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Ecosystem Service Value Changes in Response to Land Use Dynamics in Lithuania

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Abstract: Changes in land cover affect ecosystems and the services they provide. The aim of this study was to assess the spatial changes in land use from 1990 to 2018 and analyze the changes in ecosystem service value (ESV) in response to the changes in landscape structure in Lithuania. Croplands provided the majority of the ESV, followed by forests, grasslands, and wetlands. The total ESV in Lithuania was USD 29 billion year^{-1} in 2018, and land use had a significant impact on ESV, with a total decrease of USD 438 million year^{-1} between 1990 and 2018. The total ESV change was mainly influenced by the decrease in provisioning (USD 426 million year^{-1}) and regulating (USD 208 million year^{-1}) services. The reduction in cropland area was a major factor in the loss of ESV. The increase in the value of habitat and cultural services was not large enough to offset the reduction of the ESV. The highest elasticities were in the urban municipalities, indicating a significant change in ESV due to land use change. The results of this study provide valuable insight into the potential of the sustainable management and regeneration of ecosystems.

Keywords: ecosystem service; land cover change; Lithuania; benefit transfer

1. Introduction

Ecosystems directly and indirectly ensure human well-being and quality of life by providing services [1]. They include a range of benefits, from the most basic products like food and building materials to the very broad, indirect benefits such as flood regulation and recreation [2–6]. Ecosystem services are classified into categories such as provisioning, supporting, regulating, and cultural services [7], although different classifications might be used. For example, regulating services are, in some cases, grouped together with provisioning services, as the former category of ESs is often the basis for several of the others [8]. In addition, cultural ESs are difficult to assess as they are generally outside the scope of ecological science, requiring additional knowledge from relevant experts [9].

The scientific interest in ecosystem services has been growing since the 1960s and has become even more relevant in the 21st century [10]. The destruction or degradation of ecosystems has many social and economic consequences, particularly in developing countries. The palm oil boom, for example, has improved the well-being of local populations but has had a negative impact on biodiversity and ecosystem functioning [11]. On the other hand, the expansion of mining in the Amazon rainforest has negatively affected local indigenous populations [12]. Decisions that take ESs into account can bring benefits to the environment and local populations [13,14].

An ecosystem service value (ESV) is a monetary value assigned to the relative contribution of an ES to human well-being over a given time period [1,15]. The quantitative valuation of ESs helps to translate a rather vague “nature is good” approach into a more easily applicable language for concrete decision making. These monetary values can then be used as one of the arguments influencing decisions to change the environment [16,17]. Globally, Costanza et al. [18] and de Groot et al. [15] have valued the ES of each biome in

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monetary terms, which is widely used to calculate ESV across regions and at different scales and is an important part of integrated ES assessment [19]. Calculating ESV poses many challenges, mainly due to the lack of clarity or distinction between ecosystem services and ecosystem functions; this can lead to errors such as double counting. For example, crop pollination is a component of food provision, so the two services should not simply be aggregated [8,20]. Finally, the ESV presents a moral dilemma for putting a price on nature. However, incorporating ecosystem services and their value into decision making is a valuable and pragmatic tool for promoting environmental ideas in a variety of fields.

Changes in land cover/land use are a key factor affecting ecosystem services. Biodiversity loss, floods, soil erosion, and local climate change are among the most affected ecosystem services due to land use change. In many cases, ecosystem services are lost even when the land cover itself is not changed when existing management practices are changed. For example, the value of ecosystem services is highly dependent on forest management practices [21]. Similarly, a sustainably managed grassland can be a more valuable ecosystem than one where management is seeking to maximize short-term resource utilization or economic return [22,23]. It is a common practice to exploit an ecosystem in such a way that one ecosystem service is maximized while others are lost or severely degraded, thereby reducing the total value of that ecosystem [3,24–27].

Lithuania is a developed country that has undergone significant socio-economic changes in recent decades. Lithuania's population has decreased significantly, and its gross domestic product has grown considerably over the past three decades. The demand for ESs has increased accordingly. The combination of the declining population and rapid economic growth makes Lithuania an interesting object of research. More countries are projected to experience similar demographic changes, and economic prosperity is expected to continue to grow [28]. A declining population also provides an opportunity to increase the supply of ESs per capita. It can be argued that ES supply is important to sustainable wealth growth. These significant changes in social and economic life have also affected its ecosystems. Lithuanian agriculture started to change in 2004 when Lithuania joined the EU. As agriculture is a key factor in land use and quality changes, participation in the EU's Common Agricultural Policy has subsequently influenced prevailing land use practices; this is particularly important as more than half of Lithuania's land area is farmland. Since it acceded to the EU, Lithuania has also experienced societal changes, such as increased emigration, which has accelerated population decline.

An assessment of the land-use changes on ecosystem services in Lithuania, based on a non-monetary assessment using expert knowledge, showed that overall ES capacity has increased slightly [29]. Although studies on the impact of land use on ecosystem services have been carried out in some regions of Lithuania, mapping the ES potential of coastal areas [30,31] and assessing the aesthetic value of the landscape [27], the monetary evaluation of this impact at the national level has not yet been carried out. Thus, this study aims to answer the following questions: What land use changes have occurred in Lithuania between 1990 and 2018? How have changes in land use affected the value of ecosystem services in Lithuania? What is the spatial distribution of changes in land use and service values?

2. Materials and Methods

2.1. Study Area

Lithuania is a country in northeastern Europe, located on the eastern coast of the Baltic Sea and between 53°54′ to 56°27′ N and 20°56′ to 26°51′ E (Figure 1). It has a total area of 65,200 km^2, with lowlands dominating the landscape. Cropland, forest, and grassland cover over 90% of the land area in Lithuania. Cropland is prevalent in the central part of Lithuania, as it has the most fertile soils. The western and southeastern part of the country is more heavily forested, as it has less fertile, sandy, and/or more acidic soils and a more hilly landscape. With an average yearly temperature of 6.4–7.4 °C and annual precipitation of 650–800 mm, the region has a humid continental climate. Lithuania's population was

3.7 million in 1990 and 2.8 million in 2018. The main urban areas are Vilnius, Kaunas, Klaipeda, and Siauliai, each having more than 100 thousand inhabitants (Figure 1).

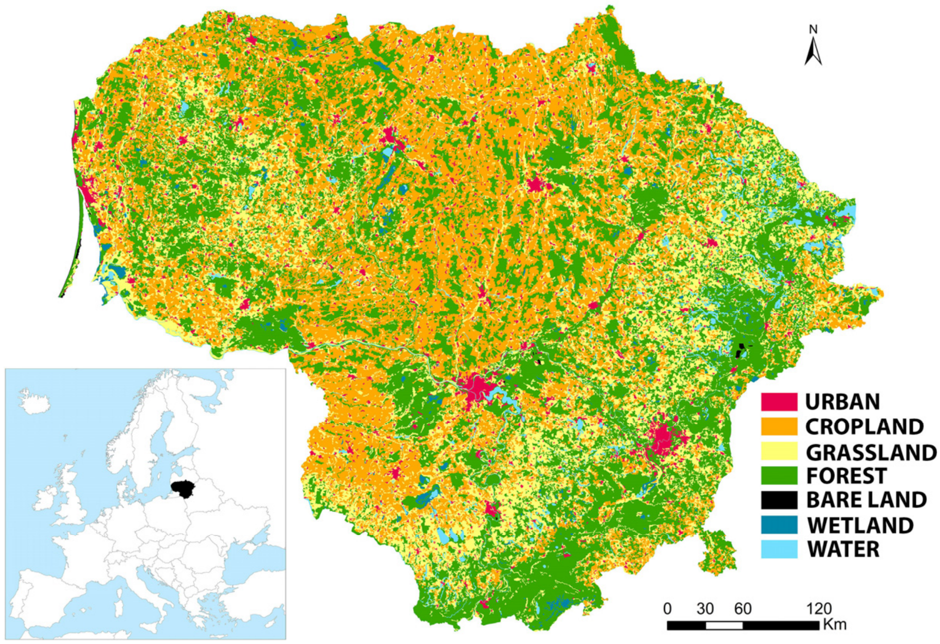

Figure 1. Map of Lithuania with municipal boundaries.

2.2. Land Cover Data and Analysis of Their Change

The land use/land cover (LULC) data were obtained from the CORINE land cover dataset, which is the most comprehensive inventory of land cover in Europe. The CORINE dataset consists of 44 land cover classes. For the assessment of ESs, CORINE land cover classes were divided into 7 main groups: urban, cropland, grassland, forest, wetland, water bodies, and bare land. Data from 1990, 2006, and 2018 were used to map LULC. Changes in LULC were assessed for the periods 1990–2006, 2006–2018, and 1990–2018.

2.3. Land Use Intensity

In comparison to intact ecosystems, land use intensity indicates how much a given type of land use is impacted by human activity. It can show the natural land characteristics and reflect the interaction of human activity with the natural environment. According to Li et al. [32], land use intensity is classified into degrees: bare land = 1 (unused land), forest, grassland, wetland, and water bodies = 2 (natural regeneration land), cropland = 3 (artificial regeneration land), and urban = 4 (rural/urban/construction land). Land use intensity (L) was calculated as [33]:

$$L = 100 \times \sum_{i=1}^{n} A_i P_i / A_T \quad (1)$$

where A_i and A_T are the areas of the ith land use type and the total area of the land, respectively; P_i is the degree of the ith land use.

2.4. Estimation of ESVs

The ecosystem service's (ESV) value was determined using a benefit transfer method. It entails the method of calculating the value by referring to prior studies of similar resources to obtain an estimate [34]. This study used ESV based on global values for main biomes (Table 1). All ecosystem service values are taken from de Groot et al. [15], except for croplands—the values of the services provided by these ecosystems are taken from Costanza et al. [18]. For the assessment of wetland and watershed ecosystem services, values for inland wetlands and freshwater ecosystems were chosen, respectively [15]. The value coefficient (USD ha^{-1} year^{-1}) was 5.57 for agricultural land, 2.87 for grassland, 3.01 for forests, 2.56 for inland wetlands, and 4.27 for freshwater (waterbodies) ecosystems. The ESV was not assigned to urban and bare land use types. Although urban ecosystems provide some ESs, they are also negatively impacted by pollution [35]. Bare land covers only a small proportion (<1%) of the total land area in Lithuania. However, both land use types were included in the calculation of land use change to estimate the elasticity of ESVs.

Table 1. Ecosystem service values (ESVs in USD ha^{-1} year^{-1}, 2007) for each type of land use/land cover calculated using global value coefficients [15,18].

Ecosystem Services	ESVs (USD ha^{-1} year^{-1})				
	Cropland	Grassland	Wetland	Waterbodies	Temperate Forest
Provisioning services					
Food	2323	1192	614	106	299
Water	400	60	408	1808	191
Raw materials	219	53	425	–	181
Genetic resources	1042	–	–	–	-
Medicinal resources	–	1	99	–	-
Ornamental resources	–	–	114	–	-
Regulating services					
Climate regulation	411	40	488	–	152
Disturbance moderation	–	–	2986	–	-
Regulation of water flows	–	–	5606	–	-
Waste treatment	397	75	3015	187	7
Erosion prevention	107	44	2607	–	5
Nutrient cycling	532	–	1713	–	93
Pollination	22	–	–	–	-
Biological control	33	–	948	–	235
Habitat services					
Nursery services	–	–	1287	–	-
Genetic diversity	–	1214	1168	–	862
Cultural services					
Aesthetics information	–	167	1292	–	-
Recreation	82	26	2211	2166	989
Culture and art	–	–	700	–	1
Total	5567	2871	25,682	4267	3013

Ecosystem services were classified into four classes, including several ecosystem services. Provisioning services include material or energetic outputs from ecosystems, including food, water, raw materials, and other resources. Regulating services cover factors that affect the ambient biotic and abiotic environment, such as climate and water flow regulation, erosion prevention, etc. Cultural services include non-material uses, such as spiritual, recreational, and cultural benefits. Habitat services cover benefits that are essential for maintaining biodiversity and include genetic and nursery services [15,18].

The ESV was calculated by summing the area of each land use type (ha) with the corresponding service value coefficient of the land use type (USD ha^{-1} year^{-1}) [36]. The total ESV for the reference year was calculated by summing the ESV of each land use type.

The change in ESV over time was assessed by evaluating the difference in value over the studied period as a percentage.

The value of individual ecosystem functions of the studied landscape was calculated by multiplying the area (ha) by the coefficient of the corresponding function value (USD ha^{-1} year^{-1}) for the LULC type [37].

2.5. Elasticity of Changes in ESVs

The sensitivity of ESs to modifications in land use is quantified by the elasticity of ESVs. The percentage change in ESVs related to the percentage change in land use is determined by the elasticity of the associated ESV change. In this study, the elasticity (*EEL*) was calculated at the municipal and national level [38]:

$$EEL = \left| \frac{\frac{ESV_{end} - ESV_{start}}{ESV_{start}} \times 100\%}{LCP} \right| \tag{2}$$

$$LCP = \frac{\sum_{i=1}^{7} \Delta LUT_i}{\sum_{i=1}^{7} LUT_i} \times \frac{1}{T} \times 100\% \tag{3}$$

where ESV_{start} and ESV_{end} are the ESVs at the beginning and end of the study period, respectively; *LCP*—land conversion percentage; ΔLUT_i—the converted area of the *i* type land use; LUT_i is the area of land use type *I*; *T* is the time of the study period (in years).

3. Results

3.1. Changes in LULC and Land Use Intensity

The dominant land use type in Lithuania was croplands. Forest covered almost 30%, followed by grassland with approximately 10%. Wetlands, water bodies, and urban land together covered less than 10% of the total area (Figure 2).

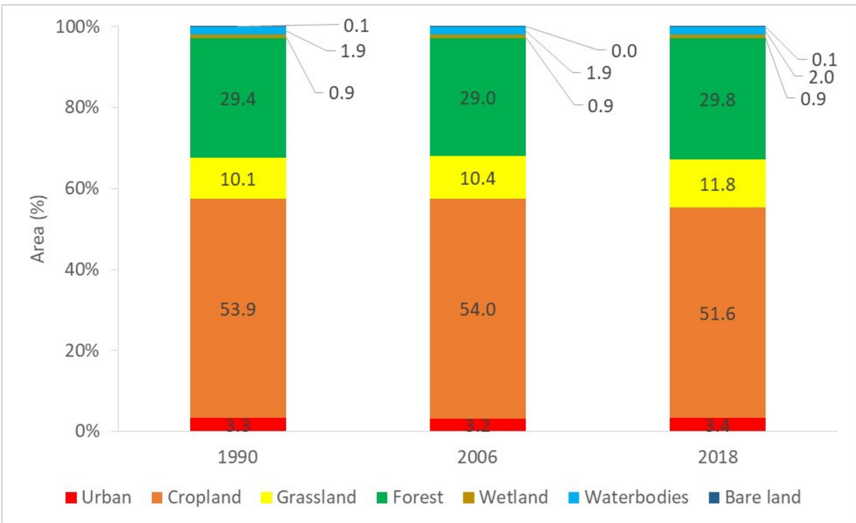

Figure 2. Percentage of each land cover type in Lithuania in 1990, 2006, and 2018.

The spatial distribution of land use areas showed that croplands were more prevalent in central Lithuania, while forests were more concentrated in the southeast (Figure 3). Since 1990, changes in land use types have been uneven, and no trend has been identified (Table 2, Figure 4). Urban areas and forests decreased between 1990 and 2006 and increased between 2006 and 2018. Meanwhile, wetland and cropland cover followed the opposite trend in these periods, increasing in the former and decreasing in the latter, respectively. Overall, the most significant land use occurred in cropland, grassland, and forest areas (Table 2). Over the whole study period, cropland area decreased by about 150,000 ha, while grasslands and forests increased by 112,000 ha and 24,400 ha, respectively. The area of wetlands decreased by 800 ha, while the area of inland water bodies and bare land increased by 4700 ha and 300 ha, respectively.

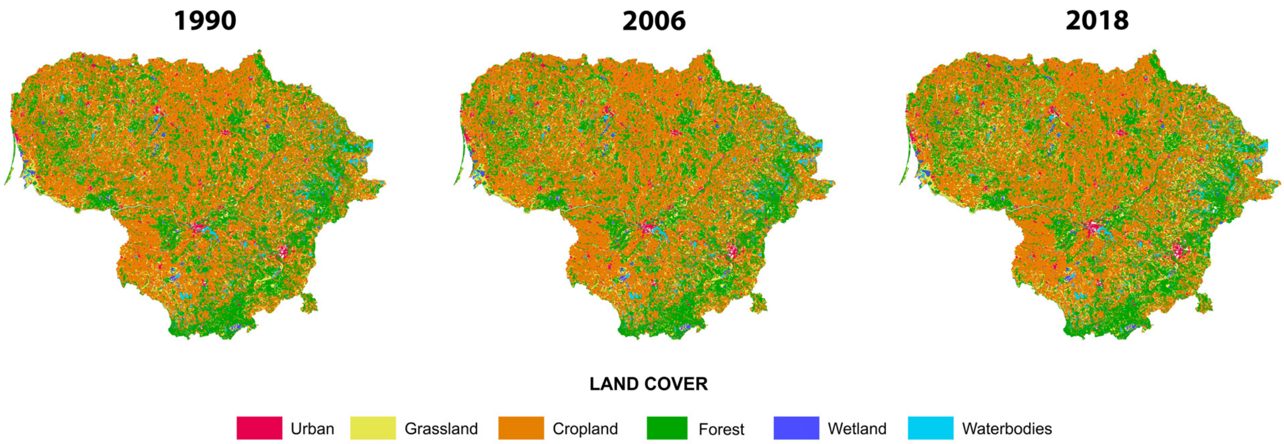

Figure 3. Distribution of the different types of land cover at a spatial scale (in Lithuania in 1990, 2006, and 2018).

Table 2. Land area by type cover (ha) in Lithuania 1990, 2006, and 2018.

LULC	Area (ha)		
	1990	**2006**	**2018**
Urban	213,501	209,342	220,746
Cropland	3,514,761	3,522,142	3,364,930
Grassland	656,272	675,985	768,753
Forest	1,919,984	1,891,764	1,944,342
Wetland	57,271	60,228	56,496
Water bodies	124,521	125,873	129,219
Bare land	3451	2969	3821

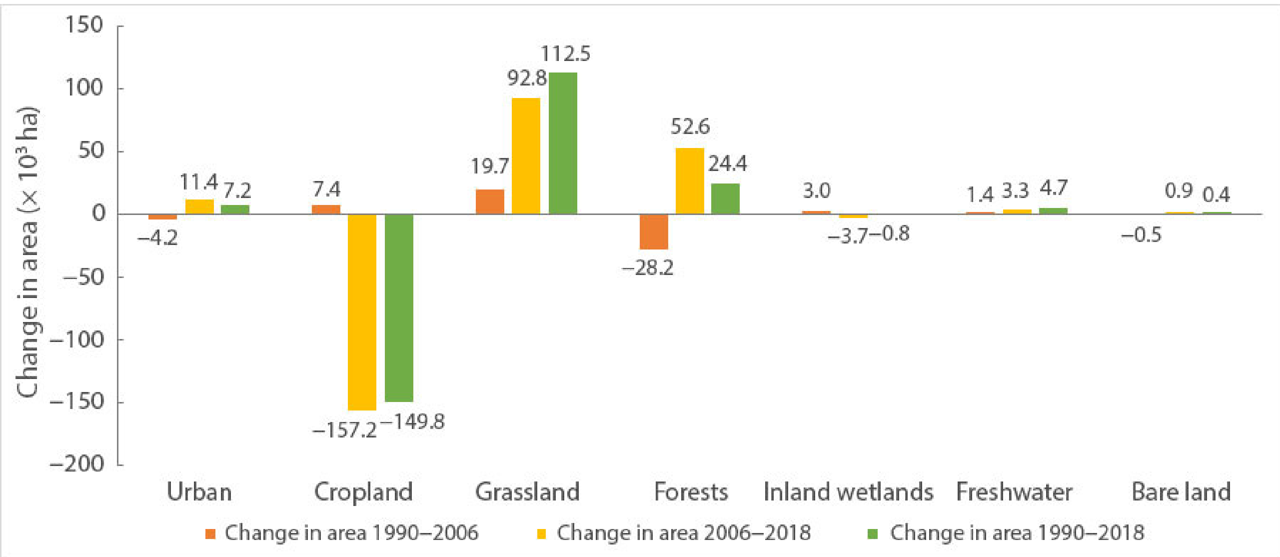

Figure 4. Changes in the extent of each land cover category in Lithuania in different time periods (1990–2006, 2006–2018, and 1990–2018).

Land use intensity decreased from 261 in 1990 and 2006 to 259 in 2018 (Figure 5). Within municipalities, land use intensity ranged between 185 and 359 during the study period. The highest intensities were observed in urban municipalities and municipalities with intensive agriculture (i.e., where cropland was the dominant land use type). The largest number of such municipalities were in central Lithuania (Figure 5). The lowest intensities were found in southeastern and some coastal municipalities with high forest cover. The municipality of Neringa in westernmost Lithuania had the lowest land use intensity over the whole period under study due to its large area of forests and sand dunes.

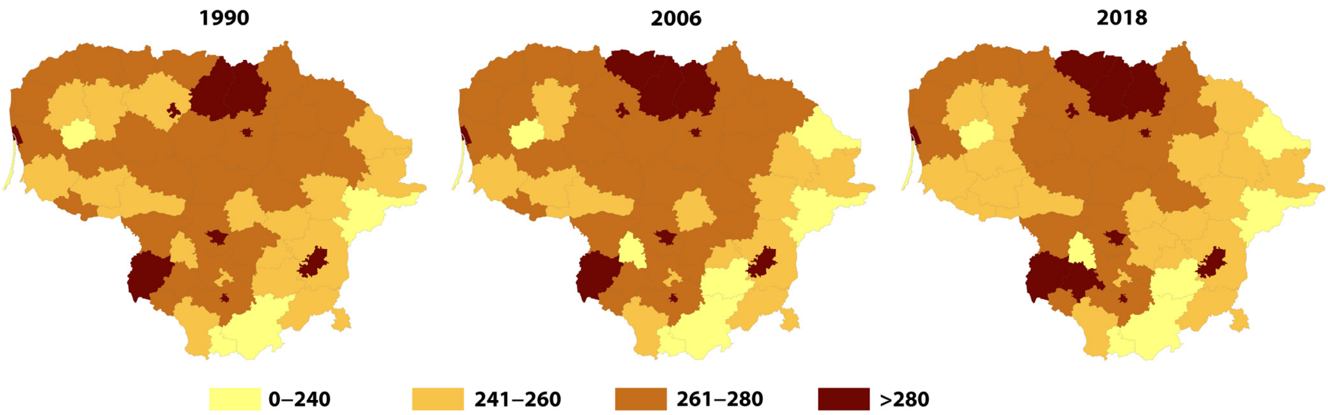

Figure 5. Land use intensity (L) in municipalities of Lithuania in 1990, 2006, and 2018.

3.2. Estimation of Changes in ESVs and Individual Ecosystem Functions

The total ESV in Lithuania was USD 28.8 billion year^{-1} in 2018, which was 1.49% and 1.81% lower compared to 1990 and 2006 (USD 29.24 and 29.33 billion year^{-1}, respectively; Table 3). Over the entire study period, the majority of the ESV (65.0–66.9%) was provided by croplands, followed by forests, grasslands, and wetlands (Figure 5). Wetlands accounted for a disproportionate share of the total ESV (about 5%), although they covered less than 1% of the total land area (Figure 3).

Table 3. Ecosystem services value (ESV in USD year^{-1}) for each land cover type in 1990, 2006, and 2018 and its change in Lithuania. Values in bold indicate the total value of ecosystem services provided by land use types.

Land Use/Land Cover Type	ESV (Million USD year^{-1})			ESV Change (Million USD year^{-1})		
	1990	2006	2018	1990–2006	2006–2018	1990–2018
Cropland	19,567	19,608	18,733	41	−875	−834
Grassland	1884	1941	2207	57	266	323
Forest	5785	5700	5858	−85	158	73
Wetland	1471	1547	1451	76	−96	−20
Water bodies	531	537	551	6	14	20
Total	29,239	29,334	28,802	94	−532	−438

Land cover/land use had a significant impact on ESVs, with a total decrease of USD 438 million year^{-1} over the entire study period (1990–2018) (Table 3). Moreover, changes in ESV differed significantly between the two periods studied (1990–2006 and 2006–2018). In the period 1990–2006, ESV increased by USD 94 million year^{-1}, which was mainly related to the wetland services (USD 76 million year^{-1}, or an annual rate of increase of about USD 5 million year^{-1}). ESVs from grasslands and croplands also increased (USD 57 million year^{-1} or an annual rate of USD 3.56 million year^{-1} and USD 41 million year^{-1} or an annual rate of USD 2 million year^{-1}, respectively). During the same period, the ESV from forests decreased by USD 85 million year^{-1} with an annual rate of USD 5 million year^{-1}.

The total ESV decreased by USD 532 million year^{-1} from 2006 to 2018 (Table 3). During this period, the ESV from croplands decreased significantly (USD 875 million year^{-1} or an annual rate of USD 73 million year^{-1}); this was followed by a decrease in ESV from wetlands (USD 96 million year^{-1} or an annual rate of USD 8 million year^{-1}). A significant increase in ESVs from grasslands (USD 266 million year^{-1} or an annual rate of USD 22 million year^{-1}) and forests (USD 158 million year^{-1} or an annual rate of USD 13.17 million year^{-1}) had not been compensated by the loss of services value from croplands, leading to the decrease in the total ESV between 2006 and 2018. Overall, changes in land cover/land use during this period were much larger and had a negative impact on the balance for the whole period (1990–2018), resulting in a decrease in USD 438 million year^{-1} (Table 3).

Provisioning ecosystem services contributed almost 57% to the total ESV value while regulating ES—less than 25% (Table 4). Together, cultural and habitat services accounted for less than 20% of the total ESV in Lithuania. The values of most of the ESs increased between 1990 and 2006, with a decrease in recreation, biological control, and raw material services. The most significant increase in ESV was due to food provisioning services (USD 34 million year^{-1} or USD 2 million year^{-1}). The increase in wetland areas led to the increase in ESV due to the regulation of water flows and waste treatment. The ESV declined between 2006 and 2018 for most ecosystem functions, with the largest losses occurring due to the reduction in cropland: food (USD 241 million year^{-1} or an annual rate of USD 20 million year^{-1}) and genetic resources (USD 164 million year^{-1} or an annual rate of USD 13 million year^{-1}).

Table 4. Ecosystem services value (ESV, million USD year^{-1}) by ecosystem function in the study year and changes in these values between the study periods.

Ecosystem Services	ESV (Million USD year^{-1})			ESV Change (Million USD year^{-1})		
	1990	2006	2018	1990–2006	2006–2018	1990–2018
Provisioning services						
Food	9570	9604	9363	34	−241	−207
Water	2060	2063	2020	2	−43	−40
Raw materials	1176	1175	1154	−1	−22	−23
Genetic resources	3662	3670	3506	8	−164	−156
Medicinal resources	6	7	6	0	0	0
Ornamental resources	7	7	6	0	0	0
Regulating services						
Climate regulation	1791	1792	1737	1	−55	−54
Disturbance moderation	171	180	169	9	−11	−2
Regulation of water flows	321	338	317	17	−21	−4
Waste treatment	1654	1667	1602	13	−66	−52
Erosion prevention	564	573	551	9	−22	−13
Nutrient cycling	2147	2153	2068	6	−85	−79
Pollination	77	77	74	0	−3	−3
Biological control	621	618	622	−4	4	0
Habitat services						
Nursery services	74	78	73	4	−5	−1
Genetic diversity	2519	2522	2675	3	154	157
Cultural services						
Aesthetics information	184	191	201	7	11	18
Recreation	2600	2583	2624	−17	41	23
Culture and art	42	44	41	2	−3	−1
Total	29,242	29,336	28,804	94	−532	−438

Between 1990 and 2018, the total ESV was mainly influenced by the decrease in provisioning (USD 426 million year^{-1}) and regulating (USD 208 million year^{-1}) services (Table 4). Food and genetic resources were the main contributors to the overall decline in ESVs. The reduction in cropland area was the major factor in the loss of ESVs. The most significant increase in ESVs was due to genetic diversity, at USD 157 million year^{-1}, mainly driven by the increase in forest and grassland areas. However, the increase in the value of habitat (USD 156 million year^{-1}) and cultural (USD 40 million year^{-1}) services was not large enough to offset the reduction of the value, with the total ESV declining by USD 438 million year^{-1} between 1990 and 2018 (Table 4).

3.3. Spatial Distribution of Changes in ESVs and Change in ESVs Associated with Land Use Change (Elasticity)

The change in ESVs was observed on the area of 1 370,693 ha, i.e., 21.5% of the total land area of Lithuania (Figure 6). The decrease in ESVs occurred in areas covering 10.3% (654,613 ha), mainly concentrated in the western and southeastern parts of Lithuania. The increase in ESVs occurred in areas covering 11.2% (716,081 ha) of the total area and was concentrated in the central part of the country, where lowlands were predominant (Figure 6).

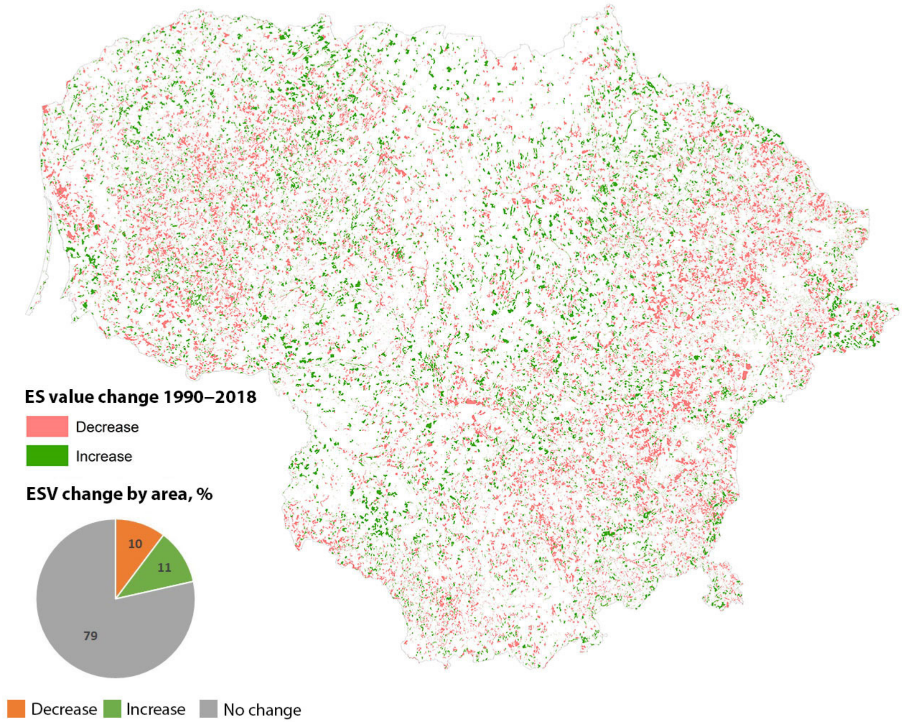

Figure 6. The spatial distribution of ESVs changed in Lithuania from 1990 to 2018.

Between 1990 and 2018, the ESVs decreased in 27 municipalities and increased in 33 municipalities. The number of municipalities with a negative change in ESVs was in the southeastern part of Lithuania (Figure 7). This region was characterized by a hilly, forested landscape with sandy, unfertile soils. The ESVs in five out of six urban municipalities decreased between 1990 and 2006. The ESVs decreased in 50 out of 60 municipalities from 2006 to 2018. Most of the municipalities with a positive change in ESVs were in the central and northern parts of Lithuania with intensive agriculture. The most significant decrease in ESVs was in the urban municipalities. Overall, the ESVs decreased in 42 out of 60 municipalities during the period 1990–2018. The positive change in ESVs was mainly observed in central and northern Lithuania (Figure 7). The largest decrease in ESVs was observed in urban municipalities, as well as in some rural municipalities in eastern Lithuania.

In Lithuania, the elasticity of ESVs change (EEL) as a result of land use change increased from 0.67 in 1990 to 2.86 in 2018, with values ranging from 0 to 55.2 (Figure 8). The values of EEL were 0.09 to 28.19 and 0.16 to 28.64 for the periods 1990–2006 and 2006–2018, respectively. Significant differences were found between municipalities. The highest values of elasticity were concentrated in the urban municipalities, which were significantly higher than the average value of Lithuania, indicating a large change in ESV due to the change in land use (Figure 8).

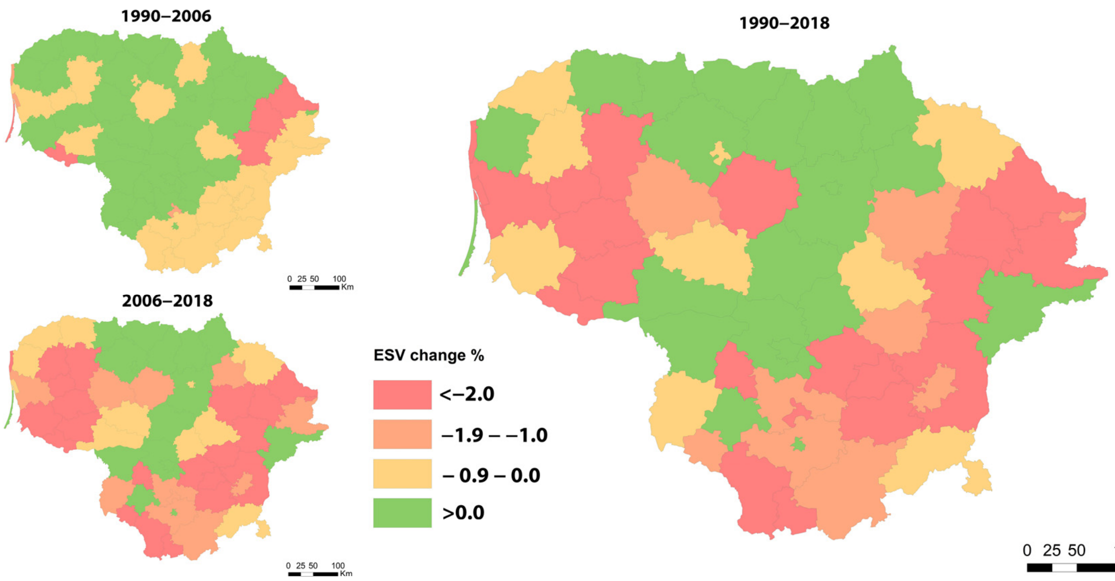

Figure 7. ES value change (%) in municipalities of Lithuania, 1990–2006, 2006–2018, and 1990–2018.

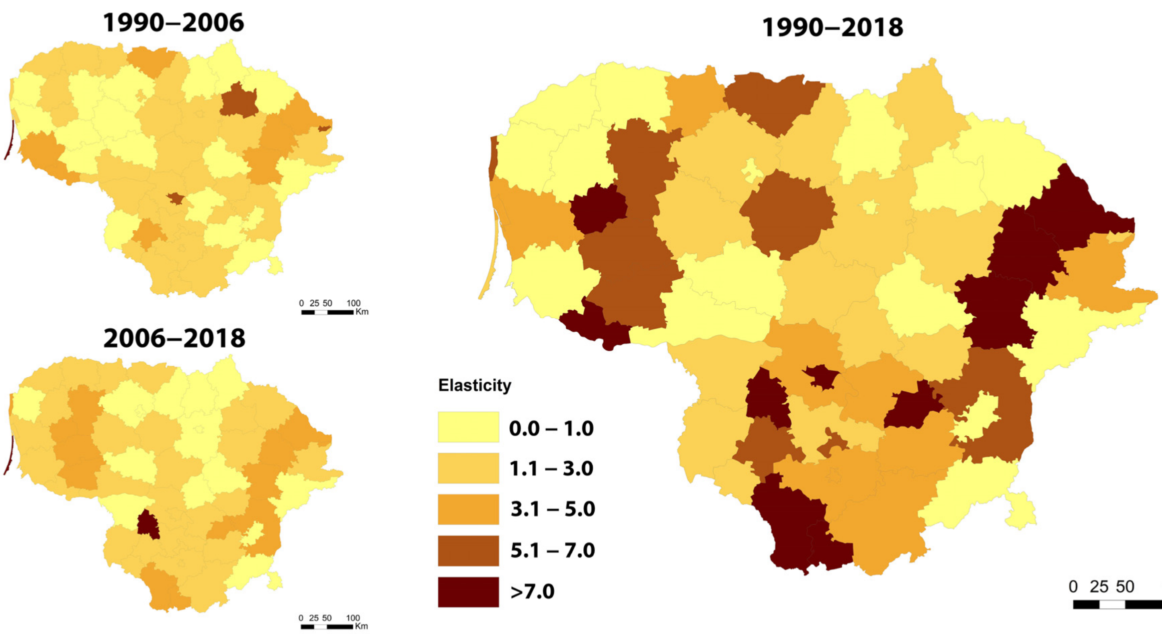

Figure 8. Elasticity (EEL) of ESV in municipalities of Lithuania, 1990–2006, 2006–2018, and 1990–2018.

4. Discussion

4.1. Land Use Change, Intensity, and Change Patterns

The largest change in land use was caused by the decrease in cropland between 1990 and 2018. The main reason was probably the shift from collective farming to free market farming at the beginning of the period (1990s). In the second half of the period (since 2004), the trends in cropland area change were mainly determined by the EU's agricultural policy. In the entire post-communist region of Central and Eastern Europe, since 1990, a trend of abandonment and general decline of agricultural land has been observed [39,40]. Many small farms have disappeared, and the agricultural sector has become dominated by industrial farms, which were prioritized under the EU's common agricultural policy [41]. One of the consequences of this trend is land consolidation [42]. The total area of forests has increased, which is one of the consequences of the abandonment of agricultural land. In addition, some land considered unsuitable for agriculture has been subsidized for afforestation [43].

In contrast, the area of grasslands has increased, the largest of any ecosystem studied, and most of this increase has been at the expense of croplands. In Lithuania, where a very large part of the land is cultivated, the replacement of croplands by grasslands can be a positive trend according to the ES potential, but the quality of grasslands has been declining. Most have been intensively used and fertilized and have lost their natural or semi-natural vegetation [44,45]. More detailed studies are needed to better assess changes in grassland ecosystems.

Urban areas have increased, much of which can be attributed to suburban sprawl around the largest cities. Although the population of Lithuania decreased from 3.6 million to 2.8 million between 1990 and 2018, the only regions where the population grew were the three suburban municipalities around the three largest cities. The growing suburbs occupy land that used to be croplands or grasslands [46].

Wetland area decreased relatively little during the study period, although other studies found an even greater decrease in wetland area [47]. But their future is becoming increasingly uncertain. Climate change poses a threat to raised bogs, which are located near the southern end of the range in Lithuania [48]. If current climate trends continue, some wetlands are likely to be replaced by forests.

Most of the bare land was in the Curonian Spit (sand dunes), but it was overgrown with grasses and, eventually, shrubs and trees. Grazing was introduced to preserve the open areas. However, it is predicted that the bare sand areas will continue to decline in the future [49]. The increase in bare areas has also been linked to military ranges where bare ground is used for training. Due to the geopolitical situation, there will likely be more military training areas in the future; for example, the former Rūdnininkai military training ground was reopened in 2022.

4.2. Changes in ESVs

The total value of ecosystem services in Lithuania in 2018 was USD 29 billion per year, the lowest since 1990 and 2006, declining by more than USD 437 million per year between 1990 and 2018. This decline was mainly due to a reduction in the areas of cropland, which was not offset by the increase in the value of services provided by natural ecosystems such as forests and grasslands; this is supported by the higher value of ecosystem services attributed to cropland than some natural ecosystems according to globally estimated values [15,18]. Arguably, this valuation needs to be revised, as food production is one of the easiest ecosystem services to value, and it overestimates the value of cropland [37,50]. The abandonment of agricultural land has affected other ecosystem services, such as biodiversity [51].

The ESV from grassland increased by 323 million USD year^{-1}; this was the largest increase in ecosystem services compared to the other ecosystems studied. In Lithuania, the increase in the area of grasslands between 1990 and 2018 was mainly due to changing agricultural practices and abandonment. Grassland ecosystems are highly diverse in their ecological structure and management. To maximize their value, grasslands need continuous but extensive management, so any changes in their management have a significant impact on their ES potential [24,45,52,53].

Managed, natural, and recreational forests have slightly different ES potentials in terms of quantity and quality. In the case of Lithuania, forests are divided into four classes according to their management. Class 1 includes undisturbed forests in reserves where no human activity or even visitation is allowed. Class 4, on the other hand, is a commercial forest where the main goal is to obtain as much timber as possible. These differences in forest management should be taken into account in future research, as differently managed forests can provide very different ecosystem services [54,55]. In addition, a more detailed classification should be applied to other ecosystems, such as grasslands, water bodies, and wetlands.

The suburbanization around the largest cities of Lithuania has reduced ESV. Built-up areas are very poor places in terms of ES, and their expansion accelerates the loss of ESV. In addition, urban sprawl also creates or exacerbates socio-economic problems, increasing travel times and distances, putting pressure on infrastructure, and, as the population declines, placing a financial burden on the city center [46,56–58].

Wetlands are the most valuable ecosystems in terms of ES provision [15,18]. However, not only are they declining in Lithuania, but the remaining wetlands (especially peatlands) are threatened by climate change and drying, among other factors. In drier conditions, peat formation slows down, peat degradation usually begins, and carbon is released back into the atmosphere [13,59]. Conservation and management of wetlands could prevent or slow the loss of this valuable ecosystem.

Despite their small total area, wetlands have a disproportionate impact on the total ESV. Most wetlands in Lithuania are drained, partly drained, or destroyed, and the peat is formed in 146 (18%) wetlands larger than 50 ha [59]. The restoration of damaged wetlands would also have a significant impact on the Lithuanian landscape, ecosystems, and the services they provide, as it would increase the ESV. The role of wetlands in carbon sequestration is particularly important in the face of climate change. However, wetlands provide many other very important functions: water retention, filtration, habitat provision, recreation, and food (e.g., berries). Several successful wetland restoration projects have been implemented in Lithuania, such as the Great Tyrulis bog [60]. However, there are many peatlands that are currently being exploited for peat. Such activities use only one thing—peat—and negate all the aforementioned services provided by an undisturbed or functioning wetland [61].

Assigning a monetary value to ecosystem services remains quite controversial because it places a price on nature, which is often considered priceless. However, it is a very useful decision-making tool when there are doubts about the environmental impact of certain activities. Although the benefits of different ecosystems are generally well known, their uncertainty can be used as a strong argument in various conflicts. The availability of monetary valuations of ESs can influence decision making [62,63].

Based on expert assessments, a similar study on the impact of land use change on the ES potential found a slight increase in value in Lithuania during the same period [29]. This discrepancy is due to different approaches to assessing the monetary benefits of the ES. The valuation methods should be more country/regional specific, and land cover types should be described in more detail.

4.3. Spatial Distribution of Land Use and Changes in ESVs

The increase in ESVs was mainly concentrated in central Lithuania, where agriculture prevails; this can be explained by the increase in cropland, primarily at the expense of grasslands. Since this part of Lithuania has the best conditions for crop production, it is economically beneficial for farmers to maximize the area of cultivated land. The flat, fertile land of central Lithuania is more suitable for large-scale industrial farms than the smaller farms in the west and southeast of the country. As mentioned above, many small farms have disappeared in Lithuania since 1990 [41].

The highest values of the elasticity of ESs were determined in urban municipalities, especially in Vilnius, Kaunas, Klaipėda, Panevėžys, and Alytus. Urban development in cities is likely to overtake more natural areas with an urban fabric. In Lithuanian cities, except for Vilnius, since 1990, the population decreased significantly [46,64]. The loss of the ESV, even as population density decreases, may indicate a need for more sustainable urban development practices in Lithuania.

5. Conclusions

This study is the first to evaluate the value of Lithuanian ecosystem services, taking into account land use changes over the last three decades. During the entire study period, the cropland area decreased by about 150 000 ha, mainly at the expense of grasslands and forests. The highest land use intensity was observed in urban areas and areas of intensive agriculture. Croplands provided the highest ecosystem service value, followed by forests, grasslands, and wetlands. The total ESV decreased throughout the period, with provisioning and regulating services declining the most. Although the population of Lithuania decreased significantly during the study period, which was supposed to reduce the demand for ecosystem services and increase prosperity, this led to an overall decrease in the ESV. Our results provide useful information on how land cover/land use changes affect the value of ecosystem services and can be used to inform decisions about sustainable ecosystem management.

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