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Social Dimensions of Projected Climate Change Impacts on Ecosystem Services in the Coastal-Rural Area of Nemunas River Reaches and Curonian Lagoon (Lithuania)

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Abstract: The capacity of ecosystems to provide ecosystem services (hereinafter referred to as ES) depends on the state of their structure, processes, and functions, which is determined by interactions with other systems. These interactions are complex and take place in different climatic areas, and have different impacts on ecosystems and the use of ES. As the most sensitive part of the Lithuanian shore zone to climate change is the seaside zone or the coastal zone, which includes the Curonian Lagoon and the sea coast, the said area was therefore chosen for research. The case study examined those ES that were specific to the study area, without attempting to account for absolutely all ES. With an emphasis on the representation of different perspectives (in the process of assessing and preserving the potential of ES), the empirical study involved representatives of different (public and private) sectors. The public sector was represented by elders and eldership employees, the private sector by farmers and businesspeople. Respondents were selected purposefully to reflect the entire existing totality of the existing area. The evaluation of the obtained theoretical and practical results of the research identified the potential of the existing area ecosystem services and perspectives for the implementation of services by assessing their use according to respondents' opinions, regional climate change, and national scale in EU environmental policy.

Keywords: coastal-rural area; ecosystem services; Nemunas Delta; Curonian Lagoon

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1. Introduction

Ecosystems are the basis for the entire life and activities of a person. Their resources and functions are vital to the support of wellbeing, as well as to the future economic and social development. The benefit provided by the ecosystems includes food, water, timber, oxygen, air purification, soil formation process, and plant pollination. However, often as a result of human activities, biological diversity is destroyed and the ability of healthy ecosystems to provide various resources and perform various functions is impacted.

The ability of ecosystems to adapt to the changing climate conditions may reduce potential damage; some benefit may even be gained from new possibilities provided by the climate. Still, when planning the methods of adaptation, one must not forget that there are no universal adaptation measures that would be suitable for the entire territory of the European Union (hereinfater–the EU), because different measures are used under varying local conditions. For this reason, in order to determine effective impact measures for the preservation of ecosystems and the services they provide, a feasibility study must be conducted on the adaptation of human activities to the ecosystem services in a specific location.

Ecosystems can provide a wide range of services that are critical to human well-being, health, subsistence, and survival Costanza [1,2], Millennium Ecosystem Assessment [3],

TEEB [4,5]. Ecosystem services are defined in the scientific literature as the benefits that people derive from ecosystems, as the direct and indirect contribution of ecosystems to human well-being TEEB [5], as the contribution of ecosystem structures and functions (among other resources) to human well-being Burkhard [6], Burkhard and Maes [7–9], Briner [10], etc. Ecosystems cannot provide benefits without people (human capital), communities (social capital) and the environment (created capital). Ecosystem services can therefore be described as a contribution of natural capital to human well-being, which is created only through interaction with human, social, and created capital Crowl [11], Kienast [12], Fürst [13].

The link between ES, humans and nature can be based on the causal links between ecosystems and human well-being. Ecosystems should be treated as biophysical structures and processes, and biophysical structures as habitat types (e.g., forests, wetlands, meadows, etc.), processes as dynamics and relationships that shape the ecosystem (e.g. primary production). Their functions are understood as ecosystem traits or behaviors that support the capacity to provide ES (i.e., the ability of forests or grasslands to generate permanent biomass reserves) Haines-Young [14–16]; Burkhard [9].

A current status of ecosystem services as well as their main trends and impact on human welfare have been analyzed in detail in the Millennium Ecosystem Assessment [3], which was conducted in 2001–2005 by over 1360 experts from around the world. Despite all debates, the concept has caught on and has a very useful characteristic, i.e. the concept allows us to conclude concisely that ecosystems and the species contained within them are (vitally) important to people.

The analysis of the services provided by the ecosystems can be carried out using different methods, depending on what specifically is being researched Brander [17]. Methods for the analysis of the capacities of ecosystems to provide services may differ from the analysis of the needs of services or actual use of those services. Scientific literature analysis has revealed that the need of people for different ecosystem services is different and researchers argue that this is either a matter of dependency (survival) or a matter of priority Wolff [18], Gozdowski [19]. It becomes a matter of survival when a person is directly dependent on the goods (such as food, timber, etc.) provided by nature.

It has been noticed Maes et al. [20,21], that ecosystem services are acknowledged as a significant aspect in policy-making and decision-making. This concept defines a holistic view of the interaction between humans and nature, and it also has a great potential to address conflicts and synergies between environmental and socio-economic goals. Policy makers have realized that solutions based on ecosystem services or nature (e.g., the use of wetlands for water filtration or flood prevention) can be more cost-effective than technical infrastructural solutions. It is argued by Müller [22,23] that the concept of ecosystem services can provide a comprehensive theoretical background for a trade-off analysis that can help to address trade-offs between competing land uses and assist with planning and development decisions across sectors, scales, and administrative boundaries.

It can be noted that policy makers became interested in the concept of ecosystem services when it became clear that the global goal of preventing biodiversity loss by 2010 had not been reached. This concept was used for the first time to strengthen nature conservation policies in the Convention on Biological Diversity and the EU Biodiversity Strategy. However, according to the European Commission, the assessment of ecosystem services is not only important for achieving biodiversity goals, but is also closely related to the implementation of similar policies, such as water, marine, climate, agriculture, forestry and regional development Maes [20], Zailani [24,25]; Iranmanesh [26], Burkhard [7].

The assessment of ecosystem services can help us to identify the socio-economic benefits of the projects, plans or specific operational strategies by selecting and prioritizing the alternatives; to make rational decisions on land use (e.g., the place for construction of buildings, or infrastructure so that the benefit of the ecosystems would not be impaired); to help organizations from different sectors to make strategic decisions (e.g., regarding

potential environmental risks); to identify the value of endangered ecosystem services ("inaction costs") or the value of restoring certain natural habitats, etc. [27].

The concept of ecosystem services is mostly based on an assessment to the human benefits of using ecosystem services. In terms of the benefits of ecosystem services to people, ES are divided into three groups (supply, regulation and support, and cultural), (Table 1) [28].

Table 1. Typologies of ecosystem services [28] and their benefits.

Typologies of Ecosystem Services	Benefits for People
Examples of the types of supply services (foodstuffs of plant origin (cereals, potatoes, etc.), foodstuffs of animal origin (pork, lamb, etc.), game fauna, fish for food and animal feeding, other natural resources (mushrooms, berries, herbs), drinkable water, non-potable water (for livestock, watering, etc.), minerals, timber, bio-fuel, wind energy, solar energy, hydropower (dams, etc.).	Services provided by land, water, wind, and solar, getting direct and indirect benefits for their use.
Examples of the types of regulation and maintenance services regulation and maintenance (retention, recovery and detoxification of waste and waste-water, air quality regulation, water quality cycle regulation, pollination, habitat allocation for plant and animal species, habitats for migratory animals, birds, climate regulation, including global regulation by reducing greenhouse gas concentration, and microclimate).	Benefits from the ability of ecosystems to regulate climatic, hydrological, physical and biochemical cycles, and variuos biological processes.
Examples of the types of cultural services (provision of recreation and nature recreation, cultural heritage, aesthetic significance, religious significance, aspiration to preserve existing natural values, provision of nature and ecological tourism, cognitive excursions, wildlife observation, cognition service, provision of recreational fishing opportunities, provision of material for research and cognition)	Benefits through recreation cognitive (scientific) development and spiritual experience.

Different typologies and approaches have been developed to categorize ES, using different criteria such as spatial characteristics and scale, service flows, service users, type of benefits received or services used by one person or group, etc. The authors of the article followed the Common International Classification of ES, developed in 2009 and revised in 2013, which proposed the following three main categories of ES: supply, regulatory-supportive, and cultural [28]. As noted, the above classification allows for proper detailing and application of ES. Detailing and disaggregation is necessary to avoid double counting in the assessment of ES—i.e., evaluating one natural element more than once because it is part of another ES.

When analyzing the diversity of income of the Lithuanian rural population, it is necessary to analyze agriculture and rural businesses, as these are and will be the main engines of rural economic life. The Lithuanian agricultural sector generates 3.5% of the country's GDP, together with the food processing industry it accounts for 7% of GDP. Agriculture generates 20% of the country's exports, guaranteeing a positive relationship with imports, i.e., goods are imported less than exported. In terms of the value of agricultural production created per 1 ha, Lithuania is the fourth in the EU. A little less than EUR 1000 is created from 1 ha. The leaders in this indicator are the Netherlands, which are able to generate EUR 14,000 per 1 ha. According to experts Buchel [29], De Bello [30], Faccionia [31], Pérez-Soba [32], Han [33], Latan [34], Lithuania should focus on Denmark, which generates about EUR 4000, Germany–EUR 3000, or the neighboring Poland, which creates a value of about EUR 2000.

The Lithuanian agricultural sector is able to create only 37% of the value per 1 ha, which is generated on average in the EU.

It is necessary to note that the risk of poverty in rural areas of Lithuania is three times higher than in the rest of the country. The rural areas have more elderly, poorer health and lower income population. Unemployment is almost twice as high as in urban areas, and only 20% of the rural population is employed in agriculture. Number of farms in the country is decreasing more than double, and young farmers account for only 15% of all farmers. It is therefore necessary to start growing and producing higher value-added products that will allow farmers to earn more from their activities. Stop the decline of the livestock sector by strengthening the dairy sector; to grow higher value-added crops: fruits, vegetables, berries, fibrous hemp, mushrooms, micro-vegetables, and similar modern crops that are in demand.

It is generally assumed that the need for ecosystem services is often a matter of priority in economically strong countries. The basic human needs can be met through the opportunities offered by the market, so everything else is just a matter of people's priorities. It is also believed that the benefits provided by the ecosystems may or may not be perceived. According to Drakou [35], Stephanie [36], Overland [37] the perception of ecosystem value is experienced (felt) and the benefit of the ecosystem for people is recognized in the local context. The results of the assessment of ecosystem services and the analysis of tendencies can provide essential information on the implementation of various EU policies (e.g., in the field of nature protection, climate change, water management, marine protection), and when assessing the impact of policy sectors that rely on the use of ecosystem services (e.g., agriculture, forestry, fisheries, etc.). However, this requires the comparable results of ecosystem assessments over time, and such data are currently not available in most countries.

The aim of the article is to identify the existing ecosystem services and offer perspectives for their improvement in order to enhance the social well-being of the population in the rural areas along the shores of the Nemunas Delta and the Curonian Lagoon. The article seeks theoretically examine the coherence between humans and ecosystems, ensuring the social wellbeing of present and future generations in the context of ecosystem services; seeks to present the empirical research, carried out on the possibilities of adapting human activities to ES in the specific area, i.e., coastal-rural area, evaluating the past, present, and future ES potential in the Lithuanian coastal zone, Nemunas Delta, and Curonian Lagoon in Lithuania.

The work of this article is organized as follows: in further sections the materials and methods are presented, dividing them into two subsections: the research setting, description and comparison of the methods. Additionally, results, discussion and conclusions sections are presented.

2. Materials and Methods

2.1. Research Setting

The elderships located in the Nemunas Delta and the Curonian Lagoon in the area of about 10 km from the shore, which are within or adjacent to the territory of the Nemunas Delta Regional Park. The following seven elderships were distinguished: Priekulė, Saugai, Kintai, Rusnė, Šilutė, Juknaičiai, and Usėnai (Figure 1).

Most of the territory of Šilutė district is in the coastal lowlands of Lithuania. The lowest point is Rusnė Island (in places even below sea level). Every spring and frequent autumn, the floods of the Nemunas in Šilutė district cover large areas (about 400 km^2), cutting off communication. The area is rich in protected areas: 44 nature reserves, 4 reserves, 7 natural heritage objects, 2 biosphere reserves, 1 national, and regional park each [38]. The total area of the territory is 1706 km^2. Population density is 24.9 people per square kilometer (LR). The climate of the area is favorable for the development of both livestock and crop production. The average air temperature varies between 6.6 and 8.5 °C, the average rainfall is 718–809 mm (per year). The area is characterized by high agricultural

use, utilized land accounts for 49% of the total area and low-productivity land covers about 45%. The arable land is sensitive to intensive tillage. The area is dominated by podzoluvisols, gleyic podzoluvisols with significant signs of soaking. There are about 37% of sandy soils in the area, 33% of light and medium loam, and 29% of sand and gravel. Soils are poor in nutrients; agricultural land productivity is rated at 40 points. Almost all lands are drained by closed drainage and are suitable for growing all types of plants except sugar beet.

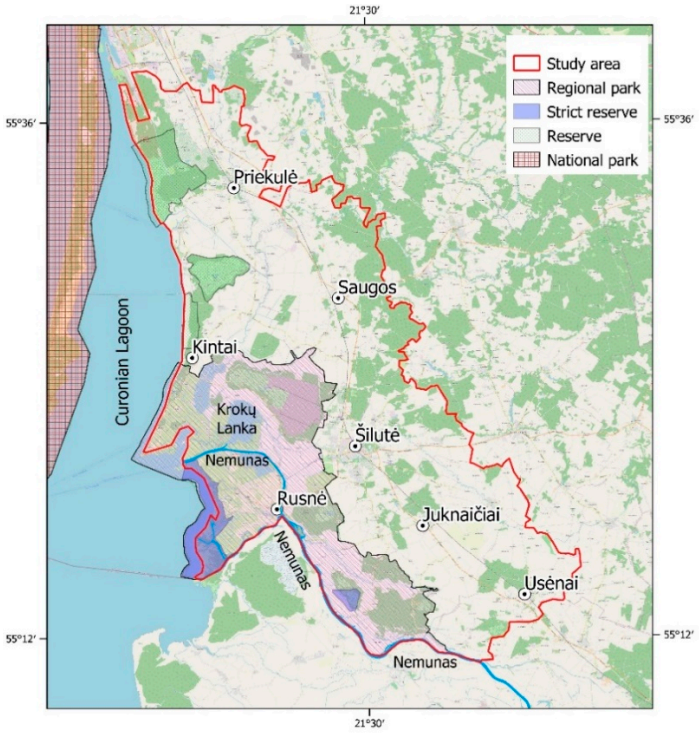

Figure 1. Study area and its location on the map of Lithuania (distribution map made by D. Gozdowski).

2.2. Description and Comparison of the Methods

The following data collection and analysis methods were used in the research, as seen in Table 2.

Representation of different perspectives is important in the process of assessing and preserving the potential of ES, so representatives from different (public and private) sectors were chosen to participate in the empirical study. The public sector was represented by elders and eldership employees, the private sector by farmers and businesspeople. The essential condition for the selection of respondents and the calculation of the survey sample were these: the residences and activities of all three groups of respondents had to be from the Nemunas Delta and the Curonian Lagoon, in the ~10 km zone from the shore. From each eldership (Saugai, Kintai, Rusnė, Šilutė, Juknaičiai, Usėnai, and Priekulė) a certain number of farmers, businessmen and eldership employees were selected. Not all potential respondents agreed to participate in the survey, therefore the target general populations were: 180 farmers, 20 entrepreneurs, 15 employees of the eldership. Sample size finite population Cochran's assumption were: 47 farmers, 10 entrepreneurs, 8 employees of the eldership and real sample size were: 64 farmers, 15 entrepreneurs, 11 employees of the eldership. Thus, a total of 64 farmers, 15 businesspeople and 11 eldership employees were questioned. Respondents were targeted to reflect the entire existing totality of the existing area. The survey was conducted in June–August 2019. Some respondents were contacted directly, explaining the purpose of the study and the planned results, to other respondents (in most cases, the questionnaires were handed over to the farmers by the employees of the agricultural department of the eldership).

Table 2. Advantages and disadvantages of the methods.

Description of the Method	Advantages of the Method	Disadvantages of the Method
Secondary document analysis		
Given the object of the research (ES), the aims and objectives of the research, this method is considered to be the most important method of data collection (acquisition). Sources of collected data: national, EU and international legislation, scientific books and journals, press publications; official statistics (information provided by the Department of Statistics, municipalities, elderships, departments of protected areas); official government publications; documents of private, state, professional, and other non-governmental organisations.	Since the secondary analysis is based on documents prepared by other authors, researchers, or data collected, researchers typically have different goals and objectives than those raised in the previous studies. The method saves time and money (compared to a new study); less bias in working with already existing data rather than people; possibility to perform comparative analysis faster (several elderships, cities, etc.).	Possible unavailability of information. Not all desired information of interest to researchers is available (especially in market conditions). The baseline data may be erroneous, but this is difficult to elucidate in the secondary analysis because then the study would have to be started from scratch.
Standardized direct survey		
In order to assess the existing problems of ecosystem protection and services provided by them, a survey of respondents (farmers, businesspeople, eldership employees) was conducted and their opinions on ecosystem conservation and possible related problem areas were examined, and the peculiarities of ES regulation and implementation were revealed. The advantages and disadvantages of social conditions (related to ongoing or potential ES) were investigated using questionnaires. The surveys provide insights into the management of ES.	The survey was applied because the phenomenon under study is related to people's attitudes, needs, interests, motivation, etc. In the social sciences, the survey is used as a tool to gather information from respondents on preconceived questions. The survey was not intended to find truths unknown to science, confirming or denying theoretical attitudes or insights that arose in practice. The survey was conducted in order to obtain representative information about the target groups studied, as well as to discover the relationships between the different parameters of the study.	Limited time is allowed for answering the questionnaire questions, as the survey was conducted not only in the respondents' homes, but also in the agricultural departments of the elderships. In order to get a better image in relation to other elderships, the environment (eldership specialists who conducted the survey) could also have an influence. Respondents may have feared that their personalities would be identified, so the reliability of their responses could vary.
Contingent valuation method		
It was based on a survey of users of ES on their priorities for ecosystem services. A hypothetical potential ES market has been created. Consumers (eldership workers, farmers and businesspeople) were asked about specific actions of their own (how they can do certain actions) and questions about public policy actions to maintain or improve the condition of ecosystems.	In a freely operating environment, people can express choices through their actions. This method is not based on human behavior but on answers to hypothetical questions.	During the survey, there is indecision among the respondents, in which case an uncertain answer is given. There is also a systemic discrepancy between hypothetical responses and actual behavior. Respondents can sincerely present their beliefs about how they would react to certain things if they happened. However, these beliefs can be systematically biased.
Consumer choice experiments		
ES consumers (farmers, businesspeople) had to choose potential (in their view) policy alternatives related to the preservation of ecosystems until 2030.	Respondents are required to select one of the proposed policy alternatives to regulate the external effects of agriculture. A package of existing policies and at least two other policy options with additional implementation were presented for selection.	Respondents may not behave as they declare during the experiment because they have many alternatives in real life.

Three types of questionnaires were prepared for the research. Ninety percent of the questions in the questionnaires were the same, as the aim was to identify respondents'

opinions on the same issues, representing different sectors. The other 10% of the questionnaire questions were different in order to find out the respondents' opinions about the activities and specifics of their sector.

The study was based on three different time segments using an interval scale: assessing the past, the current situation, and the potential future. During the survey, respondents from all three sectors had to assess the past (2014–2017), present (2018–2019), as the survey was conducted during this period, and the potential of future (2020–2030) ecosystem services. When assessing the potential of ES, the scale of attitudes was chosen by assigning the respondents' answers to scores from 1 to 5 (1—the score was the most significant, 5—the score was low significance).

Examples of ecosystem services were selected, based on literature analysis and expert opinion, by ecosystem types in the research area, such as meadow, forest, swamp, wetland, etc. In this way, 28 ecosystem services belonging to three groups according to the CICES classification (Table 1).

The year 2014–2020 was chosen as the essential period of the research, because it was wanted to analyze and evaluate not only the respondents' opinions on ecosystem conservation, but also certain past (2014–2017) or future (2020–2030) support opportunities for regional support programming periods for ES that have been or will be used in the future.

The budget of the EU structural and investment funds support to Lithuania for the period of 2014–2020 amounted to EUR 8.39 billion. According to the current ES budget plan, support to Lithuania during the period of 2021–2027 would reach about EUR 6.5 billion, i.e. would decrease by about EUR 1.89 billion (which would amount to about EUR 270 million annually) [39].

3. Results

In the initial stage of the research, changes in the activities carried out in different periods have been analyzed. It has been found out that the following core activities dominated (2014–2017), (2018–2019) and should dominate in the future (2020–2030) (the respondents could choose several (5–6) activities that they considered most significant: farming (cereals, rape, potatoes, etc.)—60% of the number of the respondents; cattle farming (for meat, milk)—44%; beekeeping—17%; collecting herbs and providing opportunities for nature observation/photography—12.5% each. The activities presented for selection, such as forestry, hunting, mushroom and berry picking, recreational fishing, commercial fishing, aquaculture, opportunity to enjoy the landscape, did not receive the attention of the respondents, and were rated at less than 10 percent.

In determining favor of the conditions of the researched areas for the development of ecosystems and the services they provide, the conditions were rated as favorable by 24 percent of the respondents, 9 % of them stated that the conditions are unfavorable, and 44 percent had no opinion about the specifics of ecosystem development (on the grounds that they do not have sufficient knowledge of ecosystems and the services they provide).

Analysis of the potential of ecosystem services for the period from 2020 to 2030 revealed that groups of farmers and entrepreneurs both in the past and in the present should be dominated by supply services; cultural ecosystem services were named in the first position by the public sector representatives (1.9 points); regulatory and support services were in the second place (in the groups of all researched elements); cultural services remained in the third position (among farmers and entrepreneurs); supply services were named in the third position by the eldership employees.

When assessing the potential of each type of ecosystem service separately (asking the question "Importance of types of ecosystem services. Please mark from 1–5 (1-most significant) which types of ecosystem services are most significant in your area?") it has been found out (in the research group of farmers) that, in terms of supply services, they saw the biggest future potential in growing foodstuffs of plant origin (1.92 points) and foodstuffs of animal origin (2.14 points). Supply ecosystem services, such as timber, biofuels, wind or solar energy were not identified as priorities (Figure 2).

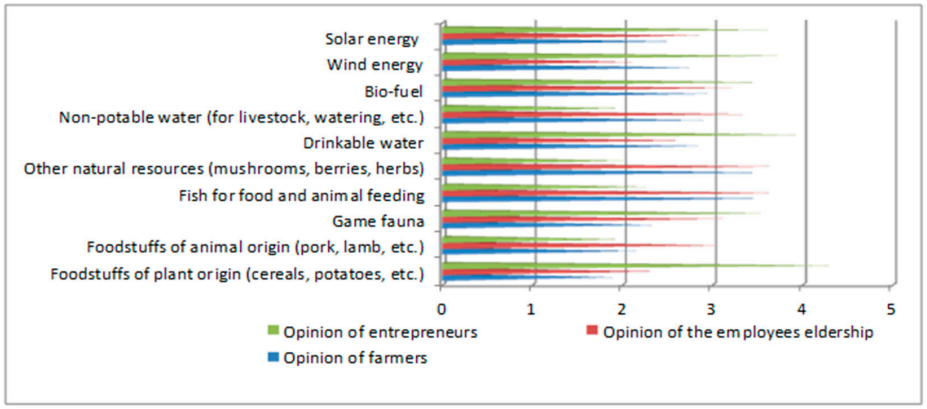

Figure 2. Respondents' views on the future (2020–2030) potential of supply ES, in score averages.

The biggest differences in opinions between the research groups were in the assessment of the importance of food of plant origin: for farmers it was the most significant ecosystem service (1.92); for entrepreneurs, it was the least significant (4.4). There are no plants for the purchase and processing of crop products in the area, so the products grown have no effect for the business. The significance of food of animal origin was assessed similarly by both groups with a score of about 2 points, as several businesses in the area directly purchase and process animal carcasses. Other natural resources (e.g., mushrooms, berries, herbs) were rated as insignificant by farmers and eldership employees (3.6–3.7 points), given priority by entrepreneurs and rated 2 points. The distribution of opinions was determined by the fact that the entrepreneurs focused their answers on the hobbies of incoming tourists to buy or collect mushrooms, berries, and herbs themselves.

According to the research data, just as a century ago, farmers in the Nemunas Delta region (in Klaipėda and Šilutė district elderships), as well as in the whole of Lithuania, are mainly engaged in grain growing, because it is just a simpler business which is still yielding a good return. As has already been mentioned, although the use of cereals for feed will increase because milk and meat production will expand, grain prices, however, are projected to remain low by 2030. The demand for products of animal origin produced from animals that have not been fed with genetically modified feed will continue to grow. In the future, the EU protein crop growers should benefit from that. At the same time, however, a decrease in protein crop areas is projected, which will be due to lower feed prices and production costs which will increase.

As a healthy lifestyle and diet will gain their popularity, and personal income will increase, more and more attention will be paid to high quality organic products made by hand from local resources. Consumption of these products is likely to increase in the future. Therefore, more attention should be paid in this region to horticulture, berry growing, production of vegetables and other activities in order to diversify income of farms. To make the income of people higher, the economic and social structure in the researched areas should be changed.

It can be noted that the re-naturalization processes are currently proceeding quite rapidly not only in the researched area, but also throughout the country, and such trend will last in the future. Due to the deteriorating demographic situation, soon there will be no one left to engage in farming. When asked if someone could take over the farm after its owner passes away or becomes old, only about 10 percent of the respondents were sure that this will be the case, nearly 35 percent responded "maybe" (were not sure), and the majority of the respondents responded that there will be no one to engage in farming after the owner passes away or becomes old. Hence, in the future there will be no one to work on much of the land currently being cultivated, and this will lead to its abandonment. Only a small percentage of small farm owners expect someone to inherit their farm. Since traditional agricultural activities in this region are unprofitable, there is no reason to expect that someone will lease the land and use it for agricultural activities.

Therefore, the area of abandoned land should increase in the future, and the problem of managing it will become increasingly relevant. It can be forecasted that in the future the rural areas located in the Nemunas Delta and in the Curonian Lagoon, and in the zone, which is about 10 km away from the coast may lose their main agricultural function. Therefore, the rural future of this region cannot be linked to agricultural activities alone because the number of people working in agriculture will decrease. It is likely that the long-dominated agrarian landscape should be gradually replaced by wooded landscape. This fact should promote the implementation of afforestation program. The villages are projected to gradually become abandoned, only homesteads located in spectacular places, whose owners will not engage in agricultural activities, will remain. Therefore, the future will also depend on the possibilities to develop non-agricultural activities.

In the attempt to find out what complex assistance of ecosystem supply services management could be provided by the public sector representatives (opinion of eldership employees) in developing the potential of services, the following were identified as essential measures: coordination of the activities of existing organizations and persons, cooperation among the state, municipal, and local action groups, landowners and other interested groups, the use of the best practice of scientific and management activities, and improving information and data management.

In analyzing the group of regulatory and maintenance ecosystem services (Figure 3), it has been found out that, in farmer's opinion, the most significant were the following services: waste and wastewater retention, recovery and detoxification services (1.3 points), water quality cycle regulation service (1.8 points), and air quality regulation service (2.5 points).

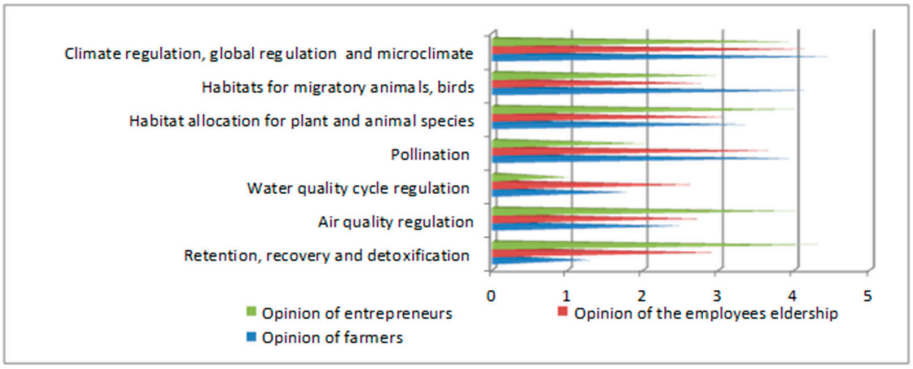

Figure 3. Respondents' views on the future (2020–2030) potential of regulation and maintenance ES, in score average.

Based on the opinion of business representatives, the priorities have been distributed as follows: water quality cycle regulation (1 point), plant pollination (2 points) and habitats for migratory animals (3 points). Regulation of water quality cycle (2.7 points) has been identified as the main priority by the public sector representatives. Air quality regulation and habitats for migrating animals remained in the following positions (2.8 points each).

ES, such as climate regulation, including global regulation, in reducing greenhouse gas concentrations and the microclimate, were rated by only 4 points by all three groups of the respondents.

The biggest differences in opinions between the study groups were in the assessment of waste and wastewater retention, utilization, and detoxification. Farmers named it as a priority service with 1.3 points, entrepreneurs only with 4.3 points, and the employees of the eldership rated it with 3 points. The distribution of opinions may have been due to the use of wastewater treatment plants in existing areas. The facilities mentioned in business enterprises are centralized and are already in use, and cleaning facilities on farmers' farms are still lacking. Legislation is being drafted to enable the rural population to receive financial support from the state by installing individual wastewater treatment plants where there is no access to centralized wastewater treatment services.

It is regrettable that ecosystem climate regulation service is considered by the respondents as not very significant. It is necessary to emphasize that extreme climate phenomena, that are becoming more and more common, lead to economic and social consequences. Many climate phenomena directly affect infrastructure (buildings, transport, energy and water supply, agriculture) and threaten the population, especially in densely populated areas.

As has already been mentioned, the respondents' views (both of farmers and entrepreneurs) on measures taken by public authorities which can help to preserve ecosystems and the services they provide have been also analyzed during the research. It has been found out that the following could be the essential measures of assistance: maintenance of habitats for animals and plants (1.75 points), control of invasive alien species of plants, animals, fish (2 points), land control/management support (1.36 points), additional garbage collection/management (1.77 points), and pollutant collection (2.1 points).

In analyzing the group of cultural ecosystem services (Figure 4), it has been found out that, in the opinion of farmers, the most significant were: provision of recreation and nature recreation (1.4 points), cultural heritage (1.8 points), services of aesthetic significance (2.4 points), aspiration to preserve existing natural values (1.56 points).

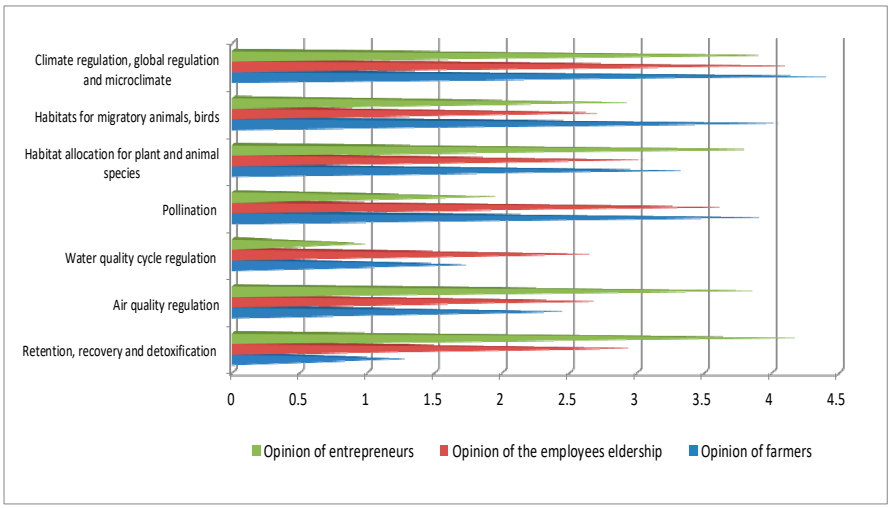

Figure 4. Respondents' views on the future (2020–2030) potential of cultural ES, in score averages.

Based on the opinion of business representatives, the priorities have been distributed as follows: cultural heritage (3.6 points), provision of recreational fishing opportunities (4.5 points), aspiration to preserve existing natural values, and provision of nature and ecological tourism, cognitive excursions, wildlife observation, cognition service (5 points each). Based on the opinion of eldership employees, the priorities have been distributed as follows: provision of recreation and nature recreation (1.7 points), aspiration to preserve the existing natural values (1.8 points), and services of aesthetic significance (2 points).

The opinions of the respondents (both of farmers and entrepreneurs) about the measures of public authorities that can help to preserve the provided services of the cultural ecosystem have been also analyzed during the research: educational sessions on nature topics (1.33 points); installation of information stands (1.66 points); stocking (3 points); maintenance, preservation of cultural heritage, etc. (1.5 points).

The biggest differences in opinions between the research groups were in the assessment of the desire to preserve the existing natural values. Farmers and eldership employees rated it respectively (1.56–1.8 points), entrepreneurs gave only 5 points for this service. The distribution of opinions may have been due to the fact that some businesses rent premises and land around them and are not the real owners. The feeling of temporality may also have led to the above assessment.

In addition to measures of public authorities, that can help to preserve ecosystem services, the possibilities of information transfer (between the public and private sectors) have

been also analyzed. It has been found out that 34 percent of business sector respondents received information from eldership employees, 31 percent from the advisory service staff, 14 percent from the employees of the Ministry of Agriculture, and 17 percent said that people themselves should be more interested in the possibilities of information transfer. Additional responses of the respondents showed that they personally find it difficult to follow information because "large flow and amount of information unbalance the daily farm works". This problem prevails not only in Lithuania, but also in other EU countries [40]. The fact that farmers and other interested entities are poorly informed about the existing measures and have relatively little experience in implementing them is one of the main reasons why risk management measures have not been used properly in the last few years.

Based on the theoretical and practical results of the study, Table 3 describes the potential of ES in terms of respondents' views, regional climate change, and the national dimension of EU environmental policy.

In preliminary assessing the forecasted ecosystem services of the rural areas of the Nemunas Delta and the coastal area of the Curonian Lagoon, it can be stated that services of supply of products of plant origin (although, for example, the prices of grain are projected to decrease), of animal origin and of potable water should increase in the future. It must be emphasized that agriculture is especially sensitive to climate changes. Over the years, farmers have adapted to growing crops for which the current climate is most favorable, and the highest yield or livestock gain can be expected. However, against the background of a changing climate, both cultivated crops and tillage practices will need to be changed. Therefore, in the future, more attention should be paid to horticulture, berry growing, production of vegetables, cultivation of herbs and other activities in order to diversify income of farms.

In the future, the focus on waste and wastewater retention, recovery and detoxification, on air and water quality regulation and climate regulation, including also global regulation to reduce greenhouse gas concentrations, and the microclimate should increase. Since climate change is already at an advanced stage, even after reduction of atmospheric pollution, everybody will need to adapt to some climate change. Adapting to climate change would mean that, after taking into consideration the negative effects of climate change and after taking appropriate actions, damage could be prevented or reduced. Therefore, early and well-planned adaptation measures could save funds and help prevent potential disasters. It is necessary to emphasize that public sector organizations, both municipalities, and elderships—in addressing climate change mitigation and adaptation issues—must actively exercise (today initiatives and activity are lacking) the rights established by law, enabling municipalities (elderships) to perform functions (both administrative and financial) in various fields according to their competence; for example, in environmental protection, transport, industry, spatial planning, agriculture, public healthcare, etc.

Most of the cultural services provided by ecosystems are directly dependent on the climate and weather of the area. Therefore, it can be predicted that the milder and more stable the climate will form, the more tourists (both local and foreign who want to use cultural services) can arrive to the region. In the future, climate changes will lead to changes in cultural ecosystem services (including changes in tourist routes), which will have significant economic consequences. The summer tourism season in Northern Europe and the Baltic States will become longer. For this reason, tourist flows are likely to grow. In the future, the focus should increase on the provision of recreation and nature recreation, nature and ecological tourism, cognitive excursions, and wildlife observation. It is necessary to expand not only recreational, but also ecological, cognitive, as well as, under favorable climatotherapeutic conditions, therapeutic (health promotion) tourism. Ecologically sustainable tourism, focused on the knowledge of natural areas, by promoting the understanding and protection of nature and culture, can help combat the negative effects of climate change. Analysis of the needs of users of cultural services should be also borne in mind. Due to climate change, the needs of persons who choose Lithuania for

their holiday may change. Therefore, a timely response to changing needs would increase competitiveness and reduce losses.

Table 3. Links between ES opportunities and the social well-being of the rural population of the Nemunas Delta and the Curonian Lagoon.

Opportunities after Assessing the Respondents' Attitudes	Opportunities after Assessing the Region's Climate Change	Opportunities for Environmental Policy on ES at National Level
Supply ecosystem services		
Applicable: precision agriculture (precision sowing, precision application of plant protection products), fertilisation maps for individual soil areas according to different soil properties, multifunctional ultraviolet optical and near-infrared spectroscopy methods for soil heterogeneity assessment. With the help of technology, it would be possible to monitor the condition of crops, assess problematic field areas, plan technological crop maintenance, save time and streamline operations without leaving home. The proposed creation of higher added value would require higher production costs, more labor (which is jobs for rural people), and more expensive plant protection measures.	Low soil, water, and air pollution provides opportunities to develop the production of organic and natural products. Favorable climatic conditions for the production of fodder and grain, which allow for the successful development of dairy and meat farming, successful development of olericulture, horticulture, cultivation of oilseed rape and other plants and animals adapted to similar climatic conditions. With reduced rainfall, the targeted and sustainable use of fertiliser minerals would help to avoid overfertilization, saving money, protecting the environment and the soil. Reforestation using less fertile, hilly forest edge arable is also recommended; by restoring natural wetlands on naturally prone wetlands, enabling wildlife to remain in the fields of arable land.	Prioritise measures to revitalize the economy and increase resilience by including in the list of funded reforms the establishment of a soil management system, including soil monitoring, development of a research database, digitization, transmission, treatment, adaptation to precision farming techniques. A soil quality management system is being developed to calculate greenhouse gas emissions at farm level in pursuit of long-term objectives. Digitization technologies would open up new opportunities for agribusiness management at all stages of the agricultural and food value chain. Automation of agricultural processes would allow precise adjustment of the quantities of raw materials and supplies used, reduction of manual work, satellite data, and sensors would improve the accuracy of crop growth, land or water quality monitoring while reducing costs.
Regulatory and maintenance ecosystem services		
For the conservation of biodiversity in natural and semi-natural meadow habitats, use the European Agricultural Fund for Rural Development appropriations, which support various financing measures for the protection of species and green infrastructure. This would guarantee investment in tangible assets, in forest areas (supported afforestation contributes to the restoration of animal migration routes, water quality and the achievement of other common environmental objectives, such as climate change mitigation), agri-environmental and climate measures to promote environmentally friendly farming systems in particularly sensitive areas (supporting biodiversity, landscape restoration and conservation), payments under which legal compensation for restrictions on or promotion of activities in areas would ensure an adequate conservation status of species and habitats.	Reduce potential flood damage in the future by focusing on the legal framework to ensure proper regulation of development and construction in potential flood risk areas. The need for engineering flood protection measures could be reduced by limiting the development of settlements in flood risk areas and by providing special (flood resistance-related) requirements for buildings under construction in these areas. Promotion of the application of green measures in solving surface wastewater treatment works. Use of tax measures to increase the amount of funds raised for surface water treatment. Detailed assessment of the risk of flooding (due to poor surface water management) to identify investment needs and impacts for adaptation to climate change.	Apply stabilization of pollutant migration, geomembranes, and other innovative biological methods in contaminated areas. Implement monitoring and surveillance measures in the National Sustainable Development Strategy (e.g., landscape, biodiversity, coastal dynamics, noise). In this way, changes would take place in climate change management policy, with medium- and long-term goals (monitoring and researching vulnerable sectors of the country's economy).

Table 3. *Cont.*

Opportunities after Assessing the Respondents' Attitudes	Opportunities after Assessing the Region's Climate Change	Opportunities for Environmental Policy on ES at National Level
	Cultural ecosystem services	
Therefore, in order to increase the tourist attraction, it is important to develop specific products by exploiting the advantages provided by local cultural resources, local socio-economic infrastructure, tourism infrastructure provision, and service development. These factors determine the need for new tourist products (creation of individual routes, trips to hard-to-reach regions, extreme trips) and the emergence of products (demand for culinary, historical, folklore, literary, etc. routes). New tourist routes should emphasize their authenticity and educational aspect, look for unused spaces for tourism, attracting local craftsmen, farmers and entrepreneurs, offering original products and services in line with local traditions.	It should be noted that the potential of CES depends and will depend on different ecosystems and their condition. It is clear that the deterioration or even disappearance of those ecosystems will reduce their ability to provide these services. Even when it seems that something is gained with environmental degradation, it is important to keep in mind that even more will be lost. The collective effort would help decision-makers incorporate relational values in their work and better understand how can collectively and individually move towards more just and sustainable relationships involving nature. Only by understanding and assessing the real potential of the services provided by ecosystems will it be possible to make appropriate, environmentally friendly decisions.	It should be emphasized that the organization of activities should include eldership communities and villagers. It is recommended to use certain incentives (depending on the funding requirements and funding period) for the implementation of these activities, such as support for rural development (support for economic start-ups in the rural areas, agri-environment and climate, organic farming), support for local projects, support for beekeeping, direct payments, projects funded by the Culture Support Fund (such as ethnic culture and cultural heritage, artists' residences, cultural education, balanced cultural development, etc.) and to use the aid in order to activate local tourism.

An analysis of the potential of ecosystem services has shown that, compared to regulatory and support or cultural services, there is a low potential of supply services in the area that was an object of the research. Only agricultural areas, forests and water habitats stand out with greater potential. In order to answer questions about the impact of these processes in the region, further research will link the results to ecosystem services indicators. Today, the projected global trajectories of societal development are recommended to be taken into consideration in predicting the impact of climate on future ecosystem services in the elderships of the coastal area of the Curonian Lagoon. This approach can be useful in familiarizing the local community with the likely opportunities in the future, in a multi-generational perspective. Using this information, the representatives of the society could move from household daily activity planning to a 'macro' perspective in making strategic decisions on activities selection.

4. Discussion

Analysis of the most important specific risks related to climate change in the activities of agricultural sector has shown that drought or rain surplus as well as cold are the most significant risks for Lithuania [41]. The analysis has also revealed that the agricultural sector in Lithuania is heavily damaged by heat waves, early spring and autumn frosts and squalls. Climate change has the greatest impact on agriculture through water. Agricultural production, the landscape and biodiversity directly depend on water quantity. Decreased precipitation or its uneven distribution also determine the thickness of snow cover, while uneven snow-covered fields pose a much higher risk of crop freezing. The average annual and July temperatures are also rising; therefore, due to decreasing rainfall, there is no doubt that the risk of droughts is increasing. The question on how to protect against spring and autumn frosts and adapt to heat waves is becoming increasingly important for Lithuanian farmers. Due to consistent and extreme natural phenomena, farmers are forced to take some actions. As a result of negative effects of the increase in temperature and humidity and pests, the disease may spread more intensively, and weeds may persist. Table 4 shows the actions taken by various foreign countries to protect farms from the rise of climate extremes.

Table 4. Actions taken by foreign countries to protect farms from the rise of climate extremes Poland [42], Denmark [43], Scotland [44], Italy [45].

Country	Actions Taken to Protect Farms from the Rise of Climate Extremes
Poland	Rational use of land resources, promotion of organic farming, provision of consultations to farmers regarding maintenance of good agricultural condition, energy efficiency guarantee in the production process of agricultural products, use of alternative energy sources in the agricultural sector and rural areas, afforestation of agricultural land, etc.
Denmark	Reduction of the impact of intense farming activities on aquatic and terrestrial ecosystems. A water resources management plan that has helped to reduce nitrogen and nitrous oxide emissions. The main measures taken are as follows: increasing the efficiency of the use of livestock manure, reducing the use of nitrogen compounds in fertilizers, complying with crop rotation and converting agricultural land to pasture or afforestation.
Scotland	The land is ploughed only in spring to form a better protective layer of snow during winter. Plant residues are collected and composted, or the land is fully ploughed in spring. Reduced fertilization rates are applied, fertilizer distributors with precise metering units are used, fertilization is carried out in accordance with natural conditions, careful selection of the type of fertilizer, giving priority to slow-spreading fertilisers in the soil. Trees are planted in the safety zones separating the fields, at the edges of the fields in order to reduce the risk of soil erosion and nutrient leaching.
Italy	Water management policy is in the focus of attention. There are three main activity trends, which are as follows: prevention of water bodies' pollution, water saving, especially in agriculture, and proper use of water.

In Lithuania, the majority of rural population employed in agriculture consists of people farming in small and medium-sized farms (up to 50 ha of farms account for about 70 percent). These farms (with rare exceptions) are in a weaker position than the buyers and suppliers due to a limited scale of operations, financial exhaustion and weak representation, and are rarely able to make use of the Rural Development Program, so their real viability potential has little chances to unfold. The current agricultural policy measures are still not sufficient to solve income inequality problems between large and small and medium-sized farms, and this consequently impedes the development of rural areas, even though significant amounts of EU and national financial resources are jointly invested in these areas.

Based on the insights of strategic management science, the evaluation of the best practices of the EU countries can lead to the assumption that the majority of small and medium-sized farms could become viable and competitive, and rural areas could be successfully developed at the same time. The choice of efficient measures would be particularly relevant for the changes in the EU's Common Agricultural and Rural Development Policy after 2020 [46]. Support for models of integrated economic development is repeatedly mentioned in the EU and national documents.

The following sectors related to ecosystems were selected for the analysis of legal documents: general European legislation, legal documents related to environmental protection; documents governing the activities of different sectors, etc. [28,47–55]. As far as the relationship between the EU law and national law is concerned, it should be noted that the EU law is directly applicable, and there is also a principle of the primacy of EU law, which ensures that national law cannot replace or repeal the EU law. In the event of a conflict between the national law of a Member State and the EU law, the EU law shall prevail.

It should be emphasized that the results of the assessment of ecosystem services can contribute to environmental policy when assessing the risks and impacts of various human activities on ecosystems or human health, and also when planning various measures to mitigate and manage these impacts. Therefore, a multidisciplinary analysis is often used in policy-making processes, in setting policy objectives and during the monitoring of policy implementation and its impact. The application of a multidisciplinary analysis for different

components of ecosystems and their services can help to improve the understanding of past, present and future changes. Therefore, the results of a multidisciplinary analysis allow us to better form and describe the future of ecosystem development Guerra [56], Gustafsson [57,58], Vadrot [59], Washbourne [60].

As it has already been noticed that, although a lot of attention is paid to the preservation of ecosystems and the services they provide, a very large flow and amount of information unbalances the choices of the country's population and the daily economic work. Such a problem occurs not only in Lithuania, but also in other EU countries. Farmers and other stakeholders are not systematically and concentrically informed about existing measures and have little experience of their implementation. This is one of the main reasons why ecosystem risk management measures have not been used to fully in the last few years.

5. Conclusions

The respondents (representatives of both public and private sectors) are indifferent enough when it concerns the problems of global climate change. They mostly link the development of ecosystem services in the Nemunas Delta area only to mitigating the potential consequences of climate change, poorly to the adaptation to climate change, and little to sustainable development. This suggests that, although the climate change management measures provided for by the European Commission are welcomed, the commitment to follow them in the development of ecosystem services in the Nemunas Delta is, however, poor.

In assessing the forecasted ecosystem services of the researched rural areas of the Nemunas Delta and of the coastal area of the Curonian Lagoon, it can be noted that over the years, farmers have adapted to grow crops for which the current climate was most favorable, and the highest yield or livestock gain could be expected. However, climate change will require changes in both crops cultivated and tillage practices. Therefore, in the future, more attention should be paid to organic horticulture, berry growing, production of vegetables, cultivation of herbs, and other activities in order to diversify income of farms.

In the future, climate changes will lead to changes in cultural ecosystem services (including changes in tourist routes), which will have significant economic consequences. The summer tourism season in Northern Europe and the Baltic States will become longer. For this reason, tourist flows are likely to grow. It is necessary to expand not only recreational, but also ecological, cognitive, as well as, under favorable climatotherapeutic conditions, therapeutic (health promotion) tourism. Ecologically sustainable tourism, focused on the knowledge of natural areas, by promoting the understanding and protection of nature and culture, can help combat the negative effects of climate change.

Compared to regulatory and support or cultural services, there is a low potential of supply services in the area that was an object of the research. Only agricultural areas, forests and water habitats stand out with greater potential. In order to answer questions about the impact of these processes in the region, further research will link the results to ecosystem services indicators. Today, the projected global trajectories of societal development are recommended to be taken into consideration in predicting the impact of climate on future ecosystem services in the elderships of the coastal area of the Curonian Lagoon. This approach can be useful in familiarizing the local community with the likely opportunities in the future, in a multi-generational perspective. Using this information, the representatives of the society could move from household daily activity planning to 'macro' perspective in making strategic decisions on activities selection.

The public sector organizations, both municipalities and elderships, in addressing climate change mitigation and adaptation issues, must actively exercise (today initiatives and activity are lacking) the rights established by law, enabling municipalities (elderships) to perform functions (both administrative and financial) in various fields according to their competence, for example, in environmental protection, spatial planning, transport, agriculture, public healthcare, etc.

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