*), integrated waste management (waste sorting, bio-pores placement, innovation and production of recycled waste materials, managing maggot house and waste bank), and collaborating with various related stakeholders. Collaboration is the key to the success of green open space management efforts and innovations in creating sustainable city and settlement areas.

Keywords: Carbon emission, Green open space, Sustainable city and settlement.

1 Introduction

Recent environmental degradation and climate change are showing widespread impacts increasingly, becoming challenges facing current and future generations of mankind and raising security risks (Nguyen et al., 2023). Now and in the future, most countries are at risk of being affected by anthropogenic climate change (Bolan et al., 2024). This phenomenon not only impacts human life but also has significant consequences for the lives of other organisms. The increase in GHGs each year results in massive global warming, with carbon dioxide (CO_2) emissions as the main component of these GHGs. CO_2 emissions which cause increased concentrations of greenhouse gases in the earth's atmosphere, especially those originating from urban activities, contribute significantly to global warming and climate change (Ekawati et al., 2024). Carbon emissions continue to increase at various levels, including local, regional, national, and global scales. Excessive carbon emissions are one of the causes of climate change, which are felt to be changes in the seasonal cycle and increasing geothermal heat. The rise of land conversion and decline in the ability of green open spaces to absorb carbon dioxide due to a decrease in the number of green open spaces will impact the quality of life of the surrounding community (I. K. P. Setiawan, 2023). Managing open space is essential to ensuring the sustainability of the infrastructure (Putra et al., 2024).

According to data compiled by the Central Statistics Agency (BPS or Biro Pusat Statistik in Indonesian), carbon emissions produced in Indonesia are 1,008,178 Gg CO_2e with a carbon emission composition of 77%, and globally it will rank 6th in 2022 behind China, the US, India, Russia, and Japan (https://tirto.id/sektor-penyumbang-emisi-karbon-terbesar-di-indonesia). The population of Bandung City in 2022 will reach 2.452.900 people (BPS of Bandung Municipality, 2022), with the average temperature in 2023 being 24.25°C, the highest temperature reaching 36ºC in October, and the minimum temperature 15.4ºC in May 2023 (https://bandungkota.bps.go.id/id/statistics-). The record for the maximum increase in air temperature for 44 years (1979-2023) is very high, namely 8.1ºC (https://bandungbergerak.id/article/detail/1597976/).

The increase in population can be detrimental to various aspects of development, such as the increasing conversion of land from open land to built-up land, one of which is the use of residential land due to increasing demands

and needs for housing. Settlements have mushroomed in various corners of urban areas, from elite residential areas to slum areas. Settlements, territorial units where various human activities occur, contribute to increasing greenhouse gas emissions into the atmosphere, originating from direct and indirect CO_2 emissions. Meanwhile, the trend of increasing urban population growth makes it difficult for cities to provide safe, resilient, and sustainable community settlements (Amirah et al., 2023; Widodo & Yuliastuti, 2013). The use of electricity, electronic devices, cooking activities, and personal transportation are concrete manifestations of the use of fossil fuels and excessive energy consumption, which together increase carbon emissions in the household sector. These activities tend to increase with population growth and the evolution of people's lifestyles (Made Wiratama et al., 2016). Another crucial problem in Bandung at the moment is the problem of handling city waste, where in 2020, the amount of waste generated in the City of Bandung reached 1,539.82 tonnes/day (Balqis & Chofyan, 2023). Since the fire occurred at the Sarimukti landfill which was already overloaded last year, the Bandung City government is serious about continuing to improve itself so that it can handle it better (https://www.detik.com/jabar/ berita/d-7582837/darurat-sampah-kota-bandung-serius-berbenah).

According to the official website of the Bandung City Housing and Settlement Area Service, the area of Green Open Space in Bandung City in 2023 only reached around 2.089,62 hectares or the equivalent of 12.47% of the total area of the city which reached 16,729.65 hectares (BPS of Bandung Municipality, 2024). This data shows a discrepancy between the targets set by law and actual achievements in green open space management in Bandung. It is realized that providing green open space (GOS) is an integral part of the mitigation strategy for global warming. One effort that can be made to maintain air quality is the provision of GOS (Momongan et al., 2017). The policies needed to plan low-carbon emission housing include mixed-use land use, providing pedestrian paths, maintaining the presence of home gardens (Private GOS), and maximizing the area of green open space by up to 30% (Syam, 2019). Providing GOS is one of the most practical and applicable approaches to dealing with increasing greenhouse gas emissions compared to other methods. Based on these considerations, green open space is recognized as an appropriate and effective step in reducing carbon emissions.

Neglasari is one of the areas in the city of Bandung and has a high population density of 201,158 people/km² (BPS Bandung City, 2022). This sub-district has made various efforts to realize a sustainable city area program. Successful programs include household waste management, green open space management, and urban farming. Neglasari can be a role model in reducing carbon emissions to mitigate climate change in residential areas and in efforts to create sustainable city areas. The sustainable concept of an area needs to be considered to identify environmental problems that can potentially arise and worsen the settlement situation in the future. Indicators for achieving a sustainable city are air quality, clean water, waste, housing, and green open space (B. Setiawan, 2007), so the availability of green open space is important to achieve sustainable cities and settlements which is the 11th Sustainable Development Goal. Based on problems described previously, this research aims to determine efforts to reduce carbon emissions in residential areas toward sustainable city areas by determining efforts that have been made in residential areas and community-based management of GOS to reduce carbon emissions, with the study site in *Kelurahan* Neglasari, Cibeunying Kaler Sub-District, Bandung City.

2 Methodology

This research uses a descriptive-qualitative method to ensure that the data collected is more valid, comprehensive, objective, and reliable. Data collection techniques are carried out through observation in field surveys, interviews, and documentation. The location of this research is *Kelurahan* Neglasari, Cibeunying Kaler District, northern Bandung City, West Java Province, Indonesia (Fig. 1), which in 2019 had a population of 9475 people (https://bandungkota.bps.go.id/id/statistics-table/1/NDc5IzE=/). Managing green open space to reduce carbon emissions discussions in the research include 1) land use and availability of green open space in the study area; 2) community-based management of green open spaces; and 3) community involvement and collaboration with parties related to green open space management.

The flow diagram of this research is as follows in Fig 2. The research began with a literature study and then continued with data collection at the study location. Data grouping was carried out according to each discussion. Primary data collected from field surveys and secondary data from literature and previous research are then analyzed and grouped into discussion sub-chapters so that they can be better understood. The data obtained was analyzed to obtain conclusions according to the research objectives and then the next stage was the preparation of research recommendations.

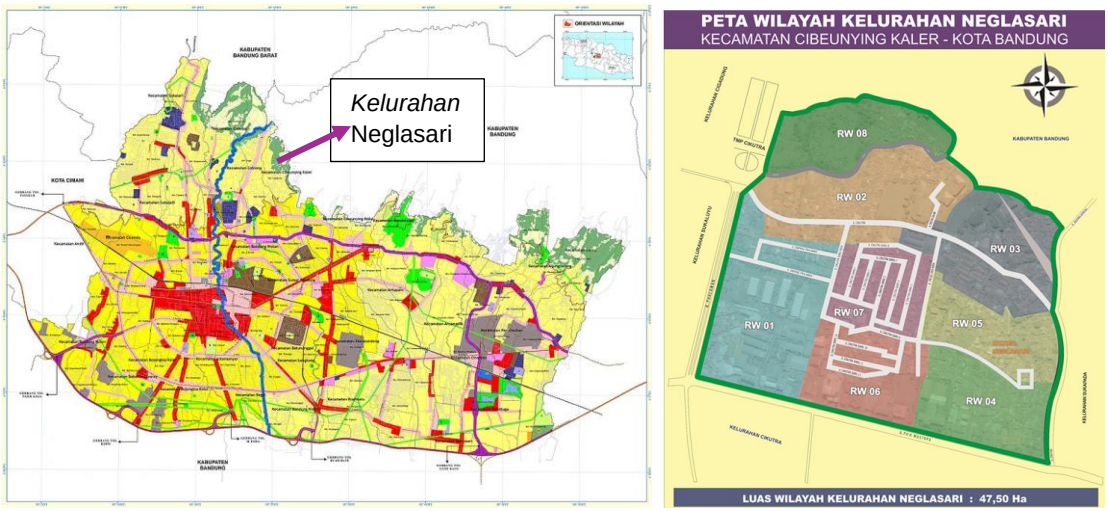

Fig. 1. Land Use Map of Bandung City and Study Location in *Kelurahan* Neglasari
Source: Processed from https://commons.wikimedia.org/wiki/ File: PetaRencana_Pola_ Ruang_RTRW_ Kota_Bandung_2011-2031_TTD.JPG; https://www.neglasari.bandung.go.id/profil/gambaran-umum/, 2024)

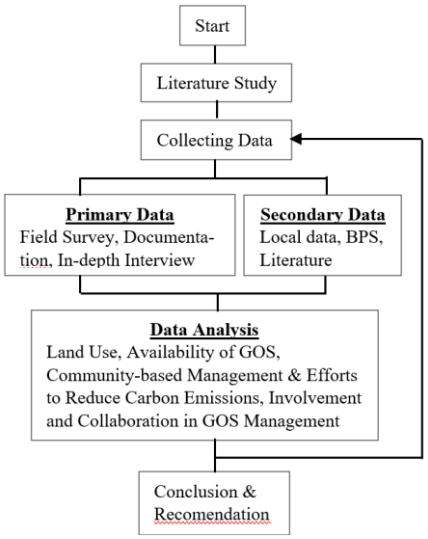

Fig. 2. Research Flow Diagram
Source: Author analysis, 2024

3 Result and Discussion

Carbon emissions that can be defined as the release of carbon-containing gases into the atmosphere that protects the Earth include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF_6) (Peraturan Menteri Lingkungan Hidup Dan Kehutanan Republik Indonesia Nomor 21 Tahun 2022, 2022). Carbon emissions as a result of human activities can be considered a form of air pollution that has the potential to harm the environment and the health of living creatures, based on its impact is divided into 2 groups: primary carbon emissions, which have a direct effect on the environment and the sustainability of living things (such as fuel consumption for transportation and LPG for cooking) and secondary carbon emissions, which result from the entire life cycle of products consumed (such as consumption daily food and electrical power usage for household electronic equipment). The amount of CO_2 emissions production is proportional to the amount of fossil fuel consumption (Wulandari et al., 2013) as the main energy source for driving community activities (Fadhilah et al., 2022).

Human participation in various activities contributes to increasing carbon emissions in the atmosphere. An increase in the concentration of CO_2 gas in the earth's atmosphere can inhibit the efficiency of solar radiation towards

the earth's surface, which prevents the sun's heat from being radiated back into space. The impact is an increase in the earth's temperature, known as global warming. One step to mitigate carbon gas emissions is through the practice of planting plants or reforestation. Vegetation has a central role in maintaining the sustainability of the environmental ecosystem, with one of its main functions being to absorb carbon emissions needed in the photosynthesis process. However, in the context of urban development, there is often negligence and lack of planning regarding the availability of green open space. The type and number of plants grown affect the ability to absorb CO_2 emissions from a green open space (GOS).

3.1 Land Use and Availability of Green Open Space

According to Syam, policies that can be developed for designing low CO_2 urban settlements are mixed-use land use, providing pedestrian ways, houses with foundations for vertical growth, maintaining the yard, and maximizing green open space by up to 30% (Syam, 2019). Setiawan (2007) in his research "City Sustainability Indicators in Indonesia: Comparative Study of Four Cities in Java" identified the level of city sustainability based on 5 indicators, namely air quality, clean water, waste management, housing, and green open space (B. Setiawan, 2007). From these indicators, GOS is mentioned as an indicator of a sustainable city and the importance of providing GOS for low CO_2 emission settlements. Thus, providing and managing adequate green open space in the area is important to realize a sustainable city area.

The rapid development of housing and trade/service activities in *Kelurahan* Neglasari is influenced by arterial roads that cross the area. The land use pattern of Neglasari is varied enough to accommodate almost all urban activities including settlements, services/industry, open land, built-up areas, and rice fields. Table 1 and Figure 3 show that land use for residential areas is dominant (more than 60% of the total area of Neglasari), followed by land use for services/industry. In the southern part, several land functions such as social, health, government, and office. Meanwhile, the open area (not built) on the north side functions as the Cikutra Public Cemetery. The potential for developing green open space in residential areas is still limited, so public green open space management is optimized in existing environmental parks.

Table 1. Land Use of the Neglasari area

No	Land Use	Area	Percentage
1	Settlement	46,77 Ha	60.19 %
2	Service/Industry	16.20 Ha	20.85 %
3	Built-up Area	2.01 Ha	2.59 %
4	Open land	6.98 Ha	8.98 %
5	Garden, moor	0.75 Ha	0.96 %
6	Public Cemetery	5.00 Ha	6.43 %
	Total	**77.71 Ha**	**100 %**

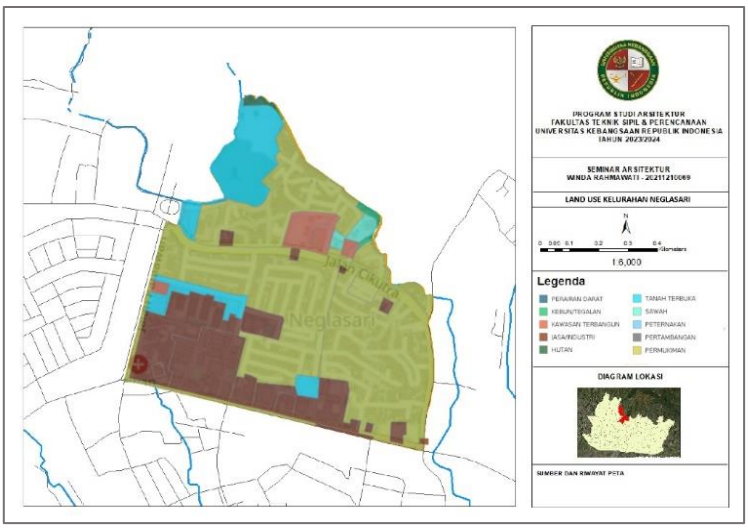

Fig. 3. Land Use Map of the Study Site
Source: Bhumi.atrbpn, 2023

Settlements in this area have a typology of planned and unplanned settlements. Planned settlements in the form of formal housing are equipped with public spaces, close to main road access as well as commercial, educational, and other facilities. Meanwhile, in unplanned urban kampong settlements, the land area is limited and access to the main road is quite far. The availability of green open space in residential areas is important for the community, especially residential residents. In this research location, there are non-natural or green open spaces developed as environmental parks, sports fields, cemeteries, and green lanes along roads (Table 2), which are generally dominated by vegetation cover in the form of grass. Based on ownership, there are public and private green open spaces, and the priority for improving the quality is environmental unit parks so that they have optimal intrinsic and extrinsic functions.

Table 2 The Area of Green Open Space and Percentage of Neglasari Area

No	Public Green Open Space	Area	Percentage
1	Neighborhood Park	0.21 Ha	0.27 %
2	Green line	0.12 Ha	0.15 %
3	Special Area Park (River Border)	0.047 Ha	0.0006%
4	Public Cemetery area	5 Ha	6.43 %
5	Open Land	2.63 Ha	3.38 %
	Total	**8.007 Ha**	**10.30 %**

Source: Author analysis, 2023

The proportion of GOS in urban areas should reach a minimum of 30%, consisting of 20% public GOS and 10% private GOS (Peraturan Menteri Pekerjaan Umum Nomor 5 Tahun 2008, 2008). The public GOS in Neglasari has an area of 8,007 Ha or 10.30% of the total area of 77.71 Ha, so it has not been able to meet the need for the proportion of GOS in the research area. Because there is not enough open land available to be used as GOS to meet the required green open space standards, it is necessary to optimize the function of existing green open spaces (Fig.4), namely environmental parks (Neglasari Park, Kunang Park, Cidurian Park, river borders, green belts, and cemetery areas) and activate private green open space. However, due to the limited private green open space owned by each residence, both in planned and unplanned settlements, the management of this private green open space is also less than optimal.

Fig 4. Availability of green open space at the settlement area
Source: Authors documentation, 2023

3.2 Community-based Management of GOS and Efforts to Reduce Carbon Emissions

According to Quina (2018), based on their movement, primary emission sources can be classified as follows: 1) Mobile emission sources, which refer to emission sources that do not have a fixed presence in one location, but move from one location to another. An example is emissions arising from transportation activities. 2) Stationary emission sources, namely sources of emission whose position is fixed at a location, like household activities, burning waste, factory activities, etc (Fadhilah et al., 2022).

Green open space management is important to reduce carbon emissions from community activities in residential areas by local governments and the community. The availability of GOS is one indicator of realizing a sustainable city (B. Setiawan, 2007). In many studies on green open space management, the local government generally manages public green open space, while the active role and participation of the community are still very lacking (Forasidah, 2021; Kinanti et al., 2021; Mulyanie et al., 2019; Nuraini, 2020; Santoso et al., 2022). As a novelty, in this research, the management of GOS is community-based, both as planners and implementers of the activities. Meanwhile, local governments play a collaborative role and support the active participation of the community.

Fig 5. Neglasari Park, Kunang-kunang Park, and Cidurian Park
Source: Authors documentation, 2023

The community and local government have initiated several efforts to reduce carbon emissions. All these efforts are carried out with the hope that community settlements will become climate-resilient kampong and follow the sustainable city concept. One of the efforts to reduce carbon emissions at the research location is the availability of green open space in community residential areas. Public green open spaces managed by the community in Neglasari, namely Taman Neglasari, and Taman Kunang-kunang (Figure 5), prioritize improving the quality of environmental unit parks so that green open spaces can function more optimally. The following are the results of observations regarding the availability of green open space at the research location.

Neglasari Park: Neglasari Park is located in RW 02 with a population of 2,405. This park has an area of 1800 m² and meets the minimum area for RW Parks (Minister of Public Works Regulation No. 5/PRT/M/2008). This park area is prepared to develop as an environmental park that not only provides ecological functions but also plays a role in providing social benefits for the community. With the development of co-working spaces, PAUD, and hydroponic gardens, it is hoped that this green open space can become a center for community activities, provide natural beauty, and support environmental sustainability (Fig.5).

Kunang-Kunang Park: This 900 m² park is located in RW 07, with a population of 488 people, it can meet the minimum area/capita of 0.5 m² for RW Parks (Minister of Public Works Regulation No. 5/PRT/M/2008). There are sports fields and hydroponic gardens, which attract people to visit. There is also a gazebo, a greenhouse, and shading vegetation that dominates the garden (Fig 5).

River border area: Cidurian Park is a park on the banks of the Cidurian River and is located in RW 08, *Kelurahan* Neglasari, a densely populated residential area with a population of 1,068. This park has an aesthetic and recreational function and an important role in protecting the river from potential disturbances, especially in maintaining the sustainability of the Cidurian River and the surrounding ecosystem. The arrangement of this special river border area park was carried out in stages, equipped with the provision of street furniture, vegetation along the side of the river, and the addition of a crossing bridge for community accessibility (Fig 5).

Green Lane and Public Cemetery: The green lane arrangements on both sides of the Cikutra Baru complex road, which stretches for approximately 287 meters, are designed to be equipped with pedestrian facilities 1 meter wide at certain points. This aims to provide safe and comfortable pedestrian access while creating a pedestrian-friendly environment throughout the complex. This effort follows the principles of sustainable urban planning and supports sustainable mobility in residential environments. The selection and placement of plants and street furniture have been adjusted to environmental conditions, and the vegetation type has also been adapted to its function as a producer of oxygen (O_2), shade, and absorber of air pollution. The cemetery's green open space has an ecological function as a water catchment area and a place to grow various vegetation. Green open space from the Cikutra Public Cemetery (TPU) in Neglasari is adjacent to the Heroes' Cemetery. However, the arrangement and boundaries of the cemetery blocks are not yet equipped with adequate pedestrians. The selection of vegetation in the burial area is required according to its purpose (Fig. 6).

Vegetation has a central role in maintaining the sustainability of the environmental ecosystem, one of its main functions is to absorb carbon emissions needed in the photosynthesis process. The type and number of plants grown affect the ability to absorb CO_2 emissions from green open space. Therefore, green open space with adequate vegetation is important to reduce carbon emissions. As the amount of CO_2 emissions increases and the area of green open spaces decreases, efforts are needed so that the ecological function of green open spaces can be more optimal. This is intended to ensure that the addition of CO_2 gas in the atmosphere can be reduced as low as possible, by recommending types of

plants to fill green open spaces that have high carbon absorption capacity and produce oxygen. The community management of green open space also implements an urban farming program called *Buruan SAE* (Urban Farming). In its implementation, this program is a policy aimed at food security and self-sufficiency for low-income communities.

Fig 6. Green Lane and Public Cemetery in Neglasari
Source: Authors documentation, 2023

Table 3. CO_2 Absorption Capacity Based on Vegetation Cover Type

Covering Type	CO_2 gas absorption capacity (kg/ha/year)	CO_2 gas absorption capacity (tons/ha/year)
A tree	129.92	569.07
Shrubs	12.65	55
Meadow	2.74	12
Ricefield	2.74	12

Source: Prasetyo et all, (2002) in Tambunan (2006) (I. K. P. Setiawan, 2023)

In Table 3, the carbon absorption capacity of a tree is much higher than the absorption capacity of shrubs, meadows, and rice fields. Therefore, increasing the number of trees in green open spaces can positively impact efforts to reduce carbon dioxide emissions and support environmental sustainability. However, the absorption capacity of CO_2 gas depends not only on the type of tree but also on the net carbohydrate mass, leaf area, and number of leaves per tree. Table 4 is a list of tree types recommended as carbon dioxide absorbers in the GOS based on research conducted by Endes N. Dahlan (Dahlan, 2008). It is hoped that selecting tree types in GOS that function as CO2 absorbers will help reduce the microclimate in Neglasari which has only around 10.30% GOS.

Some of the activities carried out by the community in managing green open space at this location include integrated urban farming by planting several types of food crops such as vegetables and onions using a hydroponic system by the gardening group and *Buruan SAE* Neglasari Asri (Fig 7), installing bio-pores in several locations and various activities in waste management. The community carries out all these activities by utilizing the green open space in their residential area. Previously, food crop harvests were even distributed to COVID-19 self-isolation patients around the area.

Fig 7. Integrated urban farming activities in green open space in the *Kelurahan* Neglasari environment
Source: https://www.instagram.com/kelurahanneglasari/

Not only managing public green open space, but the community also tries to manage private green open space to reduce carbon emissions in residential areas. Based on the results of field data, it is known that residences in Neglasari tend to have limited yard space. Most of the front yard has been covered by pavement, and some still retain the limited yard space. Efforts to organize private green open spaces have been made were optimizing environmental roads with a width of 1 to 1.5 meters planted with ornamental plants and vegetables. Potting media is used to grow family medicinal plants or live pharmacies which can be arranged vertically in limited yard space (Fig 8). Create a

vertical garden with plants that can absorb more carbon dioxide and provide a greater oxygen supply. The types of vegetation include Bamboo Palm (*Chamaedorea seifrizii*), *Sanseviera*, Yellow Palm (*Chrysalidocarpus*), and Ornamental Rubber (*Ficus Robusta*). The selection of vegetation is based on the ease of adaptation of the plant and its maintenance.

Table 4. Trees with the highest absorption of CO_2

No	Tree types	CO_2 gas absorption capacity (kg/tree/year)	Image
1	Trembesi (*Samanea saman*)	28.488,39	
2	Cassia (*Cassia sp*)	5.295,47	
3	Kenanga (*Canangium odoratum*)	756,59	
4	Pingku (*Dysoxylum excelsum*)	720,49	
5	Beringin (*Fivus benyamina*)	535,9	
6	Kiara payung (*Filicium decipiens*)	404,83	
7	Matoa *(Pometia Pinnata)*	329	
8	Mahoni *(Swettiana Mahagoni)*	295,73	
9	Saga *(Adenanthera Pavoniana)*	221,18	
10	Bungur *(Lagerstroemia Speciosa)*	160,14	

Source: Processed from (Dahlan, 2008)

Other efforts related to reducing carbon emissions by managing green open spaces include the installation of bio pores in several locations, and waste management activities, where waste management in Neglasari is already running very well. Waste management began through the *Kang Pisman* Program (Reduce, Separate, and Utilize), a

Bandung municipality program where people sort waste independently. These efforts are now increasingly developing with the production of compost fertilizer from recycled organic waste, the provision of composter tanks, the production of overlay bricks, and the operation of maggot houses and waste banks (Fig 9). Thanks to all these efforts, Neglasari won 1st place at the 2024 *Kang Pisman* Award held by the Bandung municipality.

Fig 8. Private Green Open Space at the settlement area
Source: Authors documentation, 2023

Fig 9. Management of waste at the settlement area
Source: https://www.instagram.com/kelurahanneglasari/; Authors documentation, 2023

3.3 Involvement of Community and Collaboration in Green Open Space Management

The dominant involvement of the community in reducing carbon emissions at this research site is in the *Buruan SAE* (Integrated urban farming) program, and the waste management sector, especially in the *Kang Pisman* implementation program, where both programs are implemented at GOS. Thus, community-based green open space management supports the success of efforts to reduce carbon emissions in this area in realizing the 11th goal of sustainable development, namely sustainable cities and settlements. The *Kang Pisman* Program (Reduce, Separate, and Utilize), of the Bandung City Government, initiated in 2018, is a superior program designed to overcome the problem of piling up waste in the City of Bandung. Some waste management efforts in Neglasari include:

a) Independently waste sorting (with buckets)
b) Innovation in making overlay bricks (composter)
c) *Kang empos* innovation (Sacks, buckets, and compost)
d) *Panik* innovation (Organic Paralon)
e) Maggot house
f) Waste bank management (non-organic waste management)
g) Installing some bio-pores

So that managing green open space and various efforts to realize sustainable cities and settlements can run well and get results as expected, the community as the initiator needs to collaborate with many parties. Collaborative governance can be understood as the involvement of non-state actors in the creation and implementation of policies or the existence of partnerships, collaboration, and networks between relevant stakeholders so that the results are under community expectations, where parameters in collaboration in governance: namely governance deliberation collaboration initiated by public institutions, non-state actor as a participant in the forum, involving participants directly in the decision-making process, formally organized, forum decisions through consensus and a collaborative process focused on public policy and public management (Pamungkas et al., 2024; Rinaldoa & Rahayu, 2019).

The waste management system in Neglasari is coordinated and controlled by the *Kang Pisman* team consisting of 8 personnel (5 processing team personnel and 3 personnel as accompanying teams). The government, team, and community collaborate in waste processing to achieve the goal of zero waste. Neglasari also collaborates with YPBB,

a non-profit and non-government organization, and is dedicated to helping the community in environmental conservation to achieve a better and more sustainable quality of life, especially in waste education. As one of the parameters of collaborative governance (Rinaldoa & Rahayu, 2019), community collaboration with NGO elements (YPBB) is important so that the results can meet community expectations (Pamungkas et al., 2024). Trihelix's existing collaboration with various related parties needs to be expanded into Pentahelix collaboration to increase the success of programs that have been carried out and inspire other areas, such as collaboration with private companies to help market products that have been produced and with universities to increase community capacity in mastering product processing technology. The partnership in managing green open space to realize sustainable cities and settlements, which is the 17th Sustainable Development Goal, needs to be continued because sustainable development in all fields requires collaboration between relevant stakeholders (Muqsith et al., 2023).

4 Conclusion

Providing and managing adequate green open space in the area is important to realize a sustainable city area. The public green open space in Neglasari has an area of 8,007 Ha or 10.30% of the total area of 77.71 Ha, so according to the Minister of Public Works Regulation Number 5/PRT/M/2008 (Peraturan Menteri Pekerjaan Umum Nomor 5 Tahun 2008, 2008). It has not been able to meet the need for the proportion of green open space in the study site. Optimizing the function of existing green open spaces is necessary.

The success of community-based green open space management and various innovations at the site is due to collaboration with several related stakeholders. It is also the key to Neglasari's success in managing GOS to reduce carbon emissions and create a sustainable city area. Efforts to reduce carbon emissions in the environment have been made by managing green open space, both public green open space and private green open space. Community-based public green open space management is carried out by implementing the Buruan SAE (urban farming) program, the *Kang Pisman* (waste processing) program, the *Kang empos* program, waste recycling product innovation, bio pores placement, maggot house, and waste bank management, and establishing collaboration with several stakeholders (government and NGO).

Community involvement in green open space management in their area has a significant impact because several programs directly impact the community, such as handling stunting problems. The existing trihelix collaboration needs to be expanded to be pentahelix with private companies, universities, and news agencies. Cooperation with educational institutions and the industrial world will be beneficial for increasing community capacity in green open space management, such as mastering technology for processing products resulting from waste recycling, product marketing, and management performance. Collaboration with local governments and press institutions needs to be expanded, such as providing additional green open space land and inspiring other villages to manage the built environment in their respective areas, so sustainable cities and settlements throughout Indonesia can be realized.

Compared to green open space management which does not involve the community, community participation and involvement in managing green open space at this research location has a more positive impact on efforts to reduce carbon emissions in realizing a sustainable city area. Community-based green open space management also has a greater impact on improving the ecological function of green open space, economic and social welfare, cultural activities, society’s ability to make innovation, social relations, aesthetics of regional space, and even environmental health and food security.

5 Acknowledgement

Thank you to the *Kelurahan* Neglasari Government officials, Cibenunying Kaler District, and the entire *Kelurahan* Neglasari Community who have helped as respondents and sources of valuable information in this research process.

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