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Article

The return of wooded landscapes in Wales: an exploration of possible post-Brexit futures.

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Abstract: Changes in agricultural policy may have rapid impact even on landscapes which have taken millennia to form. Here we explore the potential of UK leaving the EU as a catalyst for profound changes in pastoral landscapes in Wales. Impending change of the trading regime governing agricultural produce, concurrent to public pressure to use agricultural subsidies for environmental goals, may lead to unforeseen consequences for Welsh natural environment. We employ a combination of change demand modelling and 'story and simulation approach' to predict the effect of five hypothetical scenarios on land use and land use change in Wales by 2030. We show that the most extreme trade scenario would result in a near-uniform distribution of broadleaf woodland across most of Wales. Abandonment of marginal and low productivity grazing would likely give way to afforestation, initiating a return to forested landscapes not seen in Wales for several thousands of years.

Keywords: Brexit, land use change, Wales, agricultural policies, UK.

1. Introduction

Natural ecosystems are exposed to an ever-present change of climatic conditions, which drives a long-term adaptation of dominant vegetation types. Without human influence post-glaciation, natural succession in Wales resulted a landscape covered by forest; the wildwood in existence about 6000 years ago [1]. European broadleaf temperate rainforests grew here, and were it not for the rapid human-drive forest clearance, some may be growing on the western fringes of Wales even today [2]. Human habitation has thus left a significant mark on the Welsh landscape, the current forest cover stands at around 15% [3], and many forest-dwelling species have declined or disappeared from the country. The Welsh landscape has been profoundly changed by the historical expansion of predominantly sheep grazing, to the extent that much of the upland landscape is now treeless. The pastoral system of sheep rearing has produced a rich and interesting cultural landscape in the 'fridd' landscapes. Millennia in the making and found between the uplands and the lowlands, they are considered worthy of preservation in their own right [4–7].

During the last half a century or so, the rate of change has accelerated. A large body of literature documents the increasing rate of disappearance of species as diverse as mammals [8] birds [9] or insects [10] from agricultural landscapes. In Wales, the grazing landscapes have remained unchanged for millennia, but the recent intensification of agriculture has altered them, causing local species extinctions [11]. Recognising the lack of sustainability of modern agriculture and the negative impacts on the environment, a recent spate of proposals for reforming Welsh agricultural policy has emerged. Proposals for diverting public subsidies away from production and towards supporting ecosystem service delivery are under debate [12], up to and including a complete removal of some agricultural land from production to enact tree planting or rewilding schemes [13]. However, as the recent failure of a proposed rewilding scheme in Wales shows, such efforts face significant farmer and landowner resistance [14].

The UK voted to leave the European Union in June 2016, culminating with her official departure on January 31st, 2020. During its membership, the primary driver of UK's approach to agriculture was the EU's Common Agricultural Policy (CAP). Post-Brexit, Wales is developing its own suite of agricultural policies as agriculture is a devolved issue in the UK. In 2018, the Welsh Government launched one of their largest ever consultations of farmers, rural communities, environmental groups and interested parties called "Brexit and Our Land" [15], attracting 12000 responses. One of the outcomes was the preference for future support to be based around the principle of sustainability, with land managers providing key environmental services, as well as food. In response, the Welsh Government plans to pay farmers based on income foregone to provide environmental services (e.g. clean air, improved biodiversity, clean water) through the Sustainable Farming Scheme (Glastir), which will replace the CAP support [15–17]. Alongside an additional scheme to promote agricultural business through skills training, capital investment, and knowledge exchange, it is hoped that both will be fully in place by 2025. Current plans for post-Brexit Welsh agricultural policy are, therefore, different to the principles of the CAP, which has been criticised for not delivering on sustainability, for pushing up land prices, and for creating an entry barrier to younger farmers [15,16,18]

Despite agriculture being a devolved issue, however, the outcome of UK-EU negotiations and the nature of UK future trading relationships with the bloc and the rest of the world (RoW) is very likely to influence land use & land cover (LULC) in Wales, with the potential to enact significant changes to the landscape [19]. Since its inception, Brexit has represented a wide range of potential outcomes – ranging from a 'soft' departure (Brexit in name only) to a 'hard' reset of all regulation and trading agreements, including those pertinent to agriculture. The range of potential Brexit outcomes is large and their eventual impact currently unknown, in this paper we carry out an analysis of recent

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LULC change and then consider the impact of five distinct Brexit-related scenarios on LULC in Wales in 2030. We use existing information on agricultural and environmental policy, together with a range of future trading arrangements to modify recently observed LULC change trends and use change demand modelling to predict how will these impact LULC in Wales. The main focus of our work is to assess how Brexit may impact broadleaf forest and improved grassland cover, respectively indicators of natural habitat and of intensive grazing in Wales.

2. Materials and Methods

2.1. Analysis of past change

We used the 'Land Change Modeler' (LCM) tool in TerrSet Geospatial Monitoring & Modelling System (version 18.31, Clark Labs, Clark University, USA [20]) to analyse high-resolution (25 m) LULC maps of Wales from 2007 and 2015 (https://digimap.edina.ac.uk, [21]). We reclassified LULC types into the following nine classes: Broadleaf Forest, Coniferous Forest, Arable & Horticulture, Improved Grassland, Semi-natural Grassland, Mountain, Heath & Bog, Coastal Areas, Water Bodies and Built Areas (Supplementary Table S1). The main aim of reclassification was to simplify map typology for ease of analysis and interpretation. A change analysis was then carried out by comparing the two historical LULC maps to identify past LULC transitions across the Welsh landscape. This analysis resulted in a total of 22 LULC transitions.

2.2. Explanatory variable selection

A wide range of factors is likely to affect future decisions of landowners and must be factored in LULC change modelling [22]. Climate change will undoubtedly have an impact on the Welsh landscape, however profound changes of e.g., species distribution, ecosystem composition, crop productivity or water yield from the landscape are not predicted to take effect within the next decade. For this reason, this analysis does not explore the effects of climate change. We considered 29 variables in total, comprised of 5 biophysical, 14 proximate, 2 socioeconomic, and 8 evidence likelihood transformation variables. The selection was based on a detailed review of the literature [23–27] and the initial suite of explanatory variables was filtered by a two-step process. In the first step, the potential of each of the 29 variables to explain observed LULC change was tested by calculating its Cramer's V value [20]. Here, 8 variables were dropped on the basis of low Cramer's V ($V < 0.15$) [20]. In the second step, using a correlation cut-off value of 0.75 [28], we removed further 11 highly correlated variables. As a result, 12 explanatory variables were used to account for the LULC changes observed in Wales between 2007 and 2015 (Table 1).

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Table 1. Explanatory variables considered in this study. Column (I) shows the categorization of variables, column (II) lists all considered explanatory variables in each class, and finally column (III) shows the Cramer's V value of each variable. Variables with Cramer's V < 0.15 were deselected in the first step, the remaining variables were then tested for correlation and the least correlated variables retained (highlighted in bold).

Category (I)	Variables (II)	Selection Thresholds (III) Cramer's V (> 0.15) & Correlation (< 0.75)
Topography & Soil	**Altitude**	**0.3239**
	Aspect	**0.165**
	Slope	**0.1504**
	Hillshade	0.02
	Soil Carbon Content	0.06
Proximity	**Distance from Broadleaf Forest**	**0.191**
	Distance from Conifer Forest	0.167
	Distance from Arable & Horticulture	**0.154**
	Distance from Improved Grassland	**0.154**
	Distance from Semi-natural Grassland	0.165
	Distance from Mountain, Heath, Bog	**0.21**
	Distance from Urban Areas	**0.2**
	Distance from Water Bodies	**0.182**
	Distance from Access Points	0
	Distance from Green Spaces	0
	Distance from Motorways	0
	Distance from Road Links	**0.151**
	Distance from Hydro-nodes	0
	Distance from National Parks	0.03
Socioeconomic	**Population Density**	**0.1763**
	Night Lights	0.04
Evidence Likelihood	Arable to Built	0.1
	Arable to Improved	0.151
	Conifer to Broad	0.2647
	Mountain, Heath, Bog to Semi-natural grassland	**0.1849**
	Semi-natural grassland to Arable	0.1647
	Semi-natural grassland to Broad	0.17
	Semi-natural grassland to Built areas	0.17
	Semi-natural grassland to Improved grassland	0.17

2.3. Transition sub-models and change demand modelling

LCM enlists all LULC transitions identified by comparing the two historical LULC maps and represents each in a separate transition sub-model. We used a multi-layer perceptron (MLP) algorithm to run the transition sub-models to empirically model future LULC, taking 10,000 randomly selected pixels for developing each transition sub-model. One-half of these pixels was used to train the model, while the other half was used for model validation. After explaining past LULC transitions, we used the 'Change Demand Modelling' function in LCM to predict the change likely to occur in selected LULC categories by 2030. By default, LCM uses a Markov Chain prediction process, which calculates the amount of change based on historical observations and determines the area of land expected to undergo such transition in the future through a transition probability matrix. LCM allows the user to manipulate this matrix to create and test alternative future scenarios.

2.4. Landscape scenario storylines

We developed spatially explicit scenarios by using the 'story and simulation approach' [29], combining quantitative models with qualitative assumptions to model future LULC. We used the scenario axes method [30] to combine effects of agricultural and environmental policy with changes of trading relationships. The scenarios are based on information available at the time of writing. B-a-U and GF assume no change to the trading pattern, while FTA, WTO and UTL depict various levels of trade disruption and are described in detail by Hubbard et al 2018 [31]. Apart from B-a-U, all scenarios assume a shift towards supporting environmental services and benefits delivered alongside food production. The storylines used to develop the LULC criteria applied in each scenario can be summarised as follows:

Business-as-Usual scenario (B-a-U)

B-a-U represents a simple extrapolation of land-use change trends observed in the recent past. We assume that the Wales continues to apply a non-reformed version of the Common Agricultural Policy (CAP).

Green Future (GF)

Wales pursues its own policy geared towards environmental responsibility and landscape sustainability, based on indicative proposals of the Welsh government. The most significant change is the move away from direct payment subsidies and towards paying for environmental benefits, while maintaining financial support of agriculture (Agriculture Bill [Wales] to be presented in 2020). In addition, we assume no material change to the trading relationship between UK and the EU or RoW. Key LULC change trends remain the same as B-a-U, but by 2030 we foresee a 100% increase in the 2015 area of broadleaf and 50% increase of conifer forests. There will be no further reduction of heath and bog and a continuing decrease of grassland.

Free Trade Agreement (FTA)

Agriculture policy is the same as in GF, while the UK reaches a comprehensive trade agreement with the EU keeping EU-UK tariffs at zero. UK adopts the EU common tariff on imports from RoW and maintains its share of EU tariff rate quotas applying to imports from RoW. There is a small increase in EU-UK trade costs (2% crops and 5% livestock, see [32] for details). We assume that these policy changes will translate to a faster decline of the area of semi-natural grassland (-32%) and a slowdown of the rate of loss of mountain heath and bog (-26%), explained by stronger support for environmental features and the sensitivity of marginal sheep grazing to increases in trade costs.

World Trade Organisation (FTA)

Agriculture policy is the same as in GF, but the UK does not achieve a trade deal with the EU and reverts to WTO rules and schedules relevant to trade in agricultural products. UK trades with the EU and RoW on the 'most favoured nation' terms and has the use of its share of current EU tariff rate quotas with the RoW. There is a medium increase in EU-UK trade costs (4% crops and 8% livestock). This policy and trading environment results in an increase of both broadleaf and conifer afforestation (+90 and +44% respectively), while there is a two-fold increase in the rate of loss of semi-natural grassland (-51%). There is no further loss of mountain heath and bog (environmental policy) or loss of arable & horticulture (high value crops are competitive).

Unilateral Trade Liberalisation

Agriculture policy is the same as in GF, the UK did not manage to reach a trade agreement so reverts to WTO terms. In addition, in order to maintain food supply to its population, the UK unilaterally removes all import tariffs for foodstuffs from the EU and RoW. This is an 'extreme free trade' scenario and entails significant export market disruption for Welsh agricultural exports (5% crops and 10% livestock) and a strong domestic market competition from abroad, leading to domestic price falls, particularly for beef and sheep. This results in destocking or land abandonment in hill areas as sheep farming becomes unviable. We model this scenario as a decrease of grazing semi-natural grasslands (-75%), accompanied by a decrease in the area of improved grassland (-27%). Land no longer used for grazing reverts to mountain heath and bog (+10%), or is used for an expansion of conifer plantations (+123% due to increasing demand for homegrown timber and fast carbon uptake) and broadleaf forests (+190% due to tree planting and secondary succession). This scenario also assumes an expansion of the most profitable crops (+15% arable & horticulture). Percentage changes in areas under each scenario are presented in Table 2.

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Table 2. Area of each LULC category, historical observations in 2007 and 2015 (in '000 hectares). Business-as-usual (B-a-U), Green Future (GF), Free Trade Agreement (FTA), World Trade Organisation (WTO) and Unilateral Trade Liberalisation (UTL) translate effects of hypothesised policy changes to LULC transitions. Numbers show predicted area (in '000 hectares), square brackets indicate percentage changes of each LULC between 2015 and 2030, shaded bars illustrate the proportion of each LULC out of 2.078 million ha total area of Wales.

	2007	2015	2030				
			B-a-U	GF	FTA	WTO	UTL
Broadleaf Forest	124.5	165.0	200.2 **[+21]**	330.0 **[+110]**	199.7 **[+21]**	313.5 **[+90]**	478.6 **[+190]**
Coniferous Forest	143.0	161.0	190.3 **[+18]**	241.6 **[+50]**	190.0 **[+18]**	231.9 **[+44]**	359.3 **[+19]**
Arable & Horticulture	176.6	99.5	92.9 **[-7]**	109.4 **[+10]**	92.5 **[-7]**	99.5 **[0]**	114.5 **[+15]**
Improved Grassland	841.3	983.4	1045.7 **[+6]**	792.7 **[-19]**	1042.4 **[+6]**	934.3 **[-5]**	721.8 **[-27]**
Semi-natural Grassland	510.9	428.9	314.4 **[-27]**	317.4 **[-26]**	292.0 **[-32]**	212.1 **[-51]**	107.2 **[-75]**
Mountain, Heath & Bog	163.9	98.1	45.8 **[-53]**	98.1 **[0]**	72.6 **[-26]**	98.1 **[0]**	107.9 **[+10]**
Water Bodies	12.9	12.1	12.1 **[0]**	12.1 **[0]**	12.1 **[0]**	12.1 **[0]**	12.1 **[0]**
Coastal Areas	16.1	25.1	25.1 **[0]**	25.1 **[0]**	25.1 **[0]**	25.1 **[0]**	25.1 **[0]**
Built Areas	88.5	105.0	151.8 **[+44]**	151.8 **[+45]**	151.7 **[+44]**	151.7 **[+44]**	151.7 **[+44]**

2.5. Determining transition probability matrices for future scenarios

The transition probability matrix for the B-a-U scenario was based on past LULC transitions and constitutes the default result of Markov Chain analysis (Table 3). B-a-U future projection assumes an unchanged extrapolation of past trajectory of changes. In this process, a Markov Chain analysis first derives a LULC transition probability matrix which specifies the probability of each LULC class changing to every other class and then calculates the future land area of that class. In order to project land-use change under alternative scenarios, we first translated our policy and trade assumptions to future land demand in each LULC category. For each alternative post-Brexit scenario, we used the Linear Programming function in Microsoft Excel to generate transition probability matrix M (=(m_{ij})) where m_{ij} denotes land transition probability from LULC category *i* to *j* within a given time period. The objective function of the Linear Programming is min $\sum_{i=1}^{n}\sum_{j=1}^{n} x_{ij}c_{ij}$ which is subject to $\sum_{i=1}^{n} x_{ij} = l_{i,2007}$ for i = 1, 2, ……n, $\sum_{j=1}^{n} x_{ij} = l_{j,2030}\ for\ i = 1,2,\ldots..n$, where x_{ij} and c_{ij} denote the amount of transition area (ha) and the friction of land-use transition (unitless) from land-use class i to j, respectively. For the present study, due to insufficient information on the weighting, the friction of the land-use transition was arbitrarily defined as $c_{ij} = \begin{cases}1 (i \neq j)\\ 0 (i = j)\end{cases}$.

Table 3. Markov Chain transition probability matrix showing the probability of LULC transitions based on changes observed between 2007 and 2015 (in percent).

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From: \ To:	Broadleaf Forest	Conifer Forest	Arable	Improved Grassland	Semi-natural Grassland	Mountain, Heath, Bog	Water Bodies	Coastal Areas	Built Areas
Broadleaf Forest	0.5341	0.1349	0.0185	0.1822	0.0594	0.0133	0.0033	0.0102	0.0441
Coniferous Forest	0.1848	0.748	0.0035	0.0289	0.02	0.0041	0.0019	0.0017	0.007
Arable & Horticulture	0.05	0.0094	0.0896	0.692	0.074	0.0078	0.0019	0.0103	0.0652
Improved Grassland	0.0394	0.0079	0.0556	0.762	0.1004	0.0062	0.0006	0.0052	0.0227
Semi-natural Grassland	0.0706	0.0477	0.0328	0.3955	0.3652	0.0495	0.0013	0.0126	0.0248
Mountain, Heath & Bog	0.0595	0.0869	0.0187	0.1626	0.4409	0.2063	0.0024	0.0078	0.015
Water Bodies	0.0658	0.0158	0.0128	0.0511	0.0441	0.0141	0.6068	0.1557	0.0338
Coastal Areas	0.0161	0.0029	0.0204	0.0654	0.041	0.0047	0.0592	0.7439	0.0463
Built Areas	0.077	0.017	0.0249	0.112	0.0342	0.019	0.0035	0.0202	0.6921

3. Results

A wide range of factors is likely to affect future decisions of landowners and must be factored in LULC change modelling. The biophysical, proximate, and socioeconomic variables utilized in this study performed well; the average accuracy of all transition sub-models was 78.4%, where accuracy rate of 75% or above is considered indicative of good model performance [33]. Our modification of transition probability matrices during scenario building translates to a marked difference in area gains and losses between LULC types under different assumptions (Table 1 and Supplementary Figure S1). Looking at the two habitats of interest, by 2030 Broadleaf Forest may expand between 35000 ha (B-a-U) and 313,000 ha (UTL) when compared to 2015. Improved Grassland, on the other hand, may shrink by 260,000 ha (UTL) or increase by nearly 60,000 ha (B-a-U and FTA).

The scenarios considered in this analysis indicate a markedly different composition of the Welsh landscape by 2030 (Figure 1). While some LULC categories do not have high capacity for changing location (e.g. mountain heath and bog), others are much more sensitive to the manipulation of transition probability matrices informed by possible policy changes. For example, the difference in Broadleaf Forest between GF and UTL scenarios is noticeable even on small-scale maps (Figure 1). Looking at change trends aggregated at 2.5 x2.5 km scale, clear differences in certain LULC types dominating specific areas emerge. B-a-U is likely to result in an increase of Broadleaf Forest cover in the western part of Snowdonia, this trend is largely repeated in the GF and WTO scenarios. The UTL scenario, however, indicates that nearly all of Wales will contain land with Broadleaf Forest establishment on at least 25% of the 6.25 km^2 block. Improved Grassland may increase in the hilly areas under B-a-U and Reformed CAP, but its predicted decrease under GF and UTL will be distributed all over the country (Figure 2).

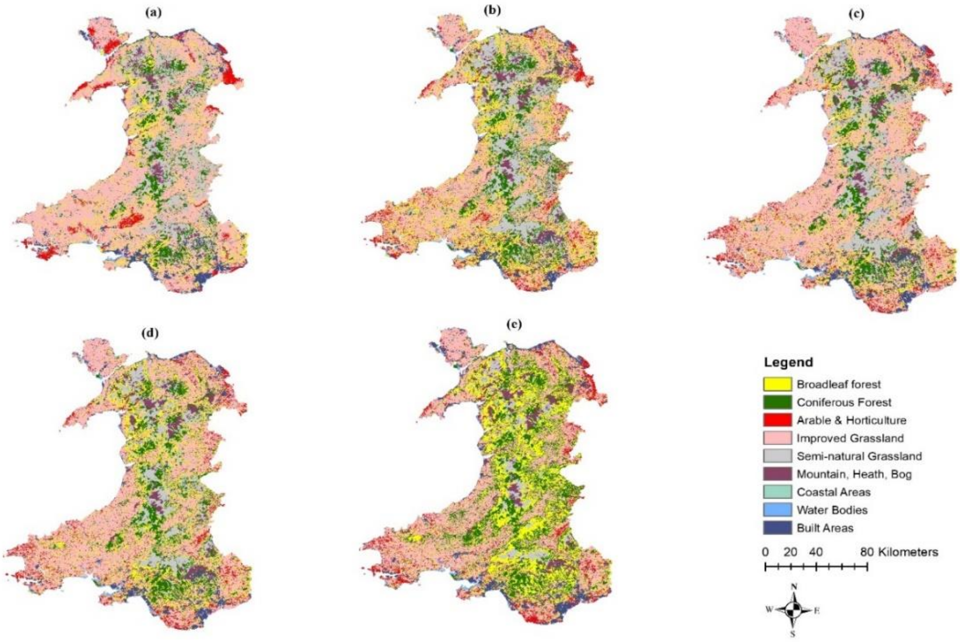

Figure 1. LULC maps of Wales projected to 2030 under a range of scenarios representing possible post-Brexit futures. Maps indicate the effect of Business as Usual (B-a-U, a), Green Future (GF, b), Free Trade Agreement (FTA, c), World Trade Organisation (WTO, d) and Unilateral Trade Liberalisation (UTL, e) scenarios.

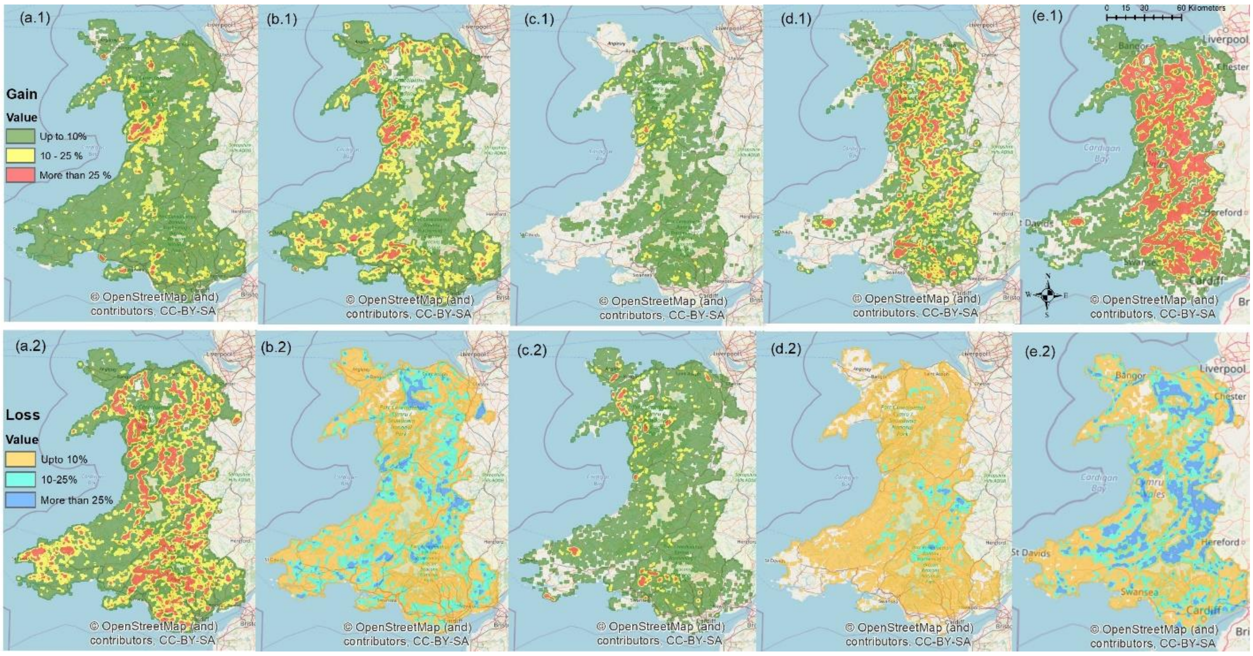

Figure 2. Land use & land cover change intensity of Broadleaf Forest (top row) and Improved Grassland (bottom row) predicted under a) Business as Usual (B-a-U), b) Green Future (GF), c) Free Trade Agreement (FTA), d) World Trade Organisation (WTO) and e) Unilateral Trade Liberalisation (UTL) scenarios. Colour mask indicates areas with gain/loss of up to 10%, between 10 and 25% and more than 25% of any 2.5 x2.5 km^2 block of land change.

Finally, we were interested how LULC change is affected at scales accessible to the people directly affected by it, namely at the farm or possibly, field scale. As an example, we focus on the area

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of the Brecon Beacons National Park. B-a-U indicates that small pockets of Broadleaf Forest would be expected to appear by 2030 even if current policy remains unchanged. The extreme free trade, UTL scenario offers the biggest contrast in terms of natural woodland expansion; well-connected tracts of Broadleaf Forest are predicted to emerge in the western and eastern parts of this national park (Figure 3).

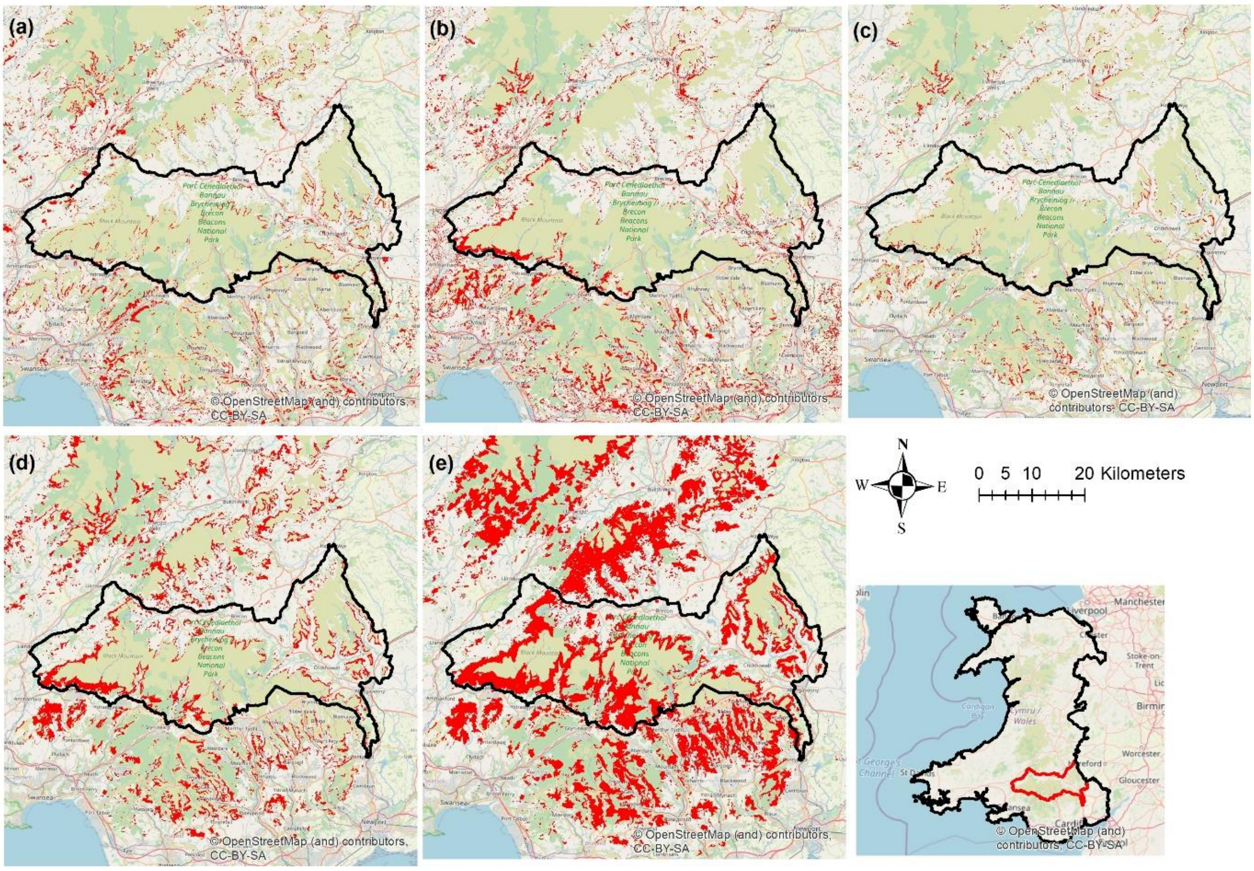

Figure 3. Projected expansion of Broadleaf Forest in and around the Brecon Beacons National Park, Wales by 2030, indicated by red overlay. Individual projections represent the a) Business as Usual (B-a-U), b) Green Future (GF), c) Free Trade Agreement (FTA), d) World Trade Organisation (WTO) and e) Unilateral Trade Liberalisation (UTL) scenarios.

4. Discussion

The EU is the largest international trading bloc, Brexit thus entails a significant disruption of existing trade flows which affect Welsh agriculture. At the time of writing, the UK government is pursuing a policy that rejects the membership of the EU Single Market and Customs Union, leaving a comprehensive trade agreement or a default to WTO as potential outcomes [19]. Either would involve at least the introduction of non-tariff barriers to Welsh exports [34]. These two factors directly affect the financial viability of Welsh farming, which in turn drives LULC change [35]. Welsh farmers may consider changing their land management practices to qualify for proposed environmental subsidies [36], may diversify or seek alternative employment, or downsize or de-intensify their farming operation [37]. Hubbard et al [31] show that the total land held on farm holdings in Wales exposed to financial risk as a result of Brexit to be around 700,000 ha (out of the 2.07 million ha total), while ~3.4 million sheep and ~77,000 beef cows currently graze on land deemed at risk from subsidy policy change. For comparison, the amount of farmland affected by LULC change under the scenarios developed in this study ranges from 183 thousand ha (B-a-U) to 598 thousand ha (UTL).

In 2018, the Welsh Government launched one of their largest ever consultations of farmers, rural communities, environmental groups and interested parties called "Brexit and Our Land" [15]. This consultation sought to gather views on what agricultural policy in Wales should look like once the Common Agricultural Policy ceases to apply post-Brexit. One of the outcomes was the preference for future support to be based around the principle of sustainability, with land managers providing key environmental services, as well as food. In response, the Welsh Government plans to pay farmers based on income foregone to provide environmental services (e.g. biodiversity enhancement, clean water and air) through the Sustainable Farming Scheme, which will replace the CAP support [15–17]. Alongside an additional scheme to promote agricultural business through skills training, capital investment, and knowledge exchange, it is hoped that both will be fully in place by 2025. Current plans for post-Brexit Welsh agricultural policy are, therefore, different to the principles of the CAP. Upland farmers may thus receive payments to primarily use their livestock as a tool for existing habitat conservation, rather than for food production [38]. It is likely that, in order to maintain the viability of agriculture, Welsh farmers will need to find new and creative solutions to this crisis [39].

We show that Brexit and associated policy changes will have a significant potential to rapidly alter LULC in Wales. It is likely that rural areas of Wales, especially in the uplands, will face land abandonment and the return of natural ecosystems. Among the many drivers, socio-economic factors and public policies are known to drive land abandonment [40]. Evidence from Europe shows that abandoned land is rapidly re-colonised by trees [41], initiating a cascade of effects such as the loss of cultural landscapes [42] or the loss of biodiversity associated with open landscapes [43]. In Wales, the land no longer exposed to grazing pressure is likely to be reseeded by a variety of native broadleaf tree species, with a contribution of non-native trees currently grown in Wales [44]. Just as elsewhere in Europe, lowering the economic viability of agriculture thus has the potential to enact a swift and profound alteration of the landscape towards natural ecosystems. Perhaps counterintuitively then, the extreme free trade UTL scenario exerting significant economic pressure may create the conditions for a well-connected patchwork of broadleaf forests. This study illustrates the fact that shifts in the terms of trade may speed up nature recovery far more rapidly and profoundly than a targeted nature conservation policy. Whilst Brexit may trigger a fairly rapid regeneration of natural ecosystems typical for Wales prior to its colonisation by humans, the process may come at the cost of losing some of the cultural landscapes associated with the evolution of pastoral farming over millennia in large parts of Wales. Should Welsh sheep and cattle farming be significantly suppressed by the new trading

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environment, the country may experience a profound change of its landscape to something resembling its natural state prior to the arrival of first human farmers.

The land cover products used for the analysis were the most accurate maps available at the time of this study. However, availability of more reliable and fine-resolution land cover maps would improve the projections in future. We included a comprehensive set of predictor variable to project LULC changes, however, many other variables such as landowners' decisions and/or introduction of new land policies in Wales could potentially affect the trajectory of change for different LULC classes.

5. Conclusion

Leaving the EU will significantly affect the financial viability of a large proportion of Welsh farms, resulting in land use change affecting most of the country. Contrasting scenarios describing impending change can be constructed to consider the impact on the landscape; from a simple extrapolation of recent change into the future, all the way to predicting the effects of a significant downturn of sheep farming. Our modelling exercise indicates that even the Business-as-usual scenario predicts the expansion of pockets of new broadleaf woodland in certain parts of the country. However, should Welsh sheep farming be significantly suppressed by the new trading arrangement, the country may experience a profound change of its landscape to something resembling its natural state prior to the arrival of the first human farmers.

Supplementary Materials: Supplementary Material S1.

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