sustainability

MDPI

Commentary

Latent Drivers of Landscape Transformation in Eastern Europe: Past, Present and Future

Marcela Prokopová [1], Ondřej Cudlín [1], Renata Včeláková [1], Szabolcs Lengyel [2], Luca Salvati [1,3] and Pavel Cudlín [1,*]

[1] Global Change Research Institute of the Czech Academy of Sciences, Lipová 9, CZ-37005 České Budějovice, Czech Republic; mar76@seznam.cz (M.P.); ondrac.c@centrum.cz (O.C.); rbur@seznam.cz (R.V.); luca.salvati@crea.gov.it (L.S.)

[2] Hungarian Academy of Sciences, Centre for Eological Research, Danube Research Institute, Department of Tisza Research, Bem tér 18/c, HU-4026 Debrecen, Hungary; lengyel.szabolcs@okologia.mta.hu

[3] Council for Agricultural Research and Economics (CREA), Viale S. Margherita 80, I-52100 Arezzo, Italy

* Correspondence: cudlin.p@czechglobe.cz

Received: 6 July 2018; Accepted: 14 August 2018; Published: 17 August 2018

Abstract: Land-use changes in Europe have been influenced by social forces including economic, demographic, political, technological and cultural factors. Contributing to a refined conceptualization of multifaceted processes of landscape transformation in the European continent, the present study proposes an extensive review of land-use trends in Eastern Europe, focusing on past, present and future conditions that may characterize latent drivers of change. Three time periods with a specific institutional, political and socioeconomic context reflecting distinct processes of land-use change were identified including: (i) the rapid transition to a centralized political system since the early 1950s (up to the late 1980s); (ii) a progressive transition from communist regimes to parliamentary democracy in 1989–1990 (up to the early 2000s); and (iii) the subsequent accession of individual countries to the European Union (2004–2007) up to nowadays. The most recent land-use trends are increasingly influenced by European directives on the environment, while national policies continue to shape economic development in member states.

Keywords: socioeconomic forces; global change; land-use change; post-socialistic countries

1. Introduction

Landscape transformations in Europe are affected by a multifaceted set of social forces that include demographic, economic, political, technological and cultural factors. In this regard, patterns and processes of Land-Use Change (hereafter LUC) are increasingly driven by the private interest of landowners and local communities, as well as by the wider interest of societies reflected in actual policy strategies [1]. Based on a meta-data analysis considering 144 case studies assessing landscape transformation across the continent, the role of latent LUC drivers in Europe was outlined evidencing distinct combinations of political/institutional, cultural and territorial forces [2–4]. In this regard, the major trajectories of landscape transformation were associated to socioeconomic processes such as urbanization (both compact and dispersed), agricultural intensification, cropland abandonment, forestation and expansion of natural, non-forest land. These processes were in turn influenced by a multiple set of factors, whose importance has changed considerably over time [5]; for instance, technological and economic factors (including greater access to loans and increased public/private investments) have promoted agricultural intensification especially along the last century [5]. Institutional and political drivers mostly affected urbanization during the second half of

the 20th century [1]. Cropland abandonment driven by economic expansion and population expansion became especially relevant since the early 1970s, a time period coinciding with major economic changes worldwide [6]. Lifestyles and cultural factors had a relevant impact on urban sprawl at the end of the 20st century [4]. Conversely, subsidies stabilizing farmers' income and farms' production often led to agricultural extensivation since the early 1980s [7].

Under the hypothesis that LUCs in Europe have been distinctively influenced by multiple socioeconomic forces [8–11], the present commentary discusses recent land-use trends in Eastern Europe, focusing on past, present and future conditions that characterize latent drivers of change. Intended as a contribution to a more comprehensive understanding of landscape transformations in the whole continent, this paper is aimed at identifying and discussing the role of direct (and indirect) forces of landscape transformation in Eastern Europe, considered as a 'laboratory' of land-use change due to the largely differentiated drivers of change over time and space (Table 1). Placed in-between Russia, Middle East, central Europe and the Mediterranean, Eastern Europe is considered a transitional area between Asia and Europe displaying multiple forces of landscape transformation that are intimately linked with the peculiar history of the region, characterized by a unique trajectory of growth and change under different economic, social and political regimes. With the aim to better understand and discuss forces of landscape transformation under distinct regimes, three time intervals with divergent institutional assets influencing significantly land-use change in the region were considered here, covering the second half of the last century: (i) the rapid transition to a centralized political system since the 1950s; (ii) a progressive transition from communist regimes to parliamentary democracy in the late 1980s and early 1990s; and (iii) the subsequent accession of individual countries to the European Union in the early 2000s.

Following the official definition provided by the United Nations Statistics Division, Eastern Europe is constituted by the following countries: Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia, as well as the Slavic Republics of Belarus, Moldova and Ukraine. The definition of "Eastern Europe" is frequently used to include European countries that were previously ruled by Communist regimes (namely, the 'Eastern Bloc') under the "Iron Curtain" regime separating Western Europe from Soviet-controlled Eastern Europe along the period of the Cold War. Under this line of thinking, the Baltic Republics of Estonia, Latvia and Lithuania, Albania, Slovenia and Croatia, as well as Bosnia and Herzegovina, Kosovo, Serbia, Macedonia and Montenegro (the countries belonging to the former Yugoslavia), were included informally in such geographic definition (Figure 1). In these regards, the institutional transition of Eastern Europe to advanced (capitalistic) economic systems has represented a unique ensemble of background factors underlying long-term landscape transformations. Under the assumption that land-use dynamics will be increasingly influenced by European directives and policies at supra-national scale, a comprehensive understanding of LUC dynamics contributes to identify the role of socioeconomic forces and national policies shaping landscape transformations in member states. In this regard, the present commentary will focus on the specific feedback between political/institutional transitions and landscape transformations in Eastern Europe, evidencing social, economic demographic, political and cultural factors of change over distinct time intervals encompassing a period from World War II to nowadays. The paper is organized as follows: Section 2 evaluates the intimate relationship between institutional transitions and landscape transformations in Eastern Europe over recent decades, identifying and commenting the role of distinct factors of land-use change in the Communist era, during the subsequent transition to open market and capitalism and in a more recent time period coinciding with the access of most Eastern countries to European Union. A narrative approach grounded on a bibliographic analysis of relevant case studies dealing with landscape transformations and the underlying environmental and socioeconomic drivers was carried out to ground discussion on an informed and updated scientific knowledge. Based on this ground, Section 3 identifies and discusses present and future LUC trends in Eastern Europe, confirming and justifying the statement that Eastern countries can be considered a laboratory of landscape transformations thanks to the latent feedback between differentiated factors of change over both time and space. Section 4 outlines the relevance of our qualitative analysis of LUC

drivers with a broader look to the whole continent, evidencing impacts and consequences of landscape transformations at both regional and local scales. Section 5 finally concludes this commentary with some statements summarizing the scientific contribution of our study and the need for further studies in the field of land-use change in Europe.

Table 1. Candidate driving forces influencing land-use in Eastern Europe (ai: agricultural intensification, u: urbanization, ae: agricultural extensivation, aa: agricultural land abandonment; X: driving force of the respective land-use process Skokanová et al. [7]).

	Driving Forces	ai	u	ae	aa
Technological	irrigation/drainage	●			
	specialization	●			
	new crops	●			
	new technologies	●			●
	mechanization	●			
	fertilizers	●			
	road construction	●	●		
	industrialization	●			●
	underdeveloped infrastructure				●
Political	self-sufficiency	●			
	collectivization	●			
	land reforms	●			●
	subsidies	●	●	●	●
	environmental law			●	●
Economic	Prices	●			
	high costs/low yields				●
	new markets/market change/loss	●			●
	economic development		●		
	structural changes		●		
	international competition				●
Cultural and socio-demographic	population growth	●	●		
	population decline				●
	life preferences		●		
	recreational facilities		●		
	environmental awareness			●	

Figure 1. A basic map illustrating countries belonging to Eastern Europe (source: our elaboration on maps presented in the website: https://www.tripsavvy.com/maps-of-eastern-europe-4123431).

2. Institutional Transition and Landscape Transformations in Eastern Europe

2.1. Socio-Political Forces of Land-Use Change in the Communist Era

Relevant socio-political forces influencing LUCs were observed in Eastern Europe with the Communist regime; intensive agriculture and forestry were increasingly important uses of land, determining land alterations towards a more anthropogenic landscape in both lowland and mountain districts. In these regards, socialist agriculture was responsible for relevant transformations in cropping systems and rural landscapes and was oriented towards agricultural self-sufficiency within the Socialist bloc. Achieving more intense production targets resulted in massive subsidies oriented towards modernization and land reforms leading to confiscation of agricultural land and the establishment of centrally-managed collective farms managing a vast amount of cropland. Even larger farms were consolidated regardless of natural conditions; for instance, mega-farms were formed in flat areas of Czechoslovakia in the 1950s and 1960s and even in mountainous regions at the beginning of the 1970s [7]. The same trend took place in other countries where agricultural land was pushed into marginal and less accessible areas, as observed for example, in Romania [12]. Conversely, in some states under Soviet occupation—for instance in Latvia-, forestry became the dominant land-use in marginal and hilly areas [13].

Together with cropland, forests frequently expanded into less accessible areas; relevant examples include Czech Republic and Lithuanian coastal areas [14]. During the Soviet period, these areas experienced strict, militarized State border limitations [15,16]. In Hungary, semi-natural grasslands were often converted to arable land. Soil type, parcel area and the distance to the road network were involved in such dynamics. However, other relevant variables were population density, distance from human settlements and land protection constraints [17]. Together with rural transformations, state-driven urban growth determined massive land-use change in both central and peripheral places across Eastern Europe. Diverging from Western European dynamics—where urbanization followed economic forces and demographic trends [18–20]—political decisions were the main factor affecting urbanization in post-socialist countries. During the Communist period, vast parts of agricultural land were confiscated for the construction of industrial settlements, road networks and residential housing as well as for opencast mining [7]. Empirical findings from a study carried out by Siedentrop and Fina [21] suggest that above-average metropolitan densities of population, buildings and activities, as well as concentration of urban functions in given regions, are a legacy of Socialist housing policies.

2.2. Socioeconomic Drivers of Land-Use Change along the Transition from Communism to Open Market

Rapid changes to more open political, social and economic structures characterizing the transition from communism to capitalistic systems were grounded on processes of private property restitution, determining real estate speculation and extensively altering land markets. Mechanisms of landscape transformations in this period included both agricultural intensification and land abandonment, natural and artificial forestation and, finally, compact urbanization. Background socioeconomic contexts at both regional and local scales were influenced by indirect consequences of the transition (e.g., a thorough reduction of the state support to agriculture and industry, the progressive decline of export markets within the socialist sphere of influence and price liberalization). Farmers suddenly experienced increasing external competition while lacking basic inputs (e.g., fertilizers) and technology (e.g., access to machinery) assuring high yields [12]. Struggling to achieve farming profitability and competitiveness caused the abandonment of agricultural land in less profitable regions. In addition, land privatization and farm restructuring [7], ownership insecurity (e.g., in Romania), basic knowledge of agricultural practices played a key role in land abandonment and migration of farmers from rural villages to urban areas [22–24].

Cropland abandonment was a major concern in Eastern Europe, mainly in Poland, Czech Republic, Slovakia, Hungary, Romania and Bulgaria, where land-use changes during transition to socialism were characterized by similar dynamics (i.e., cropland abandonment, overexploitation of

agro-forest areas and intense forestation). Abandoned agricultural land in economically-marginal areas were artificially reforested. In countries such as Latvia [13] and Serbia, conversion of cropland into construction and industrial land also occurred frequently [25]. The highest decline of cropland during 1990–2006 occurred mainly in north- and south-eastern Poland, south-eastern Czech Republic, southern Romania and northern/central Bulgaria [15]. Land abandonment led to forestation, loss of cultural landscapes [16], expansion of bushy vegetation and fire risk in areas characterized by Mediterranean-type climate regimes [26]. In Serbia, large investors replaced farmers as new owners during the privatization of public farms. Since that time period, a progressive shift from agriculture to industrial and construction use has driven intense landscape transformations [27].

Since the early 1990s, intensive agriculture spread throughout Eastern Europe [7], in line with a broader wave of agricultural intensification worldwide, with demographic and economic growth inducing high (and increasing over time) fertilizer application rates [28]. Landowners were not motivated to reduce the intensity of pesticide use, as they were still struggling to make their farms profitable [29]. In many countries (e.g., Romania and Serbia), massive exploitation of rural areas threatened the overall sustainability of arable land systems [25]. For instance, deforestation, changing tree composition and bush encroachment were the most common land-use changes in the Carpathians. In the Lithuanian landscape, reforestation was one of the prevailing state-driven landscape change [15]. Logging intensity in some countries (e.g., Slovakia, Estonia, Latvia and Lithuania) rose after a prolonged breakdown because of the rapid transition to market economy. Most of the countries doubled their logging area in respect with the Soviet time: for instance, Estonia and Latvia increased logging intensity three-fold or more. However, the global economic crisis in the late 2000s affected timber harvesting in a different way. Central Europe (Slovakia, Czech Republic and Poland) and Baltic countries experienced an increase in the logging rates, while the annual logging areas remained quite stable in other countries of Eastern Europe [30].

2.3. Political and Economic Forces of Landscape Transformation in the Most Recent Context

Rural development was an increasingly important issue in regional and national strategies for economic competitiveness and social cohesion, contributing significantly to orient local production systems towards the desired development pathway [31]. Under the assumption that policy measures can affect background conditions more quickly (e.g., via the CAP Pillar II) than biophysical factors, economic settings have demonstrated to shape patterns and processes of agricultural intensification and cropland abandonment more or less variably over time and space. In these regards, European and national policies contributed to farm stabilization occurred over the last 10 years in post-communist states [24]. The CAP policy has contributed to restore farming activities, especially in mountainous regions, promoting rural development. For instance, land abandonment declined in Latvia since access to financial support was provided by the EU, such as single area payments to abandoned meadows [16]. For instance, EU agricultural subsidies led to moderate land-use stabilization in both Czech Republic and Slovakia [32].

Increasing environmental awareness, effective enforcement of environmental policies, the progressive shift of farm subsidies from productive to non-productive agricultural functions and the implementation of Agri-Environmental Schemes (AES) targeting ecosystem services and functions, have largely affected rural landscapes in the post-socialist countries shifting agricultural systems toward sustainable cropping. For instance, grassland area has increased in both Czech Republic and Slovakia with an enhanced interest on sustainable agriculture [32]. In some cases, EU subsidies caused unexpected socioeconomic problems by consolidating regional inequalities [33], for example, excluding from economic incentives remote and small-scale farms with poor soils and restricted access to private investments [32]. As a result of agricultural subsidies, ploughing of salty meadows in Serbia caused a significant increase in grassland degradation [25].

Nature conservation policies contributed to the stabilization of (and the increase in) forest cover since 1990 in many countries and especially in Slovakia, Hungary and Poland [34]. In Romania,

evidence of the effectiveness of protected areas is more mixed because of ownership transfers, weak institutions and economic difficulties leading to illegal logging and forest fragmentation [12]. Generally speaking, after the EU accession, nature conservation and agricultural policies alongside a rising awareness of the loss of valuable mountain grasslands, resulted in a shift from arable land to high-nature value meadows and a shift from forest to pastures [14]. The type of administrative system and the public control over land-use change might be one of the most important factors explaining the spatial pattern of urban growth. Institutional fragmentation of responsibilities in land-use planning also promoted urban sprawl [35,36]. The size of local government units may be important in the relationship with collective or individual actors (e.g., investors, landowners, stakeholders) [21,37,38].

The Impact of Agronomic, Economic and Demographic Factors on Landscape Dynamics

Fraser et al. [39] identified three key socioeconomic and policy factors affecting LUC typical of Eastern Europe: (i) more or less market-based agricultural systems (in the range from command and control regimes dictating what farmers produce, through to moderate situations (using subsidies) to purely market-based systems); (ii) the way property regimes affect land use (importance of private property to create incentives for long-term conservation); and (iii) effects of population growth leading to productive systems in the short-term but less resilient in a longer time horizon. Skokanová et al. [7] identified important drivers that caused LUC in post-communist countries including: shift to a more open and competitive land market; privatization of state property; support of small and middle-sized businesses; improvement of agricultural co-operatives; liberalization of prices for inputs and agricultural products; introduction of budget constraints; decline of guaranteed markets within the socialist bloc; changes in agricultural policies stimulating local competition; rising volatility in the agricultural commodity market [40].

The socioeconomic changes in the Czech Republic at the beginning of the 1990s also led to a progressive decline in heavy industry. A case study from Pilsen suburb shows a trend leading to the controlled stop of landfill. However, the increase in the construction of solar power plants was influenced by global trends in the power industry and financial support provided by the government, [41]. Land privatization and the increase in economic wealth during the 2000s have driven substantial changes in land-use, particularly urbanization, further agricultural abandonment and the recent development of urban sprawl in Latvia and other East European countries [13]. In 2009, the Latvian economy suffered a severe setback forcing a substantial migration to find employment. Population decrease and rural-urban migration resulted in demographic aging and land abandonment.

Referring to processes that affect land-use decisions and actions at the local scale, globalization is another phenomenon linked with economic drivers of LUCs. Globalization emphasizes hyper-mobility, global communication and the neutralization of place specificity and geographical distance. New hierarchies of cities emerged and vast areas become increasingly peripheral [42–45]. As globalization connects land systems across larger distances, spatially-discontinuous linkages between an area and the intensity of changes were also observed [46–48]. An example of such dynamics is the increasing spatial mismatch between production and consumption that may allow land in one region to be set aside while the land-use footprint embodied in traded goods increases elsewhere [49–52].

Intensiveness and specialization are a result of technological progress stimulated by economic, political and social events [53–55]. The related development outcomes are manifold; an increasing level of pesticides, fertilizers and artificial manure was particularly evident in the Communist era, together with vast amelioration projects (e.g., in Hungary [17]). Extensive industrialization was achieved through the construction of roads and heavy mechanization [7]. Perhaps the most distinct change was the removal and degradation of semi-natural landscapes [24,56,57]. In some areas (e.g., in Latvia), the diffused amelioration of equipment was creating better conditions for the revival of natural swamps, altering the biodiversity profile of meadows and hayfields [15]. In addition, local development was influenced by background socioeconomic contexts and land accessibility [58–60]. In these regards, urban sprawl was stimulated by increasing transportation facilities and improved land

accessibility. Areas with low accessibility were most likely characterized as natural landscapes with stable landscapes [61–63]. Technological drivers contributing to cropland abandonment were mainly represented by factors associated to a structural lack in infrastructural development [64–66]. This was the case of some vineyards in Slovakia [67].

Urbanization linked with population growth and improved mobility of citizens was particularly intense in Eastern Europe since World War II [7]. Economic growth associated with post-war reconstruction and late industrialization contributed to the spread of urban areas and the development of transportation networks that further stimulated new urbanization [61,68,69]. This was caused by progress in technical innovations as well as through political decisions to subsidize road construction, with areas close to roads and big cities being more prone to urbanization and land-use changes [10,13,70–72]. Declining economic returns from agriculture contributed to population movements: in Romania, (i) many people moved from rural to urban areas; (ii) there was a substantial population decrease during the period from 1996 to 2003 (more than 5%); (iii) birth rates decreased during the transition and rural population aged considerably since 1989 [12]. These processes were an indirect response to diminishing economic opportunities in rural areas due to low profitability of agriculture, as well as to the emerging role of cities [36]. In some states, the increased emigration to Western Europe resulted in decreased employment opportunities in the agricultural sector, which reduced the land allowing forest succession to take place [14]. For instance, since the early 1990s, land abandonment in Ukraine occurred mostly on large agricultural fields, while subsistence agriculture continued occupying marginal land in the mountains [73]. Apart from depopulation, political-driven and cultural-driven processes were also observed (e.g., expulsion of Czech/Polish Germans or Polish Ukrainians after World War II) strengthening land abandonment.

Urbanization associated with transforming life-styles was mainly controlled by the changing accessibility of places that offer new economic opportunities [74]. The countryside affected by urbanization becomes a multifunctional space within a more intense and spatially-diffused urban network [75]. Traditional rural landscapes characterized by pivotal cultural and ecological values become fragmented and gradually lose their own identity [61,76,77]. In these regards, suburbanization processes have caused intensive changes in land-use, occurring mainly after the early 1990s [7]. At that time, suburbanization was largely driven by changes in living standards and long held preferences for living in more rural environments, improving economic opportunities in less dense areas at the same time, with better transportation infrastructure and new technologies representing the most relevant changes [44]. An increasing awareness of the aesthetic and cultural value of landscapes was also observed in many local communities [16]. The amenity or recreational quality of the landscape become an important resource for the development of rural areas [78]. Value of the remnants of the past traditional landscapes is perceived as witness to ancestral values, symbolic and cognitive values and aesthetically felt scenery [42,79,80].

Property management or property related issues also play a vital role in the farmer's landscape practice [81]. This may explain why landowners adopt agricultural practices influencing that are not related to production or that are less profitable because they are based on values that are related to family and individual strategies [29]. However, during the totalitarian era, high pressure was exerted on the natural systems with a consequent loss of landscape attractiveness. Many resident farmers were no longer interested in agriculture. A similar experience caused the forced transfer of German population; this caused a break in the continuity of landscape trajectories, altering consequently the relationship between humans and the landscape.

Finally, tourism—another important LUC driver—can have various effects, from protecting the value of landscapes for aesthetical and touristic purposes, to negative effects leading to deforestation and the increase of built-up areas, which has occurred in many touristic areas, such as in the Southern Romanian Carpathians and in the High Tatra Mountains [14]. More generally, environmental quality is attracting tourism which boosts the migration balance. This pattern is still occurring in many Eastern European countries, for example in Montenegro (i.e., development of settlements often with

illegal standards of building and construction, mainly in coastal areas, across central plains and around natural lakes and mountains [82]). Housing stock in Lithuania increased significantly in the touristic region. The rising demand for living space, prestigious dwellings and recreation were causing anthropogenic pressures on landscapes that were mainly caused by lobbying, corruption and illegal building [15]. Moreover, during the 1980s people from cities built weekend houses in recreationally-attractive locations (e.g., mountainous areas, rural and natural attractive landscapes close to big cities) especially in Czech Republic and Slovakia [83].

3. Present and Future Trends of LUC Drivers in Eastern Europe

In market economies, driving forces of land-use change act primarily through market mechanisms (i.e., supply/demand of traditional agricultural products and environmental services as well as land for other purposes). These can address cases of corrected or regulated market "failure" which can sometimes be affected by special policies [4]. Under a reference scenario, models of land-use change applied to the whole of Europe indicate that economic expansion—coupled to population growth—stimulate urban growth and industrial development. Simultaneously, the net surface area of land covered by forests continues to grow in Europe, under land abandonment and an increasing demand for energy from biomass. This process takes often place in semi-natural areas [29]. Studies investigating LUC drivers using different models under Millennium Assessment scenario show the changing dominance of drivers in time. In a 2020 scenario, spatial policies formulated at supra-national, national and local levels and market drivers result as particularly relevant in shaping LUCs, while technical development, population growth and environmental issues are considered the main driving forces in long-term scenarios referring to 2050 and 2100. For the new EU members, the coming years are considered to represent a transition toward a new land-use regime [84]. The results revealed by the socioeconomic model that uses scenarios based on the interpretation of the IPCC-SRES storylines (i.e., four alternative scenarios: A1: world market, A2: regional cooperation, B1: global sustainability, B2: local sustainability) and long-term changes in agricultural land-use based on climate change models has shown the relative importance of relevant drivers in 2020. The distinctive historical backgrounds of the EU-15 and the new members of the EU-17 impact on the importance of and in which way the dominant driving forces are affected (Table 2). Based on this scenario's analysis, the candidate drivers shaping future agricultural land-use were identified in the following social forces [1]:

(1) Demography: population growth, population density; population breakdown by age, urban-rural migration; international migration.
(2) Economy: growth of the national product; changes of income level and distribution across population; world market demand/supply, prices; domestic demand of agri-food production; pattern of market chain; energy demand; EU enlargement.
(3) Technology: innovation and deployment; development of infrastructure.
(4) Policy: agricultural policy (national); Common Agricultural Policy (CAP): price support, intervention, direct payments, rural development, environment protection; environment policy and regulations; national and international agreements (e.g., Kyoto); public awareness; food quality regulation, food safety; role of World Trade Organization (WTO); Foreign Direct Investment (FDI).
(5) social policies (education, social benefit, alternative income, support of SME's enterprises); land market regulation based on ownership or leasing and land tenure; competition for natural resources including soil and water; farm structure (size and legal form); socio-demographic characteristics of farmers (education, age).

Antrop [42] identified the following trends in the transformation of European landscapes:

(1) intensification and scale increase of agricultural production transforming wetlands and natural areas into agricultural land; this is likely to occur in densely-inhabited areas;

(2) urban sprawl, growth of infrastructure and late urbanization/suburbanization;
(3) tourism development and recreational forms of land-use that are still developing at an accelerating speed in coastal and mountainous regions;
(4) extensification of land-use and land abandonment affecting remote rural areas with less favourable and declining socioeconomic conditions and poor accessibility.

Table 2. Impact of agricultural sector drivers in old and new EU members under four climate and global change scenarios (according to Fekete-Farkas and Singh [1]; 100 indicates the actual condition).

Drivers	2020 Scenario			
	A1	**A2**	**B1**	**B2**
	Old EU members			
Common Agricultural Policy	52	90	74	85
Environmental policy	85	97	183	173
EU enlargement	108	67	92	53
Resource competition	161	123	92	52
World demand/supply	172	106	121	79
World Trade Organization	188	70	124	61
	New EU members			
CAP	100	133	123	100
Environmental policy pressure	85	92	140	110
EU enlargement	124	143	140	92
Infrastructure	161	143	159	121
Land market regulation	123	137	143	133
World demand/supply	160	100	133	83
Pattern of food chain	155	133	159	107
World Trade Organization	140	100	104	92

The future growth in population and consumption and the rising role of bioenergy crops in Europe will increase the global demand for agricultural products over the next decades [29]. To a large extent, production increases in agriculture will depend on intensifying the existing agricultural systems [31] that will cause polarization between more and less intensive land-use. There is a continuous urbanization trend and vast areas of land could become disaffected or even abandoned [42]. Generally speaking, arable land and pasture are expected to decrease but the portion of arable land for the cultivation of new energy crops will probably increase in the medium-term, especially if production will be subsidized [85]. Green infrastructure networks are also expected to expand by 0.2% by 2020 and 1.1% by 2050, mainly as a result of forestation [29].

Dryer areas, where grasslands or shrubs are dominant in the landscape but where important agricultural activities also take place, are characterized by lower productive values. This is particularly evident for regions in Hungary and Romania as well as in some regions across the Mediterranean region which are known to be affected by water stress [86]. Agrarian land in Lithuanian coastal areas are being urbanized to a much larger extent than in the past decades [15]. Similar trend can be found in coastal and mountainous areas. In Southern Europe, processes of marginalization of agriculture and a change in functions with regard to urbanization and tourism were observed at the same time [87–89]. If these tendencies will continue and expand to larger areas, landscape transformations will result in relevant environmental changes over the next decades [29].

According to empirical results presented in earlier studies [19,21,41,61], the level of urbanization in Eastern Europe will rapidly reach the current level of urbanization in Western Europe [42]. Another trend which is likely to consolidate in Eastern countries is reforestation of abandoned areas. For instance, forestation in the last three decades was the most common type of landscape change in Latvia (17.1%). Such landscape transformations may cause a decrease in biodiversity, loss of the cultural

landscape and tourism opportunities, determining an overall decline in food production that leads to reliance on foreign imports and trade imbalance [13].

4. Discussion

Rural development in economically-advanced countries results from the demands of a changing society [42,90,91]. The concept of a multifunctional landscape is gaining ground in landscape research as well as in land-use policy, focusing on joint socioeconomic and ecological targets [66,92,93]. The amenity or recreational quality of the landscape is becoming an important resource for the development of rural areas [16]. Land-use changes in Europe have been increasingly influenced by economic, political, technological and cultural factors [54,94,95]. As mentioned above, economic factors were influential drivers of landscape transformation In Western Europe. Conversely, in Eastern Europe the Communist determined political forces leading to land collectivization, agricultural intensification and forest expansion. More recently, land privatization and loss of state support for agriculture gave more importance to economic drivers, in turn causing new challenges for farmers, such as loss of profit and scarce competitiveness. These economic dynamics have also influenced demographic drivers (e.g., depopulation of rural areas, emigration), which caused the abandonment of agricultural land, mainly in marginal and remote areas. The EU national and environmental policies contributed to patterns of land-use stabilization in Europe which has occurred over the past 10 years [96]. However, some countries continue to struggle with the consequences of problems that arose during the Communist era, mainly the land overexploitation and cropland abandonment.

Adaptation strategies should include practical opportunities to lower pressures on ecosystem services, contributing to long-term sustainability of local development [97–99]. Policies should focus on services bundled around the agricultural sector (e.g., food provision, land-use diversity and crop biodiversity) or those connected with forestry (timber production, atmospheric regulation, landscape experience and forest biodiversity [100–102]). Factors determining adaptive capacity to climate change include wealth, technology and infrastructure, information, knowledge and skills, institutions, flexibility, equity and social capital [103–105]. Lung et al. [106] defined adaptive capacity as a function of three components: (i) financial capital; (ii) human capital; and (iii) technological capital. Financial capital involves the issues of productivity wealth and income equality. Human capital includes educational achievements and health services, whereas technological capital covers research and development as well as internet use. Special attention to Eastern and Southern Europe local conditions is required because of the considerable extension of vulnerable land with high risk and low adaptive capacity [57,62,66,107].

Research focus on adaptation strategies in Eastern European countries is increasingly required to move towards a more holistic approach, recognizing the importance of land for multiple purposes such as biodiversity protection, flood protection, urbanization, cultural values and climate change mitigation [108,109]. Flooding can be a relevant example in this line of thinking. Czech and Slovak Republics, Hungary and Poland all experienced a number of severe flood events in the last decades, conveying their adaptation needs to the United Nations Framework Convention on Climate Change (UNFCCC) as a preliminary socioeconomic response to flood risk. As a result, these countries were engaged in projects and adaptation strategies were progressively developed in a joint fashion. More specifically, Hungary implemented its adaptation strategy in 2008. Czech Republic and Slovenia implemented more recently their national strategies to address climate change, including measures of both adaptation and mitigation [108,109].

Based on evidence presented in this study, long-term LUC trajectories in Eastern Europe, as compared to the whole of the continent, requires a specific (comparative and diachronic) analysis of landscape processes, including (i) urbanization; (ii) forestation; (iii) agricultural intensification; and (iv) cropland abandonment. Drivers of these transformations are only in part similar to what was observed in other European regions and specific investigations of the socioeconomic mechanisms at the base of such changes—with special regards for policy and institutional drivers—provide a

relevant base of knowledge for understanding patterns and processes of landscape transformations in larger European areas—not limited to Eastern countries. Understanding the impact of multiple (geographical and economic) scales of analysis is an important research issue to figure out original processes of change and to predict—at least qualitatively—future LUC dynamics. Starting from the Corine Land Cover initiative (producing comparable maps that encompass a period of 22 years from 1990 to 2012), existing databases covering Europe as a whole are particularly relevant in the analysis of patterns and processes of landscape transformation in Eastern Europe. However, collection and improvement of digital data sources assessing land-use over longer time intervals (e.g., since World War II) are particularly required when identifying drivers of change acting in the long-term [110,111]. While limitations of a meta-data analysis of landscape transformation are relatively well known [12], a review investigation of land-use dynamics is the necessary knowledge base to build up appropriate models of land-use change providing realistic landscape scenarios under basic population, economic and social dynamics. Finally, an improved spatio-temporal analysis of the relevance of specific driving forces (and especially cultural, economic and technological factors) during different historical periods (as stated by Jepsen et al. [112]) is particularly helpful and informative in the construction of future scenarios.

5. Conclusions

It is assumed that major land-use changes in Europe include agricultural intensification, abandonment of marginal, economically-disadvantaged and remote rural land, compact urbanization, urban sprawl and tourism development. This commentary outlines the latent feedbacks between landscape transformations and socioeconomic changes in Eastern Europe during different time periods of the last century, characterized by distinct institutional and political regimes. Eastern Europe is considered a paradigmatic example of sequential institutional cycles reflecting important changes in regional and local socioeconomic contexts, in turn altering natural and agricultural landscapes. Eastern Europe is considered a paradigmatic example of long-term political transitions from a highly-centralized, Communist regime to a decentralized, open-market Capitalistic regime encompassing the second half of the last century. This transition indirectly promoted different mechanisms of landscape transformations, stimulating urbanization, agricultural development or abandonment and forestation under differentiated background contexts and policies, leading to unsustainable regional development. Challenges for the coming future will include policy more directed towards sustainable land-use, promoting non-productive aspects of agriculture and forestry. The case of Eastern Europe gives relevance to the concept of a multifunctional landscape oriented towards a balance of economic, ecological, social and cultural functions. This notion should be increasingly considered in land-use policy and in adaptive strategies to cope with global change.

Author Contributions: M.P. and O.C. identified research questions. R.V. and S.L. made the extensive bibliographic analysis. P.C. and L.S. wrote the commentary.

Funding: This research received funding from the Ministry of Education, Youth and Sports of CR within the National Sustainability Program I (NPU I), grant number LO1415.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Fekete-Farkas, M.; Singh, M.K. Main agricultural land use change in Europe. In Proceedings of the VII. Alps-Adria Scientific Workshop, Stara Lesna, Slovakia, 28 April–2 May 2008.
2. Barbati, A.; Corona, P.; Salvati, L.; Gasparella, L. Natural forest expansion into suburban countryside: Gained ground for a green infrastructure? *Urban For. Urban Green.* **2013**, *12*, 36–43. [CrossRef]
3. Salvati, L.; Tombolini, I.; Perini, L.; Ferrara, A. Landscape Changes and Environmental Quality: The Evolution of Land Vulnerability and Potential Resilience to Degradation in Italy. *Reg. Environ. Chang.* **2013**, *13*, 1223–1233. [CrossRef]

4. Plieninger, T.; Draux, H.; Fagerholm, N.; Bieling, C.; Burgi, M.; Kizos, T.; Kummerle, T.; Primdahl, J.; Verburg, P.H. The driving forces of landscape change in Europe: A systematic review of the evidence. *Land Use Policy* **2016**, *57*, 204–214. [CrossRef]
5. Salvati, L.; Carlucci, M. The estimated impact of Mediterranean land degradation on agricultural income: A short-term scenario. *Land Use Policy* **2013**, *32*, 302–308. [CrossRef]
6. Salvati, L. Long-term dynamics of self-contained urban growth in compact and dispersed regions of southern Europe. *Land Use Policy* **2013**, *35*, 213–225. [CrossRef]
7. Skokanová, H.; Falťan, V.; Havlíček, M. Driving forces of main landscape change processes from past 200 years in Central Europe—Differences between old democratic and post-socialist countries. *Ekológia* **2016**, *35*, 50–65. [CrossRef]
8. Gavalas, V.S.; Rontos, K.; Salvati, L. Who becomes an unwed mother in Greece? Socio-demographic and geographical aspects of an emerging phenomenon. *Popul. Space Place* **2014**, *20*, 250–263. [CrossRef]
9. Ferrara, A.; Salvati, L.; Sabbi, A.; Colantoni, A. Urbanization, Soil Quality and Rural Areas: Towards a Spatial Mismatch? *Sci. Total Environ.* **2014**, *478*, 116–122. [CrossRef] [PubMed]
10. Salvati, L. A socioeconomic profile of vulnerable lands to desertification in Italy. *Sci. Total Environ.* **2014**, *466–467*, 287–299. [CrossRef] [PubMed]
11. Savo, V.; Caneva, G.; McClatchey, W.; Reedy, D.; Salvati, L. Combining environmental factors and agriculturalists' observations of environmental changes in the traditional terrace system of the Amalfi Coast (Southern Italy). *Ambio* **2014**, *43*, 297–310. [CrossRef] [PubMed]
12. Kuemmerle, T.; Muller, D.; Griffiths, P.; Rusu, M. Land use change in Southern Romania after collapse of socialism. *Reg. Environ. Chang.* **2009**, *9*, 1–12. [CrossRef]
13. Fonji, S.F.; Taff, G.N. Using satellite data to monitor land-use land-cover change in North-eastern Latvia. *SpringerPlus* **2014**, *3*, 61. [CrossRef] [PubMed]
14. Munteanu, C.; Kuemmerle, T.; Boltižiar, M.; Butsic, V.; Gimmi, U.; Halada, L.H.; Kaim, D.; Király, G.; Konkoly-Gyur, É.; Kozak, J.; et al. Forest and agricultural land change in the Carpathian region—A meta-analysis of long-term patterns and drivers of change. *Land Use Policy* **2014**, *38*, 685–697. [CrossRef]
15. Veteikis, D.; Šabanovas, S.; Jankauskaité, M. Landscape structure changes on the coastal plain of Lithuania during 1998–2009. *Baltica* **2011**, *24*, 107–116.
16. Ruskule, A.; Nikodemus, O.; Kasparinskis, R.; Bell, S.; Urtane, I. The perception of abandoned farmland by local people and experts: Landscape value and perspectives on future land use. *Landsc. Urban Plan.* **2013**, *115*, 49–61. [CrossRef]
17. Biró, M.; Czúcz, B.; Horváth, F.; Révész, A.; Csatári, B.; Molnár, Z. Drivers of grassland loss in Hungary during the post-socialist transformation (1987–1999). *Landsc. Ecol.* **2013**, *28*, 789–803. [CrossRef]
18. Salvati, L.; Gargiulo, V.; Rontos, K.; Sabbi, A. Latent Exurban Development: City Expansion Along the Rural-To-Urban Gradient in Growing and Declining Regions of Southern Europe. *Urban Geogr.* **2013**, *34*, 376–394. [CrossRef]
19. Salvati, L.; Zambon, I.; Chelli, F.M.; Serra, P. Do spatial patterns of urbanization and land consumption reflect different socioeconomic contexts in Europe? *Sci. Total Environ.* **2018**, *625*, 722–730. [CrossRef] [PubMed]
20. De Rosa, S.; Salvati, L. Beyond a 'side street story'? Naples from spontaneous centrality to entropic polycentricism, towards a 'crisis city'. *Cities* **2016**, *51*, 74–83. [CrossRef]
21. Siedentrop, S.; Fina, S. Who sprawls most? Exploring the patterns of urban growth across European countries. *Environ. Plan. A* **2012**, *44*, 2765–2784. [CrossRef]
22. Palang, H.; Printsmann, A. From totalitarian to democratic landscapes: The transition in Estonia. In *Globalisation and Agricultural Landscapes: Change Patterns and Policy Trends in Developed Countries*; Primdahl, J., Swaffield, S., Eds.; Cambridge University Press: Cambridge, MA, USA, 2010; pp. 169–184.
23. Van Vliet, J.; de Groot, H.L.F.; Rietveld, P.; Verburg, P.H. Manifestations and underlying drivers of agricultural land use change in Europe. *Landsc. Urban Plan.* **2015**, *133*, 24–36. [CrossRef]
24. Van der Sluis, T.; Pedroli, B.; Kristensen, S.B.P.; Cosor, G.L.; Pavlis, E. Changing land use intensity in Europe—Recent processes in selected case studies. *Land Use Policy* **2016**, *57*, 777–785. [CrossRef]
25. MAEP Serbia. *The Fifth National Report to the United Nations Convention on Biological Diversity*; Republic of Serbia, Ministry of Agriculture and Environmental Protection: Belgrad, Serbia, 2015.

26. Weissteiner, C.H.J.; Boschetti, M.; Bottcher, K.; Carrara, P.; Bordogna, G.; Brivio, P.A. Spatial explicit assessment of rural land abandonment in Mediterranean area. *Glob. Planet. Chang.* **2011**, *79*, 20–36. [CrossRef]
27. SOER Serbia. *The European Environment State and Outlook 2015. Countries and Regions Serbia*; European Environment Agency: Copenhagen, Denmark, 2015.
28. Tilman, D.; Fargione, J.; Wolff, B.; D'Antonio, C.; Dobson, A.; Howarth, R.; Schindler, D.; Schlesinger, W.H.; Simberloff, D.; Swackhamer, D. Forecasting agriculturally driven global environmental change. *Science* **2001**, *292*, 281–284. [CrossRef] [PubMed]
29. Kristensen, S.B.P. Agriculture and landscape interaction-landowners' decision-making and drivers of land use change in rural Europe. *Land Use Policy* **2016**, *57*, 759–763. [CrossRef]
30. Turubanova, S.; Potapov, P.; Krylov, A.; Tyukavina, A.; McCarty, J.L.; Radeloff, V.C.; Hansen, M.C. Using the landsat data archive to assess long-term regional forest dynamics assessment in Eastern Europe, 1985–2012. *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci.* **2015**, *XL-7/W3*, 531–537. [CrossRef]
31. Levers, C.H.; Butsic, V.; Verburg, P.H.; Muller, D.; Kuemmerle, T. Drivers of changes in agricultural intensity in Europe. *Land Use Policy* **2016**, *58*, 380–393. [CrossRef]
32. Bezák, P.; Mitchley, J. Drivers of change in mountain farming in Slovakia: From socialist collectivisation to the Common Agricultural Policy. *Reg. Environ. Chang.* **2014**, *14*, 1343–1356. [CrossRef]
33. Salvati, L.; Zitti, M. Assessing the impact of ecological and economic factors on land degradation vulnerability through multiway analysis. *Ecol. Indic.* **2008**, *9*, 357–363. [CrossRef]
34. Olah, B.; Boltiziar, M. Land use gauges within the Slovak biosphere reserves' zones. *Ekológia* **2009**, *28*, 127–142. [CrossRef]
35. Salvati, L. 'Rural' sprawl, Mykonian style: A scaling paradox. *Int. J. Sustain. Dev. World Ecol.* **2013**, *20*, 109–115. [CrossRef]
36. Salvati, L. Land Availability vs Conversion by Use Type: A New Approach for Land Take Monitoring. *Ecol. Indic.* **2014**, *36*, 221–223. [CrossRef]
37. Salvati, L.; Zitti, M. Economic growth vs land quality: A multidimensional approach in Italy. *J. Environ. Plan. Manag.* **2011**, *54*, 733–748. [CrossRef]
38. Ceccarelli, T.; Bajocco, S.; Perini, L.; Salvati, L. Urbanisation and Land Take of High Quality Agricultural Soils—Exploring Long-term Land Use Changes and Land Capability in Northern Italy. *Int. J. Environ. Res.* **2014**, *8*, 181–192.
39. Fraser, E.D.G.; Stringer, L. Explaining agricultural collapse: Macro-forces, micro-crises and the emergence of land use vulnerability in southern Romania. *Glob. Environ. Chang.* **2009**, *19*, 45–53. [CrossRef]
40. Kuemmerle, T.; Hoster, P.; Radeloff, V.C.; der Linden, S.; Perzanowski, K.; Kruhlov, I. Cross-border comparison of post-socialist farmland abandonment in the Carpathians. *Ecosystems* **2008**, *11*, 614–628. [CrossRef]
41. Kopp, J.; Frajer, J.; Pavelková, R. Driving forces of the development of suburban landscape—A case study of the Sulkov site west of Pilsen. *Quaest. Geogr.* **2015**, *34*, 51–64. [CrossRef]
42. Antrop, M. Why landscapes of the past are important for the future. *Landsc. Urban Plan.* **2005**, *70*, 21–34. [CrossRef]
43. Salvati, L.; Sateriano, A.; Zitti, M. Long-term land cover changes and climate variations—A country-scale approach for a new policy target. *Land Use Policy* **2013**, *30*, 401–407. [CrossRef]
44. Di Feliciantonio, C.; Salvati, L. 'Southern' alternatives of urban diffusion: Investigating settlement characteristics and socioeconomic patterns in three Mediterranean regions. *Tijdschrift voor Economische en Sociale Geografie* **2015**, *106*, 453–470. [CrossRef]
45. Carlucci, M.; Grigoriadis, E.; Rontos, K.; Salvati, L. Revisiting an Hegemonic Concept: Long-term 'Mediterranean Urbanization' in between city re-polarization and metropolitan decline. *Appl. Spat. Anal. Policy* **2017**, *10*, 347–362. [CrossRef]
46. Salvati, L.; Gargiulo Morelli, V. Unveiling Urban Sprawl in the Mediterranean Region: Towards a Latent Urban Transformation? *Int. J. Urban Reg. Res.* **2014**, *38*, 1935–1953. [CrossRef]
47. Cuadrado-Ciuraneta, S.; Durà-Guimerà, A.; Salvati, L. Not only tourism: Unravelling suburbanization, second-home expansion and "rural" sprawl in Catalonia, Spain. *Urban Geogr.* **2017**, *38*, 66–89. [CrossRef]

48. Zambon, I.; Serra, P.; Sauri, D.; Carlucci, M.; Salvati, L. Beyond the 'Mediterranean City': Socioeconomic Disparities and Urban Sprawl in three Southern European Cities. *Geographiska Annaler B* **2017**, *99*, 319–337. [CrossRef]
49. Salvati, L.; Zitti, M. Land degradation in the Mediterranean basin: Linking bio-physical and economic factors into an ecological perspective. *Biota J. Biol. Ecol.* **2005**, *5*, 67–77.
50. Kastner, T.; Erb, K.; HandHaber, L.H. Rapid growth in agricultural trade: Effects on global area efficiency and the role of management. *Environ. Res. Lett.* **2014**, *9*, 034015. [CrossRef]
51. Zitti, M.; Ferrara, C.; Perini, L.; Carlucci, M.; Salvati, L. Long-term Urban Growth and Land-use Efficiency in Southern Europe: Implications for Sustainable Land Management. *Sustainability* **2015**, *7*, 3359–3385. [CrossRef]
52. Zambon, I.; Benedetti, A.; Ferrara, C.; Salvati, L. Soil Matters? A Multivariate Analysis of Socioeconomic Constraints to Urban Expansion in Mediterranean Europe. *Ecol. Econ.* **2018**, *146*, 173–183. [CrossRef]
53. Recanatesi, F.; Clemente, M.; Grigoriadis, S.; Ranalli, F.; Zitti, M.; Salvati, L. A fifty-years sustainability assessment of Italian Agro-forest Districts. *Sustainability* **2016**, *8*, 32. [CrossRef]
54. Ferrara, C.; Carlucci, M.; Grigoriadis, S.; Corona, P.; Salvati, L. A comprehensive insight into the geography of forest cover in Italy: Exploring the importance of socioeconomic local contexts. *For. Policy Econ.* **2017**, *75*, 12–22. [CrossRef]
55. Delfanti, L.; Colantoni, A.; Recanatesi, F.; Bencardino, M.; Sateriano, A.; Salvati, L. Solar plants, environmental degradation and local socioeconomic contexts: A case study in a Mediterranean country. *Environ. Assess. Impact Rev.* **2016**, *61*, 88–93. [CrossRef]
56. Salvati, L.; Colantoni, A. Land use dynamics and soil quality in agro-forest systems: A country-scale assessment in Italy. *J. Environ. Plan. Manag.* **2015**, *58*, 175–188. [CrossRef]
57. Salvati, L.; Zitti, M.; Perini, L. Fifty years on: Long-term patterns of land sensitivity to desertification in Italy. *Land Degrad. Dev.* **2016**, *27*, 97–107. [CrossRef]
58. Kairis, O.; Karavitis, C.; Kounalaki, A.; Fasouli, V.; Salvati, L.; Kosmas, K. The effect of land management practices on soil erosion and land desertification in an olive grove. *Soil Use Manag.* **2013**, *29*, 597–606. [CrossRef]
59. Forino, G.; Bonamici, S.; Ciccarelli, S.; Perini, L.; Salvati, L. Developmental policies, long-term land-use changes and the way towards soil degradation: Evidence from southern Italy. *Scott. Geogr. J.* **2015**, *131*, 123–140. [CrossRef]
60. Schuetze, T.; Chelleri, L.; Salvati, L. Integrating resilience with urban sustainability in neglected neighborhoods: Challenges and opportunities of transitioning to decentralized water management in Mexico city. *Habitat Int.* **2015**, *48*, 122–130.
61. Antrop, M. Landscape change and the urbanisation process in Europe. *Landsc. Urban Plan.* **2004**, *67*, 9–26. [CrossRef]
62. Karamesouti, M.; Detsis, V.; Kounalaki, A.; Vasiliou, P.; Salvati, L.; Kosmas, C. Land-use and land degradation processes affecting soil resources: Evidence from a traditional Mediterranean cropland (Greece). *Catena* **2015**, *132*, 45–55. [CrossRef]
63. Colantoni, A.; Mavrakis, A.; Sorgi, T.; Salvati, L. Towards a 'polycentric' landscape? Reconnecting fragments into an integrated network of coastal forests in Rome. *Rendiconti Accademia Nazionale dei Lincei* **2015**, *26*, 615–624. [CrossRef]
64. Salvati, L.; Perini, L.; Sabbi, A.; Bajocco, S. Climate aridity and land use changes: A regional-scale analysis. *Geogr. Res.* **2012**, *50*, 193–203. [CrossRef]
65. Recanatesi, F.; Ripa, M.N.; Leone, A.; Perini, L.; Salvati, L. Land use, climate and transport of nutrients: Evidence emerging from the Lake Vico case study. *Environ. Manag.* **2013**, *52*, 503–513. [CrossRef] [PubMed]
66. Kosmas, C.; Karamesouti, M.; Kounalaki, K.; Detsis, V.; Vassiliou, P.; Salvati, L. Land degradation and long-term changes in agro-pastoral systems: An empirical analysis of ecological resilience in Asteroussia—Crete (Greece). *Catena* **2016**, *147*, 196–204. [CrossRef]
67. Lieskovsky, J.; Kanka, R.; Bezak, P.; Stefunkova, D.; Petrovic, F.; Dobrovodska, M. Driving forces behind vineyard abandonment in Slovakia following the move to a market-oriented economy. *Land Use Policy* **2013**, *32*, 356–365. [CrossRef]
68. Salvati, L. Exploring the Spatial Pattern of Soil Sealing in a Mediterranean Peri-urban Area. *J. Environ. Plan. Manag.* **2014**, *57*, 848–861. [CrossRef]

69. Smiraglia, D.; Ceccarelli, T.; Bajocco, S.; Salvati, L.; Perini, L. Linking trajectories of land change, land degradation processes and ecosystem services. *Environ. Res.* **2016**, *147*, 590–600. [CrossRef] [PubMed]
70. Salvati, L. Urban expansion and high-quality soil consumption—An inevitable spiral? *Cities* **2013**, *31*, 349–356. [CrossRef]
71. Munafò, M.; Salvati, L.; Zitti, M. Estimating soil sealing at country scale—Italy as a case study. *Ecol. Indic.* **2013**, *26*, 36–43. [CrossRef]
72. Salvati, L.; Carlucci, M. A Composite Index of Sustainable Development at the Local Scale: Italy as a Case Study. *Ecol. Indic.* **2014**, *43*, 162–171. [CrossRef]
73. Baumann, M.; Kuemmerle, T.; Elbakidze, M.; Ozdogan, M.; Radeloff, V.C.; Keuler, N.S.; Prishchepov, A.V.; Kruhlov, I.; Hostert, P. Patterns and drivers of post-socialist farmland abandonment in Western Ukraine. *Land Use Policy* **2011**, *28*, 552–562. [CrossRef]
74. Kazemzadeh-Zow, A.; Zanganeh Shahraki, S.; Salvati, L.; Neisani Samani, N. A Spatial Zoning Approach to Calibrate and Validate Urban Growth Models. *Int. J. Geogr. Inf. Sci.* **2017**, *31*, 763–782. [CrossRef]
75. Salvati, L.; Zitti, M. Monitoring vegetation and Land Use Quality along the urban-rural gradient in a Mediterranean Region. *Appl. Geogr.* **2012**, *32*, 896–903. [CrossRef]
76. Salvati, L.; Gemmiti, R.; Perini, L. Land degradation and the Mediterranean urban areas: An unexplored link with planning? *Area* **2012**, *44*, 317–325. [CrossRef]
77. Colantoni, A.; Ferrara, C.; Perini, L.; Salvati, L. Assessing Trends in Climate Aridity and Vulnerability to Soil Degradation in Italy. *Ecol. Indic.* **2015**, *48*, 599–604. [CrossRef]
78. Biasi, R.; Colantoni, A.; Ferrara, C.; Ranalli, F.; Salvati, L. In-between Sprawl and Fires: Long-term Forest Expansion and Settlement Dynamics at the Wildland-Urban Interface in Rome, Italy. *Int. J. Sustain. Dev. World Ecol.* **2015**, *22*, 467–475. [CrossRef]
79. Biasi, R.; Brunori, E.; Smiraglia, D.; Salvati, L. Linking traditional tree-crop landscapes and agro-biodiversity in Central Italy using a database of typical and traditional products: A multiple risk assessment through a data mining analysis. *Biodivers. Conserv.* **2015**, *24*, 3009–3031. [CrossRef]
80. Salvati, L. Towards a Polycentric Region? The Socioeconomic Trajectory of Rome, an 'ethernal' Mediterranean City. *Tijdschrift voor Economische en Sociale Geografie* **2014**, *105*, 268–284. [CrossRef]
81. Duvernoy, I.; Zambon, I.; Sateriano, A.; Salvati, L. Pictures from the Other Side of the Fringe: Urban Growth and Peri-urban Agriculture in a Post-industrial City (Toulouse, France). *J. Rural Stud.* **2018**, *57*, 25–35. [CrossRef]
82. MSDT Montenegro. *The Fifth National Report of Montenegro to the United Nations Convention on Biological Diversity*; Ministry of Sustainability Development and Tourism: Belgrad, Serbia, 2014.
83. Balej, M.; Anděl, J.; Oršulák, T.; Raška, P. Development of environmental stress in the northeaster part of Czechia: New approaches and methods. *Geografie Sborník České Geografické Společnosti* **2008**, *3*, 117–133.
84. Fekete-Farkas, M.; Rounsevell, M.; Audsley, E. Socio-economic Scenarios of Agricultural Land Use Change in Central and Eastern European Countries. In Proceedings of the 11th International Congress "European Association of Agricultural Economists", Copenhagen, Denmark, 24–27 August 2005.
85. Pedroli, B.; Elbersen, B.; Frederiksen, P.; Grandin, U.; Hekkila, R.; Krogh, P.H.; Izakovičová, Z.; Johansen, A.; Meiresonne, L.; Spijker, J. Is energy cropping in Europe compatible with biodiversity? Opportunities and threats to biodiversity from land-based production of biomass for bioenergy purposes. *Biomass Bioenergy* **2013**, *55*, 73–86. [CrossRef]
86. Maes, J.; Barbosa, A.; Baranzelli, C.; Zulian, G.; Batista, F.; Silva, E.; Vandecasteele, I.; Hiederer, R.; Liquete, C.; Paracchini, M.L.; et al. More green infrastructure is required to maintain ecosystem services under current trends in land-use change in Europe. *Landsc. Ecol.* **2015**, *30*, 517–534. [CrossRef] [PubMed]
87. Salvati, L.; Zitti, M. Regional convergence of environmental variables: Empirical evidences from land degradation. *Ecol. Econ.* **2008**, *68*, 162–168. [CrossRef]
88. Rontos, K.; Grigoriadis, S.; Sateriano, A.; Syrmali, M.; Vavouras, I.; Salvati, L. Lost in Protest, Found in Segregation: Divided Cities in the Light of the 2015 'Oki' Referendum in Greece. *City Cult. Soc.* **2016**, *7*, 139–148. [CrossRef]
89. Salvati, L.; Bajocco, S.; Mancini, A.; Gemmiti, R.; Carlucci, M. Socioeconomic development and vulnerability to land degradation in Italy. *Reg. Environ. Chang.* **2011**, *11*, 767–777. [CrossRef]
90. Salvati, L.; Carlucci, M. Estimating land degradation risk for agriculture in Italy through an indirect approach. *Ecol. Econ.* **2010**, *69*, 511–518. [CrossRef]

91. Kairis, O.; Karavitis, C.; Kounalaki, A.; Fasouli, V.; Salvati, L.; Kosmas, K. Exploring the Impact of Overgrazing and Sustainable Grazing on Soil Erosion and Land Degradation in a Mediterranean Agro-forest Landscape (Crete, Greece). *Arid Land Res. Manag.* **2015**, *29*, 360–374. [CrossRef]
92. Salvati, L.; Carlucci, M. The economic and environmental performances of rural districts in Italy: Are competitiveness and sustainability compatible targets? *Ecol. Econ.* **2011**, *70*, 2446–2453. [CrossRef]
93. Bajocco, S.; De Angelis, A.; Salvati, L. A satellite-based green index as a proxy for vegetation cover quality in a Mediterranean region. *Ecol. Indic.* **2012**, *23*, 578–587. [CrossRef]
94. Salvati, L. Agro-forest landscape and the 'fringe' city: A multivariate assessment of land-use changes in a sprawling region and implications for planning. *Sci. Total Environ.* **2014**, *490*, 715–723. [CrossRef] [PubMed]
95. Tomao, A.; Quatrini, V.; Corona, P.; Ferrara, A.; Lafortezza, R.; Salvati, L. Resilient landscapes in Mediterranean urban areas: Understanding factors influencing forest trends. *Environ. Res.* **2017**, *156*, 1–9. [CrossRef] [PubMed]
96. Kelly, C.; Ferrara, A.; Wilson, G.A.; Ripullone, F.; Nolè, A.; Harmer, N.; Salvati, L. Community resilience and land degradation in forest and shrubland socio-ecological systems: Evidence in Gorgoglione, Basilicata, Italy. *Land Use Policy* **2015**, *46*, 11–20. [CrossRef]
97. Serra, P.; Vera, A.; Tulla, A.F.; Salvati, L. Beyond urban-rural dichotomy: Exploring socioeconomic and land-use processes of change in Spain (1991–2011). *Appl. Geogr.* **2014**, *55*, 71–81. [CrossRef]
98. Colantoni, A.; Grigoriadis, E.; Sateriano, A.; Venanzoni, G.; Salvati, L. Cities as selective land predators? A Lesson on Urban Growth, (Un)effective planning and Sprawl Containment. *Sci. Total Environ.* **2016**, *545–546*, 329–339. [CrossRef] [PubMed]
99. Salvati, L.; Zitti, M.; Ceccarelli, T. Integrating economic and environmental indicators in the assessment of desertification risk: A case study. *Appl. Ecol. Environ. Res.* **2008**, *6*, 129–138. [CrossRef]
100. Salvati, L.; Zitti, M.; Ceccarelli, T.; Perini, L. Building-up a synthetic index of land vulnerability to drought and desertification. *Geogr. Res.* **2009**, *47*, 280–291. [CrossRef]
101. Dunford, R.W.; Smith, A.C.; Harrison, P.A.; Hanganu, D. Ecosystem service provision in a changing Europe: Adapting to the impacts of combined climate and socio-economic change. *Landsc. Ecol.* **2015**, *30*, 443–461. [CrossRef] [PubMed]
102. Ferrara, A.; Kelly, C.; Wilson, G.; Nolè, A.; Mancino, G.; Bajocco, S.; Salvati, L. Shaping the role of 'fast' and 'slow' drivers of change in forest-shrubland socio-ecological systems. *J. Environ. Manag.* **2016**, *169*, 155–166. [CrossRef] [PubMed]
103. Metzger, M.J.; Rounsevell, M.D.A.; Acosta-Michlik, L.; Schroeter, D. The vulnerability of ecosystem services to land use change. *Agric. Ecosyst. Environ.* **2006**, *114*, 69–85. [CrossRef]
104. Salvati, L.; Petitta, M.; Ceccarelli, T.; Perini, L.; Di Battista, F.; Venezian Scarascia, M.E. Italy's renewable water resources as estimated on the basis of the monthly water balance. *Irrig. Drain.* **2008**, *57*, 507–515. [CrossRef]
105. Salvati, L.; Zitti, M. Substitutability and equal weighting of environmental indicators: A proposal to estimate the importance of the different components of a composite index. *Ecol. Econ.* **2009**, *68*, 1093–1099. [CrossRef]
106. Lung, T.; Lavalle, C.; Hiederer, R.; Dosio, A.; Bouwer, L.M. A multi-hazard regional level impact assessment for Europe combining indicators of climatic and non-climatic change. *Glob. Environ. Chang.* **2013**, *23*, 522–536. [CrossRef]
107. Pili, S.; Grigoriadis, E.; Carlucci, M.; Clemente, M.; Salvati, L. Towards Sustainable Growth? A Multi-criteria Assessment of (Changing) Urban Forms. *Ecol. Indic.* **2017**, *76*, 71–80. [CrossRef]
108. Bizikova, L.; Nijnik, M.; Nijnik, A. Exploring institutional changes in agriculture to inform adaptation planning to climate change in transition countries. *Mitig. Adapt. Strateg. Glob. Chang.* **2015**, *20*, 1385–1406. [CrossRef]
109. Navarro, L.M.; Pereira, H.M. Rewilding Abandoned Landscape in Europe. *Ecosystems* **2012**, *15*, 900–912. [CrossRef]
110. Hansen, M.C.; Stehman, S.V.; Potapov, P.V. Quantification of global gross forest cover loss. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 8650–8655. [CrossRef] [PubMed]
111. Kuemmerle, T.; Erb, K.; Meyfroidt, P.; Müller, D.; Verburg, P.H.; Estel, S.; Levers, C. Challenges and opportunities in mapping land use intensity globally. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 484–493. [CrossRef] [PubMed]

112. Jepsen, M.R.; Kuemmerle, T.; Müller, D.; Erb, K.; Verburg, P.H.; Haberl, H.; Björn, I. Transitions in European land-management regimes between 1800 and 2010. *Land Use Policy* **2015**, *49*, 53–64. [CrossRef]