Meeting tree planting targets on the UK's path to net-zero: A review of lessons learnt from 100 years of land use policies

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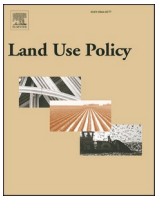
(2023) Meeting tree planting targets on the UK's path to net-zero: A review of lessons learnt from 100 years of land use policies. Land Use Policy, 125. 106502. ISSN 02648377 doi: 10.1016/j.landusepol.2022.106502 Available at https://centaur.reading.ac.uk/109392/

Land Use Policy 125 (2023) 106502

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol



Meeting tree planting targets on the UK's path to net-zero: A review of lessons learnt from 100 years of land use policies

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ARTICLE INFO

Keywords:
Afforestation
Agroforestry
Climate change
Woodland grants
Agri-environment schemes

ABSTRACT

The UK government has pledged to achieve net-zero greenhouse gas emissions by 2050. Ambitious targets have been set to plant nearly a million hectares of new woodland in the UK by 2050 to meet these net-zero commitments. More than 70% of UK's land is used for agricultural production and to meet these targets the Climate Change Committee has estimated that by 2050 approximately 21% of agricultural land will be required for tree planting, agroforestry and the extension of farm hedges. Achieving this creates a potential conflict between land for food production and land for carbon sequestration. However, trees and woodlands, when integrated into farming systems, can be multifunctional and play a significant role in helping farmers adapt and become more resilient in the face of climate change.

Over the last 100 years numerous government policies and incentive schemes have endeavoured to encourage more tree planting activities amongst farmers and landowners with varying degrees of success. This paper reviews the role of policy in determining the presence of trees in the UK's agricultural landscape over the past 100 years. We quantify the current extent of woodland and tree cover and aim to put the UK's net-zero tree planting targets in the context of historical agricultural land use patterns. We evaluate drivers behind the current extent of trees, woodland and agroforestry on UK farms and identify key elements of success in current and previous policies and incentive schemes to help inform future policy mechanisms for the UK to meet its tree planting targets.

Farmers are increasingly under pressure to deliver a wide range of environmental goals as well as producing food. The effectiveness of financial incentives to influence tree planting is dependent on the pre-existing interest and values of the farmer or landowner and grants alone may not be sufficient to encourage farmers to plant trees. Scheme complexity, bureaucracy and insufficient payment rates are barriers to the success of woodland grants and agri-environment schemes. Simplicity is important to encourage uptake, however oversimplification of schemes can lead to unintended consequences. Advice and guidance are key elements in the successful adoption of any new land management methods. A key to future progress will be scheme flexibility to enable farmers to choose to plant trees where it best suits local conditions, to align policy tools with farmer values and to ensure that farmers and landowners have the knowledge and support to make these decisions.

1. Introduction

Climate change is arguably the greatest challenge facing humanity today. Recent climate change data show temperature increases for Europe are around 0.9 °C higher than the global average (ECMWF, 2019a) and temperatures are predicted to continue to rise at a rate exceeding the global mean (IPCC, 2021). Agriculture both contributes to and is especially vulnerable to adverse effects of a changing climate. At 45.6 $MtCO_2e$ the UK's agricultural sector accounts for around 10% of total greenhouse gas (GHG) emissions (National Statistics, 2018; DEFRA, 2019) and globally agriculture causes about one-third of all GHGs (Gilbert, 2012). Reductions have been slow and UK agricultural emissions have remained broadly unchanged over the past decade (Committee on Climate Change, 2020). Key climate change-related risks

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https://doi.org/10.1016/j.landusepol.2022.106502
Received 9 November 2021; Received in revised form 28 November 2022; Accepted 29 November 2022
Available online 13 December 2022

to UK agriculture include: a reduction in the suitability of agricultural land for crop production; reduced water availability; increased flood risk; and risks from novel pests and diseases (Morison and Matthews, 2016; UK Climate Risk, 2021). If limiting factors can be managed there are also potential opportunities for agriculture and forestry from a modest level of climate change, for example via extended growing seasons and improved productivity (DEFRA, 2018a).

Trees can play a significant role in helping farmers adapt and become more resilient in the face of climate change through, for example, microclimatic modifications, increased system diversity, and a reduction in the risks from flooding and wildfires (Cole et al., 2020; Jose, 2009; Torralba et al., 2016; Tsonkova et al., 2012). Greenhouse Gas emission reductions and carbon dioxide (CO_2) capture are key to reducing the impacts of climate change. Trees sequester CO_2 during photosynthesis and growth, and tree planting and afforestation have been proposed as one of the most cost-effective nature-based solutions to climate change (Read et al., 2009). Increasing tree cover is widely agreed to be necessary for the UK to reach net-zero GHG emissions by 2050 (Committee on Climate Change, 2019b; Priestley and Sutherland, 2016; Staddon et al., 2021).

Net-zero models are based on balancing direct reductions in GHG emissions with negative emissions (e.g. tree planting or carbon capture and storage technologies). The hope is that net-zero policies will provide a safety net for industries where it is less possible to eliminate all emissions (e.g. agriculture and transportation) and ambitious targets have been set by the government to plant nearly a million hectares of new woodland by 2050 to help meet the UK's net-zero commitments (Climate Change Committee, 2020). However historically there has been a consistent gap between policy aspirations and the actual volume of tree planting (Priestley and Sutherland, 2016) and this call for rapid upscaling of tree planting and woodland creation raises the question of how and where this expansion should be achieved.

Land is a scarce resource in much of the UK with agriculture occupying over 70% of the land. To meet these targets the Climate Change Committee (2020e) has estimated that by 2050 approximately 21% of agricultural land will be required for tree planting, agroforestry and the extension of farm hedges. Agroforestry, defined simply as the integration of trees with agriculture (Lawson et al., 2016a, 2016b), takes a wide variety of forms and can be crudely divided into trees between fields (farm woodlands, shelterbelts and boundary hedgerows) or trees within agricultural fields (for example grazed woodlands, alley cropping and scattered trees). A typology of agroforestry systems based on farming types has been proposed by Lawson et al. (2016a, 2016b) (Table 1).

With the need to both increase tree cover and strengthen the resilience of agricultural systems, agroforestry has the potential to contribute towards both climate change mitigation and adaptation in agricultural systems (Kay et al., 2019; Martineau et al., 2016; Schoeneberger et al., 2012). However, we need a greater understanding of what this contribution is and how policy mechanisms could be designed to support farmer uptake of agroforestry.

Table 1
A typology of agroforestry systems (Lawson et al., 2016a,b).

	Agroforestry system	Land use classification	
		Forest land	Agricultural land
Trees within fields	Silvopastoral	Forest grazing	Parkland, wood pasture, orchard grazing, individual trees
	Silvoarable	Forest farming	Alley cropping, alley coppice, orchard intercropping, individual trees
	Agrosilvopastoral	Mixture of the above	
Trees between fields	Hedgerows, shelterbelts & riparian buffer strips	Forest strips	Shelterbelts, hedges, riparian tree strips

1.1. History of trees in the agricultural landscape of the UK

In the UK, agriculture and trees have a long and interconnected history and to understand how government policy has influenced the presence of trees on agricultural land over the past 100 years it is important to understand the context of how the current situation has arisen.

The large woodland expanses once present across much of the country were successively cleared for agriculture and timber leaving Britain with around 5% woodland cover by 1900 (Rackham, 1986). Clearance initially focussed on accessible, fertile land more favourable for agriculture and much of today's ancient woodland is found on less productive or inaccessible land (Rackham, 1986). Alongside this deforestation, from the 1750s to the early 1900s, large numbers of hedges and trees were also planted in the landscape to mark new boundaries as a result of the Enclosure Acts (Pollard et al., 1974). Following the First World War a state forestry programme was introduced to increase the national productive forest area as rapidly as possible for timber; this was successfully achieved via the formation of the Forestry Commission and with a programme of compulsory purchase of land for tree planting rates of afforestation rose rapidly (Aldhous, 1997; DEFRA, 2013). From the late 1940s onwards the effort to increase UK timber production occurred synonymously with a push to increase agricultural production (UK National Ecosystem Assessment, 2011). Removal of trees from farmland was seen as a sign of intensification and progress, especially where mechanization of agriculture was involved and this intensification resulted in the removal of 50% of farm hedgerows (Eichhorn et al., 2006; Robinson and Sutherland, 2002), and an estimated loss of 30–50% of all countryside trees outside woodland over the last 150 years (Reid. et al., 2021). The environmental impacts of intensification and the associated simplification of landscapes are now being felt especially in the light of future climate uncertainty (Armstrong McKay et al., 2019). This dual intensification of agriculture and forestry also established a division between these land uses and a siloed approach to trees and farming was further encouraged by the EU Common Agricultural Policy (CAP) which, until recently, disincentivised the planting of trees on productive agricultural land (Lawson et al., 2017). Policies aiming to increase tree and woodland cover have historically been set against policy measures such as the Single Farm Payment scheme which removed wooded areas from eligibility for subsidy payments (EFRAC, 2017; Forestry Commission, 2005) and disincentivised farmers from planting trees.

While current agricultural policy (DEFRA, 2022b) recognises tree planting on farmland as eligible for financial and other support, implementation is still poor. To understand the reasons, this review seeks to quantify the gap between policy aspirations and the actual numbers of trees planted and to answer the following questions: (1) What is the current extent of woodland, tree cover and agroforestry in the UK?; (2) Have UK governmental policy tree planting targets been achieved over the past 100 years?; (3) What woodland creation and tree planting support schemes and incentives have been the most successful in encouraging farms and land owners to plant trees and what are the key factors that limited or promoted success?; and (4) What lessons can be learnt from previous policies and schemes that can inform future policy mechanisms to allow the UK to meet its tree planting targets.

2. Methodology

This review uses relevant reports and publications to summarise the state of the art, collect relevant evidence and data on policy effectiveness and highlight the evidence gaps. The review takes a narrative approach, i.e. it is not intended to be a systematic review but is a collation of the relevant available evidence and data that reflects the current understanding in early 2022. The methodology uses techniques from the

snowball sampling procedure (Wohlin, 2014) identifying key seed texts using the search engines ScienceDirect and Google Scholar together with organisational websites and expert input. Texts included peer reviewed literature, government research and policy publications and other grey literature. Keywords and search strings were identified and refined in an iterative process. We reviewed evidence of most relevance to the English situation, with particular attention to texts from the UK and Northwest Europe. All documents were initially screened for relevance by title and then abstract. Filtered full texts were then assessed and either accepted or rejected from the final review. After screening, a total of 84 documents were retained, approximately half of these were peer reviewed research papers and the remaining papers were policy documents or reports, NGO reports or media items (Fig. 1). A list of search terms and a summary of documents used can be found in Supplementary Material.

In order to answer the first research question, we collated data from the National Forest Inventory (NFI) (Forest Research, 2022) together with Forest Research's survey of tree cover outside woodland in Great Britain (Brewer et al., 2017b, 2017a) and the Northern Ireland Woodland Register. A search of published and grey literature and expert consultation was carried out to attempt to ascertain the extent of different agroforestry systems in the UK. To address the second research question, we have identified the main woodland creation and tree planting policies and targets in the UK over the past 100 years, and compared the targets against actual rates of tree planting to assess success. To address the third research question, we identified the mechanisms implemented by the UK government to achieve these policy targets through trees planting support schemes and other incentives, and related literature that reported any unintended consequences or identified key success factors. Finally, for the fourth research question, we have then drawn out and summarised key success factors and lessons learnt to suggest recommendations for the design of future tree planting policies and incentive schemes.

3. Results and discussion

3.1. Current extent of woodland, tree cover and agroforestry in the UK

Woodland cover has more than doubled in the last hundred years and now covers approximately 13.0% of UK's total land area (Forest Research, 2022). However, when compared to an average woodland cover of 46% across Europe, this is still low (Forest Research, 2015). The UK is well known for its rich and varied patterns of field boundary hedges and hedgerow trees and in 2016 Forest Research carried out an analysis of tree cover outside woodland (TOW) in Great Britain (Brewer et al., 2017b, 2017a). This study included sub-0.5 ha woods, linear tree features, hedgerows and lone trees. The TOW data adds a further 3% cover, taking total woodland and tree cover in the UK to 16.0% (Table 2).

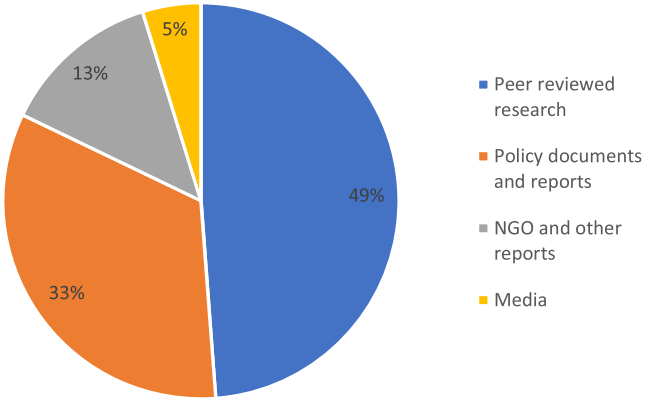

Fig. 1. Proportion of the different types of literature included in the review (n = 84).

The present-day extent and composition of trees and farmland varies geographically across the UK, with the highest woodland cover in Scotland and southeast England (Table 2). Despite the separation of farming and forestry, with most of the land used for some sort of agricultural production, much of the UK's limited tree cover is still closely associated with agriculture, in the form of hedges, in-field trees and small farm copses. The area of farm woodlands over 0.5 ha in the UK has increased in recent years from 0.8 million ha in 2010–1.0 million ha in 2020 (Defra, 2020; Forest Research, 2020). 51% of all farm woodland is in Scotland (Forest Research, 2020); however at just 1%, Scotland has the lowest cover of TOWs compared to England's 4.3% (Table 2). Most (91%) small woods and TOWs are found at an altitude of less than 200 m (Brewer et al., 2017a) and in pastoral lowland western England and Wales, the mosaic of trees and hedges closely integrated into the farmed landscape could be described as an agroforestry landscape (Rackham, 1986).

To date there has been no consistent attempt to capture the full extent of agroforestry in the UK and the actual or potential contribution of agroforestry to national tree cover figures. According to Den Herder et al. (2017), the predominant agroforestry systems in the UK are traditional silvopasture systems such as wood pasture and grazed orchards, with an estimated 547,600 ha or 3.1% of agricultural land compared to just 2000 ha of arable agroforestry. There are reasonably accurate single datasets such as the Wood Pasture and Parkland inventory which suggests an extent of 278,000 ha in England (Natural England, 2020) and woody linear features (Scholefield et al., 2016). However, in order to map agroforestry, clear boundaries are needed to define what constitutes agroforestry (Den Herder et al., 2017).

3.2. How UK government policy has influenced the presence of trees on agricultural land over the past 100 years

Afforestation targets have been a feature of UK policy since the formation of the Forestry Commission in 1919 and the introduction of a series of grant schemes, loans and tax concessions (Aldhous, 1997; Forest Research, 2020). Previous and existing targets and aspirations are summarised in Table 3.

In 1945 the Forestry Commission set a target to increase the area of productive woodland to 2 million ha in Great Britain by the year 2000. At 3.2 million ha the total woodland area of Great Britain now exceeds this target (Forest Research, 2021), although only 44% of this is certified as sustainably managed (Forest Research, 2021). In recent years tree planting targets have become an important element of political discussions around climate change emissions abatement, with the assumption that tree planting will lead to a net reduction in GHG emissions (Matthews et al., 2020). The current UK Government commitment is to create at least 30,000 ha of new woodland per year by 2025, increasing forest cover across the UK from 13% to 17.5% by 2050. However, target figures and recommendations (Table 3) remain fairly generic with a lack of specific detail on where and how these trees will be planted. There is some detail in the Sixth Carbon Budget Policy document (Committee on Climate Change, 2020) which proposes planting agroforestry on 10% of farmland by 2050; to achieve this 39,000 ha would need to be converted to agroforestry each year (Reid. et al., 2021). The report also recommends planting 40% more hedgerows by 2050, requiring the creation of over 6000 km of new hedges per year. To put this in context, hedgerow planting in England funded by agri-environment schemes (AES) over the past 5 years has averaged 213 km/ year (Natural England, 2021). A recent report suggests that the UK Government did not sufficiently consider whether its tree-planting target was actually achievable (National Audit Office, 2022).

The 25 Year Environment Plan (DEFRA, 2018b) reduced the English woodland cover target from the 15% recommended by 2013 Forestry Policy Statement to an aspiration of 12%. The current proposed statutory target to increase tree and woodland cover in England to 17.5% by

Table 2
Tree cover from the National Forest Inventory (NFI), Tree Cover Outside Woodland and total agricultural holdings in different regions and countries of the UK.

	Total land area	NFI woodland 2022[a]		Tree cover outside woodland 2017[b]		Total NFI and tree cover	Total agricultural holdings 2020[c]	
	(000 ha)	*(000 ha)*	*% land*	*(000 ha)*	*% land*	*% land*	*(000 ha)*	*% land*
UK	**24,853**	**3237**	**13.0**	**742**	**3.0**	**16.0**	**17,652**	**71.0**
England	**13,031**	**1323**	**10.2**	**565**	**4.3**	**14.5**	**9206**	**70.6**
North West	1411	120	8.5	51	3.6	12.2		
North East	857	117	13.6	21	2.5	16.1		
Yorkshire	1541	117	7.6	44	2.8	10.5		
East Midlands	1562	101	6.5	57	3.6	10.1		
East	1912	156	8.2	80	4.2	12.4		
SE & London	2065	333	16.1	124	6.0	22.1		
South West	2384	266	11.1	113	4.7	15.9		
West Midlands	1300	126	9.7	74	5.7	15.4		
Scotland	**8024**	**1486**	**18.5**	**84**	**1.0**	**19.5**	**5660**	**70.5**
Wales	**2123**	**310**	**14.6**	**93**	**4.4**	**18.9**	**1764**	**83.1**
N. Ireland	**1413**	**118**	**8.4**	**n/a**	**n/a**	**8.4**	**1023**	**72.4**

[a] Figures for total woodland from the National Forest Inventory (NFI) adjusted for new planting, Figures for Northern Ireland from the Northern Ireland Woodland Register (Forest Research, 2022). Figures for English regions from Forest Research (2020).
[b] Tree cover outside woodland figures are for Great Britain excluding Northern Ireland (Brewer et al., 2017b).
[c] Total agricultural holdings area includes woodland and other non-agricultural land but excludes common rough grazing (Defra, 2020).

2050 (DEFRA, 2022a) is considerably higher and recognises the contribution and value of all trees including those outside woodland. The increased scope reflects the government's interest in promoting agroforestry and other diverse methods of planting.

Both forestry and agriculture in the UK are devolved to the four countries and the devolved administrations have their own annual planting targets. Tree planting targets are not currently legally enforceable, and with the exception of Scotland, the UK and national governments have consistently failed to meet planting targets (Marsh, 2020). The data presented in Fig. 2 demonstrates how far each country needs to go in order to achieve their tree planting targets, especially Wales where a 15 fold increase in tree planting is needed. Various woodland opportunity maps have been created indicating that these targets are obtainable whilst avoiding priority habitats for biodiversity, peat soils and the most productive farmland (e.g. Bell et al., 2020; Sing et al., 2013; Sulis, 2020). However, most of the new planting will need to take place on private land with the agreement of the landowner, and these maps do not indicate land availability or other social and cultural constraints to woodland creation, including the considerable task of persuading farmers to plant trees (Staddon et al., 2021). If the UK and Devolved Administration governments are to meet these targets, land is needed, and policy incentives must be attractive to farmers and landowners.

3.3. *What policy mechanisms and incentive schemes have been the most successful in encouraging farms and land owners to plant trees?*

The pattern of land use in the UK is the result of decisions made by landowners, acting within local, national and European policy limitations, with government incentives and support aiming to influence landowner decisions towards certain goals (Nicholls, 1969). These restrictions and goals are set using policy mechanisms which have

Table 3
Summary of targets and recommendations relating to tree planting and climate change in recent policy documents in chronological order.

Policy / Act / Strategy	Summary of targets
1945 Forestry Act (UK legislation)	2 million hectares managed productive woodland by 2000
2000 Scottish Forestry Strategy	Expand woodland cover from 17% to 25% of Scotland's land area by 2050 planting 10,000–15,000 ha new woodland per year
2006 Northern Ireland Forestry Strategy	The Strategy aims for a steady expansion of tree cover with a broad aim to double the area of forest by 2056 Target - 900 ha per year by 2020 (DAERA, 2020)
2008 Climate Change Act (UK legislation)	Imposes a legal obligation to achieve net zero by 2050
2010 Wales Climate Change Strategy	The Welsh Government would like to see 100,000 ha of new woodland by 2030. To meet this aspiration, 5000 ha of additional woodland cover per year would need to be planted from 2010 to 2030
2013 Forestry Policy Statement (England)	Panel recommendation to increase England's woodland cover from 10% to 15% by 2060
25 Year Environment Plan (DEFRA, 2018b) (England)	- Increase tree planting by creating new forests, and incentivising extra planting on private and the least productive agricultural land. This will support the 2015 Conservative Party manifesto ambition to plant 11 m trees in England by 2020. - Increase woodland cover in England with aspiration of 12% cover by 2060: planting 180,000 ha by end of 2042
Land use: Policies for a Net Zero UK (Committee on Climate Change, 2020)	- Increase forest cover to at least 17% of the UK's land area by 2050 by planting 90–120 million trees per year by 2025. Agroforestry {no target}, planting trees on agricultural land whilst maintaining primary use, could sequester 6 $MtCO_2e$ by 2050.
Sixth Carbon Budget Policy document (CCC, 2020a) (UK Legislation)	- Increase UK afforestation rates to at least 30,000 ha per year by 2025 and 40,000 ha per year in the 2030 s - Plant trees on 10% of farmland while maintaining their primary use, extend hedgerows by 20% by 2035. - Plant energy crops on 30,000 ha per year across the UK by 2035.
England Trees Action Plan (ETAP) 2021–2024	Sets out the actions government will take this Parliament, in partnership with the private sector, the third sector and communities, to increase woodland planting rates to 7500 ha annually by March 2025 (as part of the overall 30,000 ha UK target) Ambition to increase woodland cover in England from 10% to 12% by 2050
Net Zero Strategy (HM Gov, 2021) (UK)	Underlines Sixth Carbon Budget target to increase UK forestry cover from 13% to 17% by 2050 by planting 30,000 ha or more of woodland each year from 2025. Work with water companies to plant 11 million trees by 2030
Environment Act 2021 (UK legislation)	Requires targets in 4 priority areas to be laid as draft Statutory Instruments by 31 October 2022. Proposed statutory targets include: Increase tree canopy and woodland cover from 14.5% to 17.5% of total land area in England by 2050.

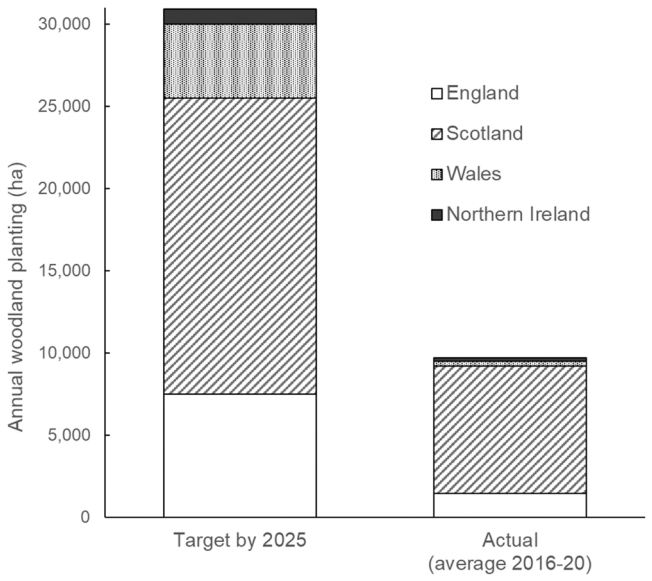

Fig. 2. Current tree planting targets by country compared to the average area of woodland planting achieved 2016 – 2020. (Data from; Forest Research, 2020; Climate Change Committee, 2020; DEFRA (2018); Scottish Government, 2020; Welsh Government, 2020; and DAERA, 2020).

changed and evolved over the last 100 years. Numerous government policies and incentive schemes have endeavoured to encourage more tree planting activities amongst farmers and landowners with varying degrees of success (Table 4).

Tax incentives and compulsory purchases although highly effective did not always result in the optimum location of new woodlands. Initially much of the incentivised tree planting in the UK took place on land with the least impact on agricultural production, i.e. marginal upland grazing, peat bogs and lowland heathland, without prior assessment of the environmental impacts. By the early 1980s environmental concerns were being expressed about forest expansion on peatlands (Lindsay et al., 2014) and substantial restoration of peatland habitat within formerly-planted areas is now occurring across the UK. After the 1988 budget removed tax breaks for afforestation, overall woodland planting reduced and there was a shift in the type of woodland creation that was grant-aided with a higher proportion of broadleaved native woodlands created for wildlife and recreation purposes compared with productive conifer plantations (Aldhous, 1997).

Where scheme effectiveness was low this is most often attributed to complexity of the application process (e.g. Countryside Stewardship, Forestry Commission loans) (Hemery et al., 2020; Lawrence et al., 2010; The Environment Food and Rural Affairs Committee, 2022; Turner and Tweedie, 2017) or scheme design (e.g. Measure 8.2 (Lawson et al., 2016)). Although inherently connected as part of a wider land use matrix, farming and forestry are still commonly viewed as mutually exclusive land uses in the UK (Lawrence et al., 2010). There remains a wide cultural gap between forestry and farming, and a lack of synergies between policies promoting woodland creation and agricultural improvement (Muñoz-Rojas et al., 2015). In 2014 Countryside Stewardship (CS) brought together Agri-Environment Schemes (AES), catchment sensitive farming and Woodland Grant Schemes (WGS) into one scheme. This was an important step in a more integrated approach to agricultural and forestry policy. However, an overly complex system and the need to engage multiple agencies resulted in low uptake of woodland creation options (Royal Forestry Society, 2020; Committee on Climate Change, 2020; Hemery et al., 2020; Turner and Tweedie, 2017).

An ongoing gap in policy support for agroforestry has been cited as one of the main barriers to wider adoption (Hernández-Morcillo et al., 2018; Soil Association and Woodland Trust, 2018; Burgess, 2017; Smith, 2010). However, with the right support, agroforestry has the potential to bridge the gap between agricultural and forestry policy whilst providing diversity of income streams for farmers and strengthening the rural economy (RPA, 2020). Agroforestry was promoted in the CAP 2014–2020, through Measure 8.2 which supports 'Establishment, regeneration or renovation of agroforestry systems'. However by 2019 only 6 countries had implemented this Measure, the planned area was reduced from 84 thousand hectares in 2015–60 thousand hectares in 2019, and by the end of 2019 only 3.3 million of a 64 million Euro budget had been spent (Szedlak, 2021). The poor implementation in the UK reflects uptake across the EU and has been attributed to a lack of available information for practitioners, variable and confusing rules, competition from other measures and low payment rates (EURAF, 2021). Measure 8.2 was taken up by Scotland and Wales but the schemes that were implemented in these countries were restrictive and have therefore had a relatively low uptake. In Scotland the scheme was only open to sheep farmers on permanent pasture and in Wales the Agroforestry grant scheme was not eligible for a fencing grant. In Northern Ireland there was more success, with over 100 ha of new silvopasture schemes in process by 2021 against a target of 52 ha by 2020 (Lawson et al., 2016a,b). As part of the new (post 2023) CAP, support for agroforestry in the EU has increased in both Pillar 1 and Pillar 2; in particular 25% of the Pillar 1 budget is allocated to Eco-schemes which must be implemented by member states from 2023, and agroforestry and carbon farming are included. This is mirrored in the UK by increased support for agroforestry and trees outside woodland in the new Environmental Land Management (ELM) scheme and the launch of a new agroforestry standard through the Sustainable Farming Incentive in 2024 (DEFRA, 2022a).

3.4. Lessons learnt – how can the UK meet its tree planting targets?

Appropriate and well-functioning grant schemes are widely agreed to be an essential part of increasing tree planting rates (EFRAC, 2017; Staddon et al., 2021). However, as demonstrated above, the effectiveness of previous financial incentives for woodland creation is variable. Studies have shown that farmers may be reluctant to plant trees for many reasons (e.g. loss of good agricultural land, lack of expertise) and despite significant evidence for public goods from afforestation and decades of incentivising woodland planting, with Table 3 showing that desired levels of planting are not being achieved (Watkins, 1996; EFRAC, 2017; Parliment, 2021; Turner and Tweedie, 2017).

Based on the review of the effectiveness of the main woodland creation and tree planting support schemes and incentives in the UK over the past 100 years we provide a list of lessons learnt and recommendations (Box 1).

Trees are a long-term responsibility and planned establishment is essential. Around a quarter of land area in the UK is tenanted; in 2019 the average length of a tenancy agreement in England was 3.2 years (Harris, 2020). Farmers on short term tenancies are less likely to invest and tenancy terms may prohibit tree planting (Parliment, 2021). Resolving tenancy constraints is recognised as important to enable long-term investment decisions such as tree planting (Committee on Climate Change, 2020).

3.5. Future policy direction

Many trees will need to be planted on agricultural land if the UK's net-zero tree planting targets are to be achieved. Beyond optimistic targets and opportunity maps we need more detail on how and where these trees will be planted; a combination of overambitious targets and a rush to fulfil them risks poorly informed actions which could lead to suboptimal or counterproductive outcomes. Previous attempts to rapidly increase afforestation rates have sometimes had undesirable outcomes.

It is important that new policy tools are designed in partnership with

Table 4
Review of the effectiveness of the main woodland creation and tree planting support schemes and incentives in the UK over the past 100 years. England (E), Scotland (S), Wales (W), Northern Ireland (NI).

Dates	Scheme/ incentive	Legitimacy/ political support	Unintended consequences	Effectiveness/ key success factors
1919 – present (E, S, W, NI)	Forestry Commission (FC) planting directly on government land	Extensively used for afforestation in the first half of the 19th century. Much of the FC's land was obtained via compulsory purchases on long leases. Now forestry is devolved and FC operates in England only. Compulsory purchase is still theoretically possible under the 1967 Forestry Act but is not often exercised (UK Government, 1967).		Today FC have direct control of 254,000 ha in England. Most of this area is already planted (Forestry Commission, 2020)
1919 – 1961 (E, S, W, NI)	FC loans for tree planting	Loans were introduced under the 1919 Forestry Act	Lack of belief amongst farmers and landowners in the reality of future profits (Nicholls, 1969)	Low uptake, due to unattractive terms and complicated accounting (Nicholls, 1969).
1947 – present (E, S, W, NI)	FC Dedication scheme	This scheme enabled private owners to dedicate their woodlands to forestry in return for a government grant		The offer of grants combined with the threat of compulsory purchase (very seldom used) "encouraged" people to dedicate (Nicholls, 1969)
1947 – 1988 (E, S, W, NI)	Income tax concessions for forestry	Tax concessions were introduced under the 1947 Forestry Act	Tree planting by third parties. Investors (often corporations), rather than existing land managers. Led to inappropriate planting of valuable habitats (e.g. peatlands) (Dandy, 2012)	The scheme's simplicity. The financial benefits were obvious to those who could afford to invest (Nicholls, 1969).
1919 – 2005 (E, S, W, NI)	Woodland Grant Schemes (WGS)	From 1988 WGS was the primary policy delivery mechanism for woodland expansion. Focus was on timber production.	Some of the grant eligibility conditions (e.g. parcel size) made WGS unattractive to farmers (Staddon et al., 2021)	Only one authority to deal with, forestry officers were available to give advice.
1988 – 2005 (E, S, W)	Farm Woodland (Premium) Scheme	This scheme was introduced to counter growing agricultural surpluses and encourage farmers to plant new productive broadleaf woodland on land formerly used for agriculture.		By 1997 48,000 ha were approved for woodland planting. A grant covered establishment costs and annual compensation payments were made for agricultural income foregone. Straightforward application process. Easy access to advice. Farmers had regular interactions with advisors (Heffernan et al., 2011).
2005 – 2014 (E)	England WGS	EWGS broadened the remit of WGS. Focused on delivery of public benefits from woodlands and reflected a move away from production-centred policies.	Some of the grant eligibility conditions (e.g. parcel size) remained making them less attractive to farmers (Staddon et al., 2021).	Only one authority to deal with, forestry officers were available to give advice.
1988 – 2014 (E, S, W, NI)	CAP: Pillar 2 Agri-Environment Schemes (AES)	The primary focus of these AES was to protect and enhance biodiversity, landscapes and historic features. Unlike early forestry grants and CAP Pillar 1 agricultural subsidies, productivity was of lesser importance.	The tree density thresholds where farmland becomes classified as woodland and therefore ineligible for CAP payments were low. This restricted the planting of agroforestry (Lawson et al., 2017).	Support included hedgerows, in-field trees, wood pastures and traditional orchards. Hedge options and protection of in field trees were amongst the most popular AES options in England (Natural England, 2021).
2014 – 2021 (E)	CAP: Pillar 2 Countryside Stewardship (CS) Woodland Grants	CS brought together AES with woodland creation grants. This was an important step in a more integrated approach to agricultural and forestry policy.	Farmer and landowner confusion dealing with multiple government agencies (Turner and Tweedie, 2017)	Low uptake of woodland creation options due to the complex application process (Turner and Tweedie, 2017). In the 2019–20 financial year just 1956 ha of land were newly planted with trees in England with support from central government.
2015 – 2022 (S, W, NI)	CAP: Pillar 2 Measure 8.2 agroforestry options	This Measure was adopted and agroforestry options were integrated into the rural development plans in Wales, Scotland and Northern Ireland in 2015 but not England.	Different interpretations of the Measure in different member states.	Uptake in Wales and Scotland has been low. In Wales the scheme design, lacking a fencing component, was not practical. Northern Ireland has been more successful, 70 ha of agroforestry schemes are in process and 35.25 ha are already established (J. McAdam, pers comm, June 2021)
2020–21–2024–25 (E)	Nature for Climate Fund Tree Programme	£ 753 million to fund tree planting through new woodland creation partnerships with local authorities and charities and to provide landowners with grants and advice to increase woodland creation, expansion and management. Strong focus on biodiversity - majority of trees broadleaf.	The Forestry Commission has not been able to process the volume of applications received as quickly as anticipated. This is because of a shortage of resources and grant applications taking longer than expected to process (National Audit Office, 2022).	Success is heavily dependent on private landowners choosing to plant trees but uncertainty about future government funding reducing the appeal to landowners (DEFRA, 2022a)
2022 - present (E)	England Woodland Creation Offer	Part of above programme. Replaces CS woodland grants No agricultural activity is allowed in EWCO funded woodland	Unsuited for agroforestry planting Launch delayed, fewer applications processed in time for 2021–22 planting season	Grants covers 100% of tree planting costs, more than previous schemes. Minimum parcel size reduced to 1 ha (DEFRA, 2022a) Demand so far has been high (DEFRA, 2022a)

Box 1
Key lessons learnt from the past 100 years of government incentives and targets for increasing tree cover in the UK.

Grants alone may not be sufficient to encourage farmers to plant trees (Lawrence and Dandy, 2014; Staddon et al., 2021). Most farmers who have planted agroforestry systems have done so without grant aid (Soil Association and Woodland Trust, 2018). However, there are currently no reliable methods of quantifying the extent of most of these systems.

Scheme complexity, bureaucracy and insufficient payment rates are well known barriers to the success of woodland grants and agri-environment schemes (Cao et al., 2018; Hemery et al., 2020; Lawrence et al., 2010; Lawrence and Dandy, 2014; Staddon et al., 2021).

Scheme simplicity is important to encourage uptake (Lienhoop and Brouwer, 2015). This is demonstrated by the success of the earlier Farm Woodland Schemes (Heffernan et al., 2011) with its straightforward application process and easy access advice. Tree planting rates also more than doubled in Scotland following a 2016 review and the subsequent simplification of procedures for forestry applications (Confor, 2020) and Scotland is currently delivering 80% of all UK planting. Tax concessions for forestry, also a simple scheme, successfully increased rates of afforestation in the 1980s.

However **oversimplification can lead to unintended consequences**. For example a lack of prescriptiveness of some earlier schemes led to some inappropriate planting, with corporate investors, rather than existing land managers, planting trees to reduce their tax burden (Dandy, 2012). There is also nervousness in some parts of the farming community about current policy driving corporate buy-up of agricultural land for tree planting to achieve corporate net-zero ambitions (Garside and Wyn, 2021).

The effectiveness of financial incentives to influence tree planting has been shown to depend on the pre-existing interest and values of the farmer or landowner (Eves et al., 2015). **Grants and other incentives only appeal to a proportion of farmers** and there is some evidence that this group may have planted trees without financial support (Staddon et al., 2021).

Advice and guidance are key elements in the successful adoption of any new land management methods. The success of the agroforestry measure in Northern Ireland may be partly attributed to the fact that all applicants are offered training at an agroforestry demonstration farm (McAdam, 2021). The Farm Woodland Premium scheme (FWPS) achieved a good level of uptake, in part linked to regular interactions with advisors (Heffernan et al., 2011) and provision of advice has been cited as critical to the successful implementation of Countryside Stewardship woodland creation options (Turner and Tweedie, 2017).

The restrictive agroforestry scheme in Scotland which was only for sheep, on a particular grade of land, and for certain tree species had very low uptake. **Scheme flexibility**, allowing farmers more freedom to plant the right trees for them and their farm, is important.

diverse groups of farmers and other stakeholders with different motivations for and attitudes towards tree expansion (Staddon et al., 2021). Farmer motivations need to be better understood, rather than assuming that farmers and landowners will plant trees for the 'right price'. In addition to longer term global benefits from climate change mitigation farmers must also be able to see direct on-farm benefits (e.g. soil protection, livestock welfare, biodiversity) from tree planting (Staddon et al., 2021). These benefits are often the motivations of farmers interested in agroforestry (Soil Association and Woodland Trust, 2018) and a recent survey of farmers and woodland owners found that of those considering increasing tree cover agroforestry was the second most popular method in terms of area after tree planting for woodland creation (Hemery et al., 2020). This reflects a wider increase in awareness amongst farmers and policy makers of the beneficial impacts of trees on farms (Soil Association and Woodland Trust, 2018) and the Rural Payment Agency have now recognised that agroforestry could play an important role in encouraging tree planting farms (RPA, 2020). However research on barriers to adoption of agroforestry practices highlight the complexity of these systems, a lack of knowledge and a need for advice and training (Westaway and Smith, 2021). Access to advice and guidance can increase transaction costs which may be an additional barrier to uptake (Turner and Tweedie, 2017) and provision of good quality advice and guidance should be incorporated into new policy incentives to ensure success (Committee on Climate Change, 2020). Farmers are increasingly under pressure to deliver a wide range of environmental goals as well as producing food but knowing how to do this effectively is a big challenge. Sustainable farming is knowledge-intensive and in order to make the right decision, farmers need trusted advisors and networks to make informed choices and demonstration projects to illustrate benefits.

The agricultural policy landscape is changing rapidly. The UK's exit from the CAP and the new Environmental Land Management (ELM) scheme is likely to create new financial incentives for afforestation including agroforestry. However current uncertainty over the design of ELM scheme has delayed DEFRA plans for tree planting post 2025 and currently acts as a disincentive to landowners to commit to long term programmes such as tree planting (DEFRA, 2022b). Once within ELM, tree-planting will also be competing for funding with a wide range of other government environmental priorities, and it is not clear how landowners will respond to the different options available to them under ELM (National Audit Office, 2022).

Under the 2021 Environment Act statutory targets for priority areas including tree cover are currently out for consultation (DEFRA, 2022a); they include a proposed target to increase tree canopy cover from 14.5% to 17.5% of the total land area in England by 2050. Previous targets based on the total area of woodland exclude TOWs and number of trees planted is an action rather than outcome based target. This broader target based on tree canopy and woodland cover now includes TOWs and recognises the importance of agroforestry in a future multifunctional landscape. The target should also be able to be assessed in a statistically robust, consistent and affordable way using National Forest Inventory (NFI) Woodland cover and NFI-reported Trees Outside Woodland (NFITOW) data (Defra, 2022).

3.6. Limitations

Due to the breadth of the subject matter, the number of different schemes that have operated over the time period in question and the lack of consistent reporting, data is often lacking to quantitatively assess the effectiveness of each scheme. Data on scheme uptake and policy success is not consistently available and undertaking a national assessment on multiple schemes is prohibitively complex (Natural England, 2018). In addition, policy development is rapid and the evaluation of previous policies and examination of the evidence base can often struggle to keep pace with policymakers, with new policies and strategies being formed before a robust analysis of the existing schemes has taken place.

It is easier to plant trees than to maintain them to maturity much more difficult to maintain them. Poor management reduces the benefits

of woodland. To date Defra has prioritised the planting of new trees over management (National Audit Office, 2022) and has not yet finalised its plans for ensuring that existing, as well as newly planted woodlands and trees, are well managed. Full consideration of whether each different tree planting incentive (current and historical) covers ongoing management costs or monitors survival post planting is also beyond the scope of this review.

4. Conclusions

A review of the role of policy in determining the presence of trees in the UK's agricultural landscape over the past 100 years has provided insights into methods for the successful implementation of future tree planting schemes and the following conclusions have been identified:

- Grants alone may not be sufficient to encourage farmers to plant trees. The effectiveness of financial incentives to influence tree planting depends on the pre-existing interest and values of the farmer or landowner.
- Key to future progress will be to enable farmers to choose to plant trees where it best suits local conditions. Tree planting grants co-designed with stakeholders are more likely to have improved uptake, ensuring that barriers are considered during the design phase.
- Scheme simplicity and flexibility are important to encourage uptake. But care is needed that a simplification of schemes does not allow for undesirable outcomes.
- Policy tools need to be aligned with farmer values and tailored high-quality advice and guidance available to ensure that farmers and landowners have the knowledge and support to make these decisions.

Achieving the government's target to increase tree canopy and woodland cover in England to 17.5% by 2050 will require tree-planting rates to increase significantly after 2025. To succeed, targets should be legally binding, but for natural climate solutions such as tree planting to be effective, they must also focus on the people whose decisions determine the long-term viability of the ecosystem and require a commitment and understanding from multiple actors from farmers to policy makers.

A key conclusion is that there is insufficient evidence to fully assess the effectiveness of previous schemes and progress towards targets. To be successfully reviewed future schemes need to ensure that data can be collected in a way that allows the effectiveness to be assessed.

Data Availability

No data was used for the research described in the article.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2022.106502.

References

Aldhous, J.R., 1997. British forestry: 70 years of achievement. Forestry 70 (4), 290–291. https://doi.org/10.1093/forestry/70.4.283.

Armstrong McKay, D.I., Dearing, J.A., Dyke, J.G., Poppy, G.M., Firbank, L., 2019. To what extent has sustainable intensification in England been achieved. Sci. Total Environ. 648, 1560–1569. https://doi.org/10.1016/j.scitotenv.2018.08.207.

Bell G. et al., 2020. Tree Suitability Modelling – Planting Opportunities for Sessile Oak and Sitka Spruce in Wales in a Changing Climate. 3.

Brewer, A., Ditchburn, B., Cross, D., WHitton, E., Ward, A., 2017a. Tree cover outside woodland in Great Britain: Statistics. For. Comm. Stat. Rep.

Brewer, A., Ditchburn, B., Cross, D., WHitton, E., Ward, A., 2017b. Tree cover outside woodland in Great Britain: Summary. Forestry Commission Summary Report.

Burgess, P. , 2017. Agroforestry in the UK. 111(2), 111–116.

Cao, Y. , Elliott, J. , Tweedie, F. , Jones, N. , & Short, C., 2018. Initial Evaluation of the Implementation of Countryside Stewardship (CS) in England Objective 4: Initial Evaluation of CS Implementation Final Report submitted for publication to: Helen Michell, Natural England Prepared by: The FERA led consortium, led by Yiying C (Issue September).

Climate Change Committee, 2020. The Sixth Carbon Budget (Issue December).

Cole, L.J., Stockan, J., Helliwell, R.,2020. Managing riparian buffer strips to optimise ecosystem services: A review. https://doi.org/10.1016/j.agee.2020.106891.

Committee on Climate Change, 2019b. Net Zero: The UK's contribution to stopping global warming. In Committe on Climate Change (Issue May).

Committee on Climate Change, 2020. Policies for the Sixth Carbon Budget and Net Zero. December 2020.

Confor, 2020. Written evidence submitted for publication by Confor to EFRA committee Tree Planting and Woodlands inquiry. October, 1–10.

DAERA, 2020. Forests for the Future.

Dandy, N., 2012. Understanding Private Land- manager Decision-making A Framework for Forestry (Issue February).

DEFRA, 2013. Government forestry and woodlands policy statement. Incorporating the government's response to the independent panel on forestry's final report. 2013, January 2013, 46.

DEFRA, 2020. Agriculture in the United Kingdom. In Department for Environment, Food and Rural Affairs.

DEFRA, 2018a. A Green Future: Our 25 Year plan to improve the environment Annex 2: Governement strategies to protect and improve the environment. December 2017, 151. ⟨https://www.gov.uk/government/publications/25-year-environment-plan⟩.

DEFRA, 2018b. A Green Future: Our 25 Year Plan to Imrove the Environment (Issue Her Majesty's Government (2018) 'Environment 25 Year Plan,' pp. 1–151.).

DEFRA, 2022a. Consultation on environmental targets (Issue May).

DEFRA, 2022b. Planting Trees in England (Issue March).

Den Herder, M., Moreno, G., Mosquera-Losada, R.M., Palma, J.H.N., Sidiropoulou, A., Santiago Freijanes, J.J., Crous-Duran, J., Paulo, J.A., Tomé, M., Pantera, A., Papanastasis, V.P., Mantzanas, K., Pachana, P., Papadopoulos, A., Plieninger, T., Burgess, P.J., 2017. Current extent and stratification of agroforestry in the European Union. Ecosyst. Environ. 121–132. https://doi.org/10.1016/j.agee.2017.03.005.

ECMWF, 2019a. European State of the Climate 2018. European State of the Climate 2018. ⟨https://climate.copernicus.eu/surface-temperature⟩.

EFRAC, 2017. Forestry in England: Seeing the wood for the trees (Issue March).

Eichhorn, M.P., Paris, P., Herzog, F., Incoll, L.D., Liagre, F., Mantzanas, K., Mayus, M., Moreno, G., Papanastasis, V.P., Pilbeam, D.J., Pisanelli, A., Dupraz, C., 2006. Silvoarable Systems in Europe – past, present and future prospects. Agrofor. Syst. 67 (1), 29–50. https://doi.org/10.1007/s10457-005-1111-7.

EURAF, 2021. EU Agroforestry Policy: an overview.

Eves, C., Johnson, M., Smith, S., Quick, T., Langley, E., Jenner, M., Richardson, W., Glynn, M., Anable, J., Crabtree, B., White, C., Black, J., MacDonald, C., Slee, B.2015. Analysis of the potential effects of various influences and interventions on woodland management and creation decisions, using a segmentation model to categorise subgroups - Volume 3: Woodland management segmentation and assessment of interventions. 4 (March).

Forest Research Forest cover: international comparisons 2015.

Forest Research, 2020. Forestry Statistics 2020 Chapter 1. In Forest Research (Issue September).

Forest Research, 2021. Provisional Woodland Statistics. First release, 1–33. www.forestresearch.gov.uk/statistics/.

Forest Research, 2022. Provisional Woodland Statistics. 2022 Edition. First release, 1–33. http://www.forestresearch.gov.uk/statistics/.

Forestry Commission, 2020. Forestry Commission framework document (Issue May).

Garside, R., Wyn, I. ,2021. Tree-planting: Why are large investment firms buying Welsh farms? BBC. ⟨https://www.bbc.co.uk/news/uk-wales-58103603⟩.

Gilbert, N., 2012. One-third of our greenhouse gas emissions come from agriculture. Nature 1–2. https://doi.org/10.1038/nature.2012.11708.

Harris, L., 2020. Tenancy term lengths stifled in cautious sector. Farmers Weekly. ⟨https://www.fwi.co.uk/business/business-management/tenancies-rents/tenancy-term-lengths-stifled-in-cautious-sector⟩.

Heffernan, L.J., Lassoie, J.P., Bills, N., 2011. An assessment of the english farm woodland premium scheme and its ability to promote and sustain environmental improvements in agricultural landscapes. J. Sustain. For. 30 (5), 441–458. https://doi.org/10.1080/10549811.2011.548271.

Hemery, G., Ambrose-Oji, B., L, O., Hemery, T., Petrokofsky, G., 2020. Awareness, action, and aspirations in the forestry sector in responding to environmental change: Report of the British Woodlands Survey 2020. ⟨https://www.researchgate.net/publication/344364922_Awareness_action_and_aspirations_in_the_forestry_sector_in_responding_to_environmental_change_Report_of_the_British_Woodlands_Survey_2020⟩.

Hernández-Morcillo, M., Burgess, P., Mirck, J., Pantera, A., Plieninger, T., 2018. Scanning agroforestry-based solutions for climate change mitigation and adaptation in Europe. Environmental Science and Policy. Elsevier Ltd, pp. 44–52. https://doi.org/10.1016/j.envsci.2017.11.013.

IPCC, 2021. Sixth Assessment Report: Regional fact sheet - Europe.

Jose, S., 2009. Agroforestry for ecosystem services and environmental benefits: an overview. Agrofor. Syst. 76 (1), 1–10. https://doi.org/10.1007/s10457-009-9229-7.

Kay, S., Rega, C., Moreno, G., den Herder, M., Palma, J.H.N., Borek, R., Crous-Duran, J., Freese, D., Giannitsopoulos, M., Graves, A., Jäger, M., Lamersdorf, N., Memedemin, D., Mosquera-Losada, R., Pantera, A., Paracchini, M.L., Paris, P., Roces-Díaz, J.V., Rolo, V., Herzog, F., 2019. Agroforestry creates carbon sinks whilst enhancing the environment in agricultural landscapes in Europe. Land Use Policy 83 (February), 581–593. https://doi.org/10.1016/j.landusepol.2019.02.025.

Lawrence, A., Dandy, N., 2014. Private landowners' approaches to planting and managing forests in the UK: What's the evidence? Land Use Policy 36, 351–360. https://doi.org/10.1016/j.landusepol.2013.09.002.

Lawrence, A., Dandy, N., Urquhart, J., 2010. Landowners' attitudes to woodland creation and management in the UK A review of current evidence. Forestry Commission, July, 1–66.

Lawson, G., Brunori, A., Palma, J., Balaguer, F., 2016a. Sustainable management criteria for agroforestry in the European Union. 3rd European Agroforestry Conference Montpellier, 23–25 May 2016, 376–.

Lawson, Gerry, Curran, E., McAdam, J., Strachan, M., Pagella, T., Thomas, T., Smith, J. ,2016b. Policies to encourage trees on farms in the UK and Ireland: comparison of CAP (2014–2020) Pillar I and Pillar II measures. (Issue Farm Woodland Forum Annual Meeting).

Lawson, Gerry, Curran, E., McAdam, J., Strachan, M., Pagella, T., Thomas, T., Smith, J., 2017. Policies to encourage trees on farms in the UK and Ireland: comparison of CAP (2014–2020) Pillar I and Pillar II measures. *Farm Woodland Forum, Annual Meeting, June*. ⟨https://www.agroforestry.ac.uk/sites/www.agroforestry.ac.uk/files/Policies⟩ to encourage trees on farms in the UK and Ireland.pdf.

Lienhoop, N., Brouwer, R., 2015. Agri-environmental policy valuation: Farmers' contract design preferences for afforestation schemes. Land Use Policy 42, 568–577. https://doi.org/10.1016/j.landusepol.2014.09.017.

Lindsay, R., Birnie, R., & Clough, J., 2014. IUCN UK Committee Peatland Programme. Ecological Impacts of Forestry on Peatlands (Issue 4). http://www.iucn-uk-peatlandprogramme.org/commission/climatechange.

Marsh, S., 2020. Disappointing planting figures in England still far below Government target. Woodland Trust. ⟨https://www.woodlandtrust.org.uk/press-centre/2020/06/government-planting-figures/⟩.

Martineau, H., Wiltshire, J., Hart, K., Keenleyside, C., Baldock, D., Bell, H., Watterson, J., 2016. Effective performance of tools for climate action policy - meta-review of Common Agricultural Policy (CAP). Ricardo AEA 340202, 286.

Matthews, K., Wardell-Johnson, D., Miller, D., Fitton, N., Jones, E., Bathgate, S., Randle, T., Matthews, R., Smith, P., Perks, M., 2020. Not seeing the carbon for the trees? Why area-based targets for establishing new woodlands can limit or underplay their climate change mitigation benefits. Land Use Policy 97 (April), 104690. https://doi.org/10.1016/j.landusepol.2020.104690.

Morison, J.I.L., Matthews, R.B., 2016. Agriculture and forestry climate change impacts summary report. Living Environ. Change 1–24. ⟨http://www.nerc.ac.uk/research/partnerships/⟩.

Muñoz-Rojas, J., Nijnik, M., González-Puente, M., Cortines-García, F., 2015. Synergies and conflicts in the use of policy and planning instruments for implementing forest and woodland corridors and networks; a case study in NE Scotland. For. Policy Econ. 57, 47–64. https://doi.org/10.1016/j.forpol.2015.05.002.

National Audit Office, 2022. Planting Trees in England (Issue March).

National Statistics, 2018. 2017 UK Greenhouse Gas Emissions, Final Figures Statistical Release: National Statistics. Department of Business Energy and Climate Change Report, March, 46.

Natural England, 2020. Wood Pasture and Parkland (England) 2020. ⟨https://data.gov.uk/dataset/bac6feb6–8222-4665–8abe-8774829ea623/wood-pasture-and-parkland-england⟩.

Natural England, 2021. Countryside Stewardship Scheme 2016 Management Options (England). Natural England Open Data ⟨https://naturalengland-defra.opendata.arcgis.com/datasets/countryside-stewardship-scheme-2016-management-options-england/explore?location=52.863301%2C-2.434032%2C7.10⟩.

Nicholls, D.C., 1969. [Archive] - The use of land for forestry within the proprietary land unit. ⟨https://www.forestry.gov.uk/PDF/FCBU039.pdf/$FILE/FCBU039.pdf⟩.

Pollard, E., Hooper, M., Moore, N.,1974. The New Naturalist No. 58 Hedges. Published by London Collins, 1975.

Priestley, S., Sutherland, N., 2016. Tree planting in the UK. In Debate Pack CDP 1016/0241 (Issue December). http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CDP-2016–0241.

Rackham, O., 1986. The History of the Countryside, 3rd ed. Phoenix Press.

Read, D., Freer-Smith, P., Morison, J.I.L., Hanley, N., West, C., Snowdon, P. 2009. Combating climate change – a role for UK forests. An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change. https://doi.org/10.23947/itno.2020.285–288.

Reid, C., Hornigold, K., McHenry, E., Nichols, C., Townsend, M., Lewthwaite, K., Elliot, M., Pullinger, R., Hotchkiss, A., Gilmartin, E., White, I., Chesshire, H., Whittle, L., Garforth, J., G., & R, Reed, T., Hugi, M., 2021. State of the UK ' s Woods and Trees 2021.

Robinson, R.A., Sutherland, W.J., 2002. Post-war changes in arable farming and biodiversity in Great Britain. J. Appl. Ecol. 39 (1), 157–176. https://doi.org/10.1046/j.1365-2664.2002.00695.x.

Royal Forestry Society, 2020. Inspiring Passion and Excellence in Woodland Management the Royal Forestry Society Forestry and Climate Change. Royal Forestry Society.

RPA, 2020. Agroforestry and the Basic Payment Scheme. ⟨https://www.gov.uk/guidance/agroforestry-and-the-basic-payment-scheme#introduction⟩. RPA.

Schoeneberger, M., Bentrup, G., De Gooijer, H., Soolanayakanahally, R., Sauer, T., Brandle, J., Zhou, X., Current, D., 2012. Branching out: Agroforestry as a climate change mitigation and adaptation tool for agriculture. J. Soil Water Conserv. 67 (5) https://doi.org/10.2489/jswc.67.5.128A.

Scholefield, P., Morton, D., Rowland, C., Henrys, P., Howard, D., Norton, L., 2016. A model of the extent and distribution of woody linear features in rural Great Britain. Ecol. Evol. 6 (24), 8893–8902. https://doi.org/10.1002/ece3.2607.

Scottish Government, 2020. Protecting Scotland, Renewing Scotland. September, 135. https://www.gov.scot/publications/protecting-scotland-renewing-scotland-governments-programme-scotland-2020–2021/pages/5/.

Sing, L., Towers, W., Ellis, J., 2013. Woodland expansion in Scotland: an assessment of the opportunities and constraints using GIS. Scott. For. 67 (4), 18–25.

Smith, J., 2010. Agroforestry Policy Review. Policy Review, October 2010, 1–28.

Soil Association, Woodland Trust, 2018. Agroforestry in England.

Staddon, P., Urquhart, J., Mills, J., Goodenough, A., Powell, J., Vigani, M., Simmonds, E., 2021. Encouraging woodland creation, regeneration and tree planting on agricultural land: a literature review. NEER020.

Szedlak, T., 2021. Agroforestry in rural development, state of play.

Terra Sulis, 2020. Opportunity Woodland Mapping in England (Vol. 2020, Issue July).

The Environment Food and Rural Affairs Committee, 2022. Tree planting. Third Report of Session 2021–2022. In The Environment, Food and Rural Affairs Committee.

Torralba, M., Fagerholm, N., Burgess, P.J., Moreno, G., Plieninger, T., 2016. Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis. Agric. Ecosyst. Environ. 230, 150–161. https://doi.org/10.1016/j.agee.2016.06.002.

Tsonkova, P., Böhm, C., Quinkenstein, A., Freese, D., 2012. Ecological benefits provided by alley cropping systems for production of woody biomass in the temperate region: a review. Agrofor. Syst. 85 (1), 133–152. https://doi.org/10.1007/s10457-012-9494-8.

Turner, H., Tweedie, F. ,2017. Initial Evaluation of the implementation of Countryside Stewardship in England.

UK Climate Risk, 2021. Findings from the third UK Climate Change Risk Assessment (CCRA3) Evidence Report 2021: Agriculture and Food.

UK Government, 1967. Forestry Act 1967 ⟨https://www.legislation.gov.uk/ukpga/1967/10/contents⟩.

UK National Ecosystem Assessment, 2011. UK National Ecosystem Assessment Synthesis of the Key Findings. Unep-Wcmc Vol.

UK Parliment, 2021. Woodland Creation (Issue 636). ⟨https://www2.gov.scot/Topics/farmingrural/SRDP/RuralPriorities/Options/WoodlandCreation/NativeWoodlands/Fencing⟩.

Watkins, C., 1996. Constraints on farm woodland planting in England: a study of Nottinghamshire farmers. Forestry 69 (2), 167–176. https://doi.org/10.1093/forestry/69.2.167.

Welsh Government, 2020. Glastir Woodland Creation Rules Booklet. Welsh Government.

Westaway, S., Smith, J, 2021. Barriers to uptake of agroforestry in the UK. EURAF 2020 Agroforestry for the Transition towards Sustainability and Bioeconomy, May, 414–415.

Wohlin, C.,2014. Guidelines for snowballing in systematic literature studies and a replication in software engineering. Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering - EASE ' 14, 1–10. https://doi.org/10.1145/2601248.2601268.