Agroforestry policy development in England: a question of knowledge transference

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A R T I C L E   I N F O

A B S T R A C T

Agroecology as a concept for reimagining food systems has grown in popularity and is now used in several food and agriculture policy frameworks around the world. While there is a significant body of research around agroecology, its origins, applications, and as a much-needed transition pathway to sustainable food systems, there is limited understanding on how agroecology may be situated within policy frameworks and how agroecological knowledge may be used to inform decision-making. In England, as the Government's post-Brexit subsidy scheme – the Environmental Land Management Scheme (ELMs) – is developed, various sectoral actors are employing different frameworks in attempts to deliver multiple objectives around land use, food, agriculture and biodiversity. This paper reviews 3 influential frameworks (Sustainable Development Goals, Ecosystem Services, FAO's 10 Principles of Agroecology) and assesses the degree to which they contribute to the development of agroecologically-oriented policy in England. With a specific focus on agroforestry as an exemplar agroecological approach, this paper contributes to the limited policy literature on agroecology. Using thematic and content analysis, nine policy documents pertaining to agroforestry were reviewed, resulting in a 'degree of embeddedness' being assigned to each framework. Results showed that all three frameworks had a low degree of embeddedness in policy; in other words, none of the frameworks considered have been coherently integrated into current policy documents. With such urgency to halt environmental degradation, biodiversity loss, climate breakdown and food insecurity, the apparent lack of knowledge transfer within critical policy documents is noteworthy. This paper concludes with a set of broad policy recommendations, applicable at both the EU and national level, alongside a set of recommendations specifically for agroforestry policy development in England.

1. Introduction

The on-going challenges of agriculture and land use have not gone away. It is widely accepted that although the 20th century model of productivism has increased yields and reduced the price of food, it has done so at significant cost to people and the planet (Rockström et al., 2020; High Level Panel of Experts, 2019; Willett et al., 2019). So significant in fact, that it now poses a threat to human health and environmental sustainability (Oliver et al., 2018; Willett et al., 2019). The global food system – defined as the complex web of societal and economic factors influencing the production, distribution and consumption of food – is a major driver of global environmental change (GEC) and is responsible for an estimated 60% of global terrestrial biodiversity loss, 24% of greenhouse gas (GHG) emissions, 33% of degraded soils and 20% of overused aquifers (UNEP, 2016). At the same time structural injustices in the system mean that 820 million people around the world are undernourished, 2 billion have micronutrient deficiencies and 650 million have been diagnosed with obesity (FAO, 2019). All the while, huge losses are seen across the food supply chain, with studies estimating anywhere from approximately a fourth (Kummu et al., 2012) to a third (Gustavsson et al., 2011) of all food produced is wasted. Our current system is failing to meet the needs of the people, whilst simultaneously harming the environment and undermining human health and well-being.

1.1. Calling for change

Civil society, social movements and affected communities have been calling for change within the food system for decades: the 60's, 70's and

80's saw significant international struggles for land redistribution, fair markets and decent livelihoods (Akram-Lodhi et al., 2007). La Via Campesina, a grassroots international farmers union has been fighting for farmers rights since 1993. Arguably, this resistance can be traced back to the systematic enclosures of the commons, first in Europe in the 15th century and then expanded internationally along colonial lines (Tomaso-Ferrando et al., 2021). The call has and continues to be for: an end to land clearances; polluted waterways; biodiversity loss; commodification and privatisation of land, seeds and water; and an end to chemical agriculture subsidised on a huge scale by financial institutions, governments and development banks in the global north (IPES-Food and ETC Group, 2021). Industrialised agriculture as it is today cannot continue and this is increasingly clear to everyone. Many inputs, such as conventional fertilisers and pesticides, are based on fossil fuels which are getting more highly taxed due to their contribution to pollution and climate breakdown. Zero pollution from fertilisers and pesticides is becoming an EU policy aim, and clear commitments to reduce negative inputs and pollution from them are already in the EU's 'Green Deal' (European Commission, 2019). The severity of our current biodiversity and climate crises is now widely accepted, but debate abounds in how we go about transforming and transitioning our societies, whether in the energy, transport, manufacturing or agricultural industries. In agriculture and food systems, approaches range from climate-smart and precision agriculture – which focus on technological solutions and innovations such as hydroponics and big data, to organic and regenerative approaches which focus on changing inputs and improving soils or agroecology and food sovereignty, which are a radical re-imagining of the food system from production to consumption. Fig. 1 illustrates the key differences between organic, regenerative and agroecology in their approaches and ultimate aims.

1.2. Agroecology now

For many, the field of agroecology represents an exciting transition pathway to sustainable food systems that, critically, addresses inequalities in food systems (Altieri, 2018; FAO, 2018; Gliessman, 2016; High Level Panel of Experts, 2019; IAASTD, 2009; IPES-Food 2018; Poux and Aubert, 2018). An agroecological approach to sustainable food systems (SFS) is one that "favours the use of natural processes, limits the use of external inputs, promotes closed cycles with minimal negative externalities and stresses the importance of local knowledge and participatory processes that develop knowledge and practice through experience, as well as scientific methods, and the need to address social inequalities." (HLPE 2019; 14). Agroecology as a definition and a practice, is still evolving but at its root is the "application of ecological concepts and principles to the design and management of sustainable agroecosystems" (Altieri, 2018). In the late 1990s, agroecology broadened its framing to incorporate elements of production, distribution and consumption (Anderson et al., 2019), leading to a more comprehensive definition as "the ecology of food systems" (Francis et al., 2003). This definition incorporates the political economy of food systems and directly addresses the power imbalances in the dominant food system (Gliessman, 2015: 304), for this reason, agroecology is controversial. There is an acknowledgement that agri-food systems are intertwined with socio-ecological systems (SES) and must be considered as such in order to feed the global population an equitable, nutritious diet within planetary boundaries. Agroecology has a deeply transformative intent, theory and practice that "reaches beyond the food system to the nature of human culture, civilization, progress and development" (Gliessman, 2016). This is recognised in the FAO's updated definition of agroecology: "the application of the science of ecology to the study, design, and management of sustainable food systems, the integration of the diverse
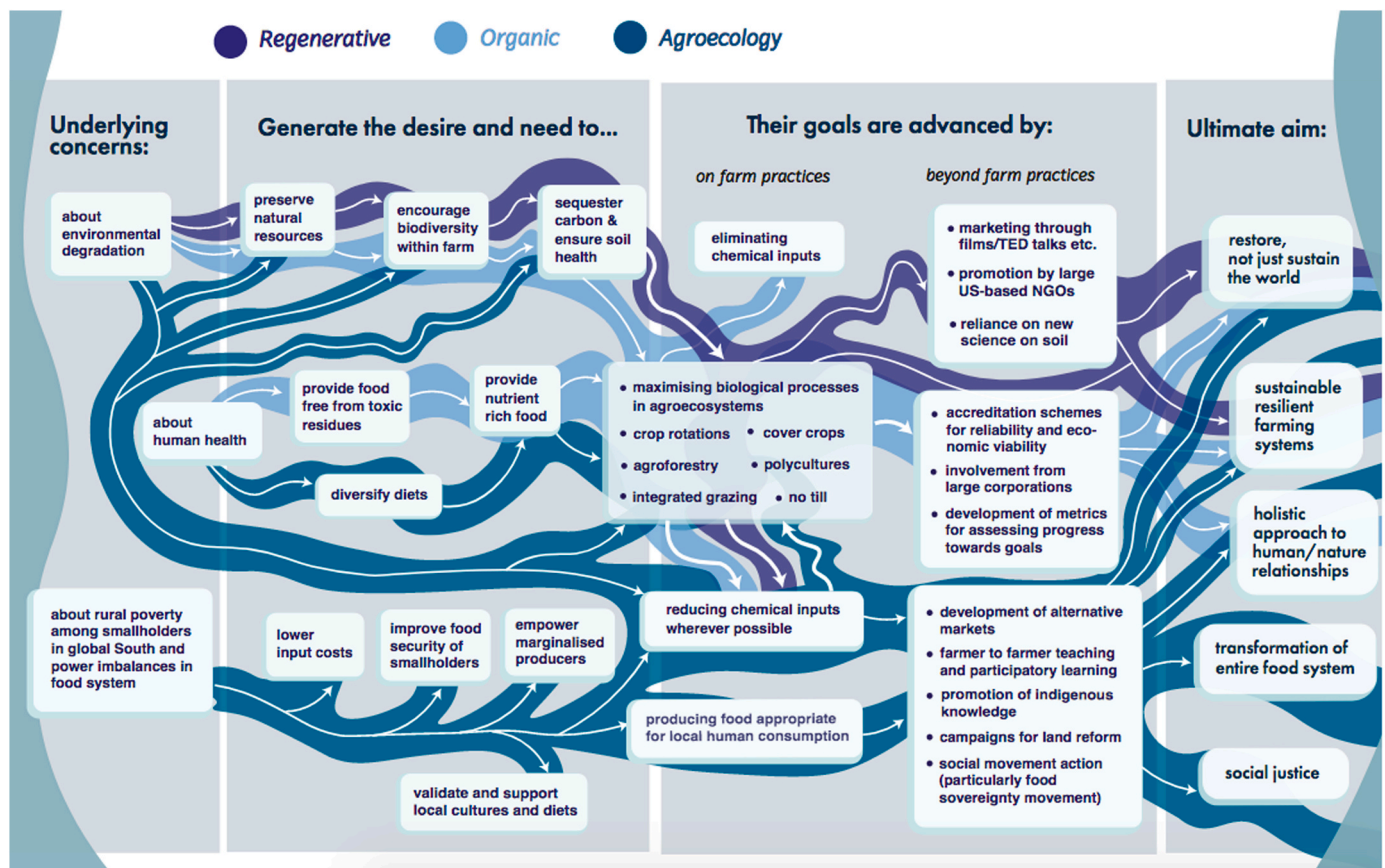

Fig. 1. 'Exploring the ebbs and flows of different agricultural movements' (Carlile et al., 2021).

knowledge systems generated by food system practitioners, and the involvement of the social movements that are promoting the transition to fair, just, and sovereign food systems" (FAO, 2018; IPES-Food, 2016). By focussing on the socio-economic elements of food production (fundamental to agroecology), cropping systems have enormous potential to be multifunctional; providing diverse incomes and jobs; alleviating rural poverty; promoting healthy foods that align with food-based dietary guidelines and supporting environmental sustainability and biodiversity (Anderson et al., 2019; Gliessman, 2016; Food, Farming and Countryside Commission, 2021; Kerr et al., 2021). Tensions exist however around the practical application of the definition. The term 'agroecology', much like 'sustainability' is being adapted and adopted by different actors in the food system to further their specific goals and objectives which can 'mainstream' the concept; inhibiting genuine, radical change (Levidow et al., 2014).

1.3. The contested policy landscape

The year 2021 saw conflicting and contesting solutions and policies aimed at transforming the food system, with losses and gains across the world. After more than a year of mass protests, Indian farmers succeeded in rejecting three controversial agricultural reforms that would have left them vulnerable to big companies (Ellis-Paterson, 2021). In Mexico, a ruling to phase out glyphosate over the 2021–2024 period was seen (USDA Foreign Agricultural Service, 2021). In Europe, the EU Farm to Fork Strategy aims to cut 50% use of chemical pesticides by 2030 and the EU Biodiversity Strategy calls for 25% of agricultural land to be under organic farming (European Commission, 2019). In the UK, the government has committed to reducing carbon emissions to net zero by 2050 and pledged that 30% of land is protected for nature by 2030 (UK Government, 2020). Meanwhile, the UN held the first ever 'Food Systems Summit' which ended up being roundly denounced by civil society, academics and the food justice movement for being co-opted and un-representative (Canfield et al., 2021). Despite the criticisms, this recognition of the political power of food systems and its place at the intersection of inequality, biodiversity loss and the soil and climate crises, is progress. Similarly, the interconnection between human and planetary health seems to be more widely recognised, perhaps due to the system shock of Covid-19. 2021 also saw another underwhelming COP, with many organisations, campaigners and advocacy groups shining a light on the marked absence of agriculture and food systems at COP26, with calls for COP27 to focus on food systems.

Agroecology as an approach to 'fixing' the food systems is indeed gaining ground and support. There is evidence of agroecology at many different levels across the world. National policies have emerged in Argentina, Brazil, France, Nicaragua, and Senegal (Place et al., 2022). Agroecology is mentioned in more than 10% of the nationally determined contributions (NDCs) by UNFCC member states as a viable approach to address climate change (Leippert et al., 2020). In Europe, agroecology has recently been included as one of the four flagship eco-schemes of the European Common Agricultural Policy (CAP) in order to address the environmental and social issues pertaining to our food systems (European Commission, 2021). It is important to note however, that despite this apparent support and momentum for agroecology, the level of financing this model receives is negligible in comparison to conventional models of agriculture and food production. Recent research shows that even within the already small amount of global finance for agricultural development, the vast majority of this funding is allocated to conventional forms of high-input agriculture (Moeller, 2020). A growing body of research highlights how agroecology as a concept and approach is continually side-lined in favour of detrimental, high-input forms of agriculture at all funding levels (Biovision and IPES-Food, 2020; Moeller, 2020) This 'mis-match' in policy, funding and action can be considered in part, as a lack of policy integration or policy coherence. Nilsson et al. (2012) define policy coherence as "an attribute of policy that systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives" (p. 396), i.e., the extent to which policies complement each other or are in line with each other. This raises the question of how research and knowledge is embedded in the policy process which this paper will address.

1.4. Agroecology, policy and agroforestry in England

1.4.1. Policy development in England

In England, there is significant scope for change in the food and farming sector. Leaving the European Union (EU), and therefore the Common Agricultural Policy, gave an occasion to rethink our food system on a fundamental level. The Covid-19 pandemic shone a light on our fragile food systems, challenging the now ubiquitous 'just in time' delivery model employed by all major British retailers. This has reinvigorated a sense of the need for national (and international) food security. Russia's invasion of Ukraine at the beginning of 2022 has compounded these effects and has catalysed a sense of urgency around food security, as well as challenging perceptions of an ever more globalised world being the 'norm'. Russia and Ukraine together supply 12% of global traded calories, as a result, wheat prices have increased by 53% since the start of 2022 (Economist, May, 2022). International trade, specifically within grain, oil and agricultural chemical inputs is being re-worked and re-assessed and the potential for reform (away from fossil fuel dependent agriculture) is there. However, the dominant narrative of the corporate food regime (needing to 'feed the world') is resulting in increased pressure from agri-businesses and petrochemical companies for farmers and governments to intensify and increase production through high-input means (IPES-Food and ETC Group, 2021). Discussions at the political level are on-going.

Within this context, the UK government has also committed to 'net zero' by 2050, which is highly unlikely to be achieved without significant changes in land-use, including: afforestation and agroforestry targets; low-carbon farming practices; and reducing the amount of land currently being farmed (Committee on Climate Change, 2020). The new Agricultural Bill (House of Commons, 2020) which replaces the CAP, alongside a suite of Environmental Land Management schemes (ELMs) and the recent Environment Act (House of Commons, 2020) include ambitious targets to reform agriculture and land use, restore biodiversity, sequester carbon, and pay farmers 'public money for public goods'. However, ELMs, which is the fundamental mechanism of the new agricultural policy, is currently under developed and un-clear, leaving farmers and landowners unhappy with the lack of clarity and information on these changes. Within civil society, organisations like the Soil Association (SA), the Food Farming and Countryside Commission (FFCC), Sustain and others are working hard to influence these policy developments towards agroecology, which, as mentioned above, incorporates the socio-economic. All of these political actors and events are drivers for change and have to be considered within current policy analyses and developments in agriculture. However, there has been no formal commitment to agroecology from the UK Government.

1.4.2. Agroforestry as an agroecological land use system

A defining feature of agroecological systems are high levels of multifunctionality and biodiversity (Altieri 1999, Gargano et al., 2021). Biodiversity performs key ecological services such as the recycling of nutrients, pest control, detoxification of harmful chemicals and regulation of local hydrological processes (Cardinale et al., 2011; Isbell et al., 2017; Ellis et al., 2019). Though by no means a new approach, agroforestry (characterised by high levels of multifunctionality and biodiversity) is receiving renewed interest by those searching for self-sustaining, low-input, diversified agricultural systems (Hernández-Morcillo et al., 2018; Maathai 2012; Mosquera-Losada et al., 2018). This is largely due to its ability to combine ecosystem services with environmental benefits and climate mitigation, which is a direct function of this increased biodiversity (Jose 2009). For example,

agroforestry can: increase carbon stocks in agricultural systems; increase biodiversity; reduce runoff and subsequent water pollution and soil erosion; and improve soil fertility (Jose 2009; Kuyah et al., 2019; Torralba et al., 2016; Tsonkova et al., 2012). However, the benefits of agroforestry go beyond just the biophysical. Agroforestry systems can add diversified income streams, through enterprise 'stacking' on farm, thereby improving rural livelihoods providing shelter, food, fuel, fodder, medicines and other products (FAO and ICRAF, 2019; Leakey 2012; Saikia et al., 2017). The restoration of degraded landscapes using agroforestry can also increase the resilience of farms and communities to shocks such as drought and food shortages (FAO 2017). The economic value of these benefits is not yet fully understood. In the global south, studies have linked agroforestry with improved livelihoods, nutrition and access to food (Kuyah et al., 2019; Regmi 2003; Pretty et al., 2011; Minang et al., 2014). This link is not particularly apparent in the literature in the global north, with the focus instead on environmental benefits and climate resilience (Soil Association 2018; Hernandez-Morcillo et al., 2018; Mosquera-Losada et al., 2018). However, the European research project AGFORWARD (AGroFORestry that Will Advance Rural Development), which aims to promote agroforestry practices that "will advance rural development" makes a point of setting out how agroforestry can support a number of the SDGs which cut across biophysical and social benefits, adapted and shown in Table 1.

With the potential to add to on farm diversity, resilience, income and yield, agroforestry is considered by many as a key element in achieving sustainable food systems (Rois-Diaz 2017; Waldron et al., 2016). This 'enthusiasm' for agroforestry can be seen in the ever-growing evidence base and accompanying policy recommendations from civil society advocates trying to embed agroforestry within standard agricultural practices. The most pertinent of which (since 2018), are listed below in Table 2.

Despite the evidence to suggest AF is an environmental net gain, and the clear message of support from civil society (see Table 2), farmer uptake and policy support of this system, is lacking. Within the UK, the current extent of AF is low, with just 3.3% of agricultural land being used in this manner (den Herder et al., 2015). Table 3 below highlights the top reasons farmers in the UK are struggling to taking up AF systems, according to a recent study by the Organic Research Centre (2021).

Notably, a lack of coherent policy does not feature on this list. A possible reason for this could be the plethora of other factors farmers must consider before policy begins to play a role in their decision making. Another could be that a farmers' interaction with policy is through the viability of grants and funding that may or may not be available.

Prior to Brexit, the CAP Pillar II, Article 23 of the Rural Development Regulation 1305/2013 (Establishment of agroforestry systems), Sub-

Table 2
Prominent publications in civil society promoting agroforestry in the UK since 2018.

1. Agroforestry in England: Benefits, Barriers and Opportunities	Soil Association and Woodland Trust 2018
2. Incentives and disincentives to the adoption of agroforestry by UK farmers: a semi-quantitative evidence review	Tosh & Westaway 2021
3. The promise of agroforestry: lessons from the field	The Landworkers' Alliance 2021
4. Trees and woodland in the farmed landscape: a farmer-led approach towards a diverse, resilient and vibrant agroforestry and farm woodland economy for England	Soil Association 2022
5. Why we need more trees in the UK	Friends of the Earth 2022
6. Farming for the future: how agroforestry can deliver for nature and climate	Woodland Trust 2022

Table 3
Top ten reasons farmers in the UK are struggling to take up AF systems (Organic Research Centre, 2021).

Rank	Reasons
1 (85%)	1. Lack of conceptual understanding and knowledge
2 (70%)	2. Lack of grants, subsidy, funding opportunities
	3. Lack of practical understanding and knowledge
3 (65%)	4. Establishments costs
	5. Capital investment requirements
	6. Management and maintenance costs
	7. Reduced profitability and loss of yield
	8. Lack of economic understanding
	9. Access to case studies and demonstrative farms
	10. Clashes with existing agricultural processes and activities

measure 8.2 provided for AF. However, this was left as an individual member state (MS) issue and not one that England adopted. The England Woodland Creation Offer Grant (Forestry Commission, 2022) offers support for the creation of new woodland via planting, payments and ten years of maintenance costs, but a minimum of 400 trees per hectare is required, which is too dense for AF. Funding can also be applied for under Measure 10 Agri-Environment Climate if the trees are being planted around sources of ammonia or as riparian buffers or on floodplains. The Countryside Stewardship schemes offers some AF related options (such as pasture creation and single trees on farmland), despite AF not being explicitly mentioned. The new ELMs all have aspects of AF and woodland creation within them, but the lack of clarity of how these schemes will work on a practical basis means many farmers are likely to decide to hold off planting new trees (or other 'nature friendly' interventions) until the schemes and related funding is confirmed.

1.5. Moving forward

As we progress with new agricultural and land-use policies, the potential to address multiple objectives for human and planetary health through renewed, forward-thinking policy is within reach. However, six years after the Brexit vote in 2016, and the farming community in England is no closer to knowing what the policies, support and 'field' will look like after the CAP transition ends. The UK is currently experiencing a 'cost of living crisis' and wealth inequality is growing. It is clear that there is a great need to find ways to de-politicise land use decisions to address these compounding issues. As discussions move forward about how to best use policy mechanisms and levers, it is critical that these decisions and resulting instruments address issues at a food-system level (Food, Farming and Countryside Commission, 2021; Parsons, 2021).

Although there is a growing body of literature around agroecology and land-use policy, there is very little which looks specifically at how this knowledge is embedded into policy (Levidow et al., 2018; Gonzalez et al., 2018). Policies can have multiple aims that originate from

Table 1
Evidence that agroforestry can support the SDGs Source: AGFORWARD (2017) Work Package 8 Agroforestry Policy Development.

Sustainable development goal	Evidence that agroforestry can support
2. Zero Hunger	Increasing food production whilst enhancing the environment
3. Good health and well being	Improved quality of drinking water and healthier food
6. Clean water and sanitation	Improved water quality due to tree uptake of pollutants
7. Affordable and clean energy	Woody vegetation in the farmed landscape for bioenergy
8. Decent work and economic growth	Opportunities for added value
11. Sustainable cities and communities	Through the promotion of fruit trees in home gardens
12. Responsible consumption and production	Sustainable production systems
13. Climate action	Enhanced carbon storage on farm land
15. Life on land	Enhanced biodiversity

multiple sources (Nilsson et al., 2012). Understanding the influence behind these policy developments will help to understand where we've gone wrong before and how we can improve policy development going forward (Bouwma et al., 2018; Swensson and Tartanac 2020). Therefore, the objective of this study is to explore the transference of knowledge into key policy documents currently in play in the UK, with a specific focus on agroforestry as an exemplar agroecological approach.

The study poses three main research questions:

1. To what extent is knowledge (with a focus on agroecological knowledge) embedded in policy?
2. How is policy for agroforestry (as an exemplar agroecological approach) currently being developed and can we expect an agroecological outcome from these policies?
3. To what extent are three influential frameworks with over-lapping objectives, reflected in critical policy documents related to agriculture and agroforestry in England?

2. Methods and analytical framework

To address the first research question, to what extent is knowledge embedded in policy, three well known frameworks were reviewed (Table 7). The three frameworks were, the 'Ecosystem Services' (ES) concept, the United Nation's 'Sustainable Development Goals' (SDGs) and the FAO's '10 Principles of Agroecology'. The frameworks were selected based on their relevance to the subject matter in the literature, popularity of discourse and their ability to effect change according to Gliessman's '5 levels of transformation' (Gliessman, 2014). Key words were identified as signposts within the policies. Adding the results of the key word search to thematic and content analysis, policies were scored to represent how 'embedded' each individual framework was within them. Though not all explicitly 'agroecological', the three frameworks do share common agroecological objectives and can be used to gauge how knowledge is transferred or embedded in policy. If, for example, all 16 SDGs were to be met, one could argue that this would represent an agroecological transition. The selected frameworks were refined from a longer list of frameworks found in the literature, which can be viewed in the Annex. The UN SDGs, the ES framework and to a lesser extent, the FAO's 10 Principles for Agroecology, are all used by civil society, governments and academics as useful tools for analysis when considering issues around sustainability and reducing humans' impact on natural ecosystems. The ES concept in particular has been influential in environmental policy making and has provided a benchmark for many multilateral agreements and initiatives such as the Ecosystem Services for Poverty Alleviation (ESPA), The Economics of Ecosystems and Biodiversity (TEEB) and the Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). However, the ways in which knowledge on ES is transferred into decision-making and policy fora is often overlooked (Mann et al., 2015; Russel et al., 2016) and institutional challenges remain in applying this knowledge (Bouwma et al., 2018; Saarikoski et al., 2018).

To address the second research question of how policies for agroforestry are currently being developed and whether we can expect an agroecological outcome from these policies, the review takes a narrative approach, looking at how key terms, ideas and frameworks relating to agroecology are included (or not included) in current policies for agroforestry and how this has developed over time.

To identify the degree to which the three frameworks are reflected in critical policy documents, thematic and content analysis of nine current policies was employed. A percentage of keywords to total words in the document alongside annotation gave insight into how key ideas and the specific frameworks were embedded in each policy. Given the continued state of flux of current policies pertaining to agriculture (and agroforestry), this study chose to focus on current policy documents which are in effect. Due to the protracted and on-going impacts of unresolved policy adaptations as a result of Brexit, England's agricultural industry is still

under the jurisdiction of European law and policies. As such, policy documents at the EU level are considered alongside UK Government policy for England. The selection of policy documents for England includes the post-Brexit 'Agriculture Act' and the 'Environment Act'. Despite on-going discussions for detailed policies post-CAP and the upcoming Environmental Land Management schemes in the UK, there is no concrete policy to analyse in this regard. Instead, the 'Agricultural Transition Plan' was used, which acts an interim, or litmus for how the policies are shaping up. To account for the link between food systems and climate change, the original selection of policies was supplemented with the UK's Nationally Determined Contributions. At the EU level, the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy were selected under the broader policy of the European Green Deal, which was not included specifically in this review, given its many objectives and ambitions for other sectors outside of agriculture and agroforestry. Though of course the Green Deal is relevant and can be considered an influential policy relating to agriculture, this review focuses instead on two of the key mechanisms of the Green Deal, rather than the deal itself as a whole (the EU Biodiversity Strategy for 2030 and the Farm to Fork Strategy). The EU Forest Strategy for 2030, also included in this review is itself an initiative of the European Green Deal and builds on the EU Biodiversity Strategy for 2030. Table 4 below, highlights the nine policies selected, which includes both binding and non-binding instruments.

The authors acknowledge that there are other policies relevant to this analysis, given the interconnected nature of food and farming policy in general. For the purpose of this paper, a selection of policies was made to keep a narrower focus on the agricultural sector for this initial investigation. Future work could well include other policy documents which branch into health, education and housing. However, position papers, policy briefs and other relevant documents from civil society are included in the discussion.

The policy documents were assessed using thematic and content analysis, as well as keyword searches, to ascertain the degree to which the three frameworks were embedded within them. This was assessed using the below scoring in Table 5, considering the framing and impacts of the frameworks, based on Helming et al. (2013). The scoring was used as a proxy to determine how knowledge is transferred into policy.

A full list of keywords and the results of the search can be found in the annex. Care was taken within the search function to record accurate results, but occasionally the results gave contesting numbers. Footnotes and proper nouns were excluded from the keyword search. For example when searching for 'environment' or 'environmental', 'Environment Bill' or 'Environmental Impact Assessments' were removed from the total word count. As a general rule, anything that was capitalised was removed.

3. Results

In this section, the findings are presented and in the subsequent Section (4), these results are expanded upon and discussed.

4. Discussion

4.1. A question of knowledge transference

All three frameworks had a low degree of embeddedness within the policy documents analysed. Ecosystem Services had an overall average of 1.78, the highest score, which is perhaps unsurprising given the established nature of ES as a framework. The FAO's 10 Principles framework was the least embedded with an average of 1.11. This was marginally higher for the EU documents than the UK (1.25 and 1.00 respectively). This apparent omission of agroecology as a framework for transitioning to sustainable food systems within key policy documents shows how much more needs to be done for agroecology to be taken seriously at the policy level. As discussed above, this is also mirrored in the very low levels of funding agroecology receives (Moeller N, 2020).

Table 4

The nine policy documents considered and analysed within this paper. Note: In the EU, 'Directive' is a legislative act that sets out a goal that all EU Member States must realise. However, it is up to the individual countries to devise their own laws on how to reach these goals. A 'Regulation' is a binding legislative act. It must be applied in its entirety across the EU. A 'Communication' is a policy document with no mandatory authority or legal effect.

Name of policy (year of adoption)	Available online	Binding instrument	Non-binding instrument
Common Agricultural Policy (2013)	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1307	Regulation	
EU Forest Strategy for 2030 (2021)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0572		Communication
Farm to Fork Strategy (2020)	https://ec.europa.eu/food/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf		Communication
EU Biodiversity Strategy for 2030 (2020)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0380&qid=1642089537803		Communication
UK Agriculture Act (2020)	https://researchbriefings.files.parliament.uk/documents/CBP-8702/CBP-8702.pdf	Act	
Agricultural Transition Plan*	https://www.gov.uk/government/publications/agricultural-transition-plan-june-2021-progress-update/agricultural-transition-plan-june-2021-progress-update#progress-since-we-published-the-agricultural-transition-plan		Directive
Environment Act (2020)	https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted	Act	
UK Forestry Standard (2017)	https://www.gov.uk/government/publications/the-uk-forestry-standard		Directive
Nationally Determined Contribution	https://www.gov.uk/government/publications/the-uks-nationally-determined-contribution-communication-to-the-unfccc		Directive

In England, 'Act' is a bill that has been approved by the House of Commons and the House of Lords and given Royal Assent by the Monarch. An Act sets out a new binding law and a 'Regulation' sets out the details of that law and are more description.

*This document has now been withdrawn on 26 September 2022 and has been replaced with 'Sustainable Farming Incentive' - https://www.gov.uk/government/collections/sustainable-farming-incentive-guidance

Table 5

Assessment and scoring values of degree of embeddedness, based on Helming et al. (2013).

0	no mention of framework, no ecological, social or environmental knowledge referred to
1	no mention of framework but some ecological, social or environmental knowledge referred to
2	framework mentioned but several aspects missing
3	framework applied but not comprehensively
4	framework applied, inclusion of most aspects but lacking in detail
5	framework fully embedded, explicit reference to agroecology and ecological, social and environmental knowledge applied

Note, the author does not explicitly state that embedding is necessarily a 'good thing', and the higher numbers don't inherently give a 'better' result. Rather, in its simplest terms, the higher number indicates the framework has been fully embedded in the policy and that knowledge has been transferred from the framework into relevant policies.

Table 6 in Section 3 highlights the breakdown of distinct policy scores. It would be very unusual and perhaps illogical for any framework to have an average score of 5, however, the low scores show how little key terms are reflected in these documents, suggesting a low level of knowledge transference both at EU and national level. With such urgency around the issues of biodiversity loss, climate breakdown and ecosystem regeneration, the ostensible minimal transference of knowledge within critical policy documents is noteworthy.

The EU formally recognises the importance of environmental sustainability in the CAP with three specific goals: tackling climate change; protecting natural resources; and enhancing biodiversity. The CAP, Farm to Fork Strategy and EU Biodiversity Strategy are at the heart of these goals. Yet, none of these documents scored higher than 2 (i.e., framework mentioned but several aspects missing) for any of the frameworks considered. The EU Biodiversity Strategy for 2030 was the highest scoring across the three frameworks, scoring 2 on each framework. As a percentage of total words, the EU Farm to Fork Strategy scored highest in the keyword search, with 6.38%. The fact it is the highest scoring is perhaps not surprising, given the objective of the document and its position within the policy landscape.

In England, where the opportunity to shake up agricultural and food policy is even greater than within the CAP reform, there is again, little evidence that the frameworks are applied and knowledge is embedded. The UK Agriculture Act is the only policy document, both at EU and national level, that scored 3 (i.e., framework applied but not comprehensively) for any framework, which was ES. In contrast, the same document scored 1 (i.e., no mention of framework but some ecological, social or environmental knowledge referred to) for SDGs and FAO 10 Principles frameworks. Despite scoring lower than the Environment Act and the UK Forestry Standard in the keyword search, the Agriculture Act on content analysis scored much higher given the 'public money for public goods' approach which is in line with the ES framework. However, there appeared to be a lack of 'joined-up' thinking in the Agriculture Act, with little space given to how agriculture or agricultural land might be used as a tool in our current crises. Within the keyword

Table 6
Results showing the degree of embeddedness of each framework within the nine policy documents analysed, full and average scores given.

Policy document	Type of doc	Date	Ecosystem services	FAO 10 Principles	SDGs	Average Score
CAP	Regulation	2013	2	1	1	**1.33**
EU Forest Strategy for 2030	Communication	2021	2	1	2	**1.67**
Farm to Fork Strategy	Communication	2020	1	1	2	**1.33**
EU Biodiversity Strategy for 2030	Communication	2020	2	2	2	**2.00**
UK Agriculture Act	Law	2020	3	1	1	**1.67**
Agricultural Transition Plan	Communication	2021	2	1	1	**1.33**
Environment Act	Law	2021	1	1	1	**1.00**
UK Forestry Standard	Communication	2017	2	1	2	**1.67**
NDC	Communication	2020	1	1	2	**1.33**
		Average score	**1.78**	**1.11**	**1.56**	
		Average score EU	1.75	1.25	1.75	
		Average score England	1.80	1.00	1.40	

search there was no mention of 'ecosystem' or 'ecology' and just 1 mention of 'biodiversity'.

Agroecological knowledge, looking specifically at the FAO's 10 Principles of AE framework, was the least embedded in policy, with an average of 1.11. Of both the EU and national policies reviewed, only the EU Biodiversity Strategy for 2030 scored a 2 for this framework, all other policies scored 1 (i.e., no mention of framework but some ecological, social or environmental knowledge referred to). The keyword search also highlights how little reference is made to agroecology across the policies reviewed ('agroecology' and 'agro-ecology' were both mentioned just five times across all policies). Considering that the EU has stated that agroecology will play a key role in delivering the eco-schemes under Pillar 1 of the CAP, this apparent lack of agroecological knowledge and/or practices within fundamental documents underpinning farming at the EU level is notable. In the English context, this is less surprising, given that the UK Government has never formally committed to agroecology.

Despite this apparent lack of applied agroecological knowledge in policy, the EU is funding research into this area. Part of the funding topic 'Strengthening the European agro-ecological research and innovation ecosystem', two, multi-year, multi-million-euro research projects are currently underway. The projects "Agroecology for Europe" (AE4EU, Grant Agreement n. 101000478) and "The European Agroecology Living Lab and Research Infrastructure Network" (ALL-Ready, Grant Agreement n. 101000349), nested within the Horizon 2020 research and innovation funding programme, both aim to strengthen agroecological research and facilitate a transition to more sustainable farming systems. Additionally, the Standing Committee on Agricultural Research (SCAR), named agroecology as a key priority in the SCAR 2019 plenary, specifically in response to the climate agenda and UN SDGs, recognising the need for a more sustainable agriculture. SCAR-AE, the new strategic working group on agroecology, formally came into being on the 1st January 2021, with the aim to "support research policy development for Agroecology at national EU and international levels, and fostering debate and providing conceptual, methodological and practical frameworks on agroecology…" (Standing Committee on Agricultural Research). Despite not being a policy document (and hence not part of this review), SCAR-AE's mission documents and terms of reference, are predominantly focussed on productivity, with little discussion or inclusion of the socio-economic aspects of agroecology. Seemingly agroecology does appear in policy fora and documents and this could be recognised by some as progress towards more sustainable food systems. However, the nature through which knowledge is integrated in the policies reviewed, is not robust, and arguably, does not go far enough to bring about the systemic changes needed in our food systems. As such, this review finds little evidence to suggest effective information flow exists between policy makers and those in the field, and whether key work produced within academia and civil society ends up reflected in critical policy documents. This highlights therefore, the need for an increased level of communication between agroecology advocates and policy makers and vice versa. Levidow.

It also worth noting that of the policy documents included in this review, only three were legally binding; the CAP; the UK's Agricultural Act; and the Environment Act. The remaining six were 'communications', meaning there's no actual legal obligation to fulfil the objectives or goals stated. There is also little to no information on the regulation or accountability within any of the documents. None included specific objectives, key metrics or ways of measuring success. Evident in the policies was significant room for interpretation, both of key terms and required objectives. This apparent flexibility and lack of accountability could give reason to doubt both the EU's and the UK's commitment to the targets.

4.2. Developing agroforestry policy in the UK

Six years after the UK voted to leave the EU in 2016 and four years after the UK government promised that farmer subsidies would be based on the principles of 'public money for public goods', agricultural policy remains unclear. The UK Agriculture Act, which provides the legislative framework for replacement agricultural schemes was only finalised at the end of 2020 and the specifics of transitioning from the CAP and how farmers will be paid is protracted (until 2027) and vague. The Basic Payment Scheme (BPS), equivalent of the EU Pillar 1 payments, will be reduced each year and gradually replaced by Environmental Land Management schemes (ELMs), which will have three tiers. The recent Agricultural Transition Plan: June 2021 progress update (DEFRA, 2021a, 2021b), stipulates that ELMs will be fully introduced and open for applications by 2024. The three tiers are: the Sustainable Farming Incentive (SFI); Local Nature Recovery (LNR); and Landscape Recovery (LR). Farmers will be paid to take more sustainable farming actions, provide more public engagement, or make large land use changes for nature and climate. However, there is limited to no detail on what these schemes will pay for and what the overall objectives these schemes are trying to achieve actually are (e.g., achieving net zero). Three recent reports by the National Audit Office, DEFRA Select Committee and Public Accounts Committee (PAC) have concluded that progress of ELMs is too slow and critical elements are yet to be included. Indeed, PAC describes the situation as "blind optimism", highlighting key gaps in DEFRA's approach: "the Department has not established the metrics that it will need… We are not convinced the Department sufficiently understands how its environmental and productivity ambitions will impact the food and farming sector… the Department is not doing enough to support farmers through the transition to the new schemes…" (House of Commons Committee on Public Accounts, 2022, pg. 5 and pg.7).

Tree-planting has featured heavily as a major political promise, with large 'spoken' support for tree planting targets in order to meet decarbonisation goals (Image et al., 2023; Staddon et al., 2021). Afforestation and agroforestry are also recognised by the UK's Committee on Climate Change (CCC) as playing an integral role in reaching net-zero, with recommendations to increase tree cover on agricultural land by approximately 21% by 2050 (Climate Change Committee 2020). However, agroforestry does not currently feature in a major way in English

The small section of policy considered in this paper is highly relevant to the chosen topic. Despite overlapping policy goals that could be achieved with agroecology, there is little support for this approach and minimal agroecological knowledge transferred into the policies reviewed. So why is it that this knowledge is not included and policy for agroecology is taking so long to develop? It could be because agroecology radically re-imagines food systems and in so doing, challenges current systems of power. It could also be that for many, the current food production system works. Examples of agroecology being firmly embedded in policy seem to mainly come from the global south, suggesting that perhaps a transition to agroecology will only come when the need is great enough.

This disregard, or lack of applied agroecological knowledge can also be seen outside the scope of this review. The plethora of frameworks, goals and position papers from academia, civil society and social justice movements highlight the amount of passion, knowledge and drive there is behind finding solutions to sustainable food systems and land-use frameworks. The Global Alliance for the Future of Food's 'Principles for Food Systems Transformations – a framework for action', The Sustainable Food Trust's 'Sustainability Metrics', The Food and Farming Countryside Commission's 'Land use Framework' and the Nyeleni 6 pillars of Food Sovereignty, to name but a few. All provide inclusive, robust tools to apply to food systems and most are deeply agroecological in nature. This expansive body of work does not appear to make it into rooms and conversations where policy is made. The results of this review, clearly suggest that agroecological and sustainable food system knowledge is not taken into consideration when it comes to designing and implementing policy. If policymakers are serious about transitioning to sustainable food production systems then this knowledge needs to be included and represented in policy forums.

4.4. Other policy drivers and influencers

This review focussed on nine policy documents, five of which were specific to England. However, there are of course, other policy drivers that have an impact on current discussions around agricultural and agroforestry policy development in England. These broader drivers are worth considering within this analysis, given the heated and contested policy landscape, particularly around Brexit, land-use, agriculture and net zero; ignoring them would be an omission. Taking a systems approach enables us to consider what other factors are influencing policy makers and farmers in their decisions and should highlight possible levers of change. Fig. 2 below, depicts some of these additional policy drivers that are influencing current decision-making in the UK. On the whole, these additional drivers were not mentioned or discussed in the reviewed policies, suggesting that agencies and organisations are working in silos, with little consideration for facilitating policy coherence. Clearly, there are tensions in policy, approaches and levers of change.

By attempting to map some of the agroforestry policy drivers and influencing actors in England, numerous agricultural, environmental, health, and economic goals emerge. The visual depiction of drivers in
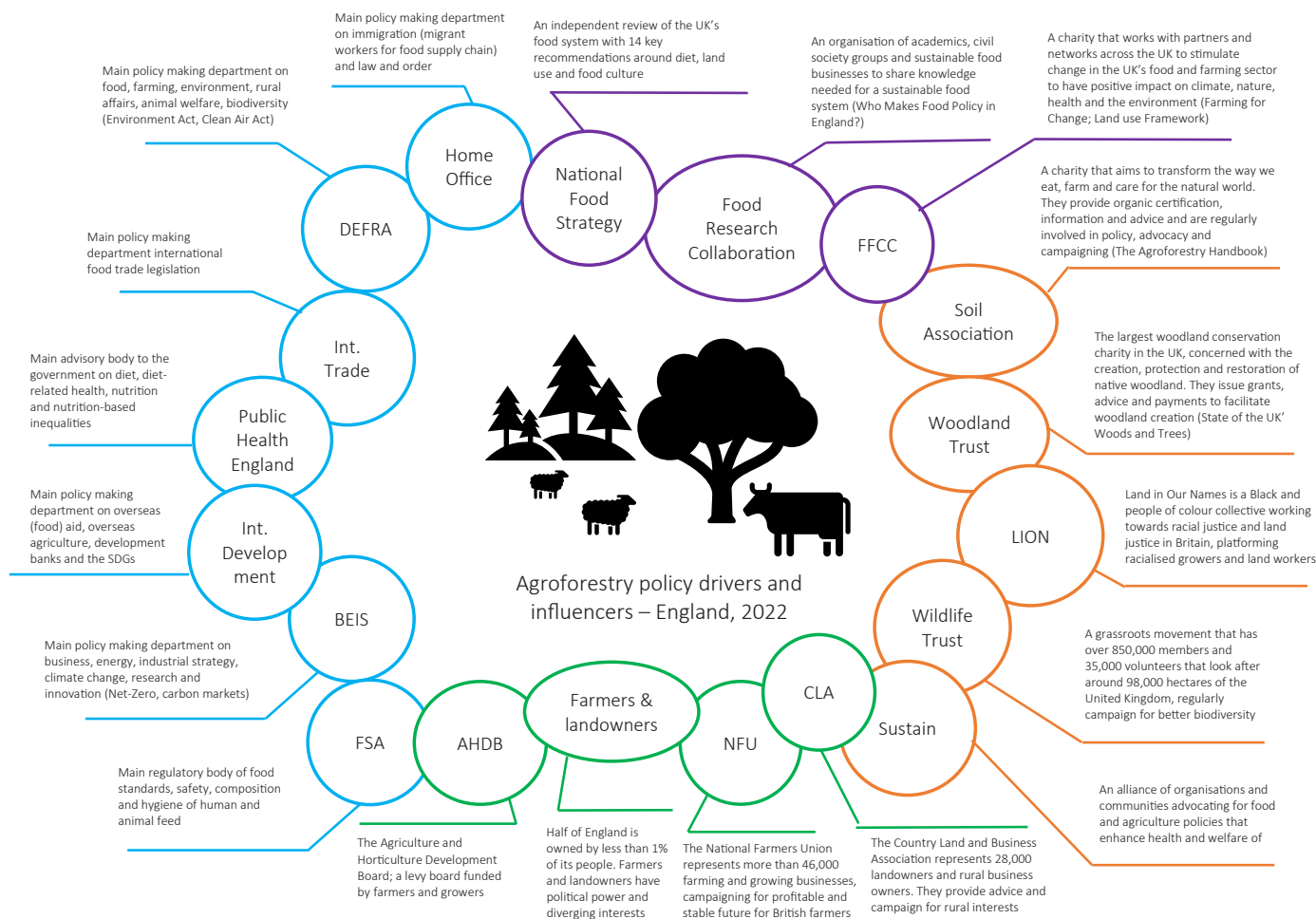
Fig. 2. Some of the many agroforestry policy drivers and influencers in England Key: Blue – Government departments Green – Farmers and farming associations Orange – Civil society Purple – Independent reviews and research councils. In brackets are specific policy documents, laws, communications or advice from the relevant department or organisation.

Fig. 2 provides an overview of the complexity of the policy landscape, whilst also highlighting the interconnected nature of policy goals. It should also be noted that other influential organisation like the Forestry Commission, Natural England, National Trust etc, are not on this 'map', despite their significant level of influence. A useful piece of work as a consequence of this exercise could be to systematically map agroforestry drivers and influencers in England. The interconnectedness, as shown in Fig. 2, though potentially overwhelming, does in itself present opportunities whereby multiple objectives might be met; achieving 'co-benefits' across sectors, agencies and organisations. It also highlights where stakeholders might find common ground and how a framework could be applied that would facilitate actors in the decision-making process. The need to tackle these issues holistically is reiterated by the FFCC's Chief Executive Sue Pritchard's response to DEFRA's recent Food Strategy (June 2022): "Responsible food businesses and citizens want the same thing. For governments to use their powers to legislate and regulate sensibly, to level the playing field for fairer, more sustainable food and farming. There is more for this government to do, to join up all the dots between food and health, farming and the environment, food security and progressive trade."

Sustainable food production systems can be seen as a lever between the policy drivers and influencing actors in Fig. 2, confirming this paper's position that decisions around land-use and agriculture must centre themselves on food systems. Out of the three frameworks analysed, FAO 10 Principles for Agroecology is the most centered on food systems. The explicit goal of this framework is to "transform food and agricultural systems… (with) an explicit focus on social economic dimensions of food systems" (FAO, pg 2). It is for this reason then, that the FAO's 10 Principles for AE framework is best suited to facilitate decisions around land use and agricultural policy development and should be used by all stakeholders. Taking a systems approach will be fundamental if we are to achieve real change in our food systems or if we are to meet net-zero, the UN SDGs or the various other commitments the UK government has promised. This paper adds to those calling for a systems-based approach, and one that is guided by environmental, health and economic goals together.

5. Conclusions and recommendations

This analysis of three frameworks and nine policies highlights the apparent lack of knowledge transfer into critical policy documents. None of the frameworks considered have been coherently integrated into EU or English policy. The only framework that was 'applied but not comprehensively' was the ecosystem services concept, in just one policy: the UK Agriculture Act. This shows that the current policies aimed at improving agriculture and agroforestry are ill-equipped to catalyse the systemic change needed to reach sustainable food production systems.

Out of the three frameworks analysed, the FAO's 10 Principles of Agroecology has the most potential to re-imagine our food systems whilst delivering on a many nature, environmental and societal goals, with a strong focus on equity. This is because the framework cohesively integrates aspects of sustainable food systems in a more interconnected way than the other frameworks. In addition, it provides a contextualised, place-based approach (Bocchi, 2020; Owen et al., 2020) which allows users to make comprehensive decisions, maximising possible synergies between environment, health and economic goals.

In conclusion, there is considerable scope to improve agricultural, and particularly agroforestry policy, both at the EU level and nationally in England. Given the plurality of views and objectives when it comes to sustainable food systems, a common framework is needed (Hebinck et al., 2021). To achieve an agroecological outcome, policy development and policy-makers should centre discussions on the FAO's 10 Principles

for Agroecology as this is the framework with the most potential to bring about systemic change. Using a metric or an evaluation tool such as the Global Alliance For the Future of Food's 'Principles for Food System Transformation' in conjunction with the 10 Principles for Agroecology in the policy development stage, as well as conducting robust policy mapping exercises to ensure a diverse set of stakeholders and goals are included should be made the norm. This is in line with similar recommendations made by Hebinck et al., 2021 and Brouwer et al. (2020).

This paper makes the following broad policy recommendations, applicable for both the EU and England:

o Policy papers should include a methodology and other external drivers of policy
o More tools are needed to share and engage and co-create; more must be done to enable cross-sector dialogue and knowledge sharing
o Policy makers need to engage diverse stakeholder groups in policy development to ensure knowledge transference
o When frameworks are developed by civil society and academia, their practical application in policy and legislation should be considered thoroughly
o The full extent of policy levers should be employed; more legally binding policies are required alongside directed taxes and subsidies, with robust metrics and ways or reporting
o The FAO's 10 Principles for Agroecology should be urgently adopted by governments to guide decision making around land use, in particular nascent agroforestry policy

Along with the following recommendations for agroforestry policy development in England:

o Policy makers need tools to better utilise available knowledge from practitioners, researchers and civil society
o Policies pertaining to agriculture, the environment and our health need to better integrated
o DEFRA should base all future policy developments on the FAO's 10 Principles for Agroecology
o A robust set of objectives and metrics should be made available that show how ELMs will deliver public money for public goods, with a particular focus on agroforestry
o Farmers must be supported with time, money and knowledge to facilitate a transition to greater agroforestry uptake
o All policies must take a food systems approach and include diverse actors to enable identification of possible co-benefits and trade-offs

CRediT authorship contribution statement

Venn Rosemary: Conceptualization, Investigation, Methodology, Visualization, Writing – original draft. **Burbi Sara:** Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing.

Declaration of Competing Interest

Data Availability

The data is included in the paper and annex.

Annex

KEYWORDS	CAP	EU Forest Strategy for 2030	Farm to Fork Strategy	EU Biodiversity Strategy for 2030	Highest scoring keywords across policies (EU only)	UK Agriculture Act	Agricultural Transition Plan	Environment Act	UK Forestry Standard	NDC	Highest scoring keywords across policies (England only)	Highest scoring keywords across policies (EU and England)
Agro-ecology	0	0	0	1	1	4	0	0	0	0	4	5
Agro-ecosystem	0	0	0	0	0	0	0	0	0	0	0	0
Agroecological	0	0	0	0	0	3	0	0	0	0	3	3
Agroecology	0	0	0	1	1	4	0	0	0	0	4	5
Agroecosystem(s)	0	0	0	2	2	0	0	0	0	0	0	2
Agroforestry	0	4	1	2	7	0	1	0	0	0	1	8
Agro-forestry	0	0	0	1	1	0	0	0	0	0	0	1
Bio-diverse	0	0	0	0	0	0	0	0	0	0	0	0
Bio-diversity	0	0	0	0	0	0	0	0	0	0	0	0
Biodiverse	0	4	0	2	6	0	0	0	0	0	0	6
Biodiversity	8	72	19	123	222	1	5	259	190	18	473	695
Climate	17	72	26	27	142	4	8	0	56	29	97	239
Climate change	2	23	9	13	47	27	4	0	191	22	244	291
Climatic	0	3	0	0	3	0	0	0	9	0	9	12
Ecological	31	9	2	13	55	6	0	0	64	2	72	127
Ecology	0	0	3	1	4	0	0	0	11	0	11	15
Ecosystem(s)	0	33	3	49	85	0	2	0	111	2	115	200
Ecosystem services	0	20	0	9	29	0	1	0	30	1	32	61
Ecosystem-services	0	0	0	0	0	0	0	0	0	0	0	0
Environment	18	16	14	20	68	122	5	155	213	12	507	575
Environmental	17	42	31	36	126	99	23	244	115	3	484	610
Environmentally	5	0	2	1	8	12	0	0	4	0	16	24
Food	1	5	263	21	290	427	1	11	11	4	454	744
Food system(s)	0	0	57	1	58	6	0	0	0	1	7	65
Food-system(s)	0	0	0	0	0	0	0	0	0	0	0	0
Nature	6	25	5	87	123	7	0	53	83	12	155	278
Resource(s)	5	9	6	9	29	12	1	103	99	9	224	253
Service(s)	2	37	16	13	68	15	2	35	117	4	173	241
Sustainability	0	16	47	7	70	4	0	0	20	4	28	98
Sustainable	1	65	110	26	202	22	0	0	333	15	370	572
Sustainable development	1	3	4	4	12	1	0	2	18	5	26	38
Total references to keywords	**114**	**458**	**618**	**469**		**776**	**53**	**862**	**1675**	**143**		
Total words in document (minus title page, contents, annex)	39078	14544	9679	11039		57,678	7808	105962	98549	7889		
Keywords as a %	**0.29**	**3.15**	**6.38**	**4.25**		**1.35**	**0.68**	**0.81**	**1.70**	**1.81**		

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