CARBON OFFSETS

ACHIEVEMENT REPORT

Laporan Capaian Carbon Offset

UNIVERSITAS DIPONEGORO

2026

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EXECUTIVE SUMMARY

Universitas Diponegoro (UNDIP) memiliki peran strategis dalam mendukung upaya mitigasi perubahan iklim melalui pengelolaan emisi karbon (carbon footprint) serta optimalisasi cadangan karbon di kawasan kampus. Sebagai institusi pendidikan tinggi, UNDIP menghasilkan jejak karbon yang berasal dari berbagai aktivitas operasional, antara lain penggunaan energi listrik, konsumsi bahan bakar untuk transportasi, pengelolaan limbah, serta aktivitas akademik dan pendukung lainnya. Inventarisasi carbon footprint menjadi langkah penting untuk memahami besaran emisi yang dihasilkan dan sebagai dasar dalam penyusunan strategi pengurangan emisi. Inventarisasi carbon footprint Undip tahun 2025 menunjukkan angka 14.435,51 metrik ton/tahun. Nilai ini mengalami penurunan12,5% dibandingkan tahun lalu yang menunjukkan implikasi dari kegiatan dan program rendah emisi yang dijalankan Undip. Di sisi lain, kawasan kampus UNDIP memiliki potensi besar sebagai penyerap karbon (carbon sink) melalui keberadaan ruang terbuka hijau, vegetasi, dan tanah yang berfungsi secara ekologis. Laporan ini menyajikan hasil estimasi cadangan karbon tahun 2026 yang terdiri atas dua komponen utama, yaitu cadangan karbon biomassa (Above Ground Biomass/AGB) sebesar 23.712,25 metrik ton per tahun dan cadangan karbon organik tanah (Soil Organic Carbon/SOC) sebesar 1.729.329,77 metrik ton per tahun. Nilai ini menunjukkan kapasitas signifikan kawasan kampus dalam menyimpan karbon dalam jangka panjang. Keterkaitan antara carbon footprint dan cadangan karbon menjadi dasar dalam pendekatan carbon offset, dimana sebagian emisi yang dihasilkan dapat diimbangi oleh kapasitas serapan dan penyimpanan karbon yang dimiliki kawasan kampus. Dengan demikian, UNDIP tidak hanya berperan sebagai penghasil emisi, tetapi juga sebagai bagian dari solusi melalui penguatan fungsi ekosistem kampus sebagai penyerap karbon.

Universitas Diponegoro (UNDIP) plays a strategic role in supporting climate change mitigation efforts through the management of carbon emissions (carbon footprint) and the optimization of carbon stocks within the campus area. As a higher education institution, UNDIP generates a carbon footprint from various operational activities, including electricity consumption, fuel use for transportation, waste management, as well as academic and supporting activities. The inventory of the carbon footprint is an essential step to understand the magnitude of emissions generated and serves as a basis for developing emission reduction strategies. The 2025 carbon footprint inventory of UNDIP recorded a total of 14,435.51 metric tons per year, representing a 12.5% decrease compared to the previous year. This reduction reflects the positive impact of low-emission initiatives and programs implemented by the university.
On the other hand, the UNDIP campus has significant potential as a carbon sink through its green open spaces, vegetation, and ecologically functioning soils. This report presents the estimated carbon stock for 2026, consisting of two main components: Above Ground Biomass (AGB) amounting to 23,712.25 metric tons per year and Soil Organic Carbon (SOC) amounting to 1,729,329.77 metric tons per year. These values demonstrate the substantial capacity of the campus area to store carbon over the long term. The relationship between carbon footprint and carbon stock forms the basis of a carbon offset approach, in which a portion of the emissions generated can be balanced by the carbon sequestration and storage capacity of the campus ecosystem. Therefore, UNDIP not only acts as a source of emissions but also as part of the solution by strengthening the role of its campus ecosystem as a carbon sink.

I. PENDAHULUAN

1.1 Latar Belakang Pemanasan Global

Pemanasan global merupakan salah satu isu lingkungan utama yang menjadi perhatian global dalam beberapa dekade terakhir. Fenomena ini merujuk pada peningkatan suhu rata-rata permukaan bumi akibat meningkatnya konsentrasi gas rumah kaca di atmosfer, seperti karbon dioksida (CO_2), metana (CH_4), dan dinitrogen oksida (N_2O) (Intergovernmental Panel on Climate Change, 2021). Gas-gas tersebut memperkuat efek rumah kaca dengan menahan panas di atmosfer sehingga memicu kenaikan suhu global serta berbagai dampak lingkungan, seperti meningkatnya frekuensi kejadian cuaca ekstrem, perubahan pola curah hujan, degradasi ekosistem, dan kenaikan permukaan air laut.

Kesadaran global terhadap urgensi pengendalian perubahan iklim mendorong terbentuknya berbagai kebijakan dan kesepakatan internasional. Salah satu kerangka kerja utama adalah *United Nations Framework Convention on Climate Change* (UNFCCC) yang menjadi dasar kerja sama global dalam mitigasi dan adaptasi perubahan iklim. Dalam kerangka tersebut, negara-negara dunia mengadopsi *Paris Agreement* pada tahun 2015 dengan tujuan menahan kenaikan suhu rata-rata global jauh di bawah 2°C dibandingkan tingkat pra-industri serta mengupayakan pembatasan hingga 1,5°C untuk meminimalkan dampak perubahan iklim (UNFCCC, 2015).

I. INTRODUCTION

1.1 *Background Global Warming*

Global warming is one of the main environmental issues that has attracted global attention in recent decades. This phenomenon refers to the increase in the average surface temperature of the Earth due to the rising concentration of greenhouse gases in the atmosphere, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (Intergovernmental Panel on Climate Change, 2021). These gases enhance the greenhouse effect by trapping heat in the atmosphere, thereby triggering global temperature rise and various environmental impacts, such as increased frequency of extreme weather events, changes in rainfall patterns, ecosystem degradation, and rising sea levels.

Global awareness of the urgency of climate change control has driven the formation of various international policies and agreements. One of the main frameworks is the United Nations Framework Convention on Climate Change (UNFCCC), which serves as the basis for global cooperation in climate change mitigation and adaptation. Within this framework, countries around the world adopted the Paris Agreement in 2015 with the aim of keeping the global average temperature rise well below 2°C compared to pre-industrial levels and striving to limit it to 1.5°C to minimize the impacts of climate change (UNFCCC, 2015).

Indonesia has also shown its commitment to climate change control through various national

Indonesia juga menunjukkan komitmennya dalam pengendalian perubahan iklim melalui berbagai kebijakan nasional, seperti Peraturan Presiden Nomor 98 Tahun 2021 tentang Penyelenggaraan Nilai Ekonomi Karbon serta penyampaian target penurunan emisi melalui dokumen *Nationally Determined Contribution* (NDC). Kebijakan tersebut menjadi dasar bagi berbagai upaya pengurangan emisi gas rumah kaca di berbagai sektor pembangunan.

Sejalan dengan upaya pengurangan emisi tersebut, berbagai pendekatan mulai dikembangkan untuk mengelola emisi gas rumah kaca, salah satunya melalui mekanisme *carbon offset*. Pendekatan ini memungkinkan penyeimbangan emisi yang masih dihasilkan melalui kegiatan yang mampu menyerap atau mengurangi emisi, seperti penanaman pohon atau pengelolaan ekosistem.

Program Net Zero Emission (NZE)

Net Zero Emission (NZE) merupakan kondisi ketika jumlah emisi gas rumah kaca yang dilepaskan ke atmosfer seimbang dengan jumlah emisi yang dapat diserap kembali melalui berbagai mekanisme penyerapan karbon. Penerapan konsep ini dilakukan melalui berbagai upaya pengurangan emisi dari aktivitas manusia, seperti peningkatan efisiensi energi, pemanfaatan energi yang lebih bersih, serta pengelolaan sumber daya secara berkelanjutan.

Indonesia memiliki komitmen untuk mencapai *Net Zero Emission* pada

policies, such as Presidential Regulation Number 98 of 2021 on the Implementation of Carbon Economic Value and the submission of emission reduction targets through the Nationally Determined Contribution (NDC) document. These policies serve as the basis for various efforts to reduce greenhouse gas emissions in various development sectors.

In line with efforts to reduce emissions, various approaches have begun to be developed to manage greenhouse gas emissions, one of which is through the carbon offset mechanism. This approach allows for the balancing of emissions that are still produced through activities capable of absorbing or reducing emissions, such as tree planting or ecosystem management.

Program Net Zero Emission (NZE)

Net Zero Emission (NZE) is a condition when the amount of greenhouse gas emissions released into the atmosphere is balanced with the number of emissions that can be reabsorbed through various carbon absorption mechanisms. The implementation of this concept is carried out through various efforts to reduce emissions from human activities, such as improving energy efficiency, utilizing cleaner energy, and managing resources sustainably.

Indonesia has a commitment to achieve Net Zero Emission by 2060 or earlier as part of its contribution to mitigating global climate change. Therefore, the government is currently preparing various policies and strategic roadmaps to reduce

tahun 2060 atau lebih cepat sebagai bagian dari kontribusi dalam mitigasi perubahan iklim global. Oleh karena itu, pemerintah tengah menyusun berbagai kebijakan dan roadmap strategis untuk menurunkan emisi gas rumah kaca di berbagai sektor pembangunan.

Sejalan dengan upaya tersebut, Universitas Diponegoro sebagai salah satu institusi pendidikan tinggi di Kota Semarang turut berperan dalam mendukung pelaksanaan program dekarbonisasi secara terencana dan terstruktur. Komitmen ini diwujudkan melalui berbagai kebijakan internal, seperti Surat Edaran Rektor Universitas Diponegoro No. 37/UN7.P/SE/2017 tentang Program Carbon Neutrality serta Surat Edaran Rektor Universitas Diponegoro No. 35/UN7.P/SE/2017 tentang Kebijakan Kendaraan Bebas Emisi di lingkungan Universitas Diponegoro.

1.2 Tujuan

Menghitung carbon offset Undip sehingga dapat berfungsi sebagai penyeimbang emisi karbon yang dihasilkan oleh Undip dan mengurangi dampaknya terhadap lingkungan.

greenhouse gas emissions in various development sectors.

In line with these efforts, Diponegoro University, as one of the higher education institutions in Semarang City, also plays a role in supporting the implementation of decarbonization programs in a planned and structured manner. This commitment is realized through various internal policies, such as the Circular Letter of the Rector of Diponegoro University No. 37/UN7.P/SE/2017 concerning the Carbon Neutrality Program and the Circular Letter of the Rector of Diponegoro University No. 35/UN7.P/SE/2017 concerning the Emission-Free Vehicle Policy within Diponegoro University.

1.2 *Objectives*

Calculate Undip's carbon offset so that it can function as a counterweight to carbon emissions produced by Undip and reduce its impact on the environment.

II. KEGIATAN CARBON OFFSET

Sebagai bagian dari komitmen dalam mendukung keberlanjutan lingkungan dan upaya mitigasi perubahan iklim, Universitas Diponegoro terus mengembangkan berbagai kegiatan carbon offset di lingkungan kampus maupun wilayah sekitarnya. Upaya ini dilakukan untuk menyeimbangkan emisi karbon yang dihasilkan dari berbagai aktivitas kampus melalui peningkatan penyerapan karbon serta penerapan praktik pengelolaan lingkungan yang lebih berkelanjutan. Berbagai program telah dilaksanakan, antara lain melalui kegiatan penanaman pohon, rehabilitasi ekosistem mangrove, pengelolaan kawasan hutan kampus, serta penyediaan fasilitas transportasi ramah lingkungan.

II. CARBON OFFSET ACTIVITIES

As part of its commitment to supporting environmental sustainability and climate change mitigation efforts, Diponegoro University continues to develop various carbon offset activities on campus and in the surrounding areas. These efforts are carried out to balance the carbon emissions generated from various campus activities through increased carbon absorption and the implementation of more sustainable environmental management practices. Various programs have been carried out, including tree planting activities, mangrove ecosystem rehabilitation, management of campus forest areas, and the provision of environmentally friendly transportation facilities.

No	Program / *Program*	Lingkup / *Scope*	Peserta / *Participant*
1	*Buggy Cars as Electric Shuttle Service at Diponegoro University*	*Regional*	*Civitas Academica of UNDIP*
2	*Enviro Action 2025: Implementation of Environmental Education at Mangunharjo Beach*	*Regional*	*More Than 40 Participant*
3	*UNDP and Central Java Regional Police Promote Environmental Conservation through Tree Planting at KHDTK Wanagama, 2025*	*Regional*	*UNDP and The Chief of Central Java Regional Police*
4	*UNDP and Bacteriaca Foundation Plant 48,000 Trees at KHDTK Wanagama to Promote Conservation of the Environment, 2025*	*Regional*	*The Director of Bacteriaca Foundation, and The Farmers Group*
5	*FPP UNDIP and PT United Tractors Tbk Collaborate to Plant 300 More Trees and Provide Tools for Timor Bear, 2025*	*Regional*	*The Vice Rector IV of UNDIP, The Dean of FPP UNDIP, and PT United Tractors Tbk*
6	*Earth Day: Small Step for a Sustainable Earth, 2025*	*Regional*	*UNDIP College Student*
7	*Green Environment Program: Mangrove Nursery and Planting at Edupark Tembalang, 2025*	*Regional*	*Student, PLM, PUSR, and Civitas Academica UNDIP*
8	*UNDP SDGs Center Participation in the "Mangunharjo Mangrove: 200,000 Trees Planting Movement," 2025*	*National*	*More than 500 Participant*
9	*Green Environment Program by Vocational College UNDIP: Mangrove Planting in Tugu Beach, 2025*	*Regional*	*UNDP College Students and lecturers*
10	*Medical Environment Care 2025: Environmental Education, Beach Clean-Up, and Tree Planting at Tugu Beach*	*Regional*	*UNDIP College Students*

Penggunaan Kendaraan Buggy sebagai Layanan Shuttle Listrik di Universitas Diponegoro

Penyediaan shuttle listrik kampus UNDIP berperan dalam mendukung sistem transportasi yang lebih bersih dan berkelanjutan. Penggunaan kendaraan listrik sebagai sarana mobilitas internal membantu mengurangi emisi karbon sekaligus meningkatkan efisiensi transportasi

Buggy Cars as Electric Shuttle Service at Diponegoro University

The provision of electric shuttle services at UNDIP contributes to the development of a cleaner and more sustainable transportation system. The use of electric vehicles for internal mobility helps reduce carbon emissions while improving transportation efficiency within the campus. In addition to environmental

di lingkungan kampus. Selain memberikan manfaat lingkungan, shuttle listrik juga berkontribusi dalam menciptakan kenyamanan dan kualitas udara yang lebih baik bagi sivitas akademika. Melalui inisiatif ini, UNDIP menunjukkan komitmennya dalam mengintegrasikan aspek keberlanjutan ke dalam pengelolaan fasilitas kampus.

benefits, electric shuttles enhance comfort and air quality for the academic community. Through this initiative, UNDIP demonstrates its commitment to integrating sustainability into campus facility management.

Gambar 1. Shuttle Listrik UNDIP
Figure 1. *UNDIP Electric Shuttle*

Enviro Action 2025: Aksi Nyata Implementasi Edukasi Lingkungan di Pantai Mangunharjo

Sebagai bagian dari program Peduli Bumi 2025, Fakultas Kesehatan Masyarakat Universitas Diponegoro menyelenggarakan kegiatan Enviro Action di kawasan pesisir Pantai Mangunharjo. Kegiatan ini menekankan pada penerapan edukasi lingkungan melalui aksi nyata, seperti penanaman mangrove dan pembersihan pantai. Sebanyak 600 bibit mangrove ditanam secara kolaboratif oleh volunteer sebagai upaya rehabilitasi ekosistem pesisir. Selain itu, kegiatan beach cleanup dilakukan untuk mengurangi pencemaran akibat sampah anorganik. Melalui kegiatan ini,

Enviro Action 2025: Implementation of Environmental Education at Mangunharjo Beach

As part of the Peduli Bumi 2025 program, the Faculty of Public Health, Universitas Diponegoro, conducted Enviro Action in the coastal area of Mangunharjo Beach. This activity emphasized the implementation of environmental education through direct actions, such as mangrove planting and beach clean-up. A total of 600 mangrove seedlings were planted collaboratively by volunteers as part of coastal ecosystem rehabilitation efforts. In addition, the beach clean-up activity aimed to reduce pollution caused by inorganic

peserta diharapkan mampu memahami pentingnya konservasi lingkungan sekaligus berperan aktif dalam menjaga keberlanjutan ekosistem. Kegiatan ini menjadi wujud komitmen bersama dalam mendukung pelestarian lingkungan secara berkelanjutan.

waste. Through this program, participants were expected to better understand the importance of environmental conservation while actively contributing to ecosystem sustainability. This activity reflects a shared commitment to supporting sustainable environmental preservation.

Gambar 2. Aksi Nyata Edukasi Lingkungan di Pantai Mangunharjo
Figure 2*. Implementation of Environmental Education at Mangunharjo Beach*

Dorong Konservasi Lingkungan, UNDIP dan Polda Jateng Tanam Pohon di KHDTK Wanadipa

Kegiatan penanaman pohon di KHDTK Wanadipa merupakan bentuk kolaborasi antara Universitas Diponegoro dan Kepolisian Daerah Jawa Tengah dalam mendukung pelestarian lingkungan. Program ini menekankan pentingnya aksi nyata dalammenjaga keberlanjutan ekosistem hutan melalui penanaman pohon sebagai upaya meningkatkan fungsi ekologis kawasan. Selain memberikan manfaat lingkungan, kegiatan ini juga menjadi sarana edukasi bagi mahasiswa dalam memahami pentingnya

UNDIP and Central Java Region Police Promote Environmental Conservation through Tree Planting at KHDTK Wanadipa, 2025

The tree-planting activity at KHDTK Wanadipa represents a collaboratic between Universitas Diponegoro ar the Central Java Regional Police to support environmental conservatio This program emphasizes the importance of direct action in maintaining forest ecosystem sustainability through tree planting efforts. In addition to its environme benefits, the activity also serves as a educational platform for students t

konservasi. Sinergi antara institusi pendidikan dan aparat kepolisian diharapkan dapat mendorong gerakan penghijauan yang berkelanjutan di masyarakat

understand the importance of conservation. We expect the collaboration between academic institutions and law enforcement to encourage sustainable greening initiatives in the community.

Gambar 3. Penanaman Pohon di KHDTK Wanadipa
Figure 3. *Tree Planting at KHDTK Wanadipa*

UNDIP dan Pertamina Foundation Tanam 48.000 Pohon di KHDTK Wanadipa untuk Perkuat Konservasi Hulu DAS Babon

Universitas Diponegoro (UNDIP) bersama PT Pertamina (Persero) melalui Pertamina Foundation melaksanakan kegiatan kick-off penanaman hutan lestari di KHDTK Wanadipa, Ungaran Timur. Sebanyak 48.000 pohon ditanam pada area seluas 48 hektare sebagai upaya memperkuat konservasi lingkungan di kawasan hulu DAS Babon. Kegiatan ini melibatkan berbagai pemangku kepentingan, termasuk akademisi, pemerintah daerah, dan kelompok tani, serta bertujuan untuk mendukung fungsi ekologis kawasan sekaligus pemberdayaan masyarakat. Program ini tidak hanya

UNDIP and Pertamina Foundation Plant 48,000 Trees at KHDTK Wanadipa to Strengthen Upstream Conservation of the Babon Watershed, 2025

Universitas Diponegoro (UNDIP), in collaboration with PT Pertamina (Persero) through Pertamina Foundation, initiated a sustainable forest planting program at KHDTK Wanadipa, Ungaran Timur. A total of 48,000 trees were planted across 48 hectares to strengthen environmental conservation in the upstream area of the Babon Watershed. The activity involved multiple stakeholders, including academics, local government, and farmer groups, aiming to enhance ecological functions while supporting community empowerment. This program not only focuses on

berfokus pada penghijauan, tetapi juga untuk memberikan manfaat ekonomi melalui tanaman produktif serta mendukung riset dan edukasi kehutanan. Kolaborasi ini mencerminkan komitmen bersama dalam mendukung keberlanjutan lingkungan melalui pendekatan terpadu antara konservasi dan pemberdayaan.

reforestation but also provides economic benefits through productive plants and supports forestry research and education. The collaboration reflects a shared commitment to environmental sustainability through an integrated approach combining conservation and community development.

Gambar 4. Kolaborasi UNDIP dan Pertamina Foundation tanam 48.000 pohon di KHDTK Wanadipa

Figure 4. *Collaboration between UNDIP and Pertamina Foundation plants 48,000 trees at KHDTK Wanadipa*

Gambar 5. UNDIP bersama PT. United Tractors Tanam 300 Pohon Langka

Figure 5. UNDIP and PT United Tractors Plant 300 Rare Trees

Kolaborasi FPP UNDIP dan PT United Tractors Tbk. Tanam 300 Pohon Langka dan Sediakan Pakan Rusa Timor

Universitas Diponegoro melalui Fakultas Peternakan dan Pertanian bekerja sama dengan PT United Tractors Tbk melaksanakan program CSR berupa penanaman 300 pohon buah langka serta pemberian pakan rusa timor. Kegiatan ini merupakan bagian dari komitmen UNDIP sebagai kampus berkelanjutan yang telah meraih peringkat ke-2 nasional dalam UI GreenMetric. Selain memberikan manfaat ekologis melalui peningkatan tutupan vegetasi, program ini juga mendukung konservasi satwa dan penguatan fungsi edukasi di lingkungan kampus. Kolaborasi ini mencerminkan sinergi antara dunia akademik dan industry dalam mendukung pembangunan berkelanjutan.

FPP UNDIP and PT United Tractors Tbk. Collaborate to Plant 300 Rare Trees and Provide Feed for Timor Deer, 2025

Universitas Diponegoro, through the Faculty of Animal and Agricultural Sciences, in collaboration with PT United Tractors Tbk, implemented a CSR program involving the planting of 300 rare fruit trees and the provision of feed for Timor deer. This initiative reflects UNDIP's commitment as a sustainable campus, which has been ranked 2nd nationally in the UI GreenMetric. In addition to ecological benefits through increased vegetation cover, the program also supports wildlife conservation and strengthens the educational function of the campus environment. This collaboration highlights the synergy between academia and industry in supporting sustainable development.

Gambar 6. Kegiatan penanaman pohon Hari Bumi 2025 di Kelurahan Jangli
Figure 6. *Tree planting activity on Earth Day commemoration in Jangli Subdistrict*

Hari Bumi: Langkah Kecil untuk Bumi yang Berkelanjutan, 2025

Earth Day: Small Step for a Sustainable Earth, 2025

Kegiatan peringatan Hari Bumi yang diselenggarakan oleh Himpunan Mahasiswa Teknik Geologi merupakan upaya peningkatan kepedulian lingkungan yang melibatkan mahasiswa, dosen, dan alumni. Salah satu kegiatan utama berupa penanaman pohon bersama masyarakat di Kelurahan Jangli berkontribusi langsung terhadap peningkatan cadangan karbon, karena vegetasi yang ditanam berpotensi menyerap karbon dioksida dari atmosfer seiring pertumbuhannya. Melalui kegiatan ini, kampus turut mendorong partisipasi aktif sivitas akademika dalam mendukung pengelolaan lingkungan yang berkelanjutan.

The Earth Day commemoration organized by the Geological Engineering Student Association represents an effort to enhance environmental awareness involving students, lecturers, and alumni. One of the main activities, tree planting with the local community in Jangli Subdistrict, directly contributes to increasing carbon stocks, as the planted vegetation has the potential to absorb carbon dioxide from the atmosphere as it grows. Through this initiative, the university also encourages active participation of the academic community in supporting sustainable environmental management.

Gambar 7. Dokumentasi kegiatan pembibitan dan penanaman mangrove di Edupark Tambakrejo dan Pantai Mangkang

Figure 7. *Documentation of the Mangrove Seedling and Planting Activity in Edupark Tambakrejo and Mangkang Beach*

Program Lingkungan Hijau: Pembibitan dan Penanaman Mangrove di Edupark Tambakrejo, 2025

Program penanaman mangrove yang dilaksanakan melalui Green Environment Program (GEP) merupakan salah satu upaya peningkatan cadangan karbon di kawasan pesisir. Kegiatan ini

Green Environment Program: Mangrove Nursery and Planting at Edupark Tambakrejo, 2025

The mangrove planting program, implemented through the Green Environment Program (GEP), is one of the efforts to increase carbon reserves in coastal areas. This activity involves students in the entire process, from seedling cultivation to

melibatkan mahasiswa dalam proses pembibitan hingga penanaman mangrove yang dilaksanakan di Edupark Tambakrejo dan kawasan Pantai Mangkang. Vegetasi mangrove yang ditanam memiliki kemampuan menyerap dan menyimpan karbon dalam jumlah tinggi, sehingga berkontribusi signifikan terhadap penyerapan karbon dioksida dari atmosfer. Selain itu, kegiatan ini juga mendukung upaya pelestarian ekosistem pesisir secara berkelanjutan melalui keterlibatan aktif sivitas akademika.

the planting of mangroves, which takes place in Edupark Tambakrejo and the Mangkang Beach area. The mangrove vegetation planted has the ability to absorb and store carbon in significant amounts, thus contributing greatly to the absorption of carbon dioxide from the atmosphere. In addition, this activity also supports the preservation of coastal ecosystems through the active involvement of the academic community.

Pusat SDGs UNDIP Berpartisipasi dalam Inisiatif "MageriSegoro": 200.000 Mangrove Ditanam Serentak

Partisipasi Universitas Diponegoro dalam program penanaman mangrove "Mageri Segoro" berkontribusi terhadap peningkatan cadangan karbon di kawasan pesisir. Kegiatan ini melibatkan ribuan peserta lintas sektor, termasuk sivitas akademika, dengan pelaksanaan penanaman lebih dari 200.000 bibit mangrove secara serentak di wilayah pesisir Jawa Tengah. Penanaman ini memperkuat fungsi mangrove sebagai penyerap karbon alami yang berperan dalam mitigasi perubahan iklim. Melalui kegiatan ini, universitas mendukung pengelolaan lingkungan pesisir secara berkelanjutan melalui kolaborasi multi-pihak.

UNDIP SDGs Center Participates in the "Mageri Segoro" Initiative: 200,000 Mangroves Planted Simultaneously

Universitas Diponegoro's participation in the "Mageri Segoro" mangrove planting program contributes to increasing carbon reserves in coastal areas. This activity involves thousands of participants from various sectors, including the academic community, with the planting of over 200,000 mangrove seedlings simultaneously in the coastal areas of Central Java. This planting strengthens the role of mangroves as natural carbon absorbers that help mitigate climate change. Through this activity, the university supports sustainable coastal environmental management through multi-party collaboration.

Gambar 8. Partisipasi sivitas akademika dalam kegiatan penanaman mangrove "Mageri Segoro" di kawasan pesisir Jawa Tengah

Figure 8. *Participation of the academic community in the "Mageri Segoro" mangrove planting activity in the coastal areas of Central Java*

Program Terkait SDGs oleh Mahasiswa Sekolah Vokasi Universitas Diponegoro: Penanaman Mangrove di Desa Timbulsloko, 2025

Kegiatan penanaman mangrove di Desa Timbulsloko yang dilakukan oleh mahasiswa Sekolah Vokasi Universitas Diponegoro berkontribusi dalam meningkatkan cadangan karbon di kawasan pesisir. Kegiatan ini melibatkan mahasiswa dan masyarakat lokal dalam menanam 1.000 bibit mangrove di area yang terdampak abrasi. Vegetasi mangrove yang ditanam berfungsi sebagai penyerap karbon alami sekaligus mendukung pemulihan ekosistem pesisir. Melalui kegiatan ini, universitas menunjukkan peran aktifnya dalam pengelolaan lingkungan berkelanjutan melalui kolaborasi dengan masyarakat lokal.

SDG-Related Program by Students of the Vocational School, Universitas Diponegoro: Mangrove Planting in Timbulsloko Village, 2025

The mangrove planting activity in Timbulsloko Village, carried out by Universitas Diponegoro Vocational School students, contributes to increasing carbon reserves in coastal areas. This activity involves students and local communities in planting 1,000 mangrove seedlings in areas affected by abrasion. The planted mangrove vegetation serves as a natural carbon absorber while also supporting the recovery of coastal ecosystems. Through this activity, the university demonstrates its active role in sustainable environmental management through collaboration with local communities.

Gambar 9. Kegiatan penanaman 1.000 bibit mangrove di Desa Timbulsloko sebagai upaya peningkatan cadangan karbon pesisir

Figure 9. *Planting 1,000 mangrove seedlings in Timbulsloko Village as an effort to increase coastal carbon reserves*

Medical Environment Care 2025: Edukasi Lingkungan, Aksi Bersih Pantai, dan Penanaman Pohon di Pantai Tirang

Medical Environment Care 2025 merupakan program pengabdian masyarakat yang dilaksanakan oleh BEM FK Universitas Diponegoro pada tahun 2025 di Pantai Tirang, Semarang, melalui rangkaian kegiatan webinar edukasi lingkungan, aksi bersih pantai, dan penanaman pohon sebagai bentuk kepedulian terhadap kelestarian ekosistem pesisir. Kegiatan ini menjadi wujud nyata kontribusi mahasiswa dalam meningkatkan kesadaran lingkungan sekaligus mendukung upaya mitigasi perubahan iklim melalui aksi sederhana yang berdampak langsung bagi kawasan pesisir.

Medical Environment Care 2025: Environmental Education, Beach Clean-Up, and Tree Planting at Tirang Beach

Medical Environment Care 2025 is a community service program carried out by BEM FK Universitas Diponegoro in 2025 at Tirang Beach, Semarang, through a series of activities including an environmental education webinar, a beach clean-up action, and tree planting as a form of concern for the preservation of coastal ecosystems. This program reflects the students' tangible contribution in raising environmental awareness while also supporting climate change mitigation efforts through simple actions that create direct benefits for coastal areas.

Gambar 10. Medical Environment Care 2025 di Pantai Tirang, Semarang

Figure 10. *Medical Environment Care 2025 Activity at Tirang Beach, Semarang*

III. METODE PERHITUNGAN KARBON

3.1 Jejak Karbon

Jejak karbon menggambarkan jumlah emisi karbon yang dihasilkan dari berbagai aktivitas, baik oleh organisasi, produk, maupun individu (Pratama, 2019). Jejak karbon dinyatakan dalam satuan ton atau kilogram karbon dioksida ekuivalen (CO_2e) untuk menunjukkan besarnya emisi gas rumah kaca yang dihasilkan. Semakin tinggi aktivitas dan penggunaan energi, maka semakin besar pula jejak karbon yang dihasilkan (Rahayuningsih et al., 2021).

Emisi CO_2 dari konsumsi listrik per tahun: **(Konsumsi Listrik per tahun dalam kWh/1000) x 0,84**
Keterangan: 0,84 = koefisin untuk mengkonversi satuan kWh menjadi ton

Emisi CO_2 dari konsumsi BBM per tahun: **(Konsumsi BBM per tahun dalam liter/1000) x 2,54**
Keterangan: 2,54 = koefisin untuk mengkonversi satuan liter menjadi ton

3.2 Metode Pengambilan Data

Metode pengambilan data dalam perhitungan cadangan karbon mengacu pada SNI 7724:2019 tentang Pengukuran dan Perhitungan Cadangan Karbon – Pengukuran Lapangan untuk Penaksiran Cadangan Karbon Berbasis Lahan (land-based carbon accounting). Standar ini digunakan sebagai pedoman pelaksanaan pengukuran lapangan dengan tahapan pengukuran sebagaimana pada bagian berikut.

III. DATA COLLECTION LOCATION

3.1 Carbon Footprint

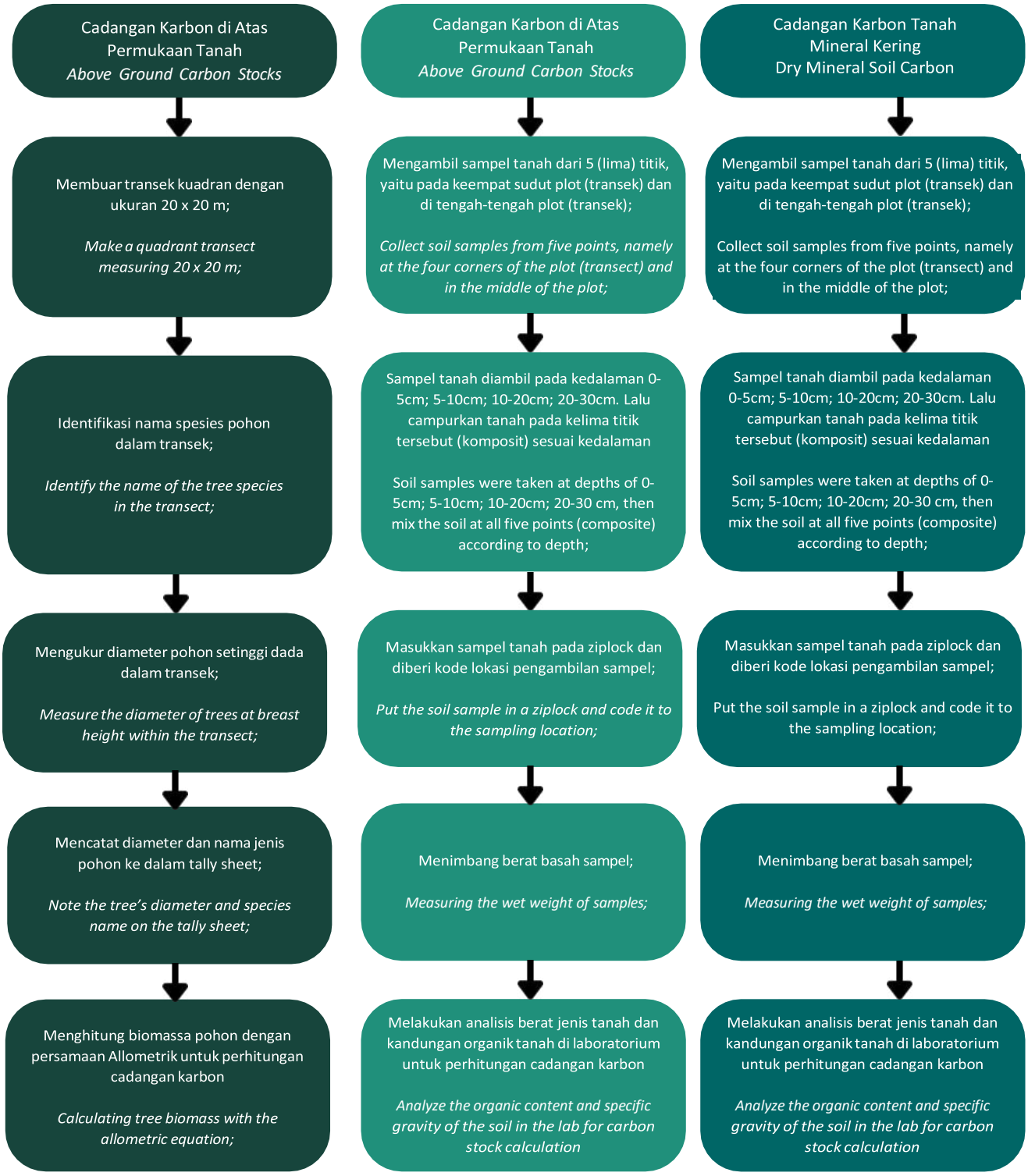
Carbon footprint refers to the amount of carbon emissions generated from various activities carried out by organizations, products, or individuals (Pratama, 2019). It is commonly expressed in tons or kilograms of carbon dioxide equivalent (CO_2eq) to represent the amount of greenhouse gas emissions produced. In general, higher levels of activity and energy consumption will result in a larger carbon footprint (Rahayuningsih et al., 2021).

CO_2 emission from electricity:
(Electricity Consumption per year in kWh/1000) x 0,84
Description: 0,84 = Coefficient used to convert kWh into tons.

*CO_2 emissions from fuel consumption per year:**(Fuel consumption per year in liters/1000) x 2,54***
Description: 2,54 = Coefficient used to convert liters into tons.

3.2 Data Collection Method

The data collection method for carbon stock calculation refers to SNI 7724:2019 on Carbon Stock Measurement and Calculation – Field Measurement for Land-Based Carbon Stock Estimation (land-based carbon accounting). This standard is used as a guideline for conducting field measurements to obtain systematic and measurable estimates of carbon stocks. The measurement process is carried out through several steps as described in the following section



Gambar 11. Metode Pengambilan data Perhitungan Karbon
Figure 11. *Data Collection Method of Carbon Calculation*

Gambar 12. Dokumentasi Pengambilan Data Carbon
Figure 12. *Documentation of Carbon Data Collection*

3.3 Perhitungan Cadangan Karbon Biomassa Atas Permukaan

Tanaman Berkayu
(Ketterings *et al*., 2001)
$Y = 0,11 \times \rho \times D^{2+c}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
ρ = berat jenis (gr/cm3)
c = 0,62
D = Diameter (cm)

Pohon Sengon (*Albizia chinensis*)
$$Y = 0,027 \times D^{2,23}$$
(Krisnawati *et al*., 2012)
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter (cm)

Pohon Ketapang (*Terminalia catappa*)
(Brown, 1997)
$Y = 0,0661 \times D^{2,591}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter (cm)

Pohon Suar (*Samanea saman*)
(Mardiatmoko, 2016)
$Y = \frac{2172,6 \times D - 8821,9}{1000}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter (cm)

Pohon Mahoni (*Swietenia mahagoni*)
(Tim AruPA, 2014)
$Y = 0,9029 \times (D^2 \times H)^{0,684}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter (cm)
H = Tinggi (m)

3.3 Carbon Stock Calculation
Above-ground Biomass

Woody Plant
(Ketterings et al., 2011)
$Y = 0,11 \rho D^{2+c}$
Description:
Y = Standing biomass (kg/tree)
ρ = specific gravity (gr/cm3)
c = 0,62
D = Diameter (cm)

Silk Tree (Albizia chinensis)
(Krisnawati et al., 2012)
$Y = 0,027 \times D^{2,23}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Tropical Almond Tree (Terminalia catappa)
(Brown, 1997)
$Y = 0,0661 \times D^{2,591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Saman Tree (Samanea saman)
(Mardiatmoko, 2016)
$Y = \frac{2172,6 \times D - 8821,9}{1000}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Mahogany Tree (Swietenia mahagoni)
(Tim AruPA, 2014)
$Y = 0,9029 \times (D^2 \times H)^{0,684}$
Description:
Y = Biomassa tegakan (kg/tree)
D = Diameter (cm)
H = Height (m)

Mangrove (Komiyama *et al*., 2005)
$Y = 0{,}251 \times \rho \times D^{2{,}46}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
ρ = berat jenis (gr/cm^3)
D = Diameter/DBH (cm)

Bakau Hitam (*Rhizophora mucronate*) (Komiyana et al., 2005)
$Y = 0{,}1466 \times D^{2{,}3136}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Pohon Jati (*Tectona grandis*) (Krisnawati et al., 2012)
$Y = 0{,}0149 \times (D^2 \times H)^{1{,}0835}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)
H = Tinggi (m)

Akasia (*Acacia mangium*) (Kwisnawati et al., 2015)
$Y = 0{,}070 \times (D^{2{,}58})$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Pohon Mahoni (*Swietenia macrophylla*) (Kaliky, F., & Hut, S., 2021)
$Y = 0{,}1 \times D^{2{,}458}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Asem Jawa (*Tamarindus indica*) (Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Zaitun (*Olea paniculata*) (Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$

Mangrove Tree *(Komiyana et al., 2005)*
$Y = 0{,}251 \times \rho \times D^{2{,}46}$
Description:
Y = Standing biomass (kg/tree)
ρ = specific gravity (gr/cm^3)
D = Diameter (cm)

Asiatic Mangrove (Rhizophora mucronate) *(Komiyana et al., 2005)*
$Y = 0{,}1466 \times D^{2{,}3136}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Teak Tree (Tectona grandis) *(Krisnawati et al., 2012)*
$Y = 0{,}0149 \times (D^2 \times H)^{1{,}0835}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)
H = Height (m)

Black Wattle Tree (Acacia mangium) *(Krisnawati et al., 2015)*
$Y = 0{,}070 \times (D^{2{,}58})$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Mahogany Tree (Swietenia macrophylla) *(Kaliky, F., & Hut, S., 2021)*
$Y = 0{,}1 \times D^{2{,}458}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Tamarind Tree (Tamarindus indica) *(Brown, 1997)*
$Y = 0{,}00661 \times D^{2{,}591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Olive Tree (Olea paniculata) *(Brown, 1997)*

Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Karree (*Searsia lancea*) (Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Jambu Biji (*Psidium guajava*) (Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Salam Koja (*Murraya koenigii*) Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

Tusam (*Pinus merkusii*) (Siregar, 2007)
$Y = 0{,}0936 \times D^{2{,}4323}$
Keterangan:
Y = Biomassa tegakan (kg/pohon)
D = Diameter/DBH (cm)

IV. LOKASI PENGAMBILAN DATA

Universitas Diponegoro (UNDIP) sebagai institusi pendidikan tinggi memiliki peran strategis dalam mendukung *sustainable development agenda* khususnya dalam upaya mitigasi perubahan iklim. Melalui pengelolaan kawasan kampus yang mendukung aktivitas akademik, operasional, dan fungsi ekologis, UNDIP menunjukkan potensi yang besar dalam mendukung penyimpanan karbon yang

$Y = 0{,}00661 \times D^{2{,}591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Karre Tree (Searsia lancea) *(Brown, 1997)*
$Y = 0{,}00661 \times D^{2{,}591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Guava Tree (Psidium guajava)
(Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Curry Leaf Tree (Murraya koenigii)
Brown, 1997)
$Y = 0{,}00661 \times D^{2{,}591}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

Sumatran Pine Tree (Pinus merkusii)
(Siregar, 2007)
$Y = 0{,}0936 \times D^{2{,}4323}$
Description:
Y = Standing biomass (kg/tree)
D = Diameter (cm)

IV. *DATA COLLECTION LOCATION*

Universitas Diponegoro (UNDIP), as a higher education institution, plays a strategic role in supporting the sustainable development agenda, particularly in climate change mitigation efforts. Through the management of campus areas that support academic, operational, and ecological functions, UNDIP demonstrates strong potential to sustain carbon storage within the campus environment.

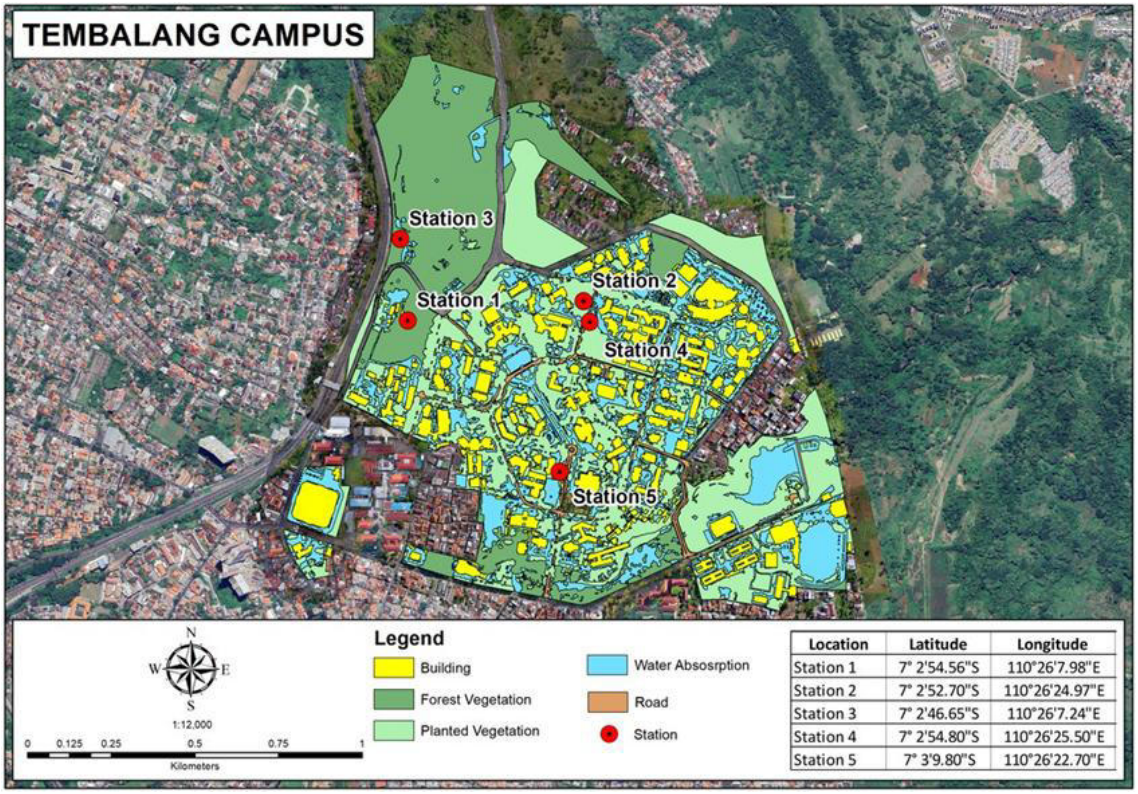
berkelanjutan di lingkungan kampus.

Sebaran kawasan yang menjadi lokasi pengambilan data dalam laporan ini meliputi Kampus Tembalang, Kampus Pleburan, Kampus Teluk Awur Jepara, Kampus Batang, Kampus Pekalongan, Kampus Rembang, KHDTK Penggaron, serta kawasan UNDIP Blado dan UNDIP Kesesi. Keberagaman karakter pada kawasan tersebut menunjukkan bahwa setiap lokasi memiliki peran yang berbeda dalam mendukung cadangan karbon Universitas Diponegoro secara keseluruhan, baik sebagai pusat kegiatan universitas maupun sebagai area dengan fungsi ekologis.

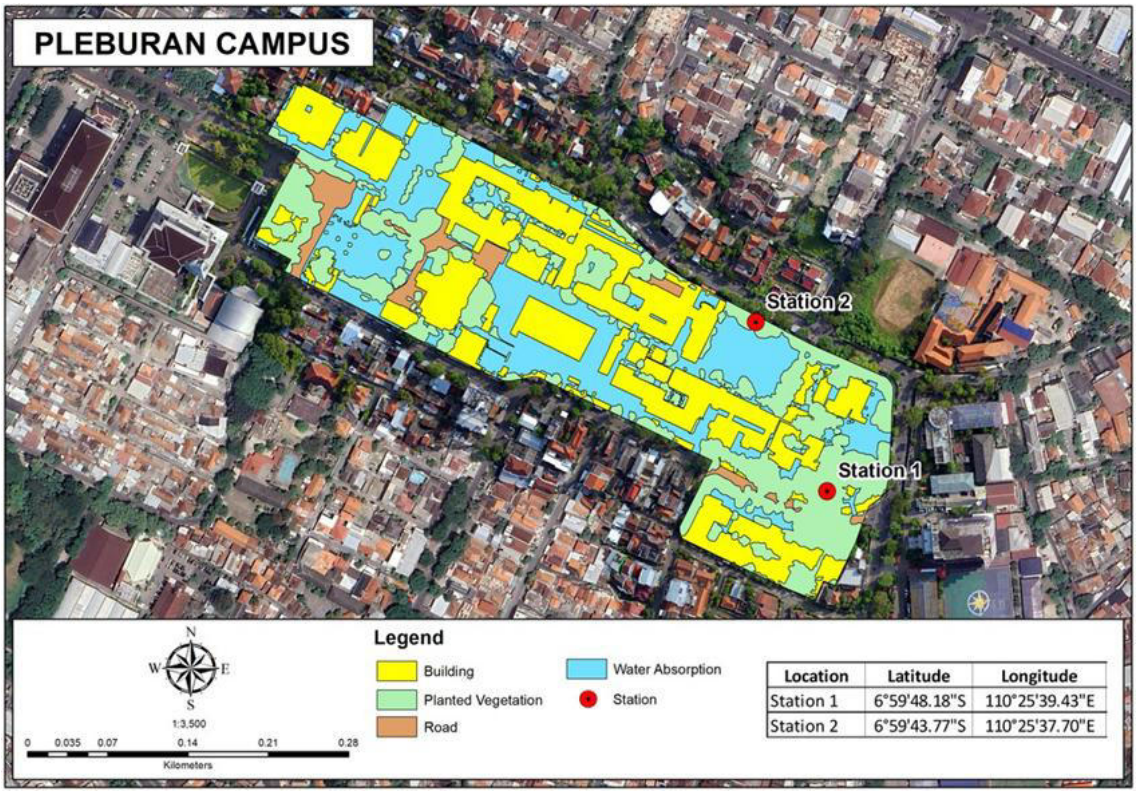
Dalam laporan ini, pengambilan sampel karbon dilakukan pada seluruh lokasi yang telah dipetakan dengan total 72 titik sampling. Sampel yang dikumpulkan terdiri atas karbon biomassa atas permukaan (*Above Ground Biomass*/AGB) dan karbon organik tanah (*Soil Organic Carbon*/SOC) sebagai dua komponen utama dalam pengukuran cadangan karbon Universitas Diponegoro.

The areas designated as data collection locations in this report include Tembalang Campus, Pleburan Campus, Teluk Awur Jepara Campus, Batang Campus, Pekalongan Campus, Rembang Campus, KHDTK Penggaron, as well as the UNDIP Blado and UNDIP Kesesi areas. The diversity of characteristics across these locations indicates that each area plays a distinct role in shaping the overall carbon profile of Universitas Diponegoro, both as a center of university activities and as an area with ecological functions.

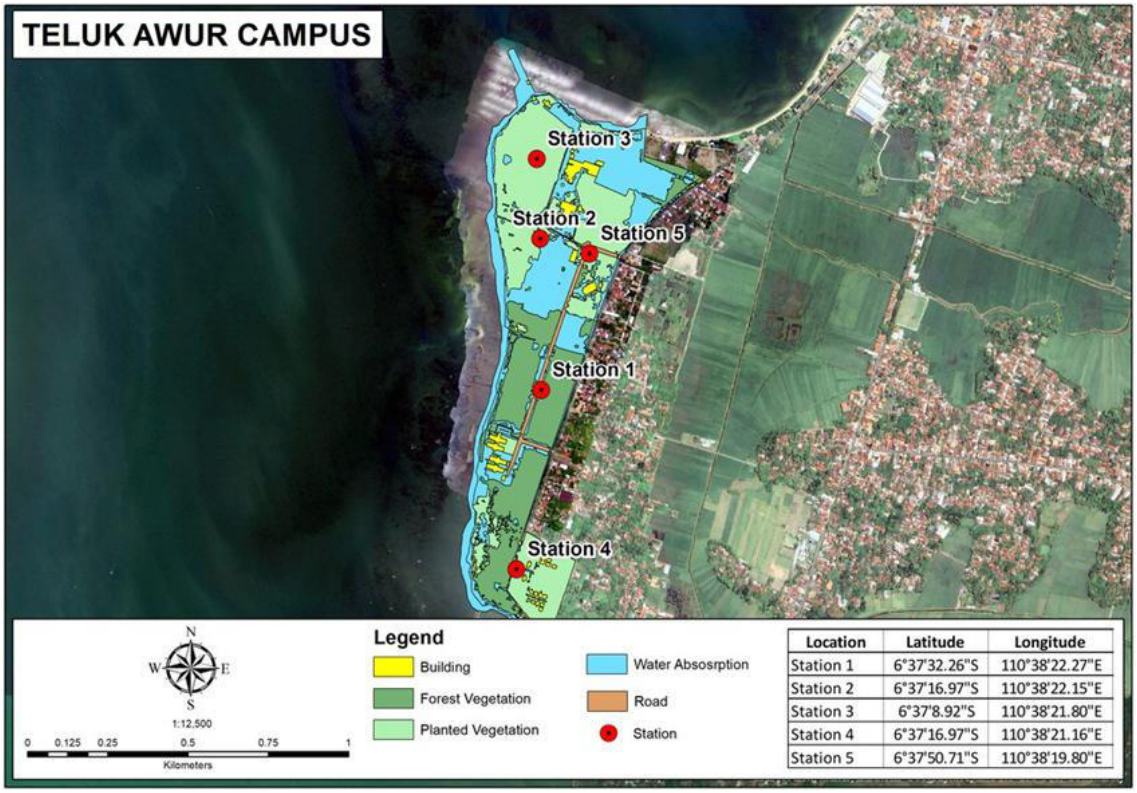
In this report, carbon sampling was carried out across all mapped locations, with a total of 72 sampling points. The samples collected consisted of Above Ground Biomass (AGB) carbon and Soil Organic Carbon (SOC), which serve as the two main components in measuring the carbon stock of Universitas Diponegoro.



Gambar 13. Titik pengambilan Sampel Kampus UNDIP Tembalang
Figure 13. *Sampling Points at UNDIP Tembalang Campus*

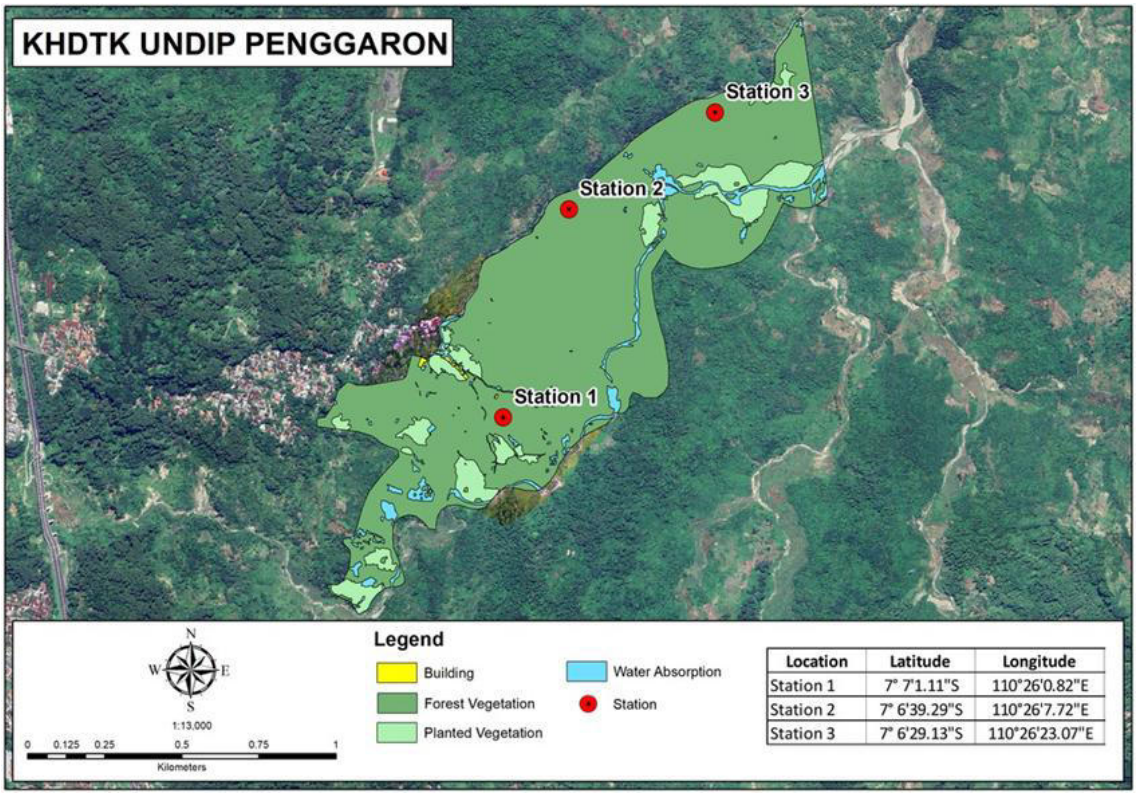


Gambar 14. Titik Pengambilan Sampel Kampus UNDIP Pleburan
Figure 14. *Sampling Points at UNDIP Pleburan Campus*



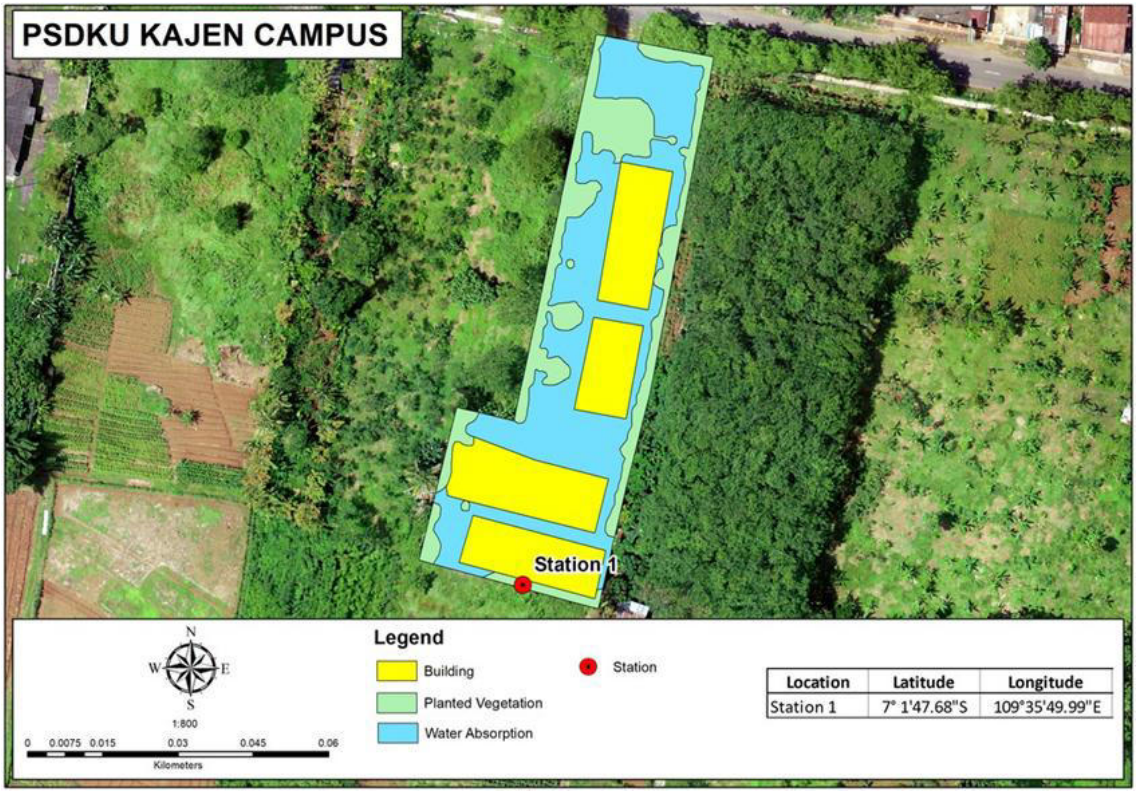
Gambar 15. Titik Pengambilan Sampel Kampus UNDIP Telukawur, Jepara

Figure 15. *Sampling points at UNDIP Telukawur Campus, Jepara*

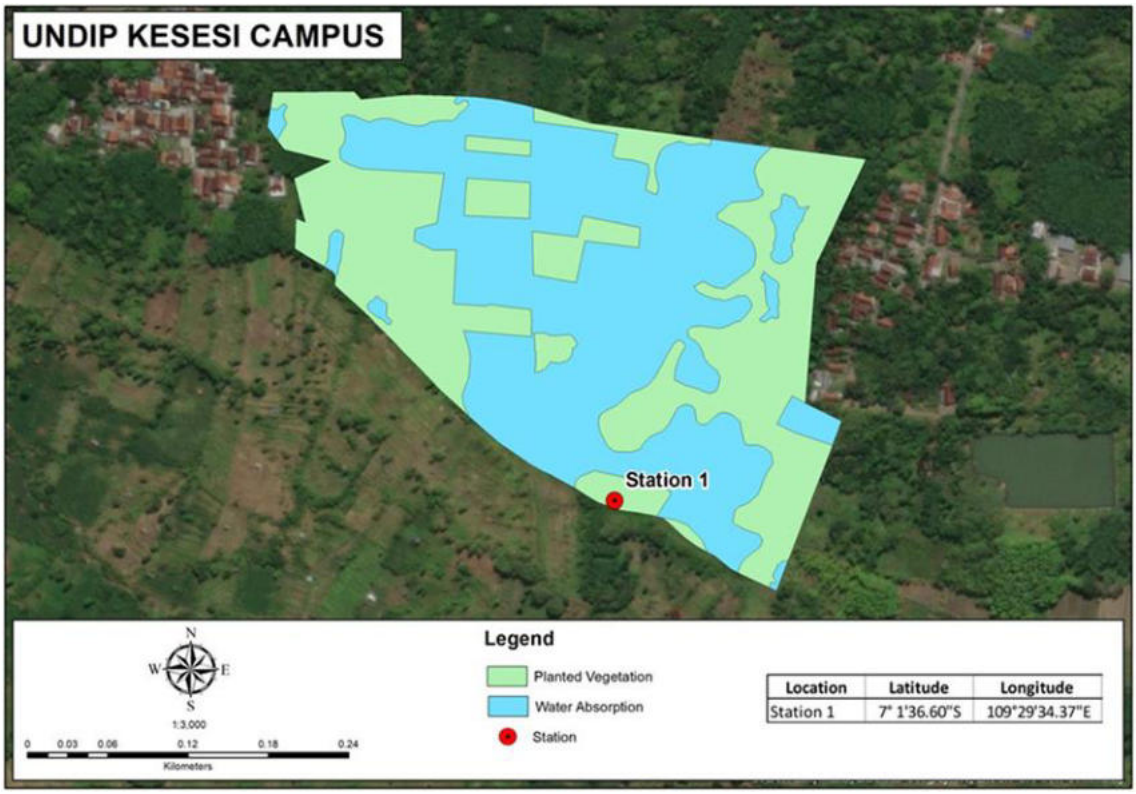


Gambar 16. Titik Pengambilan KHDTK UNDIP Penggaron

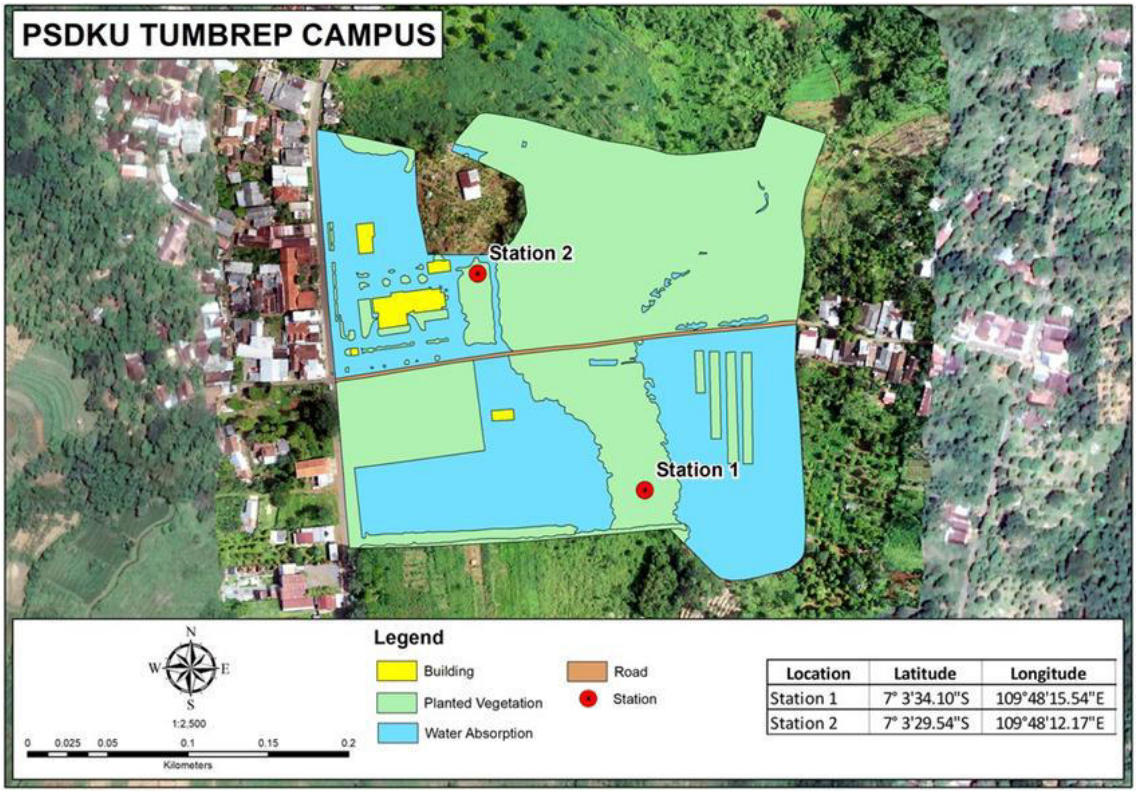
Figure 16. *Sampling points at KHDTK UNDIP Penggaron*



Gambar 17. Titik pengambilan sampel Kampus PSDKU Kajen, Pekalongan
Figure 17. *Sampling points at PSDKU Kajen, Pekalongan Campus*

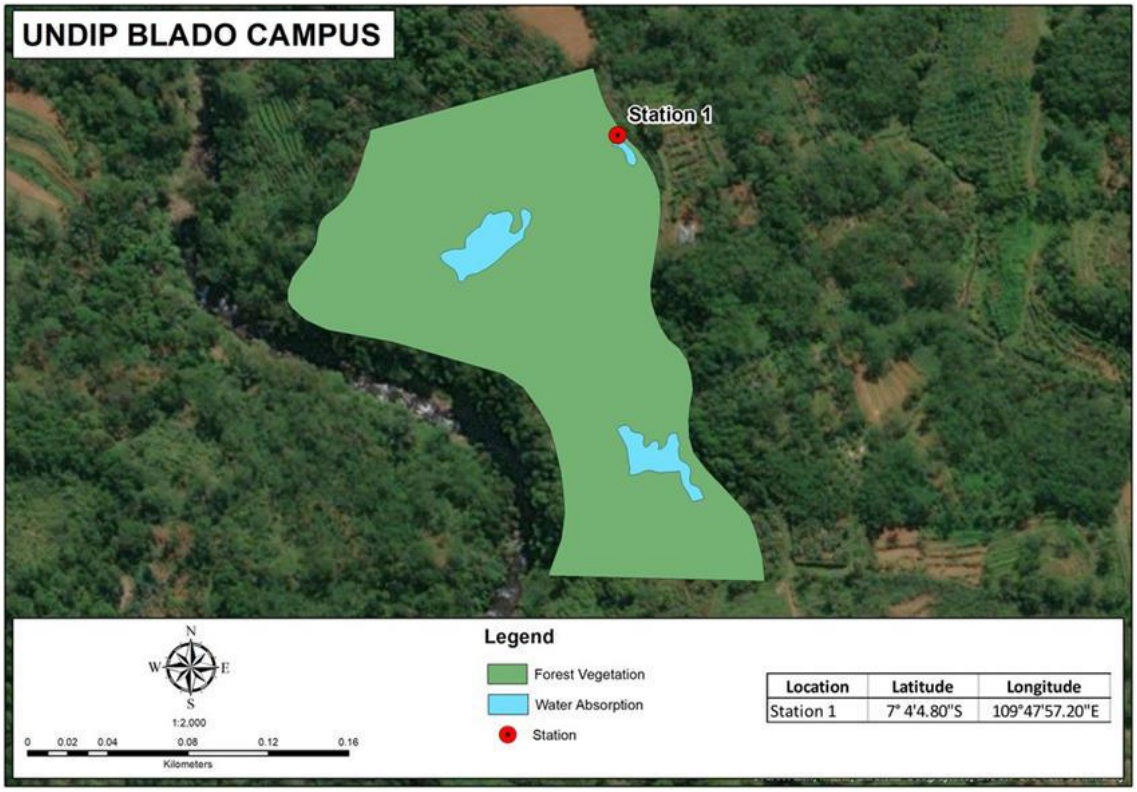


Gambar 18. Titik pengambilan sampel Kampus PSDKU Kesesi, Pekalongan
Figure 18. *Sampling points at PSDKU Kesesi, Pekalongan Campus*



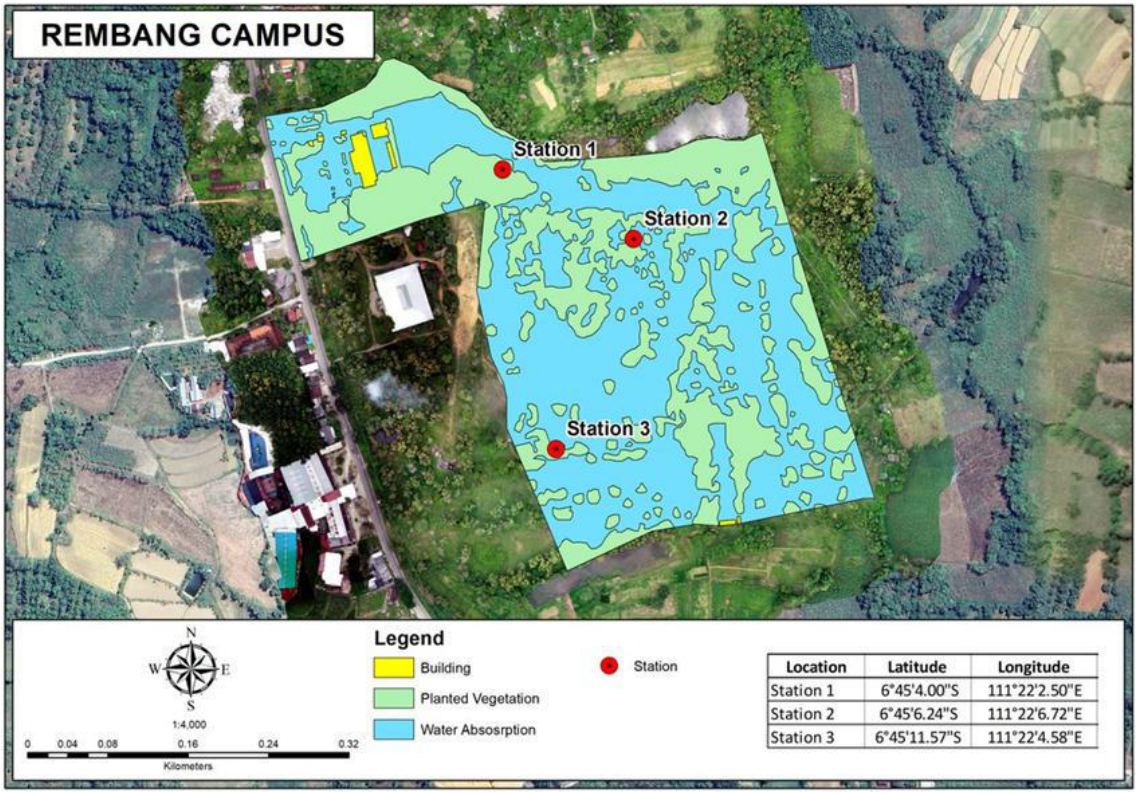
Gambar 19. Titik pengambilan sampel Kampus PSDKU Tumbrep, Batang

Figure 19. *Sampling points at PSDKU Tumbrep, Batang Campus*



Gambar 20. Titik pengambilan sampel Kampus PSDKU Blado, Batang

Figure 20. Sampling points at PSDKU Blado, Batang Campus



Gambar 21. Titik pengambilan sampel Kampus PSDKU Rembang
Figure 21. *Sampling points at PSDKU Rembang Campus*

V. CADANGAN KARBON UNDIP

5.1 Jejak Karbon

Carbon Footprint merupakan total emisi gas rumah kaca (GRK) yang dihasilkan dari berbagai aktivitas sehari-hari. Secara umum, carbon footprint mengukur jumlah emisi GRK yang berkontribusi terhadap pemanasan global. Sebagai salah satu institusi pendidikan terkemuka di Indonesia, UNDIP juga berkontribusi terhadap emisi karbon yang dihasilkan dari berbagai kegiatan akademik dan operasionalnya. Berdasarkan data pada Gambar x, penggunaan listrik dan transportasi menghasilkan total emisi sebesar **14.435,51 metrik ton/tahun.** Dari sektor transportasi, kendaraan bermotor menyumbang emisi dengan

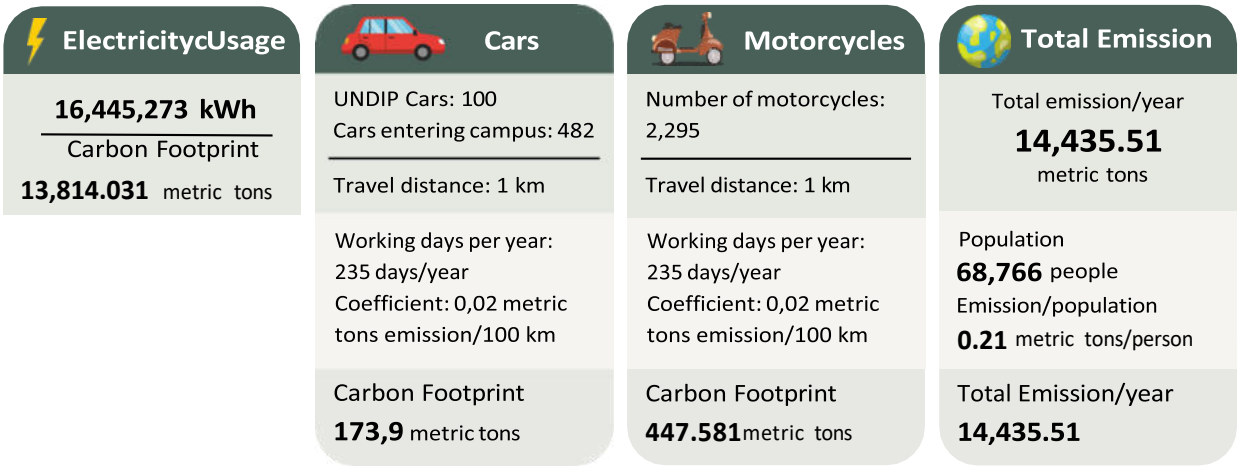
V. *UNDIP CARBON STOCK*

5.1 Carbon Footprint

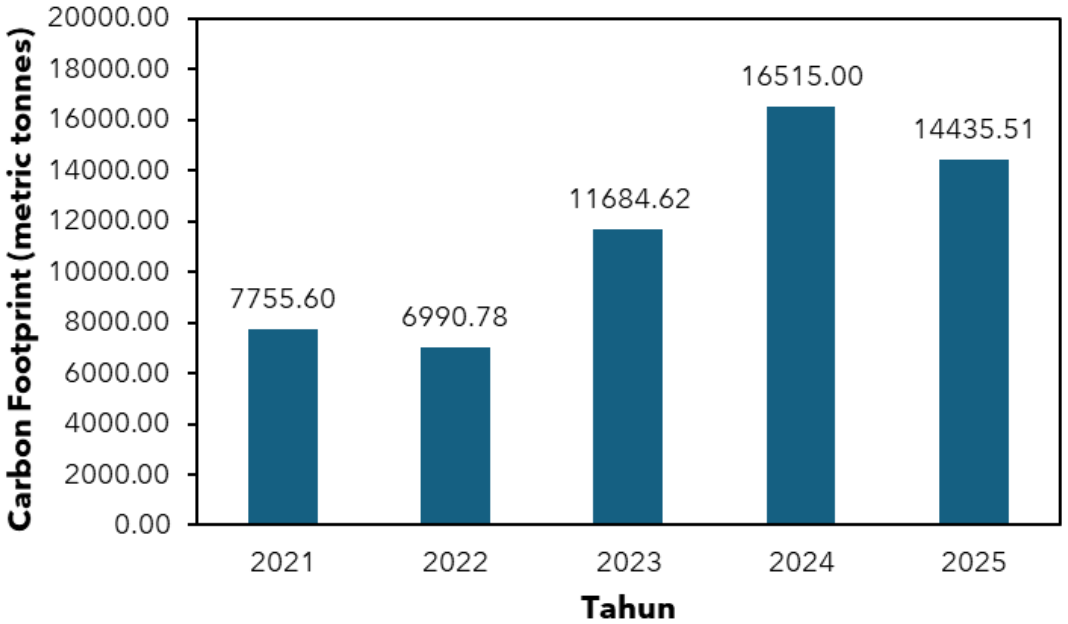
Carbon footprint refers to the total greenhouse gas (GHG) emissions generated from various daily activities. In general, it measures the amount of GHG emissions that contribute to global warming. As one of the leading educational institutions in Indonesia, UNDIP also contributes to carbon emissions generated from its academic and operational activities. According to the data in Figure 20, electricity consumption and transportation produce a total emission of 14.435,51 ***metric tons/year.*** *In the transportation sector, motor vehicles contribute emissions totaling 447,581 metric tons per year, with the majority of student*

total sebesar 447,581 metrik ton per tahun, dimana mobilitas mahasiswa mayoritas menggunakan sepeda motor sebagai sarana transportasi utama di lingkungan kampus.

mobility using motorbikes as the main mode of transportation on campus.



Gambar 22. Total Jejak Karbon Universitas Diponegoro
Figure 22. *Total Carbon Footprint Universitas Diponegoro*



Gambar 23. Profil Jejak Karbon Universitas Diponegoro 2021-2025
Figure 23. *Total Carbon Footprint Profile Universitas Diponegoro 2021-2025*

5.2 CADANGAN KARBON

Pengukuran cadangan karbon pada berbagai lokasi kampus UNDIP di Jawa

5.2 CARBON STOCK

Various UNDIP campus locations in Central Java were carried out as part of

Tengah dilakukan sebagai bagian dari komitmen UNDIP dalam memperkuat pengelolaan kampus yang berkelanjutan dan berorientasi pada pengurangan jejak lingkungan. Arah ini sejalan dengan Surat Edaran Nomor 37 Tahun 2017 tentang Carbon Neutrality Program di Universitas Diponegoro, Surat Edaran Nomor 14 Tahun 2025 tentang Ketentuan Pengelolaan Pohon di Lingkungan Universitas Diponegoro, serta peta jalan UNDIP menuju tahun 2050 yang menempatkan isu keberlanjutan sebagai bagian penting dalam pengembangan institusi.

Komitmen tersebut tercermin melalui berbagai langkah, seperti program penanaman yang melibatkan mahasiswa dan pengelola kampus serta upaya menjaga ruang terbuka hijau di berbagai lokasi. Dalam konteks ini, cadangan karbon menjadi indikator yang relevan untuk menilai kapasitas kawasan kampus dalam menyimpan karbon melalui vegetasi dan tanah.

Penghitungan cadangan karbon tahun 2026 mencakup sejumlah lokasi kampus UNDIP, yaitu Pekalongan, Batang, Teluk Awur, Rembang, Tembalang, KHDTK, dan Pleburan. Keseluruhan lokasi tersebut merepresentasikan bentang kampus dengan karakter penggunaan lahan, luasan vegetasi, dan kondisi ekologis yang berbeda, sehingga memberikan gambaran yang lebih utuh mengenai sebaran cadangan karbon di lingkungan UNDIP.

Dalam laporan ini, cadangan karbon

UNDIP's commitment to strengthening sustainable campus management and reducing its environmental footprint. This direction is aligned with Circular Letter Number 37 of 2017 on the Carbon Neutrality Program at Universitas Diponegoro, Circular Letter Number 14 of 2025 on Tree Management Provisions within the Universitas Diponegoro Environment, as well as UNDIP's roadmap toward 2050, which places sustainability as an important part of institutional development.

This commitment is reflected in various initiatives, such as planting programs involving students and campus management, as well as efforts to maintain green open spaces across different locations. In this context, carbon stock serves as a relevant indicator for assessing the capacity of campus areas to store carbon through vegetation and soil.

The 2026 carbon stock assessment covered several UNDIP campus locations, namely Pekalongan, Batang, Teluk Awur, Rembang, Tembalang, KHDTK, and Pleburan. Taken together, these locations represent campus landscapes with different land-use characteristics, vegetation cover, and ecological conditions, thus providing a more comprehensive picture of carbon stock distribution within UNDIP.
In this report, carbon stock is reviewed through two main components: Above Ground Biomass

ditinjau melalui dua komponen utama, yaitu biomassa atas permukaan tanah (Above Ground Biomass atau AGB) dan karbon organik tanah (Soil Organic Carbon atau SOC). AGB menunjukkan karbon yang tersimpan pada vegetasi hidup di atas permukaan tanah, sedangkan SOC menunjukkan karbon yang tersimpan di dalam tanah sebagai hasil akumulasi bahan organik.

(AGB) and Soil Organic Carbon (SOC). AGB refers to carbon stored in living vegetation above the ground surface, while SOC refers to carbon stored in the soil as a result of organic matter accumulation.

Tabel 1. Cadangan Karbon AGB dan SOC Universitas Diponegoro 2026
Table 1. AGB and SOC carbon stock of Universitas Diponegoro

Lokasi Kampus ***Campus Location***	**Total Area Vegetasi** ***Total Vegetation Area (ha)***	**Karbon Biomassa Atas** ***Aboveground Biomass Carbon (ton C)***	**Karbon Organik Tanah** ***Soil Organic Carbon Stock (ton C)***
Tembalang	174,1	10.051,50	1.043.930,74
Pleburan	3,62	758,00	22.114,28
Pekalongan	0,108	0,87	716,24
Kesesi	4,513	20,55	16.199,83
Batang	3,93	54,92	33.989,72
Blado	4,71	31,98	34.501,44
KHDTK	91,54	9.287,83	355.272,13
Rembang	6,21	233,60	21.441,68
Telukawur	31,659	3.273	201.163,72
TOTAL	320,39	23.712,35	1.729.329,77

Hasil pengukuran tahun 2026 menunjukkan bahwa cadangan karbon UNDIP terdiri atas 23.721,25 metrik ton karbon biomassa atas dan 1.729.329,77 metrik ton karbon organik tanah, sehingga total cadangan karbon yang teridentifikasi mencapai 1.752.601,02 metrik ton. Nilai tersebut menunjukkan bahwa simpanan karbon di lingkungan UNDIP masih didominasi oleh komponen tanah.

The 2026 measurement results show that UNDIP's carbon stock consists of 23.721,25 metric tons of above-ground biomass carbon and 1.729.329,77 metric tons of soil organic carbon, bringing the total identified carbon stock to 1.752.601,02 metric tons.

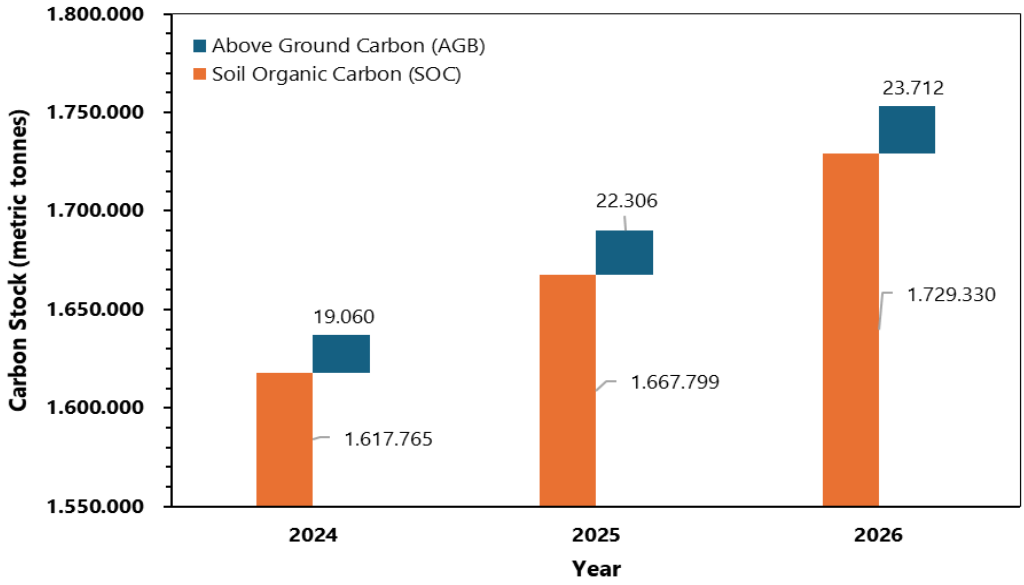
These figures indicate that carbon storage within UNDIP is still dominated by the soil component.

Sebaran cadangan karbon tahun 2026

The distribution of carbon stock in 2026 also shows an uneven pattern

juga menunjukkan pola yang tidak merata antar lokasi kampus. Kontribusi terbesar berasal dari KHDTK dan Kampus Tembalang, sementara Teluk Awur juga menonjol sebagai salah satu lokasi dengan simpanan karbon yang cukup besar. Sebaliknya, Pekalongan, Batang, dan PSDKU Rembang menunjukkan nilai yang lebih rendah. Pola ini menegaskan bahwa besarnya cadangan karbon dipengaruhi oleh luas vegetasi dan karakter ekologis masing-masing kawasan.

across campus locations. The largest contribution comes from KHDTK and the Tembalang Campus, while Teluk Awur also stands out as one of the locations with relatively high carbon storage. In contrast, Pekalongan, Batang, and PSDKU Rembang show lower values. This pattern confirms that the amount of carbon stock is influenced by vegetation extent and the ecological characteristics of each area.



Grafik 24. Perbandingan Cadangan Karbon AGB Undip 2022 – 2026
Grafik 24 AGB carbon stock comparison of Undip 2022 – 2026

Di antara lokasi yang diamati, Teluk Awur memiliki arti penting karena mewakili kawasan kampus yang berdekatan dengan ekosistem pesisir. Pada lokasi ini teridentifikasi satu titik rawa payau bermangrove yang turut diukur dalam kegiatan lapangan.

Among the observed locations, Teluk Awur is particularly important because it represents a campus area adjacent to a coastal ecosystem. At this location, one brackish swamp mangrove point was identified and measured during fieldwork.

Temuan tersebut menunjukkan adanya potensi simpanan karbon pesisir atau blue carbon di lingkungan kampus UNDIP. Namun, karena pengamatan masih terbatas pada satu titik, pembahasannya pada tahap ini belum diarahkan pada

This finding indicates the presence of potential coastal carbon storage, or blue carbon, within the UNDIP campus environment. However, because observations are still limited to a single point, the discussion at this stage has not been directed

estimasi yang menyeluruh dan masih ditempatkan sebagai indikasi awal untuk pengembangan kajian berikutnya.

Jika dibandingkan antar periode pengukuran, cadangan karbon biomassa atas UNDIP menunjukkan kecenderungan meningkat dari tahun 2022 ke 2024 dan kembali naik pada tahun 2026. Nilai AGB tercatat sebesar 19.059,84 metrik ton pada 2022, meningkat menjadi 22.306,6 metrik ton pada 2024, dan mencapai 23.721,25 metrik ton pada 2026. Pola ini menunjukkan adanya perkembangan positif pada komponen biomassa atas, yang kemungkinan berkaitan dengan pertambahan vegetasi dan penguatan pengelolaan ruang hijau kampus. Sementara itu, data karbon organik tanah baru tersedia pada tahun 2024 dan 2026, dengan nilai yang menunjukkan perbedaan cukup besar.

Secara umum, hasil pengukuran cadangan karbon tahun 2026 memberikan dasar penting bagi UNDIP untuk mengevaluasi arah kebijakan kampus berkelanjutan. Besaran Cadangan karbon yang teridentifikasi menunjukkan bahwa keberadaan ruang terbuka hijau, Kawasan bervegetasi, dan pengelolaan lahan yang baik memiliki kontribusi nyata terhadap fungsi ekologis kampus.

Oleh karena itu, upaya penanaman, pemeliharaan vegetasi, dan pemantauan cadangan karbon perlu dilakukan secara berkelanjutan agar perubahan yang terjadi dapat dibaca dengan lebih baik dari waktu ke waktu.

toward a comprehensive estimate and is instead positioned as an initial indication for further study.

When compared across measurement periods, UNDIP's above-ground biomass carbon stock shows an increasing trend from 2022 to 2024 and rises again in 2026. AGB was recorded at 19,059.84 metric tons in 2022, increased to 22,306.6 metric tons in 2024, and reached 23.721,25 metric tons in 2026. This pattern indicates positive progress in the above-ground biomass component, which may be associated with increased vegetation cover and stronger campus green space management. Meanwhile, soil organic carbon data are only available for 2024 and 2026, with values showing a fairly large difference.

Overall, the 2026 carbon stock measurement provides an important basis for UNDIP to evaluate the direction of its sustainable campus policy. The identified carbon stock demonstrates that the presence of green open spaces, vegetated areas, and proper land management contributes significantly to the campus's ecological function.

Therefore, planting efforts, vegetation maintenance, and carbon stock monitoring need to be carried out continuously so that changes over time can be better understood. In this way, carbon stock is not only environmental data, but can also serve as a basis for strengthening strategies toward a more resilient and sustainable campus development.

VI. PENUTUP

6.1 Kesimpulan

Aktivitas di lingkungan perguruan tinggi secara tidak langsung membentuk jejak karbon yang berasal dari berbagai kegiatan akademik, administratif, dan operasional. Dalam hal ini, perguruan tinggi memiliki tanggung jawab sekaligus peluang untuk berperan aktif dalam mitigasi perubahan iklim melalui pengelolaan lingkungan yang berkelanjutan. Universitas Diponegoro (UNDIP) menunjukkan kapasitas yang cukup besar dalam menyimpan karbon melalui vegetasi dan tanah. Data menunjukkan bahwa cadangan karbon biomassa atas meningkat dari 19.059,84 metrik ton pada tahun 2022 menjadi 22.306,6 metrik ton pada tahun 2024 dan kembali meningkat menjadi 22.658,85 metrik ton pada tahun 2026. Sementara itu, cadangan karbon organik tanah pada tahun 2024 tercatat sebesar 1.667.798,97 metrik ton dan pada tahun 2026 sebesar 1.139.921,61 metrik ton. Di sisi lain, emisi karbon yang dihasilkan kampus mengalami fluktuasi, yaitu sebesar 12.994,72 metrik ton per tahun pada tahun 2022, meningkat menjadi 16.515,05 metrik ton per tahun pada tahun 2024, dan menurun menjadi 14.435,51 metrik ton per tahun pada tahun 2026. Kondisi ini menunjukkan bahwa meskipun aktivitas kampus sempat meningkatkan emisi, terdapat upaya pengendalian yang mulai memberikan dampak pada periode berikutnya.

Jika dibandingkan secara keseluruhan, Cadangan karbon yang dimiliki kampus tetap jauh lebih besar dibandingkan dengan emisi yang dihasilkan. Hal ini menegaskan bahwa

VI. *CONCLUSION*

Conclusion

Activities within higher education institutions inherently generate carbon footprints, stemming from academic, administrative, and operational processes. In this regard, universities hold both the responsibility and the opportunity to actively contribute to climate change mitigation through sustainable environmental management. Universitas Diponegoro (UNDIP) exhibits a considerable capacity for carbon storage through both vegetation and soil systems. Data indicate that above-ground biomass carbon increased from 19,059.84 metric tons in 2022 to 22,306.6 metric tons in 2024, and further to 22,658.85 metric tons in 2026. Meanwhile, soil organic carbon was recorded at 1,667,798.97 metric tons in 2024 and 1,139,921.61 metric tons in 2026. In contrast, campus carbon emissions fluctuated, with values of 12,994.72 metric tons per year in 2022, rising to 16,515.05 metric tons per year in 2024, and then declining to 14,435.51 metric tons per year in 2026. This pattern suggests that while campus activities temporarily increased emissions, mitigation efforts have begun to show measurable impacts. When viewed comprehensively, the campus carbon stock remains substantially higher than its emissions. This confirms that UNDIP possesses a strong capacity as a carbon sink.

The increase in biomass reflects

UNDIP memiliki kapasitas yang kuat sebagai penyerap karbon. Peningkatan biomassa mencerminkan keberhasilan pengelolaan vegetasi, sedangkan dominasi karbon tanah menunjukkan pentingnya peran pengelolaan lahan dalam mendukung keberlanjutan lingkungan kampus.

Rekomendasi

Efisiensi *carbon footprint* dapat dilakukan dengan mempertimbangkan beberapa hal sebagai berikut:

- Mengintegrasikan konsep *sustainable urban campus* dalam perencanaan tata ruang untuk meningkatkan efisiensi dan keberlanjutan lingkungan.
- Mendorong penerapan *green infrastructure systems* untuk meningkatkan ketahanan. lingkungan terhadap perubahan iklim
- Mengurangi emisi melalui transisi menuju energi bersih dan transportasi listrik sesuai tren *decarbonization pathway*.
- Mengembangkan sistem pelaporan dan pemantauan karbon sebagai bagian dari standar *environmental, social, and governance* (ESG).
- Mendorong kemitraan strategis lintas sektor dalam memperkuat program keberlanjutan berbasis kolaborasi global.

effective vegetation management, while the dominance of soil carbon underscores the importance of land management for long-term sustainability.

6.1 Recommendations

Carbon footprint efficiency can be achieved by considering the following aspects:

- *Integrate the concept of a sustainable urban campus into spatial planning to enhance environmental efficiency and sustainability.*
- Promote *the implementation of green infrastructure systems to improve climate resilience on campus.*
- *Reduce emissions through the transition to clean energy and electric mobility in line with the decarbonization pathway.*
- *Develop carbon reporting and monitoring systems aligned with environmental, social, and governance (ESG) standards.*
- *Encourage cross-sector strategic partnerships to strengthen sustainability programs through global collaboration.*

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