BOOK OF PROCEEDINGS

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13th - 14th October 2023

ISSUES OF HOUSING, PLANNING, AND RESILIENT DEVELOPMENT OF THE TERRITORY
Towards Euro-Mediterranean Perspectives

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Issues of Housing, Planning, and Resilient Development of the Territory Towards Euro-Mediterranean Perspectives

Conference Theme and Rationale

Albania, along with other Western Balkan countries, has undergone significant economic, social, and political changes in recent years. As a result, housing, planning, and the resilient management of territorial development have emerged as critical issues. This is because these regions face significant challenges in providing affordable housing, addressing the impact of urbanization on the environment, fostering evidence-based decision-making on the territory, and bringing forth the commitments towards climate neutrality.

The organizers use the term "multi-modality" to define complex situations (in matters of territorial planning, management, architecture, housing, public space, technology, etc.) that have historically encompassed Western Balkans and Mediterranean cities in a logic of coexistence and value co-creation. A combination of knowledge and heritage that throughout time and history have given life to civilization in this region of Europe. The active involvement of Albania in the existing network of the Mediterranean Basin and the EU, through a joint action plan with UN / UNECE, and the Albanian and regional authorities, including reputable scientific bodies such as the Academy of Sciences of Albania, makes this conference even more intriguing to explore fascinating areas of research. The conclusions, to be considered as a stage for open innovation, will include recommendations for further scientific and applied research, projects, and events.

The geographical focus of the conference covers three dimensions: i) Albania; ii) the Western Balkans; iii) Euro-Mediterranean countries. POLIS University aims to focus on the above-mentioned research areas that are of common interest to both Western Balkans and Mediterranean cities, including, but not limited to: housing policies, urban history and architecture typology, innovation and digitalization in urbanism, energy efficiency, resilience and environmental sustainability, governance and smart technologies for city management, education and gender aspects in urban planning research.

In this regard the main aim of this international conference is to bring together scholars, policymakers, and practitioners to examine the pressing issues of housing, planning, and land development in these regions, in a context of transition fatigue, climate challenges and post-pandemic realities.

Issues of Housing, Planning, and Resilient Development of the Territory Towards Euro-Mediterranean Perspectives

Conference Aim

The main aim of this international conference is to bring together researchers, policy makers and practitioners to examine the urgent issues of housing, planning and land development in these regions, in a context of transition, climate challenges and post-pandemic realities.

Objective

-Consolidation of the cooperation network between Albanian and non-Albanian researchers, lecturers, managers, with the aim of participating in joint research projects at the regional and international level;
-Support of local authorities with contemporary data, on the state of housing issues, planning and sustainable urban and environmental management, as well as representatives of public and private institutions operating in this field.

The conference is organized by POLIS University (U_POLIS) in cooperation with the Academy of Science of Albania, and supported by other local and international partners.
In the framework of resilience, the main conference theme is devoted to Issues of Housing, Planning, and Resilient Development of the Territory from a Euro-Mediterranean Perspective, including Albania, Western Balkans and the Mediterranean Basin. This event aims to bring together academics, policymakers, researchers, experts, practitioners, and stakeholders from diverse backgrounds to discuss and address critical challenges related to housing, urban planning, and the development of resilient territories.

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Evaluating Ecosystem Services Through Cross-cutting Methods Case Study: Kune-Vain Lagoon, Assessment of Carbon Storage and Sequestration Ecosystem Service

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Abstract

The wetland ecosystems are home to multiple species of flora and fauna and provide a myriad of ecosystem services from which people directly and indirectly benefit. By nature, ecosystem services are intrinsic characteristics of such areas and only recently their values have been recognized as beneficial, for local communities in particular. Despite such benefits, those areas are often threatened by new development and land-use practices, favouring quick economic growth, especially true in developing countries like Albania. Yet another threat to such ecosystems is climate change, further underlining the imminent need to protect them. Such a task is difficult to perform when the awareness level of the community for these topics is low and the scarcity of data is evident.

This paper explores how to tackle those two challenges, low community awareness and data scarcity, by intertwining different methods with the specific aim of evaluating ecosystem services. To better illustrate the process of data generating and the methods used, this paper will focus only on one ecosystem service, which is carbon storage and sequestration. Through it, we will analyse the different methods available for generating such data and ultimately give a specific value to this ecosystem service, to make it comparable with other economic activities. The methods that will be analysed vary from the use of available open data sources to field measurements. This research was conducted in the frame of the WBC-RRI.net Horizon 2020 Project.

Keywords
Ecosystem services, carbon storage and sequestration, data scarcity, citizen science

Introduction
Habitats such as wetlands or lagoons offer a bundle of ecosystem services from which people directly or indirectly benefit. In general, ecosystem services are described as ecological structures and functions that contribute to human well-being (The National Wildlife Federation, 2023). As a result, those services are frequently categorized as supporting, providing, regulating, and cultural services. The advantage offered by ecosystem processes that control natural phenomena is referred to as a regulatory service (The National Wildlife Federation, 2023). Pollination, decomposition, water purification, erosion and flood management, carbon sequestration and storage, and climate regulation are all examples of regulating services (The National Wildlife Federation, 2023). In this paper, we will focus on the regulatory service of carbon storage and sequestration, through which we will analyze the different methods to assess it.
The protected area under study was formerly divided among three lagoons: Tale, Vain, and Kune. The protected status of Tale Lagoon was removed as a result of permanent anthropological changes, such as modifications to land use and development plans. With a current extent of about 4,393 acres, the protected area in question is known as Kune-Vain Lagoon (Ministry of Tourism and Environment, 2020). Broadleaf and mixed woods, with about 330 plant species (Mullaj, Bici, & Sanxhaku, 2022), make up the lagoon's biodiversity, which also includes Mediterranean woodlands and Illyrian deciduous forests.
In the Kune-Vain Lagoon, the service of carbon storage and sequestration is provided by three main components which are:
- The forest is comprised mostly of pine trees of different species (Pinus halapensis, Aleppo pine, etc.) and in some areas we find mixed forests. The forest area covers roughly 0.7 ha of the lagoon.
- The aquatic vegetation or the marshland, is characterized by low vegetation and it covers an area of roughly 446 ha.
- The soil is the last component and is the one that stores the largest amount of carbon. Wetlands are substantial reservoirs of carbon, which despite occupying only 5-8% of the Earth's land surface, hold between 20 to 30% of all estimated organic soil carbon, according to research (Neufeld, 2022).

Tools and Methodology
To map and assess carbon sequestration for Kune-Vain Lagoon was quite challenging and it required a number of alternative methods to cover each component that needed to be addressed for this specific ecosystem service.
At first, it was important to assess if the Kune-Vain Lagoon had sustained any drastic changes through the years. To cover this component a number of methods were deployed. Firstly, old forestry maps from 1985, provided by the Regional Agency of Protected Areas, were digitalized and analyzed. Secondly, available ortho imagery and old military maps, from official sources (State Authority for Geospatial Information ASIG, 2023), were also analyzed. To perform a complete timelapse of the lagoon, from 1940 (the year it gained its status as a protected area) until today (2023), available satellite images from the Google Earth platform were also taken under consideration. Lastly, a drone survey was performed in the main forest areas creating an updated ortho imagery of those areas. This way we could better grasp the situation about the forest area inside the lagoon.
Assessing the carbon stored in the soil component is a quite difficult task. Normally, it is advised to collect random soil samples inside the perimeter of the lagoon and analyze them in a lab to assess the amount of CO_2 it can store. However, this process is time-consuming and has a rela-

tively high cost. In this context, other methods were used to assess this component. There are a number of available databases for the classification of soil. After some research ARIES platform (Ecoinformatics Collaboratory, University of Vermont, 2012) was selected to perform this task since it intersects the available databases of soil with the evaluation of ecosystem services through an AI system. Of course, it has its limitations. ARIES is a platform that is still in its beta phase, it uses worldwide open-source datasets which are not extremely accurate for small areas, and does not perform well in coastal areas. Despite those limitations, it proved to be the most accurate platform for the task at hand, giving a rough estimation of the amount of carbon stored from the soil component of the Kune-Vain Lagoon. Specifically, ARIES calculates the carbon stored in the first 200 cm of soil, using the information in a global database under the International Soil Reference and Information Centre (ISRIC). SoilGrids (ISRIC — World Soil Information, 2023) is a system for automated soil mapping based on state-of-the-art spatial prediction methods. It serves as a collection of updatable soil property and class maps of the world at 1 km / 250 m spatial resolutions produced using automated soil mapping based on machine learning algorithms. The generated map for soil storage created through the ARIES platforms is made of pixels containing the necessary information to make a rough estimation of this component in the study area.

For the other two components, high vegetation (forest area) and low vegetation (aquatic plants), the instructions provided by TESSA were followed. The Toolkit for Ecosystem Service Site-Based Assessment (TESSA) was designed for those without substantial technical expertise or financial resources, to provide practical guidance on how to assess and monitor site scale flows of ecosystem services and some of the stocks of underlying natural capital (Peh, et al., 2022). The instructions provided by this toolkit were used essentially to create a database for the specific site of the Kune-Vain Lagoon. Then this dataset was intersected with other methods or open-source databases to assess the amount of carbon sequestrated and stored by those two components.

For building the database for the forest component, a citizen science approach was implemented. The preliminary work required creating a grid of 5x100 meters rectangles (500 m2) on 5 pine forest parcels (2 in Vain Lagoon and 3 in Kune Lagoon) and for each parcel were selected 5 rectangles at random to perform the field measurements. Then, for the field measurements, groups of 2-3 people were formed by Co-PLAN experts, students from Polis University and volunteers from RAPA. Thus, the volunteers that participated helped to build the dataset and, in the process, learned what is needed to create it, helpful for similar endeavours in the future. The final product of this endeavour is an Excel sheet with the number of trees, the code of the parcel and sample, the type of tree, the Latin name of the tree, the perimeter in centimetres, the diameter in centimetres, the age of the tree, the height of the tree and actual conditions of the tree.

To assess the amount of sequestrated carbon for each sample, two proven methods were used to ensure accuracy:

- First method - the accumulated data was inserted in a global database of trees called i-Tree Eco (USDA Forest Service, 2006) which determines the amount of sequestrated carbon by each type of tree, necessary to assess the amount of sequestrated carbon by the pine forest inside the perimeter of the lagoon.
- Second method - each calculation was performed manually, following the instructions of the paper ‘Calculating tree carbon’ (Trees for the Future, 2020), written by Trees for the Future, whose research and methodology are based on research papers, university publications, and other information freely available on the Internet. The process consists of: a) Determine the total (green) weight of the tree; b) Determine the dry weight of the tree; c) Determine the weight of carbon in the tree; d) Determine the weight of carbon dioxide sequestrated in the tree; and e) Determine the

weight of CO_2 sequestrated in the tree per year.
The two methods gave slightly different final results, the differences being on average 3.4 tons for the storage component and 0.2 tons for the sequestration component per sample. Hence, an average of the two results was used to assess the amount of sequestrated carbon from the pine forest in the lagoon.
In the case of the aquatic vegetation, the TESSA methods (Peh, et al., 2022) instructed to take random samples from a grid of 1 meter square. At this point, 10 random samples were collected and brought to a lab to be analyzed. The samples were fragmented into three parts, namely dead material, stems and green leaves. Before fragmenting the sample, the total fresh weight of all clippings from each plot was measured. Sub-samples, weighing no less than 100g, were selected to be dried in the oven at 105oC to obtain constant dry weight. After applying the necessary conversion factors and performing the calculations, the above-ground biomass carbon stock is obtained.
The final step is to evaluate the ecosystem service of carbon storage and sequestration provided by the lagoon. Since we have the amount of carbon stored and sequestrated, the question is how much is it worth in the market. Carbon, like other goods, has a different price in different markets. For the purpose of this study, the Action Clearing Price of CO_2 in Euro/t of The European Energy Exchange (EEX) was used. The EEX is the leading energy exchange that builds secure, successful and sustainable commodity markets worldwide, including environmental markets like the emissions market (The European Energy Exchange (EEX), 2023). According to EEX the price of carbon on 19 December 2022 was 84.1 Euro/t.

Main Findings

Changes in the Kune-Vain Vegetation 1940 – 2022
To see how the protected area had changed through the years, a catalogue of topographic maps, satellite images and orthophotos of the Kune-Vain Lagoon was collected and a drone survey of the main forest areas was performed. The main changes evidenced by this procedure are as follows:
-In 1944 the Kune-Vain-Tale Lagoon was at its natural peak.
The first pressures on the lagoon came from intensified agricultural activity through the years -1959 – 1985 when Tale Lagoon lost most of its natural properties and the Kune-Vain Lagoon gained a well-defined and rigid border.
As a support to the agricultural activities, a network of drainage and irrigation canals was built which connected the agricultural land with the lagoon.
-An infrastructure of embarkments was also created to better mitigate flood events.
-Second pressure came from new development for touristic purposes through the years 2000 – 2022, which are more evident in the Kune Lagoon.
-Natural pressures regard mostly the periodical changes in the coastal line of the lagoon, the location of the communication canals between the lagoon and the sea and climate change effects (which is a global trend, worsened due to human activities).
-On the other hand, the vegetation component of the lagoon, including forests and water vegetation, has undergone vary few changes through the years, making the Kune-Vain Lagoon one of the most preserved coastal protected areas in the country.
It was not possible to make an accurate estimation of the changes in vegetation inside the Kune-Vain Lagoon by using a geographic information system (GIS) based program, given the constant natural changes in the coastline of the lagoon. Also, the format of the collected aerial images and their resolution were not always the same, hindering the task.
Below are some examples of the ortho imagery generated through the drone survey. 12 areas

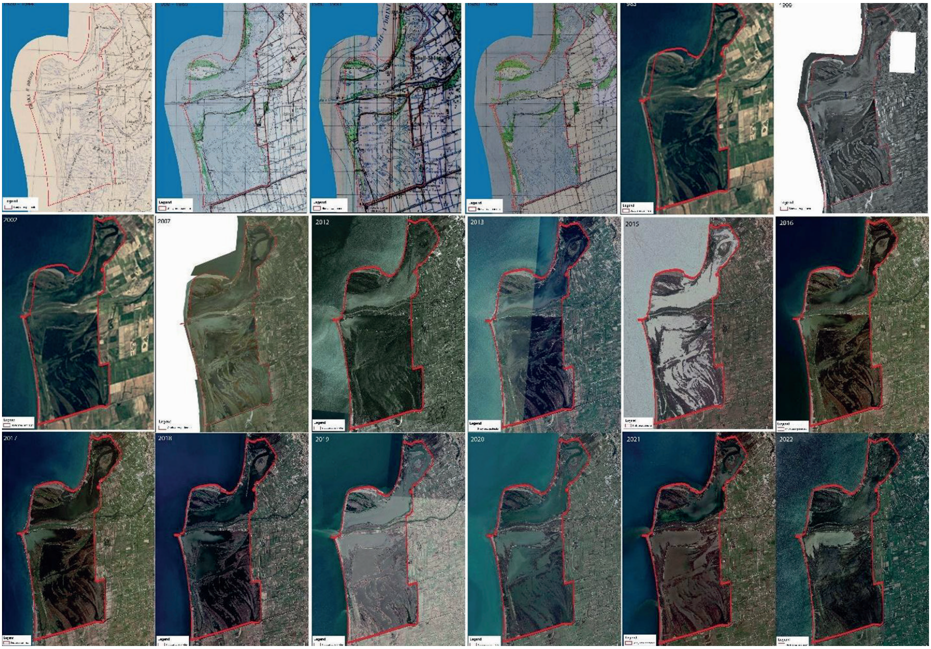

Figure 1: The catalogue of historical maps and images of the Kune-Vain Lagoon from 1944 – 2022, (18 in total) / Source: ASIG Geoportal (State Authority for Geospatial Information ASIG, 2023), Satelite imagery from Google Earth (Google, 2023); Author's processing

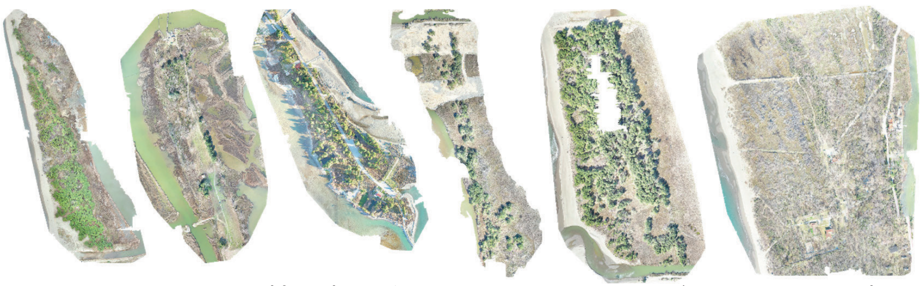

Figure 2: Orto Image generated from drone MAVIC 2 Pro, Kune - Vain Lagoon / Source: Co-PLAN archive

were mapped through this method in total, using a MAVIC 2 Pro drone type. The process had its difficulties (like battery span, memory issues, weather obstacles, etc.) and it was quite time-consuming, but it enables updated photography of the current situation in usually inaccessible areas.

The amount of carbon stored in the soil component

As mentioned before, to estimate this component the ARIES platform was chosen. ARIES uses a system called SoilGrids to determine how much carbon is stored in the top 200 cm of soil for the soil component. It is an automated soil mapping system built on cutting-edge spatial prediction techniques. Predictions from SoilGrids are based on models that have been globally fitted using data from soil profiles and environmental covariates. At the moment, SoilGrids.org provides a collection of spatial resolution maps of 1 km / 250 m for soil property and class of the world that are currently updateable. These maps were created utilizing automated soil mapping techniques based on machine learning algorithms. Under the terms of the Open DataBase License, SoilGrids data is accessible to everyone (Ecoinformatics Collaboratory, University of Vermont, 2012).

The data shown below was extrapolated from the map of carbon storage, generated by the ARIES Platform. The map is made of cells with an approximate size of 15x20 meters (300 m2), containing information about the overall stored carbon in that specific area. ARIES automatically divides the cells in intervals, as shown in the table below. The selected area has a total of 197,239 cells with information, which is equivalent to 5,917.2 ha of land. Each section of cells, that belongs to a specific interval, was converted into surface and then multiplied with the average amount of stored carbon, specific to the interval. The final step is to convert the stored carbon into monetary value, which was done by using the Auction Clearing Price of CO2 of the European Energy Exchange platform (The European Energy Exchange (EEX), 2023), which was 84.1 Euro/t CO2 on 19 December 2022.
Example from the first interval 308 – 528.4 t/ha:
Area in ha = (No. of Cells x 300 m2) x 0.0001 ha = 137,266 * 300 m2 * 0.0001 ha = 4,118 ha
Stored Carbon in Vegetation and Soil = Area in ha x Average t/ha = 4,118 ha * 409.55 t/ha = 1,686,518.7 ton/year
Auction Clearing Price = Stored Carbon in Vegetation and Soil x 84.1 Euro/t CO2 = 1,686,518.7

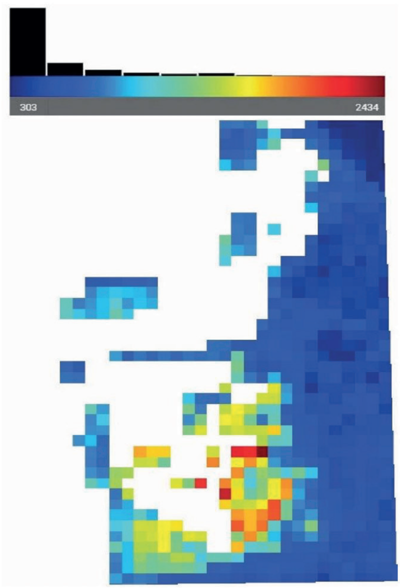

Figure 3: The amount of carbon stored in the first 200 cm of soil. Data in t/ha. ARIES Platform, 2023 / Source: ARIES Platform (Ecoinformatics Collaboratory, University of Vermont, 2012)

Interval in t/ha	Average t/ha	No. of Cells	Area in m2	Area in ha	Stored Carbon in Soil, ton/year	Auction Clearing Price €/year CO2
303 - 516.1	409.55	137,266	41,179,800	4,118.0	1,686,518.71	141,836,223.43
516.1 - 729.2	622.65	26,198	7,859,400	785.9	489,365.54	41,155,642.00
729.2 - 942.3	835.75	13,654	4,096,200	409.6	342,339.92	28,790,786.85
942.3 - 1155.4	1,048.85	6,390	1,917,000	191.7	201,064.55	16,909,528.23
1155.4 - 1368.5	1,261.95	4,446	1,333,800	133.4	168,318.89	14,155,618.73
1368.5 - 1581.6	1,475.05	5,767	1,730,100	173.0	255,198.40	21,462,185.48
1581.6 - 1794.7	1,688.15	2,438	731,400	73.1	123,471.29	10,383,935.57
1794.7 - 2007.8	1,901.25	673	201,900	20.2	38,386.24	3,228,282.57
2007.8 - 2220.9	2,114.35	264	79,200	7.9	16,745.65	1,408,309.33
2220.9 - 2434	2,327.45	144	43,200	4.3	10,054.58	845,590.51
Total		197,240	59,172,000	5,917.2	3,331,464	280,176,102.72
*Cell size is approximately 15x20 meters						
*EEX Auction Clearing Price on 19 December 2022 was 84.1 Euro						

Table 1: The amount of CO2 stored in the soil component / Source: Data extracted by ARIES Platform (Ecoinformatics Collaboratory, University of Vermont, 2012) and processed by author

ton/year * 84.1 Euro/t CO2 = 141,836,223.43 Euro/year

In the case of stored carbon in the soil, in 5,917.2 ha of area is stored 3,331,464 tons of carbon annually, which has an approximate value of 280,176,102.72 Euro annually. This can be translated into 47,349.4 Euro per hectare. Since the lagoon has a surface of 4,393 ha, the ecosystem service value performed by the component of soil in the lagoon is approximately 208,005,914.2 Euros per year.

The amount of carbon stored and sequestrated by the forest

The forest area inside the Kune-Vain Lagoon is approximately 41.2 ha and is mostly made up of pine trees. As mentioned before, to calculate the amount of carbon sequestrated and stored by the forest were used two methods, which gave slightly different results:

-Cross-cutting the created database from field measurements with the database of i-Tree Eco (USDA Forest Service, 2006).

-Manually calculating the stored and sequestrated carbon by following the instructions of the paper 'Calculating tree carbon' (Trees for the Future, 2020).

The average of both methods, as indicated in the table below, was used to evaluate this ecosystem service in order to ensure accuracy. The pine forest around the lagoon stores 6,299.9 tons of CO2 yearly on average, and it also sequesters 454.9 tons of CO2, for a combined value of roughly 529,817.8 euros per year for carbon storage and 38,258.9 euros per year for carbon sequestration.

Data		Ecosystem service	
		Carbon storage (t/year)	Carbon sequestration (t/year)
Kune Lagoon	Kune 9	3.33	0.30
	Kune 12	7.99	0.49
	Kune 14-1	4.87	0.35
	Kune 14-2	8.53	0.60
Vain Lagoon	Vain 2-1	2.78	0.27
	Vain 2-2	8.66	0.72
	Vain 2-4	2.49	0.37
	Vain 2-5	2.15	0.23
	Vain 2-6	2.94	0.23
	Vain 4-1	4.84	0.22
	Vain 4-2	7.99	0.92
	Vain 4-3	9.18	0.58
	Vain 4-4	3.85	0.39
	Vain 4-5	13.67	0.60
Average from the samples		5.95	0.45
Total from the samples		83.28	6.26
Area covert from the samples (ha)		0.7	
The total area of pine forest in the lagoon (ha)		41.2	
Total carbon storage and sequestration by pine forest (t/year)		4,901.78	368.36

Table 2: Summary of the findings from the first method using the i-Tree Eco program / Source: Data extracted by i-Tree (USDA Forest Service, 2006) and processed by author

The amount of carbon stored by the aquatic vegetation

Being a marshland, the lagoon's water vegetation is primarily made up of herbaceous plants and occupies a space of about 452.6 acres. A grid of squares with a size of 10x10 meters was created using a GIS application, and 10 random samples with an area of 1x1 meters each were taken to evaluate the ecosystem service of carbon storage. After collecting the samples in the field, they were weighed and divided into three main parts, leaves, stems and dry parts, following the instructions of TESSA (Peh, et al., 2022).

Following this stage, 100-gram sub-samples were randomly chosen from the total quantity of frag-

Data		Ecosystem service	
		Carbon storage (t/year)	Carbon sequestration (t/year)
Kune Lagoon	Kune 9	4.08	0.29
	Kune 12	17.43	1.23
	Kune 14-1	6.88	0.48
	Kune 14-2	11.59	0.82
Vain Lagoon	Vain 2-1	4.01	0.27
	Vain 2-2	12.49	0.88
	Vain 2-4	3.52	0.25
	Vain 2-5	4.10	0.29
	Vain 2-6	6.65	0.47
	Vain 4-1	6.12	0.42
	Vain 4-2	20.32	1.43
	Vain 4-3	13.58	0.96
	Vain 4-4	4.07	0.29
	Vain 4-5	15.95	1.12
Average		9.34	0.66
Total		130.79	9.20
Area covert (ha)		0.7	
The total area of pine forest in the lagoon (ha)		41.2	
Total carbon storage and sequestration by pine forest (t/year)		7,697.93	541.49

Table 3: Summary of the findings from the second method using the instructions from the paper 'Calculating tree carbon' (Trees for the Future, 2020) / Source: Author's processing

mented pieces (dead material, stems, and green leaves). The sub-samples were chosen, and then they were dried for 48 hours at 105°C in an autoclave (thermostat) to maintain a constant dry weight. We developed conversion factors for each sample component from this sub-sample phase (dry weight of sample / wet weight of sample = conversion factor). It is important to determine the mean dry mass of all the sampling plots and divide this result by 100 to express it in dry mass per hectare, after applying the conversion factors to each sample. The carbon stock from above-ground biomass is then estimated to be 47% of the total dry mass.

The entire carbon stock of the marshland cover in the Kune-Vain Lagoon is estimated to be 4,222.96 tons, as can be seen in the summary table. As was done for the forest component, the value of the ecosystem service given by the water vegetation in the lagoon is 355,150.94 Euros, or 80.8 Euros/ha, using the EEX Auction Clearing Price EUR/t $CO2$ of 84.1 Euros/t.

Ecosystem Service	1 Method (t/year)	2 Method (t/year)	Average (t/year)	Value of the ecosystem service (Euro/year)
Carbon Storage	4,901.78	7,697.93	6,299.85	529,817.75
Carbon Sequestration	368.36	541.49	454.92	38,258.93
*Sample size is 0.7 ha				
*Pine forest area in the lagoon is 41.2 ha				
*EEX Auction Clearing Price €/t CO2 is 84.1 Euro/t				

Table 4: The value of Carbon Storage and Carbon Sequestration by the forest in the Kune-Vain Lagoon / Source: Author's processing

Dry weight of tons/ha	Vain (ha)	Total Carbon Waste (tons)	Kune (ha)	Total Carbon Kune (tons)	Total Carbon Lagoon (tons)
9.47	326	3,086.74	120	1,136.22	4,222.96

Table 5: Final results for the marshlands carbon storage in the Kune-Vain Lagoon

Conclusions and Recommendations

From the findings, we can conclude that the lagoon stores approximately 2,483,781.81 tons of CO2 per year, a service that can be valued at approximately 208,890,882.94 EUR per year . This proves what we already know and often take for granted, that ecosystems such as wetlands provide invaluable services from which we benefit.

Evaluating the carbon storage and sequestration ecosystem service provided by the Kune-Vain Lagoon required a lot of research on the available methods, manpower for conducting field measurements, time to generate a reliable dataset for the vegetation component, and skill to operate different programs. The absence of periodical data, given the fact that it is a protected area, added to the difficulty of the task. Given their value, the well-being of such ecosystems should be monitored periodically by the responsible agencies. At least for protected areas, there should be a database with the number of trees in the area, all species of vegetation, the area they occupy, their age and their conditions periodically to conduct proper research on the ecosystem services provided by them.

The engagement of different actors in the process proved beneficial for all parties. The local experts provided significant input on the local vegetation, local fauna and the accessibility of specific areas. The field measurements phase proved to be a useful arena for mutual learning for the involved participants, especially for students. It offered an interactive way of teaching about the benefits of the ecosystem and at the same time provided the necessary dataset for the research.

However, the methods illustrated in this paper are not the only ones that exist and are not infallible. The margin of error exists and varies from accuracy to the human factor. Having said that, endeavours such as this help to better visualise and grasp the vastity of the service that such ecosystems provide, from a monetary perspective.

Figure 4: Map of water vegetation in the Kune-Vain Lagoon / Source: Author's processing

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