



SDGs CENTER
UNIVERSITAS DIPONEGORO

CARBON OFFSETS ACHIVEMENT REPORT

Laporan Capaian Carbon Offset



**Universitas Diponegoro
2024**

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RINGKASAN EKSEKUTIF

EXECUTIVE SUMMARY

Universitas Diponegoro (UNDIP) sebagai institusi pendidikan tinggi memiliki peran strategis dalam mendukung agenda nasional dan global untuk menanggulangi perubahan iklim. Melalui berbagai aktivitas akademik, administratif, dan operasional, kampus berkontribusi terhadap jejak karbon yang perlu dikelola secara bijaksana. Di sisi lain, UNDIP juga memiliki potensi besar dalam menyerap dan menyimpan karbon melalui keberadaan ruang terbuka hijau, vegetasi kampus, serta kondisi tanah yang sehat. Laporan ini menyajikan hasil pengukuran dan estimasi cadangan karbon tahun 2024 yang tersimpan di kawasan kampus UNDIP, yang terdiri dari dua komponen utama: (a) Cadangan Karbon Biomassa Atas (Above Ground Biomass/AGB) mencapai 22.306,4 metrik ton per tahun; (b) Cadangan Karbon Organik Tanah (Soil Organic Carbon/SOC) sebesar 1.667.798,97 metrik ton per tahun. Potensi ini perlu dikelola dan ditingkatkan melalui integrasi dalam kebijakan tata ruang kampus, perencanaan pembangunan berkelanjutan, serta partisipasi aktif sivitas akademika dalam menjaga ekosistem kampus. UNDIP memiliki peluang besar untuk menjadi model kampus hijau yang berkelanjutan dan tangguh terhadap perubahan iklim, dengan memanfaatkan kekuatan ekologisnya sebagai bagian dari strategi aksi iklim institusional.

Universitas Diponegoro (UNDIP), as a higher education institution, plays a strategic role in supporting national and global agendas to address climate change. Through various academic, administrative, and operational activities, the campus contributes to a carbon footprint that must be managed wisely. On the other hand, UNDIP also holds great potential for carbon absorption and storage through the presence of green open spaces, campus vegetation, and healthy soil conditions. This report presents the results of the 2024 carbon stock measurement and estimation stored within the UNDIP campus are, which consists of two main components: (a) Above Ground Biomass (AGB) Carbon Stock, amounting to 22,306.4 metric tons per year; and (b) Soil Organic Carbon (SOC), amounting to 1,667,798.97 metric tons per year. This potential needs to be managed and enhanced through integration into campus spatial planning policies, sustainable development strategies, and the active participation of the academic community in preserving the campus ecosystem. UNDIP has a great opportunity to become a model of a sustainable and climate-resilient green campus by leveraging its ecological strengths as part of its institutional climate action strategy.

I. PENDAHULUAN

1.1 Latar Belakang

Pemanasan Global

Pemanasan global (*global warming*) adalah suatu bentuk ketidak seimbangan ekosistem di bumi akibat terjadinya proses peningkatan suhu rata - rata atmosfer, laut dan daratan di bumi. Meningkatnya temperatur global akan menyebabkan perubahan - perubahan di bumi, seperti meningkatnya intensitas kejadian cuaca yang ekstrim, perubahan iklim, peningkatan hujan dan banjir.

Meningkatnya pemanasan global (*global warming*) sangat memprihatinkan masa depan bumi. Jika hal tersebut tidak segera diatasi, akibatnya bisa sangat fatal, lapisan es di kutub akan mencair dan permukaan air laut akan naik. Gelombang panas akan mengacaukan iklim dan menimbulkan badai.

Berdasarkan data yang diperoleh dari *United Nations Framework Convention on Climate Change* (UNFCCC), terdapat 7 aktivitas manusia yang menjadi pendorong utama dalam perubahan iklim, yaitu penebangan hutan, manufaktur barang dan pertambangan, pengubahan energi, penggunaan alat transportasi, produksi makanan, suplai energi untuk ruangan, dan pemakaian berlebihan pakaian hingga sampah dan plastik. Menurut *International Energy Agency* (IEA, 2022), konsumsi energi untuk produksi logam dan mineral hampir dua kali lipat selama 20 tahun terakhir dibandingkan sebelumnya.

Kenaikan suhu bumi akibat pemanasan global (*global warming*) dari GRK telah mendapat perhatian besar dunia. Hal ini

I. INTRODUCTION

1.1 Background

Global Warming

Global warming is a form of ecosystem imbalance on earth due to the process of increasing the average temperature of the earth's atmosphere, ocean, and land.

Increasing global temperatures will cause changes on earth, such as increasing the intensity of extreme weather events, climate change, increased rain, and flooding.

Increasing global warming is a major concern for the future of the earth, and if it is not addressed, the consequences could be devastating, polar ice caps will melt and sea levels will rise. Heat waves will disrupt the climate and cause storms.

Based on data obtained from the United Nations Framework Convention on Climate Change (UNFCCC), there are 7 human activities that are the main drivers of climate change, namely deforestation, goods manufacturing and mining, energy conversion, transportation use, food production, energy supply for space, and excessive use of clothing to waste and plastic. According to the International Energy Agency (IEA, 2022), energy consumption to produce metals and minerals has almost doubled over the last 20 years compared to before.

The increase in the earth's temperature due to global warming from GHGs has received great attention worldwide. This was realized in the Paris Climate Agreement in 2015, which stated that the parties to the agreement agreed to keep the increase in the earth's average temperature well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature

diwujudkan dalam *Paris Climate Agreement* pada tahun 2015 yang menyatakan bahwa pihak yang terlibat dalam perjanjian tersebut sepakat untuk menjaga peningkatan suhu rata-rata bumi jauh di bawah 2° C di atas tingkat pra-industri, dan untuk mengejar upaya membatasi kenaikan suhu lebih jauh ke 1,5° C (Pasal 2) (UNFCCC, 2015). Upaya dari perjanjian Paris ini mengerucut pada program *Net Zero Emissions* (NZE) atau nol bersih emisi.

Program Net Zero Emission (NZE)

Program Net Zero Emission (NZE) merupakan program yang bertujuan untuk menekan pencemaran lingkungan yang berpotensi mengakibatkan pemanasan global. Untuk dapat mencapainya diperlukan sebuah transisi dari sistem energi yang digunakan saat ini ke sistem energi bersih guna mencapai kondisi seimbang antara aktivitas manusia dengan keseimbangan alam. Salah satu upaya yang dapat dilakukan adalah mengurangi jumlah karbon atau gas emisi yang dihasilkan dari berbagai kegiatan (aktivitas) manusia pada kurun waktu tertentu, atau lebih sering dikenal dengan istilah pengurangan jejak karbon (*carbon footprint*).

Indonesia merupakan salah satu negara yang turut serta dalam penandatanganan *Paris Agreement* dan sangat serius mewujudkan komitmen Net Zero Emission (NZE) pada tahun 2060 atau lebih cepat dari tahun tersebut. Oleh karena itu, pemerintah tengah Menyusun sebuah roadmap untuk merelisasikan NZE demi menghadapi berbagai tantangan serta risiko perubahan iklim di masa mendatang. *UNDIP* sebagai salah institusi pendidikan tinggi di Kota Semarang memiliki

increase further to 1.5°C (Article 2) (UNFCCC, 2015). The efforts of the Paris agreement led to the Net Zero Emissions (NZE) program.



Net Zero Emission (NZE) Program

The Net Zero Emission (NZE) program is a program that aims to reduce environmental pollution that has the potential to cause global warming. To achieve this, a transition from the current energy system to a clean energy system is needed to achieve a balanced condition between human activities and the balance of nature. One of the efforts that can be made is to reduce the amount of carbon or gas emissions generated from various human activities (activities) in a certain period of time, or more commonly known as carbon footprint reduction.

Indonesia is one of the countries that participated in the signing of the Paris Agreement and is very serious about realizing its Net Zero Emission (NZE) commitment by 2060 or sooner. Therefore, the government is developing a roadmap to realize NZE to face the challenges and risks of climate change in the future. *UNDIP*, as one of the higher education institutions in Semarang City, has an obligation to play an active role in the implementation of a planned and structured decarbonization program. This is in accordance with the Circular Letter of the Rector of Universitas

kewajiban untuk berperan aktif dalam pelaksanaan program dekarbonisasi secara terencana dan terstruktur. Hal ini sesuai dengan Surat Edaran Rektor Universitas Diponegoro No. 37/UN7.P/SE/2017 tentang Program Carbon Neutrality di Lingkungan Universitas Diponegoro dan Surat Edaran Rektor Universitas Diponegoro No. 35/UN7.P/SE/2017 tentang Kebijakan Kendaraan Bebas Emisi di lingkungan ingkungan 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.

Diponegoro No. 37/UN7.P/SE/2017 concerning Carbon Neutrality Program in Universitas Diponegoro Environment and Circular Letter of the Rector of Universitas Diponegoro No. 35/UN7.P/SE/2017 concerning Emission Free Vehicle Policy in Universitas Diponegoro environment.

1.2 Purpose

Calculating UNDIP's carbon offset so that it can serve as a counterweight to carbon emissions generated by UNDIP and reduce its impact on the environment.



II. KEGIATAN CARBON OFFSET

II. CARBON OFFSET ACTIVITIES



Sebagai wujud komitmen terhadap keberlanjutan, UNDIP terus mengembangkan upaya carbon offset melalui konservasi hutan, penghijauan kampus, dan penerapan teknologi ramah lingkungan. Penelitian ini menjadi dasar perumusan kebijakan carbon offset yang lebih efektif untuk mendukung target netralitas karbon di masa depan. UNDIP tidak hanya berperan sebagai institusi pendidikan dan penelitian, tetapi juga sebagai pelopor dalam aksi nyata mitigasi perubahan iklim di tingkat lokal dan nasional. Berbagai program telah dilaksanakan, seperti penanaman mangrove dan pohon, pendataan jenis pohon, serta penyediaan bus dan sepeda kampus, yang tersebar di berbagai Location dengan detail kegiatan dapat dilihat pada tabel di bawah ini.

As part of its commitment to sustainability, UNDIP continues to advance carbon offset initiatives through forest conservation, campus greening, and the adoption of environmentally friendly technologies. This research serves as a foundation for formulating more effective carbon offset policies to support future carbon neutrality targets. UNDIP not only serves as an educational and research institution but also as a pioneer in tangible climate change mitigation efforts at both local and national levels. Various programs have been implemented, such as mangrove and tree planting, tree species inventory, as well as the provision of campus buses and bicycles, with activity details presented in the table below.

Tabel 1. Kegiatan Carbon Offset Universitas Diponegoro

Table 1. Carbon Offset Activities of Universitas Diponegoro

No	Program / Program	Lingkup / Scope	Peserta/Participant
1	Utilization of UNDIP Campus Buses	Regional	Civitas Academica of UNDIP
2	Enviro Project 2024 "Mangrove Magic Adventure"	Regional	63 Participant

No	Program / Program	Lingkup / Scope	Peserta/Participant
3	UNDIP Together with Djarum Foundation's Environmental Service and Padma Care for Environmental Sustainability	Regional	More than 500 Participants
4	UNDIP's Participation Breaks MURI Record in the 2024 Eco Enzyme Festival	Nasional	More than 100 participants
5	UNDIP and Amal Sehat Sragen Hospital Launch Wanadipa Greenhouse to Support Agricultural Innovation and Sustainability	Regional	Researchers and academics from UNDIP, students, and Amal Sehat Islamic Hospital Sragen
6	Supporting Climate Change Impact Mitigation, UNDIP Plants 2,000 Tree Seedlings in Campus Forest	Regional	UNDIP and Ikatan Alumni Sekolah Kehutanan Menengah Atas
7	UNDIP Research Team Applies Mangrove Ecosystem Rehabilitation Technology in the Capital City of the Archipelago, East Kalimantan	Nasional	Undip lecturers, local government, government agencies, and the community
8	Eco Generation 2024, From BU Undip for the Community	Regional	Asa Edu and the community
9	UNDIP Makes a Breakthrough in Mangrove Nursery Using Environmentally Friendly Technology	Regional	BUMDes Tambakbulusan Demak, collage students, and the community
10	Climate Crisis is Getting Real, Undip Students Introduce Coastal Ecosystems and Climate Change Early on	Regional	Collage students, and the community

Penggunaan Bus Kampus UNDIP

Penyediaan transportasi massal mendorong penggunaan kendaraan pribadi oleh mahasiswa dan staf menjadi berkurang. Hal ini secara langsung menurunkan tingkat kemacetan dan emisi polusi udara di lingkungan kampus. Fasilitas bus kampus mendorong civitas akademika untuk beralih ke moda transportasi yang lebih berkelanjutan, sejalan dengan upaya menciptakan kampus yang lebih hijau dan sehat. Penurunan jumlah kendaraan pribadi mengurangi polusi udara dan suara, yang berdampak positif pada kesehatan dan kenyamanan civitas akademika. Penyediaan bus kampus memberikan kontribusi besar terhadap pengurangan emisi karbon melalui

Utilization of UNDIP Campus Buses

The provision of mass transportation encourages the use of private vehicles by students and staff to be reduced. This directly reduces the level of congestion and air pollution emissions in the campus environment. Campus bus facilities encourage the academic community to adopt more sustainable modes of transportation, aligning with efforts to create a greener and healthier campus. The decrease in the number of private vehicles reduces air and noise pollution, which has a positive impact on the health and comfort of the academic community. The provision of campus buses makes a major contribution to the reduction of carbon emissions through

efisiensi transportasi dan pengurangan ketergantungan pada kendaraan pribadi.



Gambar 1. Bus Kampus UNDIP
Figure 1. UNDIP's Campus Bus

transportation efficiency and reduced reliance on private vehicles.



Enviro Project 2024 "Petualangan Ajaib Mangrove"

Enviro Project 2024 diselenggarakan dengan tema "Petualangan Ajaib Mangrove", sebagai bagian dari upaya pelestarian lingkungan dan mitigasi perubahan iklim. Kegiatan meliputi penanaman bibit mangrove di Pantai Tirang, Tambakrejo, Semarang, yang bertujuan untuk memperkuat ekosistem pesisir serta meningkatkan kesadaran akan pentingnya konservasi alam. Program ini menjadi wujud nyata komitmen mahasiswa dalam menjaga keberlanjutan lingkungan dan mendukung aksi iklim yang berkelanjutan.



Gambar 2. Kegiatan Penanaman Bibit Mangrove di Pantai Tirang, Semarang
Figure 2. Mangrove Seedling Planting Activity at Tirang Beach, Semarang

Enviro Project 2024 "Mangrove Magic Adventure"

Enviro Project 2024 was held with the theme "Mangrove Magic Adventure" as part of efforts to preserve the environment and mitigate climate change. This activity involved the planting of mangrove seedlings at Tirang Beach, Tambakrejo, Semarang, aiming to strengthen coastal ecosystems and raise awareness of the importance of nature conservation. Organized by the Environmental Engineering Student Association, this program serves as a tangible commitment by students to environmental sustainability and supports sustainable climate action.



UNDIP Bersama Bakti Lingkungan Djarum Foundation dan Padma Peduli Kelestarian Lingkungan

Dalam rangkaian kegiatan Dies Natalis ke-67, UNDIP melakukan penanaman pohon bersama Bakti Lingkungan Djarum Foundation (BLDF) di lingkungan kampus UNDIP, Tembalang. Penanaman ini melibatkan lebih dari 500 mahasiswa UNDIP yang menanam 405 bibit pohon di area gedung Muladi Dome, kawasan waduk pendidikan UNDIP serta area Gedung Prof Soedarto. UNDIP berhasil menduduki peringkat ke-4 level Asia dan ke-29 level dunia pada UI GreenMetric, dan berhasil mempertahankan peringkat ke-2 nasional sebagai perguruan tinggi berkelanjutan terbaik di Indonesia tahun 2020 sampai dengan tahun 2023.



Gambar 3. Penanaman pohon bersama Bakti Lingkungan Djarum Foundation (BLDF) di lingkungan kampus UNDIP, Tembalang

Figure 3. Tree planting with Bakti Lingkungan Djarum Foundation (BLDF) in UNDIP campus, Tembalang

UNDIP Together with Djarum Foundation's Environmental Service and Padma Care for Environmental Sustainability

As part of the 67th Dies Natalis celebrations, UNDIP conducted a tree-planting event in collaboration with Bakti Lingkungan Djarum Foundation (BLDF) within the UNDIP campus in Tembalang. This initiative involved more than 500 UNDIP students, who planted 405 tree seedlings in the Muladi Dome building area, the UNDIP educational reservoir area, and the Prof. Soedarto Building area. UNDIP has achieved the 4th rank in Asia and the 29th rank globally in the UI GreenMetric ranking and has successfully maintained the 2nd national rank as the best sustainable university in Indonesia from 2020 to 2023.



Partisipasi UNDIP Pecahkan Rekor MURI dalam Festival Eco Enzim 2024

UNDIP dengan predikat sebagai the 2nd Most Sustainable University in Indonesia (2020-2024), terus berkomitmen untuk menjaga kesejahteraan alam dan

UNDIP's Participation Breaks MURI Record in the 2024

Recognized as the 2nd Most Sustainable University in Indonesia (2020-2024), UNDIP committed to preserving environmental well-being and maintaining ecosystem

keseimbangan ekosistem. Dalam rangka menyambut *Festival Eco Enzyme 2024*, *UNDIP* bersama Universitas Indonesia dan 40 Perguruan Tinggi melakukan penuangan cairan *Eco Enzyme* secara serentak. Penuangan Cairan *Eco Enzyme* di wilayah *UNDIP* dilaksanakan di Waduk Pendidikan Diponegoro, Semarang.



balance. In celebration of the 2024 Eco Enzyme Festival, UNDIP, together with the University of Indonesia and 40 other universities, simultaneously carried out the pouring of Eco Enzyme liquid. At UNDIP, the eco enzyme pouring activity was held at the Diponegoro Education Reservoir, Semarang.



Gambar 4. Festival Eco Enzyme 2024

Figure 4. Festival Eco Enzyme 2024

UNDIP dan Rumah Sakit Amal Sehat Sragen Luncurkan Greenhouse Wanadipa Dukung Inovasi Pertanian dan Keberlanjutan

Greenhouse Wanadipa di Kawasan KHDTK *UNDIP* resmi dibuka dan mulai difungsikan sebagai bagian dari upaya pengembangan riset dan inovasi lingkungan di kawasan kampus. *Greenhouse* Wanadipa yang merupakan program CSR dari Rumah Sakit Islam Amal Sehat Sragen adalah bagian dari komitmen *UNDIP* dan Rumah Sakit Amal Sehat Sragen untuk meningkatkan kualitas penelitian ilmiah dan pengembangan teknologi pertanian, serta mendukung keberlanjutan lingkungan. *Greenhouse* ini akan menjadi pusat penelitian bagi berbagai varietas tanaman dan teknologi pertanian modern.

UNDIP and Amal Sehat Sragen Hospital Launch Wanadipa Greenhouse to Support Agricultural Innovation and Sustainability

The Wanadipa Greenhouse at KHDTK of UNDIP was officially inaugurated and is now operational as part of efforts to advance environmental research and innovation on campus. The Wanadipa Greenhouse, which is a CSR program from Amal Sehat Sragen Islamic Hospital, is part of UNDIP and Amal Sehat Sragen Hospital's commitment to improve the quality of scientific research and agricultural technology development, and support environmental sustainability. This greenhouse will be a research center for various plant varieties and modern agricultural technology.



Gambar 5. Peresmian Greenhouse Wanadipa UNDIP
Figure 5. Inauguration of Greenhouse Wanadipa UNDIP



Dukung Mitigasi Dampak Perubahan Iklim, UNDIP Tanam 2.000 Bibit Pohon di Hutan Kampus

KHDTK UNDIP bekerja sama dengan Ikatan Alumni Sekolah Kehutanan Menengah Atas (IKA SKMA) menyelenggarakan kegiatan penanaman pohon bersama. Kegiatan ini berlangsung di KHDTK Wanadipa UNDIP, Penggaron, Kabupaten Semarang. Pada kesempatan ini, sebanyak 2.000 bibit pohon ditanam di area KHDTK Wanadipa UNDIP. Kegiatan ini juga bertujuan mendukung pemeringkatan UI GreenMetric UNDIP. "Seperti yang kita ketahui, selama lima tahun berturut-turut UNDIP sukses meraih peringkat kedua di UI GreenMetric.

Supporting Climate Change Impact Mitigation, UNDIP Plants 2,000 Tree Seedlings in Campus Forest

KHDTK UNDIP in collaboration with the Alumni Association of the High School of Forestry (IKA SKMA) held a joint tree planting activity. This activity took place at KHDTK Wanadipa UNDIP, Penggaron, Semarang Regency. On this occasion, 2,000 tree seedlings were planted in the KHDTK Wanadipa UNDIP area. This activity also aims to support UNDIP's UI GreenMetric ranking. "As we know, for five consecutive years UNDIP has successfully achieved the second rank in UI GreenMetric.



Gambar 6. UNDIP Tanam 2.000 Bibit Pohon di Hutan Kampus
Figure 6. UNDIP Planted 2,000 Tree Seedlings in Campus Forest

Selain menjalankan berbagai inisiatif internal dalam upaya penanganan perubahan iklim, UNDIP juga secara aktif terlibat dalam kegiatan eksternal yang mendukung aksi iklim. Kegiatan ini mencakup kolaborasi dengan pemerintah daerah, lembaga swadaya masyarakat, hingga komunitas lokal dalam program edukasi, penelitian terapan, dan pengabdian kepada masyarakat. Melalui keterlibatan eksternal ini, UNDIP berperan sebagai agen perubahan yang mendorong kesadaran dan aksi nyata terhadap isu perubahan iklim di tingkat lokal, regional, hingga nasional.

Tim Peneliti UNDIP Terapkan Teknologi Rehabilitasi Ekosistem Mangrove di Ibu Kota Nusantara, Kalimantan Timur

Tim Peneliti LPPM UNDIP menerapkan teknologi rehabilitasi ekosistem mangrove sebagai sistem carbon capture and storage (CCS) di kawasan Ibu Kota Nusantara (IKN) untuk mendukung terciptanya Smart-Sustainable Forest City. Program ini bertujuan memulihkan lahan mangrove yang rusak akibat alih fungsi lahan, serta memperkuat peran mangrove sebagai penyerap karbon dan benteng alami pesisir. Dengan teknologi yang telah terbukti efektif di Demak, serta pendekatan valuasi jasa ekosistem dan proyeksi cadangan karbon, kegiatan ini menjadi bagian dari upaya mitigasi perubahan iklim yang mendukung SDGs dan target Net Zero Emission 2060. Program ini juga melibatkan masyarakat lokal dalam proses rehabilitasi sebagai bentuk pemberdayaan dan peningkatan kapasitas adaptasi. Ke depan, pendekatan ini diharapkan dapat direplikasi di wilayah pesisir lainnya sebagai solusi berbasis alam yang berkelanjutan.

In addition to implementing various internal initiatives to address climate change, UNDIP is also actively involved in external activities that support climate action. These activities include collaborations with local governments, non-governmental organizations, and local communities through educational programs, applied research, and community service. Through this external engagement, UNDIP plays a role as an agent of change, promoting awareness and concrete action on climate change issues at the local, regional, and national levels.

UNDIP Research Team Applies Mangrove Ecosystem Rehabilitation Technology in the Capital City of the Archipelago, East Kalimantan

The UNDIP LPPM Research Team applies mangrove ecosystem rehabilitation technology as a carbon capture and storage (CCS) system in the Capital City of the Archipelago (IKN) area to support the creation of a Smart-Sustainable Forest City. This program aims to restore mangrove land damaged by land conversion, and strengthen the role of mangroves as carbon sinks and natural coastal fortresses. With technology that has been proven effective in Demak, as well as ecosystem service valuation approaches and carbon stock projections, this activity is part of climate change mitigation efforts that support SDGs and the 2060 Net Zero Emission target. This program also involves local communities in the rehabilitation process as a form of empowerment and capacity building for climate adaptation. In the future, this approach is expected to be replicated in other coastal areas as a sustainable nature-based solution.



Gambar 7. Penanaman Mangrove di Ibu Kota Nusantara
Figure 7. Mangrove Planting in Ibu Kota Nusantara

Eco Generation 2024, Dari BU Undip Untuk Masyarakat

Dalam upaya menjaga kelestarian lingkungan dan meningkatkan kesadaran masyarakat akan pentingnya penghijauan, para-awardee Beasiswa Unggulan Universitas Diponegoro menggelar Project "Eco Generation: Membangun Generasi Kreatif dan Peduli Lingkungan". Kegiatan ini berlangsung di kawasan pesisir Kelurahan Tambak Lorok, Semarang, dengan melibatkan Komunitas Asa Edu, sebuah komunitas yang berfokus pada pemberdayaan anak-anak di daerah pesisir.

Eco Generation 2024, From BU Undip for the Community

To preserve the environment and increase public awareness of the importance of greening, the awardees of the Universitas Diponegoro Excellence Scholarship held the "Eco Generation: Building a Creative Generation and Caring for the Environment". This activity took place in the coastal area of Tambak Lorok Village, Semarang, by involving Asa Edu Community, a community that focuses on empowering children in coastal areas. Successfully becoming an inspiring platform for collaboration, Eco

Berhasil menjadi wadah kolaborasi yang inspiratif, Kegiatan Eco generation 2024 bertujuan untuk menciptakan lingkungan yang lebih hijau dan sehat, sekaligus memberikan edukasi lingkungan kepada generasi muda.



generation 2024 aims to create a greener and healthier environment, while providing environmental education to the younger generation.



Gambar 8. Beasiswa Unggulan Universitas Diponegoro menggelar Project “Eco Generation”
Figure 8. Excellent Scholarship Universitas Diponegoro held the “Eco Generation” Project

UNDIP Lakukan Terobosan Pembibitan Mangrove Menggunakan Teknologi Ramah Lingkungan

Tim Pengabdian Masyarakat Universitas Diponegoro (UNDIP) memperkenalkan inovasi pembibitan mangrove menggunakan polybag ramah lingkungan di Desa Tambakbulusan, Kabupaten Demak, sebagai bagian dari upaya rehabilitasi kawasan pesisir yang berkelanjutan. Program ini tidak hanya melibatkan masyarakat setempat dan Badan Usaha Milik Desa (BUMDes) sebagai mitra utama dalam implementasinya, tetapi juga mendorong partisipasi aktif warga dalam menjaga ekosistem pesisir yang semakin terancam. Mahasiswa UNDIP juga berperan aktif dalam setiap tahapan kegiatan, mulai dari sosialisasi, pelatihan teknis pembibitan mangrove, hingga monitoring dan evaluasi hasil program di lapangan.

UNDIP Makes a Breakthrough in Mangrove Nursery Using Environmentally Friendly Technology

The Community Service Team of Diponegoro University (UNDIP) introduced an innovative mangrove seedling method using eco-friendly polybags in Tambakbulusan Village, Demak Regency, as part of a sustainable coastal rehabilitation effort. This program not only involves local communities and the Village-Owned Enterprise (BUMDes) as key partners in its implementation, but also encourages active participation of residents in protecting increasingly threatened coastal ecosystems. UNDIP students also play an active role in every stage of the program, from community outreach and technical training on mangrove seedling to field monitoring and evaluation of program outcomes.



Gambar 9. Pembibitan Mangrove Menggunakan Teknologi Ramah Lingkungan
Figure 9. Mangrove Nursery Using Environmentally Friendly Technology

Krisis Iklim Makin Nyata, Mahasiswa Undip Kenalkan Ekosistem Pesisir dan Perubahan Iklim Sejak Dini

Mahasiswa KKN Tim II Universitas Diponegoro mengadakan kegiatan edukasi bertema “Edukasi Ekosistem Pesisir dan Perannya dalam Mitigasi Perubahan Iklim” di SD Negeri Jatimulya 01, Desa Jatimulya, Kabupaten Tegal. Edukasi ini bertujuan mengenalkan pentingnya ekosistem pesisir, seperti mangrove, padang lamun, dan terumbu karang, dalam menyerap dan menyimpan karbon, sehingga berperan dalam mitigasi perubahan iklim. Melalui pengenalan sejak dini, kegiatan ini diharapkan menumbuhkan kesadaran generasi muda terhadap krisis iklim dan pentingnya menjaga lingkungan pesisir.

Climate Crisis is Getting Real, Undip Students Introduce Coastal Ecosystems and Climate Change Early on

The Community Service (KKN) Team II of Diponegoro University held an educational activity themed “Coastal Ecosystem Education and Its Role in Climate Change Mitigation” at SD Negeri Jatimulya 01, Jatimulya Village, Tegal Regency. The education initiative sought to introduce the importance of coastal ecosystems—such as mangroves, seagrass beds, and coral reefs—in absorbing and storing carbon, thereby playing a role in climate change mitigation. By introducing these concepts at an early age, the activity is expected to foster awareness among the younger generation about the climate crisis and the importance of protecting coastal environments.



Gambar 10. Edukasi Ekosistem Pesisir dan Perannya dalam Mitigasi Perubahan Iklim
Figure 10. Coastal Ecosystem Education and its Role in Climate Change Mitigation

III. METODE PERHITUNGAN KARBON

3.1 Carbon Footprint

Jejak karbon merupakan jumlah dari gas rumah kaca yang diproduksi oleh setiap kegiatan manusia, baik secara langsung maupun tidak langsung. Jejak karbon biasanya dinyatakan dengan satuan Kg.CO₂-eq atau dengan ton.CO₂-eq, banyaknya gas rumah kaca yang dihasilkan manusia yang disebut sebagai jejak karbon (Setyaningsih, 2019).

- Emisi CO₂ dari konsumsi listrik:
(Konsumsi listrik per tahun dalam kWh/1000) x 0,84
Keterangan: 0,84 = koefisien untuk mengkonversi satuan kWh menjadi ton
- Emisi CO₂ dari konsumsi BBM per tahun:
(Konsumsi BBM per tahun dalam liter/1000) x 2,54
Keterangan: 2,54 adalah koefisien untuk mengkonversi liter menjadi ton

3.2 Metode Pengambilan Data

Metode pengambilan data untuk perhitungan karbon mengacu pada SNI-7724-2019 mengenai Pengukuran dan penghitungan cadangan karbon - Pengukuran lapangan untuk penaksiran cadangan karbon hutan (*ground-based forest carbon accounting*) dengan tahapan mendetail sebagai berikut.

III. CARBON CALCULATION METHOD

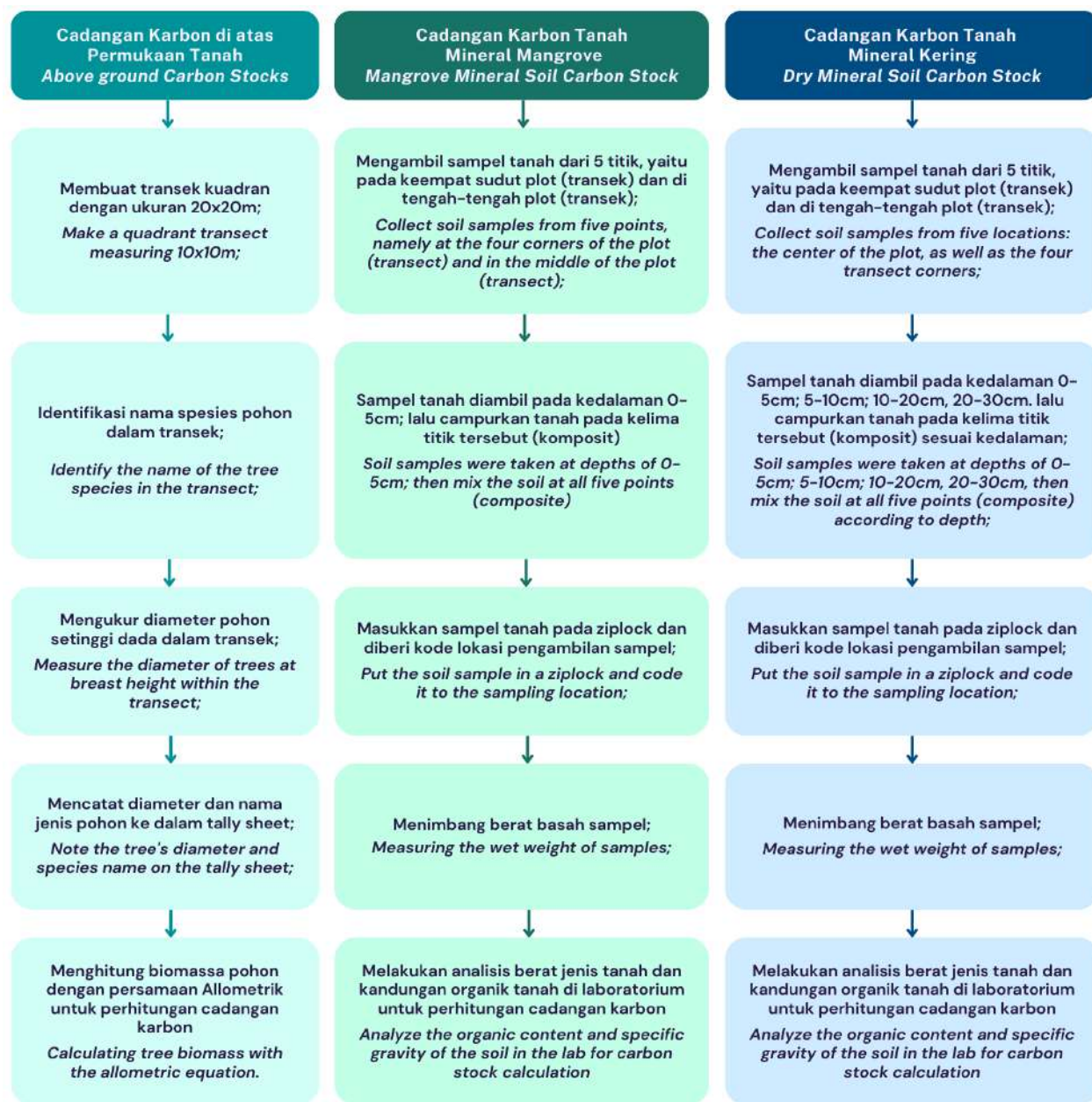
3.1 Carbon Footprint

The carbon footprint is the amount of greenhouse gases produced by every human activity, either directly or indirectly. Carbon footprint is usually expressed in units of Kg.CO₂-eq or tons.CO₂-eq, the amount of greenhouse gases produced by humans, is referred to as the carbon footprint (Setyaningsih, 2019).

- CO₂ emission from electricity:
(Consumption per year Electricity in kWh/1000) x 0.84
Description:
0.84 = coefficient to convert kWh to ton
- CO₂ emissions from fuel consumption per year:
(Fuel consumption per year in liters/1000) x 2.54
Description:
2.54 is the coefficient for converting liters to ton

3.2 Data Collection Method

The data collection method for carbon accounting refers to SNI-7724-2019 regarding the Measurement and accounting of carbon stocks -Field measurements for ground-based forest carbon accounting with the following detailed steps.



Gambar 11. Metode pengambilan data perhitungan karbon
Figure 11. Data collection method of carbon calculation



Gambar 12. Dokumentasi pengambilan data karbon
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)

Rhizophora mucronata (Kridiborworn et al., 2012)

$$B = 0,275 \times D^{3,19}$$

Keterangan:

B= Biomassa tegakan (kg/pohon)

D= Diameter (cm)

Pohon Mangga (*Mangifera indica*) (Naik et al., 2019)

$$Y = 1,77 \times CD^{1,020}$$

Keterangan:

Y = Biomassa tegakan (kg/pohon)

CD = Diameter (cm)

Pohon Mahoni (*Swietenia mahagoni*)

(Hairiah et al., 2011)

$$Y = 0,048 \times D^{2,68}$$

Keterangan:

Y = Biomassa tegakan (kg/pohon)

D = Diameter/DBH (cm)

Pohon Sengon (*Albizia chinensis*) (Hairiah et al., 2011)

$$Y = 0,027 \times D^{2,23}$$

Keterangan:

Y = Biomassa tegakan (kg/pohon)

D = Diameter/DBH (cm)

Pohon Akasia (*Acacia*) (Hairiah et al., 2011)

$$Y = 0,0000478 \times D^{2,76}$$

Keterangan:

3.3 Calculation of Carbon Stocks

Above-ground Biomass

Woody Plant (Ketterings et al., 2001)

$$Y = 0.11 \times \rho \times D^{2+c}$$

Description:

Y = Standing biomass (kg/tree)

ρ = specific gravity (gr/cm³)

c = 0.62

D = Diameter (cm)

Rhizophora mucronate (Kridiborworn et al., 2012)

$$B = 0.275 \times D^{3.19}$$

Description:

B = Standing biomass (kg/pohon)

D = Diameter (cm)

Mango Tree (*Mangifera indica*) (Naik et al., 2019)

$$Y = 1.77 \times CD^{1.020}$$

Description:

Y = Stand biomass (kg/tree)

CD = Diameter (cm)

Mahogany Tree (*Swietenia mahagoni*)

(Hairiah et al., 2011)

$$Y = 0.048 \times D^{2.68}$$

Description:

Y = Stand biomass (kg/tree)

D = Diameter/DBH (cm)

Silk Tree (*Albizia chinensis*) (Hairiah et al., 2011)

$$Y = 0.027 \times D^{2.23}$$

Description:

Y = Stand biomass (kg/tree)

D = Diameter/DBH (cm)

Akasia Tree (*Acacia*) (Hairiah et al., 2011)

$$Y = 0.0000478 \times D^{2.76}$$

Description:

Y = Stand biomass (kg/tree)

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

Pohon Lamtoro (*Leucaena leucocephala*)

(Banaticla et al. 2007)

$$Y = 0,206 \times D^{2,305}$$

Keterangan:

D = Diameter/DBH (m)

Pohon Jati Putih (*Gmelina arborea*)

(Banaticla et al. 2007).

$$Y = 0,153 \times D^{2,217}$$

Keterangan:

D = Diameter/DBH (cm)

Perhitungan Karbon Tanah (SNI-7724-2019)

$$Ct = Kd \times \rho \times \%C \text{ organik}$$

Keterangan:

Ct = kandungan karbon tanah (gr/cm²)

Kd= kedalaman contoh tanah/kedalaman tanah (cm)

%C organik = nilai persentase kandungan karbon yang diperoleh dari hasil analisis laboratorium.

D = Diameter/DBH (cm)

Lamtoro Tree (*Leucaena leucocephala*)

(Banaticla et al. 2007)

$$Y = 0.206 \times D^{2.305}$$

Description:

D = Diameter/DBH (m)

White Teak tree (*Gmelina arborea*)

(Banaticla et al. 2007).

$$Y = 0.153 \times D^{2.217}$$

Description:

D = Diameter/DBH (cm)

Calculation of Soil Carbon (SNI-7724-2019)

$$Ct = Kd \times \rho \times \%C \text{ organics}$$

Description:

Ct = soil carbon content (gr/cm²)

Kd = the depth of the soil sample/soil depth (cm)

%C organic = the percentage value of carbon content obtained from laboratory analysis.

IV. LOCATION PENGAMBILAN DATA

UNDIP memiliki 7 wilayah kampus yang tersebar di berbagai Location strategis di Jawa Tengah. Kampus utama terletak di Tembalang, Semarang, yang menjadi pusat kegiatan akademik dan administratif utama, serta tempat bagi sebagian besar fakultas dan fasilitas penelitian. Selain itu, Kampus Pleburan yang berLocation di pusat Kota Semarang difokuskan untuk program pascasarjana dan beberapa pusat administrasi universitas.

UNDIP juga memiliki kampus di beberapa daerah lain, termasuk Kampus Rembang, yang mendukung pendidikan dan penelitian di bidang perikanan dan kelautan, serta Kampus Pekalongan yang berperan dalam pengembangan ilmu kesehatan dan kewirausahaan. Di Kampus Batang, UNDIP mengembangkan program berbasis teknologi dan industri, sementara Kampus Teluk Awur di Jepara menjadi pusat kajian ilmu kelautan dan pesisir. Selain itu, UNDIP juga memiliki kawasan Kampus KHDTK yang berfungsi sebagai area konservasi dan penelitian di bidang kehutanan dan lingkungan.

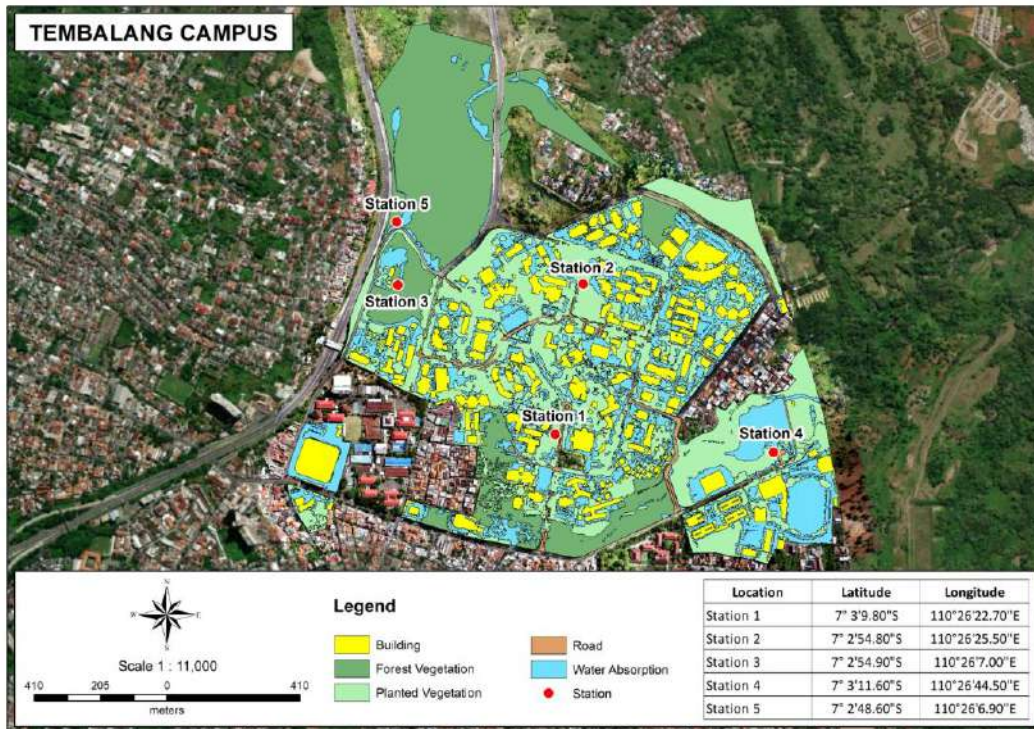
Dengan jaringan kampus yang tersebar di berbagai wilayah ini, UNDIP berkomitmen untuk memperluas akses pendidikan, meningkatkan kualitas penelitian, serta memberikan kontribusi nyata bagi pembangunan daerah dan nasional. Dalam studi ini, pengambilan sampel karbon dilakukan di seluruh wilayah kampus UNDIP, mencakup total 32 titik sampling. Sampel yang dikumpulkan terdiri dari karbon di atas permukaan tanah (AGB) serta karbon organik tanah

IV. DATA COLLECTION LOCATION

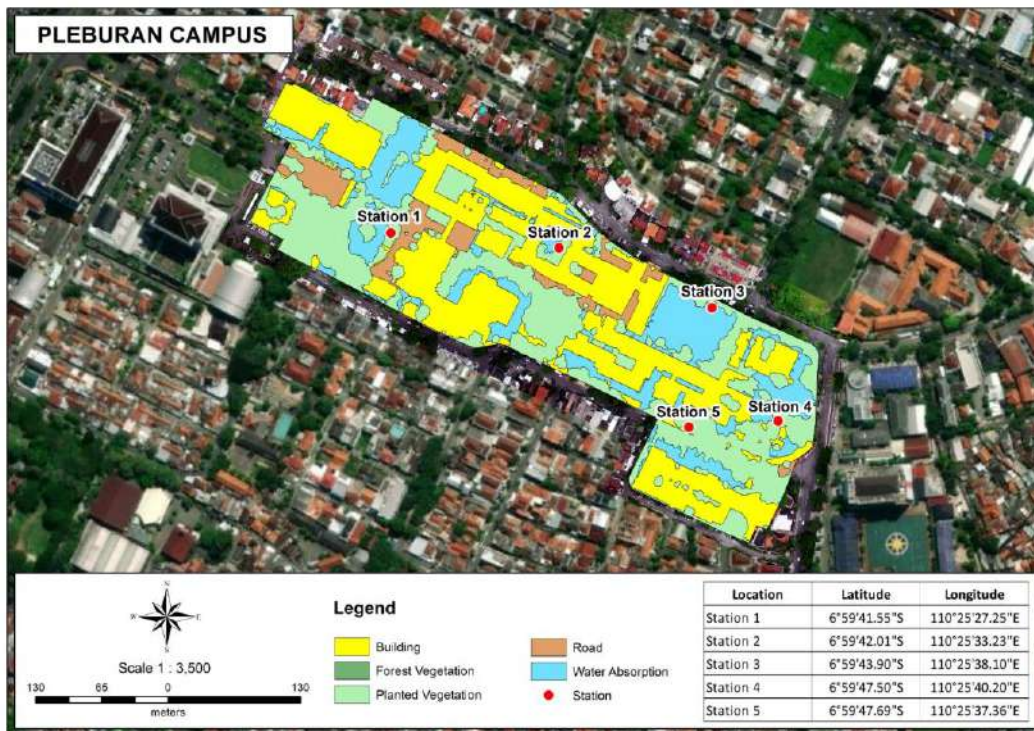
UNDIP has seven campus areas spread across various strategic locations in Central Java. The main campus is located in Tembalang, Semarang, serving as the central hub for academic and administrative activities, as well as housing most faculties and research facilities. Additionally, the Pleburan Campus, situated in the heart of Semarang City, focuses on postgraduate programs and several university administrative centers.

UNDIP also has campuses in other regions, including the Rembang Campus, which supports education and research in fisheries and marine sciences, and the Pekalongan Campus, which plays a role in the development of health sciences and entrepreneurship. At the Batang Campus, UNDIP develops technology and industry-based programs, while the Teluk Awur Campus in Jepara serves as a center for marine and coastal studies. Furthermore, UNDIP has the KHDTK Campus which functions as a conservation and research area for forestry and environmental studies.

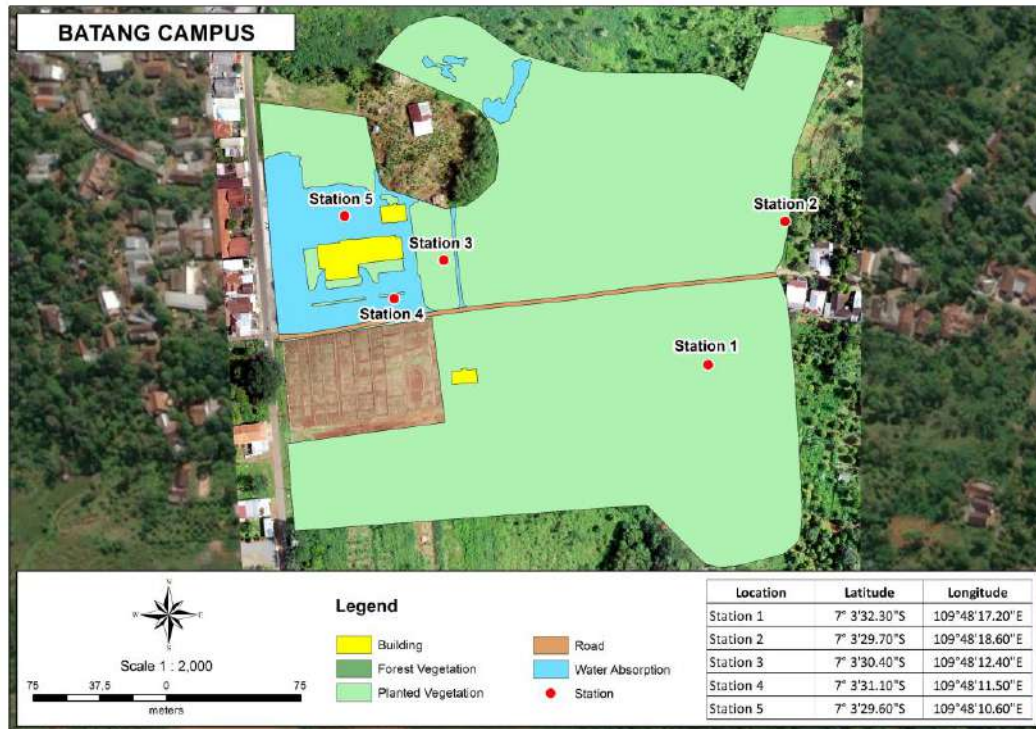
With this network of campuses spread across various regions, UNDIP is committed to expanding access to education, enhancing research quality, and making a significant contribution to regional and national development. In this study, carbon sampling was conducted across all UNDIP campus areas, covering a total of 32 sampling points. The collected samples consist of above-ground biomass (AGB) carbon and soil organic carbon, which were analyzed.



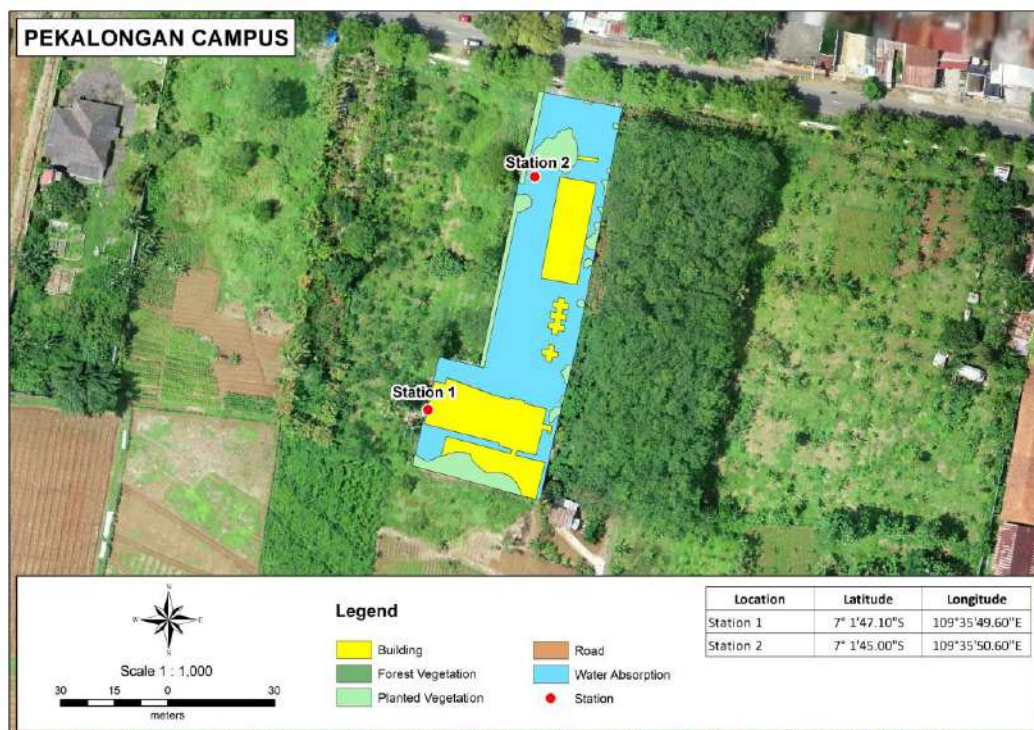
Gambar 13. Titik pengambilan sampel Kampus UNDIP Tembalang
Figure 13. Sampling points at UNDIP Tembalang Campus



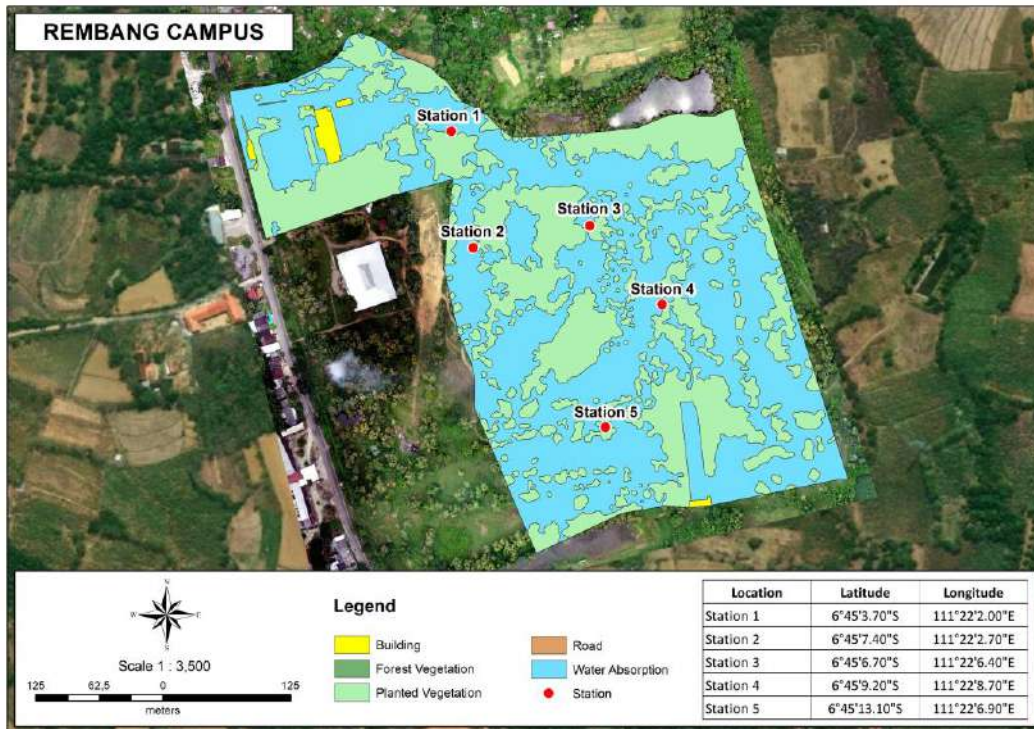
Gambar 14 Titik pengambilan sampel Kampus UNDIP Pleburan
Figure 14. Sampling points at U NDIP Pleburan Campus



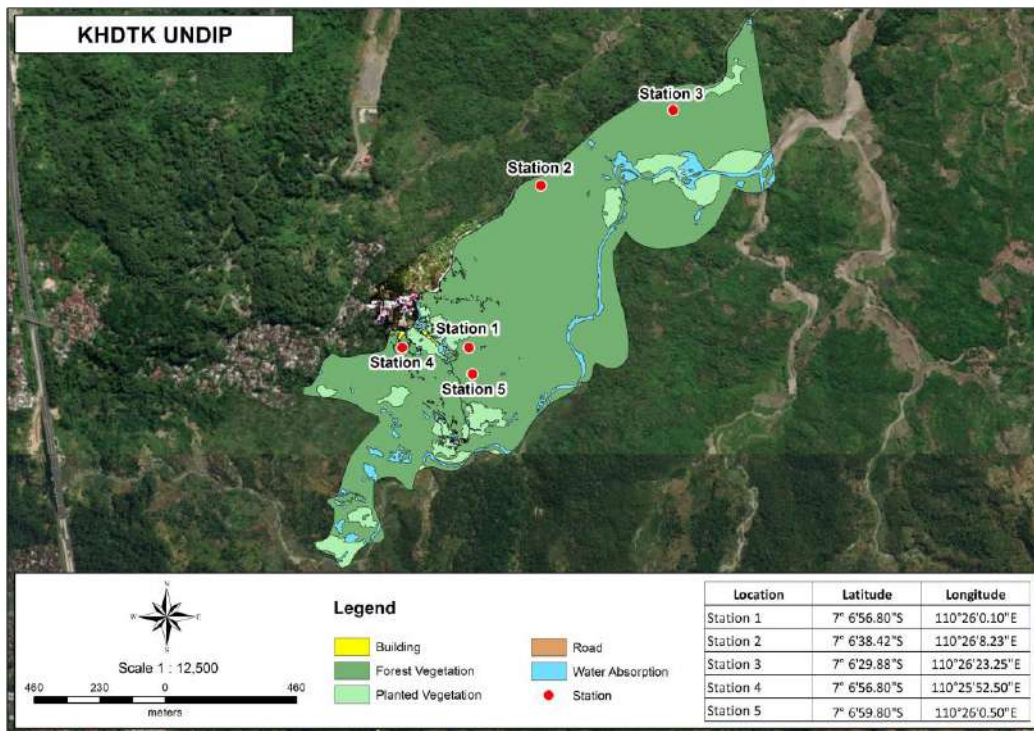
Gambar 15. Titik Pengambilan sampel Kampus PSDKU Batang
Figure 15. Sampling points at PSDKU Batang Campus



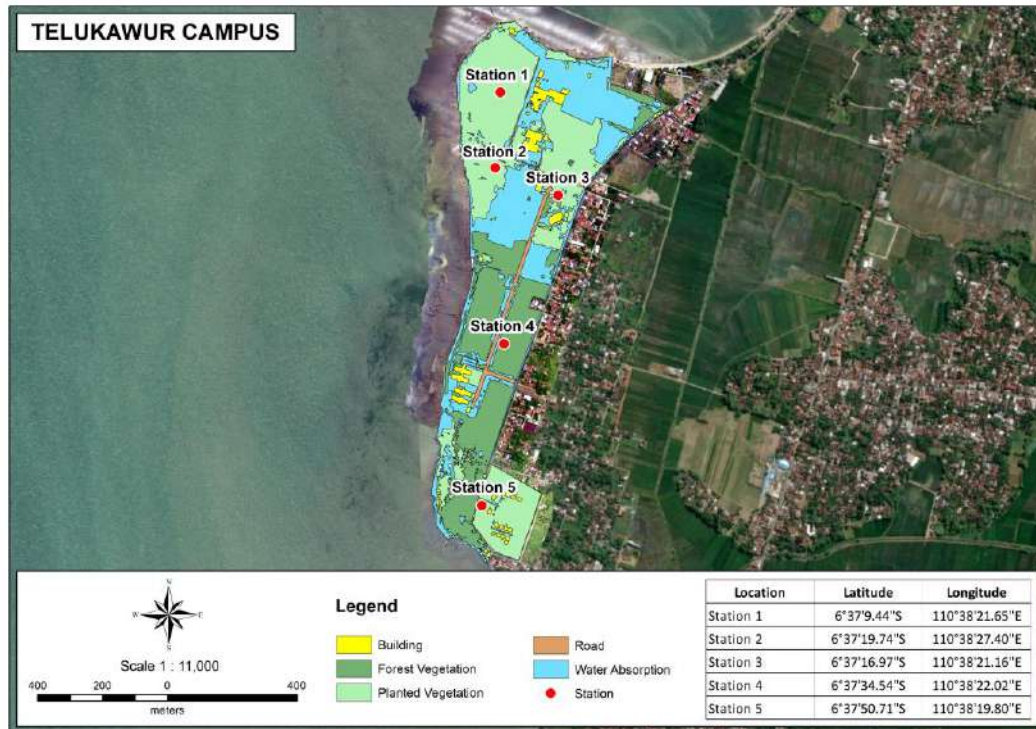
Gambar 16. Titik pengambilan sampel Kampus PSDKU Pekalongan
Figure 16. Sampling points at PSDKU Pekalongan Campus



Gambar 17. Titik Pengambilan sampel Kampus PSDKU Rembang
Figure 17. Sampling points at PSDKU Rembang Campus



Gambar 18. Titik Pengambilan KHDTK UNDIP Penggaron
Figure 18. Sampling points at KHDTK UNDIP Penggaron



Gambar 19. Titik pengambilan sampel Kampus *UNDIP* Telukawur, Jepara
Figure 19. Sampling points at *UNDIP* Telukawur Campus, Jepara

V. CADANGAN KARBON UNDIP

5.1 Carbon Footprint

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 20, penggunaan listrik dan transportasi menghasilkan total emisi sebesar **16.515,05 metrik ton/tahun**. Dari sektor transportasi, kendaraan bermotor menyumbang emisi tertinggi dengan total sebesar 1.325,05 metrik ton per tahun. Hal ini mencerminkan pola mobilitas mahasiswa, yang mayoritas menggunakan sepeda motor sebagai sarana transportasi utama di lingkungan kampus.

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 **16.515,05 metric tons/year**. In the transportation sector, motorcycles account for the highest emissions, with a total of 1,325.05 metric tons. This reflects the mobility pattern of students, who primarily use motorcycles as their main mode of transportation on campus.

Electricity Usage/ Year	Electricity usage/year 24,791,306 kwh	Carbon footprint 15,190.15 metric tons
Carbon Footprint by Transportation/year (Shuttle)	Number of the shuttle bus: 2.00 Total trips: 24 trip/bus/day Travel distance: 4.3 km Working days per year: 240 days/year Coefficient: 0.01 mtons emmision/100km	Carbon footprint 4.95 metric tons
Transportation/year (Car)	Number of car: 3,947 Travel distance: 1 km Working days per year: 240 days/year Coefficient: 0.02 mtons emmision/100km	Carbon footprint 305.05 metric tons
Transportation/year (motorcycle)	Number of motorcycle: 27,397.00 Travel distance: 1 km Working days per year: 240 days/year Coefficient: 0.01 mtons emmision/100km	Carbon footprint 1,015.05 metric tons
Total Emission/year 22,523.62 metric tons	Population 55611 Students	Emmision/Population 0.30 metric tons/individu

Gambar 20. Total Karbon Footprint Universitas Diponegoro

Figure 20. Total Carbon Footprint Universitas Diponegoro

5.2 Cadangan Karbon

Sebagai bagian dari komitmen UNDIP dalam mendukung agenda pembangunan berkelanjutan, khususnya dalam upaya mitigasi perubahan iklim, dilakukan penghitungan dan pemetaan cadangan karbon di seluruh wilayah kampus UNDIP yang tersebar di berbagai Location di Provinsi Jawa Tengah. Fokus utama dari pengukuran ini adalah pada dua komponen utama penyimpanan karbon: above ground biomass (AGB) dan carbon organik tanah (Soil Organic Carbon/SOC). Komponen ini merupakan indikator penting dalam menilai kapasitas ekosistem kampus dalam menyerap emisi karbon dioksida dari atmosfer serta menjaga keseimbangan lingkungan.

Pengukuran ini mencakup seluruh kawasan kampus UNDIP yang berada di: Kampus Tembalang, Semarang; Kampus Pleburan, Semarang; Kampus Teluk Awur Jepara; Kampus Batang; Kampus Pekalongan; Kampus Rembang dan KHDTK Penggaron. Sehubungan dengan perencanaan infrastruktur hijau kota, pengelolaan lahan yang efisien dapat secara signifikan mengurangi jejak karbon institusi akademis dan berkontribusi pada pelestarian beragam penggunaan lahan untuk pembangunan berkelanjutan. Pentingnya pepohonan terletak pada perannya dalam melestarikan keanekaragaman hayati dan meningkatkan inventarisasi karbon dalam institusi.

Komitmen Indonesia dalam pengurangan emisi gas rumah kaca telah tertuang pada UU No. 16/2016. Indonesia mempertegas ambisi untuk mencapai Net Zero Emission pada tahun 2060 atau lebih cepat. Salah satu

5.2 Carbon Stock

As part of UNDIP's commitment to supporting the sustainable development agenda, particularly in efforts to mitigate climate change, carbon stock assessment and mapping have been carried out across all UNDIP campus areas located in various regions of Central Java Province. This assessment focuses on two key components of carbon storage: above ground biomass (AGB) and soil organic carbon (SOC). These components are crucial indicators in evaluating the campus ecosystem's capacity to absorb atmospheric carbon dioxide emissions and maintain environmental balance.

The measurement encompasses all UNDIP campuses located in: Tembalang Campus (Semarang), Pleburan Campus (Semarang), Teluk Awur Campus (Jepara), Batang Campus, Pekalongan Campus, Rembang Campus, and the KHDTK Penggaron. In the context of green infrastructure planning for urban areas, efficient land management can significantly reduce the carbon footprint of academic institutions and contribute to preserving diverse land uses for sustainable development. The importance of trees lies in their role in conserving biodiversity and enhancing institutional carbon inventories.

Indonesia's commitment to reducing greenhouse gas emissions is legally supported by Law No. 16/2016. The country has reinforced its ambition to achieve net-zero emissions by 2060 or sooner. One of the strategies to realize this commitment is the development of the Carbon Economic Value.

cara yang dilakukan Indonesia untuk mencapai komitmen tersebut adalah dengan mengembangkan Nilai Ekonomi Karbon (NEK).

Kementerian Kehutanan dan Lingkungan Hidup menyebutkan bahwa penurunan emisi CO₂ terus menanjak. Pada 2021, penurunan emisi CO₂ mencapai 70 juta ton. Kemudian, pada 2022 (91,5 juta ton) dan pada 2023 ditargetkan bisa mencapai 116 juta ton penurunan emisi CO₂. Lebih lanjut, laporan ini menempatkan peran ruang hijau dalam konteks yang lebih luas dalam kaitannya dengan gerakan menuju kampus universitas berkelanjutan di seluruh dunia.

Above Ground Biomass (AGB) dan Soil Organic Carbon (SOC)

AGB mewakili cadangan karbon yang tersimpan dalam vegetasi hidup seperti pohon, semak, dan tanaman lainnya, sedangkan SOC mencerminkan karbon yang tersimpan dalam lapisan tanah sebagai hasil dari proses alami dekomposisi bahan organik dan aktivitas biologis di dalam tanah. Kedua komponen ini tidak hanya penting dalam konteks mitigasi perubahan iklim, tetapi juga berkontribusi terhadap kesehatan ekosistem, produktivitas lahan, dan ketahanan lingkungan kampus terhadap perubahan iklim.

Nilai cadangan karbon secara keseluruhan sangat dipengaruhi oleh luasan tutupan vegetasi yang ada. Area dengan ruang terbuka hijau yang lebih luas dan vegetasi yang lebih rapat cenderung memiliki kapasitas penyimpanan karbon yang lebih tinggi, baik di atas permukaan tanah maupun di dalam tanah. Oleh karena itu, peningkatan luasan vegetasi tidak hanya memperindah

According to the Ministry of Environment and Forestry, CO₂ emission reductions have continued to rise. In 2021, CO₂ emissions dropped by 70 million tons. In 2022, the reduction reached 91.5 million tons, and in 2023, the target was set to reach 116 million tons. Furthermore, this report positions the role of green spaces within the broader context of the global movement toward sustainable university campuses.

Above Ground Biomass (AGB) and Soil Organic Carbon (SOC)

AGB represents the carbon stock stored in living vegetation such as trees, shrubs, and other plants, while SOC reflects the carbon stored in the soil layer as a result of the natural decomposition of organic matter and biological activity within the soil. These two components are not only important in the context of climate change mitigation but also contribute to ecosystem health, land productivity, and the campus's environmental resilience to climate change.

The overall value of carbon stock is strongly influenced by the extent of existing vegetation cover. Areas with larger green open spaces and denser vegetation tend to have a higher carbon storage capacity, both above ground and within the soil. Therefore, expanding vegetation cover not only enhances the visual and ecological functions of the campus environment but also plays a strategic role in institutional climate action. The overall value of carbon reserves is greatly influenced by the extent of existing vegetation cover. Areas with larger green open spaces and denser vegetation tend to have higher carbon storage capacity, both above and below ground. Therefore, increasing vegetation cover not only enhances the aesthetic and ecological

dan memperkaya fungsi ekologi kawasan kampus, tetapi juga memainkan peran strategis dalam aksi iklim institusional.

functions of the campus area but also plays a strategic role in institutional climate action.

Tabel 2. Cadangan Karbon AGB dan SOC Universitas Diponegoro

Table 2. AGB and SOC carbon stock of Universitas Diponegoro

Location Campus Campus Location	Total Area Vegetasi Total Vegetation Area (square meter)	Karbon Biomassa Atas Aboveground Biomass Carbon (metric ton)	Karbon Organik Tanah Soil Organic Carbon Stock (metric tons)
Tembalang	1,740,858	14,634.3	1,029,777.20
Pleburan	36,162	888.7	20,403.98
Pekalongan	45,555	38.6	25,723.21
Batang	86,376	18.1	67,446.03
KHDTK Penggaron	915,400	4,213.4	315,062.77
Teluk Awur Jepara	316,062	2,479.7	192,560.77
Rembang	62,119	33.8	16,824.937
Total		22,306.4	1,667,798.97

Data tersebut menunjukkan kontribusi masing-masing Location kampus terhadap penyimpanan karbon sebagai bagian dari upaya mitigasi perubahan iklim berbasis institusi pendidikan. Secara keseluruhan, total cadangan karbon biomassa atas (AGB) yang tersimpan di seluruh kawasan kampus UNDIP mencapai **22.306,4 metrik ton**, sedangkan cadangan karbon organik tanah (SOC) mencapai angka yang jauh lebih besar yaitu **1.667.798,97 metrik ton**.

Perbedaan ini menegaskan bahwa tanah merupakan penyimpan karbon yang sangat penting dalam ekosistem kampus. Kampus Tembalang menunjukkan kontribusi paling signifikan dalam penyimpanan karbon, baik dari AGB maupun SOC. Hal ini mencerminkan pentingnya keberadaan ruang terbuka hijau yang luas dan vegetasi yang beragam di kampus utama UNDIP. Area ini bukan hanya pusat akademik, melainkan juga ruang ekologis yang memiliki

*The data shows that contribution of each campus location to carbon storage as part of climate change mitigation efforts based on educational institutions. Overall, the total upper biomass carbon stock (AGB) stored in the entire UNDIP campus area reached **22,306.4 metric tons**, while the soil organic carbon stock (SOC) reached a much greater figure of **1,667,798.97 metric tons**.*

This difference confirms that soil is a very important carbon store in the campus ecosystem. Tembalang campus showed the most significant contribution in carbon storage, both from AGB and SOC. This reflects the importance of large green open spaces and diverse vegetation on UNDIP's main campus. This area is not only an academic center, but also an ecological space that has an important role in mitigating carbon emissions. The location with the lowest total stored carbon is Batang Campus. This value underscores the challenges in

peran penting dalam mitigasi emisi karbon. Location dengan total karbon tersimpan paling rendah adalah Kampus Batang. Nilai tersebut menggarisbawahi tantangan dalam pengelolaan ruang terbuka hijau di lingkungan kampus yang berada di tengah kota atau lahan terbatas.

Total karbon biomassa atas tahun 2023 adalah sebesar 19.059 Metrik ton. Hal ini menunjukkan peningkatan cadangan karbon dari tahun 2023 ke 2024 yaitu sebesar 3.247 atau sekitar 17,04%. Peningkatan cadangan karbon tersebut menunjukkan adanya kemajuan positif dalam upaya pelestarian lingkungan dan penyerapan. Hal ini bisa disebabkan oleh beberapa faktor seperti peningkatan tutupan vegetasi yang terjadi di lingkungan Universitas Diponegoro dan keberhasilan dalam pengelolaan lahan secara berkelanjutan. Penguatan vegetasi kampus melalui penanaman kembali pohon, konservasi tanah, dan perencanaan ruang hijau yang adaptif terhadap iklim merupakan langkah konkret yang dapat dilakukan.

managing green open space in a campus environment that is in the middle of the city or limited land.

The total aboveground biomass carbon in 2023 is 19,059 Metric tons. This shows an increase in carbon stocks from 2023 to 2024 by 3,247 or about 17.04%. The increase in carbon stocks shows positive progress in environmental conservation efforts and carbon sequestration. This can be caused by several factors such as the increase in vegetation cover that occurs in Universitas Diponegoro and the success in sustainable land management. Strengthening campus vegetation through tree replanting, soil conservation, and climate-adaptive green space planning are concrete steps that can be taken.

VI. PENUTUP

6.1 Kesimpulan

Jejak karbon di sektor perguruan tinggi berasal dari berbagai aktivitas akademik, administratif, dan operasional yang berlangsung secara rutin dan masif. Sebagai pusat pendidikan, penelitian, dan inovasi, kampus memiliki tanggung jawab moral sekaligus peluang strategis untuk menjadi pelopor dalam aksi mitigasi perubahan iklim dan penerapan prinsip-prinsip keberlanjutan. Universitas Diponegoro (UNDIP), melalui pemanfaatan dan pelestarian ruang terbuka hijau serta sistem pengelolaan lahan yang berkelanjutan, menunjukkan potensi signifikan dalam menyimpan karbon. Total cadangan karbon biomassa atas (Above Ground Biomass/AGB) yang tersimpan di seluruh kawasan kampus mencapai 22.306,4 metrik ton per tahun, sementara cadangan karbon organik tanah (Soil Organic Carbon/SOC) jauh lebih besar, yakni mencapai 1.667.798,97 metrik ton per tahun. Angka-angka ini tidak hanya mencerminkan kontribusi ekologis kampus terhadap pengurangan emisi karbon, tetapi juga menegaskan pentingnya integrasi antara perencanaan tata ruang kampus dan strategi aksi iklim institusional. Dengan demikian, UNDIP dapat menjadi contoh konkret dalam membangun kampus hijau yang tangguh terhadap perubahan iklim.

6.2 Rekomendasi

Efisiensi *carbon footprint* bisa dilakukan penghematan sebagai berikut:

- Melakukan audit energi dan jejak karbon untuk mengidentifikasi efisiensi.

VI. CONCLUSION

6.1 Conclusion

The carbon footprint in the higher education sector originates from a wide range of academic, administrative, and operational activities that occur routinely and at scale. As centers of education, research, and innovation, universities carry both a moral responsibility and a strategic opportunity to become pioneers in climate change mitigation and the implementation of sustainability principles. Universitas Diponegoro (UNDIP), through the utilization and preservation of green open spaces and sustainable land management practices, demonstrates significant potential in carbon storage. The total Above Ground Biomass (AGB) carbon stock stored across the campus area reaches 22,306.4 metric tons per year, while the Soil Organic Carbon (SOC) stock is considerably higher, amounting to 1,667,798.97 metric tons per year. These figures not only reflect the university's ecological contribution to carbon emission reduction but also highlight the importance of integrating campus spatial planning with institutional climate action strategies. In this way, UNDIP can serve as a concrete example of building a green campus that is resilient to climate change.

6.2 Recommendations

Carbon footprint efficiency savings can be made as follows:

- *Conduct energy and carbon footprint audits to identify efficiencies.*
- *Switch to sustainable raw materials and green production processes.*
- *Adopt circular economy principles to reduce waste.*

- Beralih ke bahan baku berkelanjutan dan proses produksi hijau.
- Mengadopsi prinsip ekonomi sirkular untuk mengurangi limbah.
- Meningkatkan ruang hijau dan hutan sebagai penyerap karbon.
- Mendorong desain bangunan ramah lingkungan dan hemat energi.
- Mengembangkan sistem transportasi publik berbasis listrik
- *Increase green spaces and forests as carbon sinks.*
- *Encourage eco-friendly and energy-efficient building designs.*
- *Develop an electricity-based public transportation system*

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