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Policies for agroforestry, a narrative review of four 'continental' regions: EU, India, Brazil, and the United States

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Agroforestry is receiving renewed interest due to its highly diversified, multifunctional nature. With a long history and roots in many indigenous farming systems, agroforestry offers a 'win-win' for biodiversity, carbon sequestration, on-farm profitability, resilience, and social wellbeing. However, the re-integration of trees on farms goes against the previous decades' push for de-mixing, intensifying, and simplifying production methods, and farmer uptake remains low. As understanding and support for more integrated, complex farming systems builds, an enabling policy landscape is needed. This narrative policy review considers policies for agroforestry across four 'continental' regions: the EU, India, Brazil, and the United States. Using an agroecological framework, we explore the content, development, objectives, and alignment of both direct and indirect policies to provide insight into: how policies for agroforestry are currently framed; their development process; and, whether over-lapping and interconnected policy objectives are included. We find that policies for agroforestry are increasing gradually, but are typically confined to an agronomic understanding, with limited inclusion of the socio-political aspects of food and farming. Except in Brazil, policies appear to be narrow in scope, with few stakeholders included in their development. Policies do not challenge the status quo of the dominant corporate agri-food system and appear to miss the transformative potential of agroforestry. We recommend: greater coordination of policy instruments to achieve co-benefits; focused integration of agricultural and climate policies; greater inclusion of diverse stakeholders in policy development; and a widening of agroforestry systems' objectives, both in policy and practice.

KEYWORDS

agroforestry, multifunctional, sustainable food systems, policy coherence, nature-based solutions

1 Introduction

Globally, agriculture is the driving force behind several major global crises: it is responsible for an estimated 60% of terrestrial biodiversity loss due to land use change (Benton et al., 2021), as well as for 24% of greenhouse gas emissions (GHGE), 33% of soil degradation and 20% of the overuse of aquifers (UNEP, 2016). More than 60 years after the spread of the 'green revolution', 820 million people around the world are undernourished, 2 billion are deficient in micronutrients and 650 million are obese (FAO and ICRAF, 2019). When looking at the food sector from a system perspective that covers the full and complex web of activities from

production, processing, transport and consumption, the global organization of our 'food system' seems highly dysfunctional. There is widespread awareness well beyond academia (Benton et al., 2021; Fanzo et al., 2021; Webb et al., 2020) that the sector needs to change its practices; evident from the significant number of reports, papers, summits, and conferences seen across civil society (WWE, GRAIN, FIAN), landworkers' organizations (LaVia Campesina), governments (UN Food Systems Summit, 2021), as well as global agribusinesses (Bayer, 2023; Cargill, 2022). However, despite broad agreement over the issues at stake, different actors have different ideas and visions for what this 'sustainable future' of the food system entails (IPES-Food and ETC Group, 2021). Calls for high-tech innovations from climate-smart and precision agriculture to organic and regenerative approaches, through to agroecology and food sovereignty, coexist and contradict. One may accuse the former innovations of being just an extension of the existing and dysfunctional, dominant agri-food system, that has expanded internationally along colonial lines (Ferrando et al., 2021), and that as a mainly 'corporate food regime' is oriented around principles of gaining profits, rather than providing nutritious food to humans (Holt-Giménez, 2019). By contrast, the latter has been criticized for being inefficient and labor and land intensive (Sanderson Bellamy and Ioris, 2017). Despite the pertaining contestation of the 'right' approach, there seems to be an unprecedented and, in general, agreed upon understanding and valuation of the links between planetary and human health (IAASTD, 2009; Willett et al., 2019; IPBES-IPCC, 2021) and in particular the impacts of climate change on sustainable food production (IPCC, 2019). This can be seen in the mainstream acceptance of concepts such as 'The Economics of Ecosystems and Biodiversity' (TEEB) and more recently 'Nature-based solutions' (Nbs), which aim to make nature's 'value' to society visible.

1.1 Re-integrating planetary and human health through trees

'Nature-based solutions' (Nbs) are a key concept propagated to address numerous ecological and climate challenges (IUCN, 2020; Mori et al., 2021). A broadly shared definition is that Nbs are "solutions to societal challenges that involve working with nature" (Seddon et al., 2021). In the context of national climate mitigation and adaptation plans, Nbs schemes, including tree planting, are championed for their capability to sequester carbon and support biodiversity while reducing the vulnerability of social-ecological systems to the impacts of climate change (Girardin et al., 2021; Roe et al., 2021). Afforestation and /or Reforestation (A/R) is one distinct Nbs approach that features highly in numerous state political campaigns, Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs), as well as international initiatives (such as the Great Green Wall or the Bonn Challenge), local community projects, and corporate net-zero goals and Community Interest Companies such as Ecosia. However, 'nature-based' means different things to different people. While tree plantations may be seen as an efficient 'natural' way to adapt to and mitigate the impacts of climate change, others would reject this approach to Nbs, witnessing the significant impacts on and costs to local communities, local resource right holders or the pre-existing native ecosystems (Seddon et al., 2021). The supposed potential of A/R based Nbs may also distract from the need to rapidly phase out fossil

fuels, protect existing ecosystems from further climate impacts or improve livelihood resilience in the face of climate shocks. There are also red flags raised around land grabbing for monoculture tree planting by corporations attempting to offset their carbon emissions, which again, often come at significant cost to local communities, local resource rights and pre-existing carbon rich biodiverse native ecosystems (Ollinaho and Kröger, 2021).

Apart from classical A/R, agroforestry systems (AFS) are another Nbs that involves both trees and agricultural land use. Agroforestry is defined as "the practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or animal systems to benefit from the resulting ecological and economic interactions" (Burgess et al., 2015). AFS as a multifunctional land-use, built on diversification and low-inputs (Hernandez-Morcillo et al., 2018), offer a set of different benefits at the farm, landscape and global levels that can: increase carbon stocks and biodiversity in agricultural systems; improve soil fertility; reduce runoff, water pollution and soil erosion; improve on-farm resilience and enhance food sovereignty (Castle et al., 2021; Jose, 2009). This 'multifunctionality' is widely recognized; indeed, AFS feature in the recent IPCC report as a sustainable land management practice that, with 'very high confidence', can "prevent and reduce land degradation, maintain land productivity, and sometimes reverse the adverse impacts of climate change on land degradation" (IPCC, 2019; p. 23). Yet, despite the potential of AFS and a growing interest among policymakers, farmer uptake remains relatively low (Buratti-Donham et al., 2023).

1.2 Policies for agroforestry

Globally, barriers to scaling AF among farmers are remarkably similar. The most commonly cited issues are: unclear and deficient tenure or resource use rights; a lack of clear policies and regulations; insufficient financing (for implementation and maintenance); and a lack of knowledge and capacities (FAO, 2013; Organic Research Centre, 2021). Irrespective of regional and context dependent variations on the barriers for AF uptake, policies remain a key lever to encourage uptake and address the pertaining issues. Accordingly, it is highly relevant and interesting to understand how policies develop in this field (Westaway et al., 2023; FAO, 2013; van Noordwijk, 2019). Within the EU, the Common Agricultural Policy (CAP), for instance, has disincentivized tree planting on agricultural land until very recently. The traditional understanding of agriculture as an 'exceptional sector' plays into the non-adoption of integrated systems, like AFS. It has led to a highly compartmentalized approach in land use policies that separates agriculture for food production not only from forestry but also from interlinked objectives such as climate change mitigation or adaptation, biodiversity conservation, or public health (Candel and Biesbroek, 2016; Nilsson and Weitz, 2019; Biesbroek and Candel, 2020). This compartmentalization also inhibits effective policy integration and coherence, key concepts when attempting to address complex systems and their respective actors, disciplines and ideologies (Tosun and Lang, 2017; Runhaar et al., 2014).

Although agroforestry is considered a regenerative, agroecological approach to land management (Peredo Parada et al., 2020; Snapp et al., 2021), it can take many forms in practice. Depending on what objectives are prioritized, the transformative potential of AFS on food systems is impacted. Policies need to adopt a 'coherent' systems-thinking approach (Kuhmonen, 2018) if they are going to succeed in

addressing overlapping and interconnected societal objectives. Moreover, and in line with commonly shared ideas of systems transformation and scaling, policy efforts need to open avenues for a full set of diverse practices, rather than conceptually narrowing down options to simply adding woody components, thereby missing the opportunity to change the nature of how farming as a system works.

Within this context, this paper reviews agroforestry policies in four major food producing regions of the world, with the aim to understand how these policies are being developed and with what narratives, reflecting on the scope of AFS to contribute to a fairer and more sustainable food system through the lens of agroecology as a transformational framework. Including the state and development of public policies in relation to AFS we specifically ask:

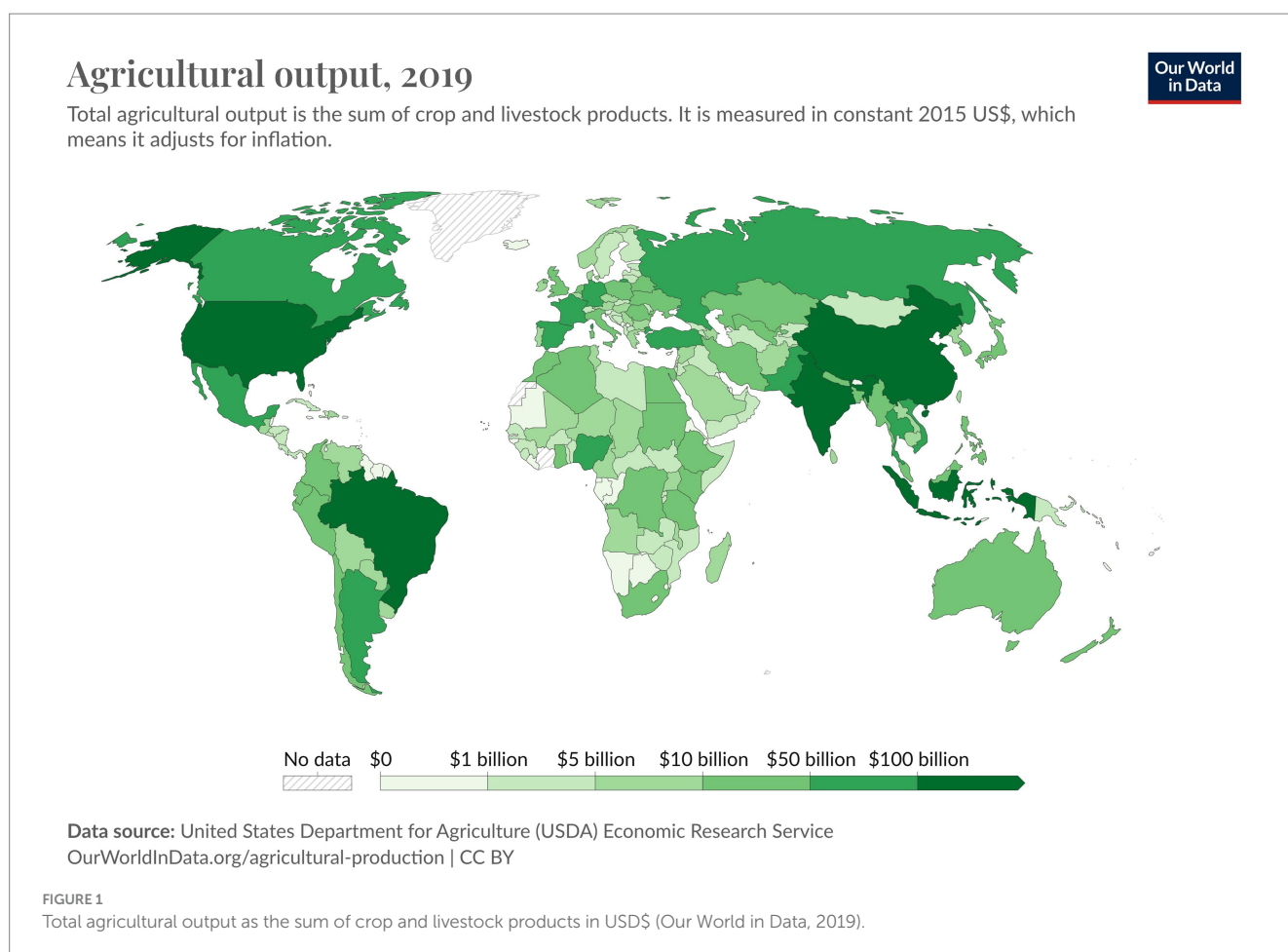
- 1 How is agroforestry currently framed in direct and indirect policies?
- 2 To what extent are policies for agroforestry aligned with other interconnected policy objectives, such as carbon sequestration, biodiversity, food security and diet related health?

2 Analytical framework and methods

This research seeks to analyze public policies on or of relevance to agroforestry, their coherence and whether or not the content is narratively leaning toward a more integrated agroecological reading.

To narrow the scope of the research, four ‘continental’ regions were chosen for this analysis: the European Union (EU), India, Brazil, and the United States of America (U.S.A). Together, these regions represent a significant proportion of total global cropland; out of a total global cropland figure of 1.63 billion hectares, the selected regions represent about one third (0.507 billion hectares) of global cropland (Goldewijk, 2023). Given their collective contribution to global agricultural production and export (see Figure 1), and therefore their contributions to global greenhouse gas emissions (GGHE), agricultural and land use policy environments in these regions are highly relevant. Moreover, the EU, India, Brazil and the U.S.A have comparable policy models in that they all have a combination of overarching policies at the federal level (or supranational level in the case of the EU), as well as at the individual state or member state level, which can work against or in tandem with the broader policies.

Policies, both direct and indirect, were identified for each region following a ‘snowball sampling’ approach (Parker et al., 2019). The legislative and policy database, FAOLEX, was employed to source policies. Relevant government websites, academic and gray literature, and expert knowledge were also used to complement the list of policies. The authors define ‘direct policies’ to be those that specifically mention agroforestry, such as India’s *National Agroforestry Policy, NAP (2014)* or the U.S.A’s ‘*Agroforestry Strategic Framework 2019–2024*’ (2019). Given the small number of direct policies for agroforestry, ‘indirect policies’, such as Brazil’s ‘*National Low Carbon Agricultural Plan*’ (2012) or India’s ‘*National*



Environment Policy' (2006) were also included. The inclusion (or exclusion) of the indirect policies was decided based on an initial assessment of the policies' perceived relevance to either agroforestry, trees on farms, agricultural production, or, where the authors considered the policy goals to overlap, such as the U.S.A's 'Agriculture Resilience Act' (2021) or India's 'Biological Diversity Act' (2002). Policies up to and including the year 2022 were included in the policy framework review. All policies included in the framework review are listed in [Table 1](#).

To address our aims, a novel policy framework was developed ([Table 2](#)). The framework was generated inductively, informed by relevant policy literature on sustainable food systems and just transition pathways. A list of attributes in line with environmental and societal sustainability were identified and grouped into four categories: *policy development*, *subject included*, *policy goals* and *policy coherence*. In this attempt, these four categories, and the attributes within them, provide a 'picture' of the narrative leaning of the policies. *Policy development* refers to the way in which the policies appear to have been developed and how they may be operationalized. *Subject included* lists a broad range of topics related to sustainable food systems and just transitions from the literature, as well as known barriers to scaling AFS. *Policy goals* include specific benefits that AFS can contribute to ([Jose, 2009](#)) as a means to understand in what ways and for which purposes are AFS included in policies. *Policy coherence* looks at the alignment of the policies with key national and international targets (such as the Nationally Determined Contributions and SDGs) as a means to specify the extent to which different policy goals are integrated or 'coherent'. Taken together these categories provide a framework through which to assess current policies and address the two research questions listed above.

Given their relevance to the agroecological discourse on transition pathways, the High Level Panel of Experts' '13 Principles of Agroecology' (2019) serve as a basis for defining whether policies adhere to an agroecological reading or not. They were thematically grouped (see [Appendix 1](#)) and included as distinct *subject* attributes in the analysis.

An expanded definition of each attribute, its relevance and accompanying reference(s) are provided in the [Supplementary materials](#).

The policies were reviewed using a narrative approach, using content and thematic analysis. ATLAS.ti 23 software was used to manage and code data ([ATLAS.ti, 2023](#)). Each policy was scored against each attribute, either scoring 1 for yes, 0.5 for partially or 0 for no. 'Not Applicable' and 'Not Enough Information' were also included to allow for specific instances such as a policy being created before the UN SDGs, or to highlight where there was not enough sufficient information for the authors to score the policy. An example of the coding is given in [Table 3](#). As the review progressed, the authors adapted the framework collectively in an iterative process. When ambiguity in scoring arose, the authors collectively addressed the issue (an intercoder agreement).

3 Results and discussion

In this next section, we present our results and discuss them in the following order. We start with key figures on the agricultural sector

and general AFS trends for each region. The visual representation of the policy framework review is then presented, and each region discussed in turn. Cross-cutting topics and themes are approached in a comprehensive discussion, drawing parallels from each region. Finally, limitations are presented, before concluding and providing recommendations.

3.1 Key agricultural and AFS trends across regions

Land classified as 'agricultural' in the EU spans around 157 million hectares, representing 38% of the total land area ([EUROSTAT, 2023](#)). As a sector, agriculture contributed just 1.4% to the EU's GDP in 2022 ([EUROSTAT, 2023](#)) a number which has been steadily decreasing. In 2018, the total area of agroforestry in the EU was 114,621 km², representing 6.4% of the total utilized agricultural area (UAA), with the majority located in the Mediterranean bioregion ([Rubio-Delgado et al., 2023](#)). Silvopastoral systems are the most widespread AFS, representing 81% of the total agroforestry area and 5% of UAA. The EU has direct policies both at the regional and individual member state (MS) level to support AFS. Yet, despite the existence of policy support, there has been a low degree of farmer uptake for direct AF measures, and subsequently large leftover budgets for such measures that could have been allocated to maintaining and increasing AFS ([Mosquera-Losada et al., 2016](#)). In fact, there has been a 47% decline in AFS in Europe ([Rubio-Delgado et al., 2023](#)) between 2009 and 2018 despite the CAP providing for AFS since 2007.

The U.S.A is the second-largest agricultural trader in the world, after the European Union ([USDA, 2022](#)). According to the USDA, agriculture, food and related industries contributed 5.2% toward GDP in 2019. 44.36% of the U.S.A.'s land mass is registered as agricultural land ([World Bank Group, 2021](#)). Figures for AFS as a land use do not yet exist, however, according to the 2017 Census of Agriculture (COA), 1.5% of all farm operations responded that they had at least one agroforestry practice on their farm ([Smith et al., 2022](#)). AFS, in the more traditional sense of perennial polycropping systems, have been used by Indigenous and First Nation peoples in the U.S.A for centuries. AFS were first formally recognized in the U.S.A in the 1930s in the form of windbreaks ([Jose and Udawatta, 2021](#)). The U.S.A. does not have direct national policies for AFS at the federal level but supporting policies can be found at the state level.

In India, agriculture is the largest source of livelihoods, contributing to about 17% of GDP and employing roughly 47% of the total national workforce (Ministry of Labor and Employment, 206). As the Indian economy has diversified, agriculture's contribution to GDP has declined. Current estimations of AFS as a land use vary substantially ([Sharma et al., 2017](#)). Taking FAO's figures that agricultural land in India represents 60% of the total land area alongside the Central Agroforestry Research Institute of India's estimations that AFS make up 8.65% of agricultural land, we can estimate 14.41% of utilized agricultural area is AFS. India was the first country to introduce a [National Agroforestry Policy, NAP \(2014\)](#), but no direct regional or state policies were identified.

Brazil, the world's fifth-largest country in both area and population, accounts for the largest share of arable land and the

TABLE 1 The 33 documents included in the policy framework review.

Region / country	Name of policy (year of adoption)	Binding instrument in law (laws, acts, decrees)	Non-binding instrument (communications, strategies, plans)
EU	Common Agricultural Policy (2013)	X	
	European Green Deal (2019)		X
	EU Biodiversity Strategy for 2030 (2020)		X
	Farm to Fork Strategy (2020)		X
	EU Forest Strategy for 2030 (2021)		X
India	National Forestry Policy (1988)	X	
	National Agricultural Policy (2000)		X
	Biological Diversity Act (2002)	X	
	Forest Rights Act (2006)	X	
	National Environment Policy (2006)		X
	National Policy for Farmers (2007)		X
	National Biodiversity Action Plan (2008)		X
	Green India Mission (2010)		X
	National Agroforestry Policy (2014)		X
	Agricultural Export Policy (2017)		X
Nationally Determined Contribution (2022)		X	
United States	National Environmental Policy Act (1969)	X	
	The National Forest Management Act of (1976)	X	
	Farm Bill Agricultural Improvement Act (2018)	X	
	Agroforestry Strategic Framework (2019–2024)		X
	Agriculture Resilience Act (2021)	X	
	Nationally Determined Contribution (2021)		X
	USDA Food System Transformation Framework (2022)		X
Brazil	National Family Farming Policy (2006)	X	
	National Forest Code (2012)	X	
	National Low Carbon Agricultural Plan “Plano ABC” (2012)		X
	National Agroecology and Organic Agriculture Policy (2013)	X	
	National Integrated crop-livestock-forestry systems Policy (2013)	X	
	National Adaptation Plan to Climate Change (2016)		X
	National Plan for Native Vegetation Recovery (2017)		X
	National Food Acquisition Program (2021)	X	
	Nationally Determined Contribution (2022)		X
	National Agribusiness Financing Plan “Plano Safra” (2022–2023)		X

TABLE 2 Policy framework developed by authors, with attributes grouped into four thematic categories.

Thematic categories	Attributes
Policy development	Policy is legally binding
	Cross-ministerial collaboration
	Farmers, practitioners, and food system experts consulted
	Indigenous knowledge / ways of knowing, included or referred to
	Development of targets based on holistic food systems approach
	Specific objectives / key metrics included
Subject included	Land tenure
	Land access
	Water access
	Farm succession
	Financing for agroforestry
	Knowledge and training
	Deforestation
	Emissions reduction included in relation to policy ambition
	Support for new entrants
	Fair employment
	Territorial or landscape approach encouraged
	HLPE environmental
	HLPE social
	HLPE economic
HLPE political	
Policy goals	Contribute to an agroecological transition
	Carbon sequestration
	Biodiversity preservation & conservation
	Soil health
	Improve air and water quality
	Flood mitigation
	On-farm resilience
	Food security and nutrition
Inclusion of cultural ecosystem services	
Policy coherence	Links to climate goals / NDCs
	Links to UN SDGs
	Links to biodiversity priorities
	Links to other agricultural and environmental state policies
	Intersectionality
	Diet related health

fourth-largest agricultural land globally (2.3 million sq. km; [World Bank Group, 2021](#)). Brazilian agriculture and livestock (including processing and distribution) contributed to almost 25% of the national GDP in 2022 ([CEPEA, 2022](#)). AFSs are increasing; there was a 67% increase from 8.4 to 13.1 million hectares between 2006 and 2017 ([Manzatto et al., 2019](#)), however, this represents just 5% of total farmed land ([Schuler et al., 2022](#); [Alexandre et al., 2021](#)). Brazil does not have direct national policies for AFS, but indirect policies at the state level include AFS as a management practice.

3.2 Regional policy framework analysis

Policies relating to AFS are increasing gradually over time, our analysis yielded 16 out of 33 policies created after 2015. More recent policies include a greater diversity of policy goals, such as carbon sequestration, improving air and water quality, and biodiversity preservation and conservation. Issues around land tenure and access (known barriers to scaling AFS) are for the most part, not included. Notably, the UN SDGs are also largely absent within the policies

TABLE 3 Intercoder agreement on codes (with example) allocated to each policy attribute.

Code	Definition	Example from data
1	Yes	EU Forestry Strategy for 2030 (EU, 2021)—this scored 1 for attribute ‘deforestation’ as the policy mentions deforestation multiple times as well as its commitment to ensure that any products sold on the EU market, originating from the EU or globally, will not contribute to deforestation.
0.5	Partially	Green India Mission (India, 2010)—this scored 0.5 for attribute ‘Indigenous knowledge/ ways of knowing included or referred to’ as the policy only makes one mention in section 4.3 whereby “Traditional Ecological Knowledge of communities, along with forestry science and state-of-the-art technology would improve the Mission interventions”
0	No	National Adaptation Plan to Climate Change (Brazil, 2016)—this scored 0 for attribute ‘Policy is mandatory’ as the policy explicitly mentions its purpose whereby “The purpose of the Brazilian Federal Government’s National Adaptation Plan, hereinafter referred to as the National Adaptation Plan (NAP) is to guide initiatives for management and reduction of long-term climate risks, as established in Ministry of Environment (MMA) Order 150 of 10th of May 2016, published in the Official Gazette (DOU) of 11th May 2016.”
NI	Not enough information	When not enough information is found in the document, we asserted the value NI.
NA	Not applicable	National Environment Policy Act (U.S.A, 1969)—this scored NA for attribute ‘Links to UN SDGs’ as the policy was written before the UN SDGs

reviewed. A policy summary matrix is used to visualize the results from the policy framework analysis (Figure 2).

In terms of *policy development*, Brazil scored highest, with strong cross-ministerial collaboration and stakeholder consultation. Policies in the EU appear to have specific objectives and key metrics included, but only partially consult with key actors. The only attribute not fulfilled in India in *policy development* was the development of policies with a holistic food systems approach. In the U.S.A, consultation with stakeholders is minimal. None of the regions have addressed either partially or in full all subjects, however financing for agroforestry was addressed in full in at least one policy for all regions. Brazil has included the majority of *subject* attributes (13 out of 14), followed by India (10), the EU (6), and the U.S.A (5). The High Level Panel of Expert’s (HLPE) attributes scored low across all regions: ‘environmental’ was addressed in full in just one policy in India; ‘social’ addressed in full in three policies in Brazil and one in India; ‘economic’ was only partially addressed or not at all in all regions and ‘political’ only addressed in full in two policies in Brazil.

Brazil is the only region that fulfills the agroecological transition attribute, and the only region with at least one policy addressing each *policy goals* attribute. The EU appears to address provisioning ecosystem services, with at least one policy either partially or fully addressing carbon sequestration, biodiversity preservation and conservation, soil health, air and water quality and flood mitigations. According to our analysis, policies in the U.S.A appear not to demonstrate coherence; with only one policy fully addressing climate goals. The other three regions have addressed most of the *policy coherence* attributes. Brazil, India, and the EU have policies linked to biodiversity priorities. Despite many of the assessed policies dated post 2015, (the date of the UN SDGs), only the EU has developed policies in line with these goals.

Figure 3 visualizes the total scores of each region and each attribute, which enables some additional trends to be observed in the data. Seemingly, the more agronomic or environmental attributes such as carbon sequestration, biodiversity and air and water quality are more readily included than the socio-economic or political attributes such as land tenure, access to land or fair employment. Interestingly, food security and nutrition scores higher than flood mitigation and on-farm resilience across the regions. For the most part, Brazil is the highest contributor across attributes, followed by India and the EU with the U.S.A the lowest contributor across attributes. Attributes in

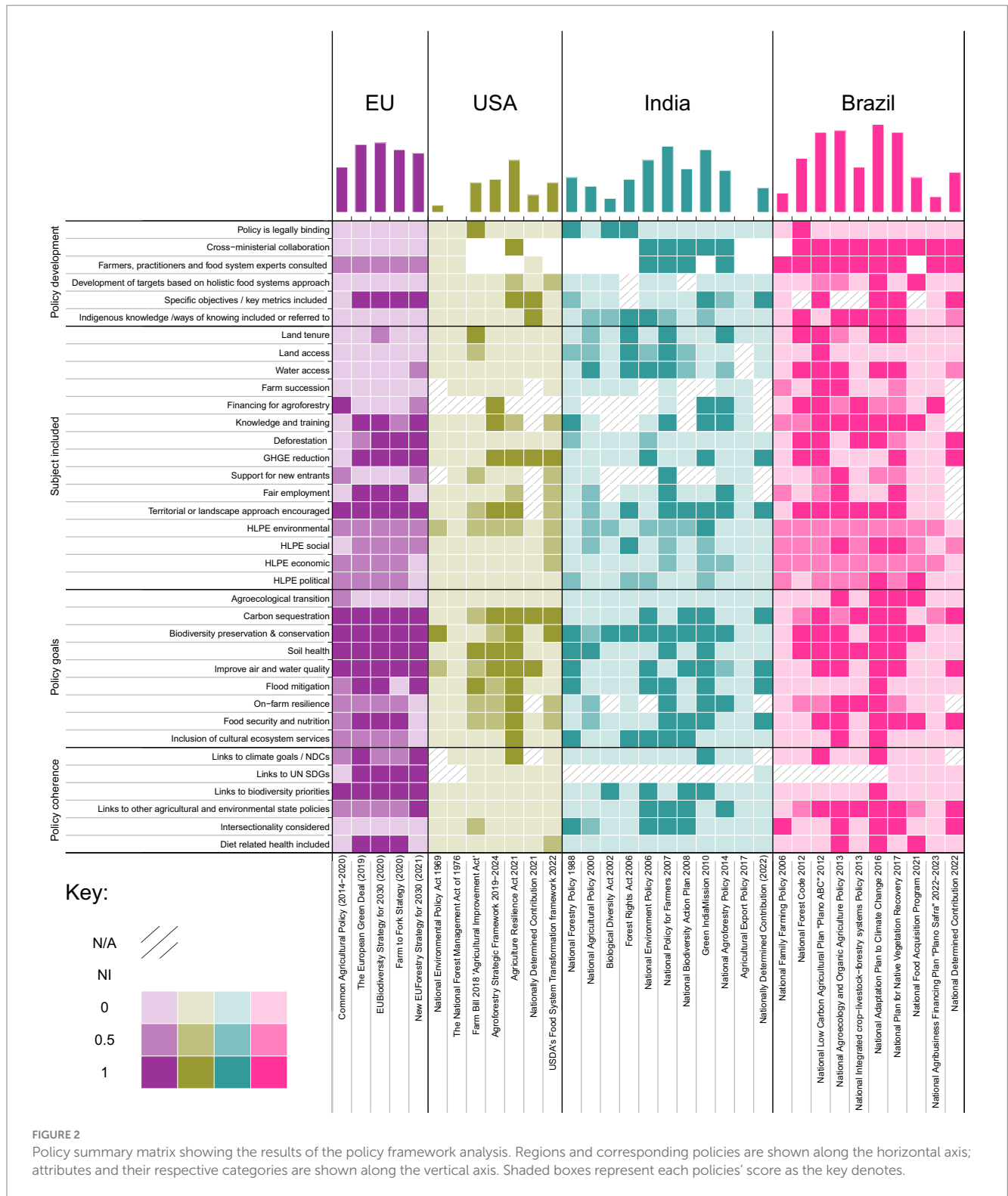
the *policy coherence* category are represented the least, with minimal links to climate goals or NDCs or the UN SDGs, though links to other agricultural and environmental state policies are included in all regions except the U.S.A.

3.2.1 European union

The Common Agricultural Policy (CAP) is the primary legislation guiding EU agricultural production. The CAP is renewed every 6 years and represents 40% of the total EU budget. The CAP primarily functions through direct subsidies based on the size of land or heard, and through rural development subsidies. In 2019, farmers received €38.2 billion in direct payments and €13.8 billion in rural development subsidies (European Parliament, 2021). Over the last decade, the policy environment for AFS across the EU has been growing. While the EU has defined AF as “land use systems in which trees are grown in combination with agriculture on the same land,” (European Parliament, 2020), the minimum and maximum number of trees per hectare can be defined by each MS. This could be seen as positive as it gives each MS the opportunity to take into account their own realities, yet, it has resulted in a huge variety of definitions, which is suggested to negatively impact uptake and go as far as disincentivizing AFS (EURAF, 2020).

Within the 2007–2013 period, only five EU MS directly supported AF within the CAP (Belgium; France; Hungary; Italy; and Portugal), while the 2014–2020 CAP saw an additional three (United Kingdom; Greece; and Spain). Some Member States (MS) like Hungary supported AF across the entire country, while in places like the UK and Italy, it was only supported in certain regions. AFS were also supported indirectly within Pillar II of the 2014–2020 Rural Development Plans (RDs) through 22 other Measures (EURAF, 2020), and through the CAP’s Statutory Mandatory Regulations (SMRs), Good Agricultural and Environmental Conditions (GAECs) and Ecological Focus Areas (EFAs).

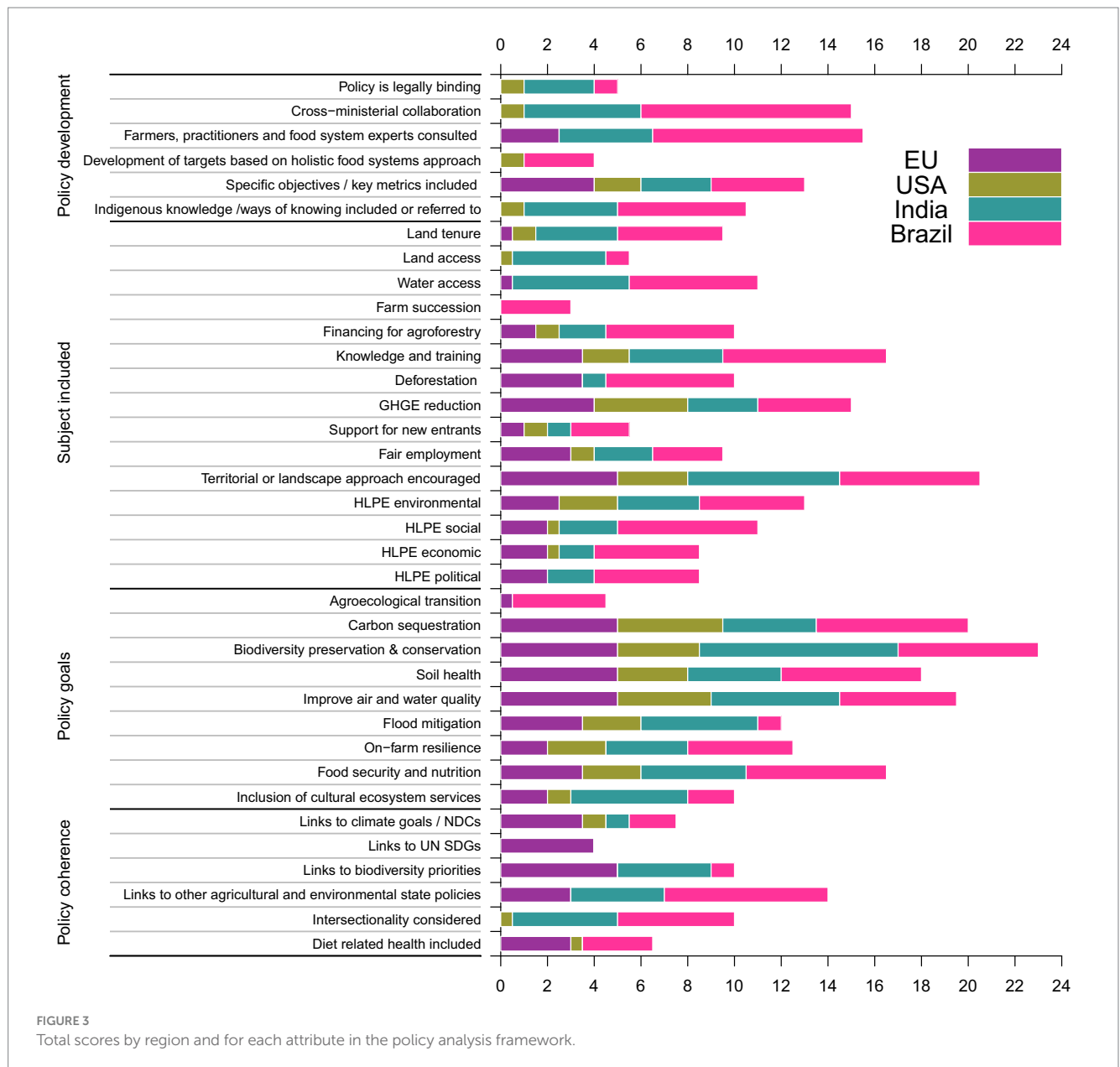
In the recent CAP (2023–2027), AFS can be directly supported as part of the ‘Eco-schemes’, a novel instrument which is voluntary for farmers but is ring-fenced by 25% of the Pillar 1 direct payment budget. These schemes prioritize the protection of the environment and climate through a list of possible practices that can be implemented by MS at their own discretion. These include the expansion of organic farming practices, integrated pest management, agroecology, animal welfare, the protection of water resources and soil, and many others.



However, only four countries have included an agroforestry related Eco-scheme (Czech Republic; Germany; Greece; and Portugal). AFS also find direct and indirect support through the Eco-schemes that have been implemented by MS on landscape features (Belgium Flanders; Bulgaria; Croatia; Estonia; France; Hungary; Italy; Ireland; Lithuania; Netherlands; Romania; Spain; and Portugal). In general, the types of policies that appear to be most beneficial to the protection and expansion of AFS are the ones that support traditional systems, the

implementation of new systems and the yearly support for the management of those new systems. From the data gathered, this type of policy support is only found in France and Portugal.

As the CAP continues to evolve and the EU makes ambitious targets such as '30 by 30' (the worldwide initiative for governments to designate 30% of Earth's land and ocean areas as protected areas by 2030) and 'net-zero by 2050' (net-zero carbon emissions by 2050), AFS are indirectly supported, to a limited extent, outside the



CAP. Within the EU Biodiversity Strategy for 2030 for example, AF is mentioned directly twice and indirectly through landscape features, which are an inherent part of AF. In the Farm-to-Fork Strategy, AF is mentioned once. In these documents AFS is mentioned as an opportunity for tree planting, as well as a system that represents strong benefits for biodiversity, people, and climate. Within the primary European Green Deal Strategy document, AF is mentioned just once. Within the EU Forest Strategy for 2030, it is mentioned multiple times. However, most of these European Green Deal strategies contain measures that are vague, leaving implementation and assessments to the discretion and ambition of individual MS.

The EU shows relatively robust *policy coherence* (Figure 2) with various policies cross-referencing each other as a source of guidance, for example on reforestation and biodiversity in both agricultural and environmental policies. This is perhaps unsurprising given the interconnected nature of the policies reviewed; the Farm to Fork Strategy being a sub-strategy of the Green Deal for example. The

Green Deal in particular is explicit in its integrated ambition: “All EU actions and policies will have to contribute to the European Green Deal objectives. The challenges are complex and interlinked.” Additionally, most of the policies had at least partial links to climate goals, NDCs, and UN SDGs. Intersectionality was not considered in any of the policies and diet related health was referenced only in the three documents reviewed of the EU Green Deal.

The EU scored quite highly across all attributes, prioritizing carbon sequestration, biodiversity preservation and conservation, air quality improvement, food security, and to a lesser extent, flood mitigation, on-farm resilience and cultural ecosystem services. All policies reviewed demonstrated partial inclusion of ‘farmers, practitioners and food system experts consulted’ but none suggested cross-ministerial collaboration and reference to knowledge co-creation was minimal. The consideration of the social components of a fair food system was also lacking, especially on matters of access to land or water, or farm succession (Figure 2). However, support for new entrants was partially considered within the CAP and EU

Forestry Strategy. There was partial inclusion of all four themes of the HLPE's Principles for Agroecology across the policies reviewed, except for 'social' in the CAP, and 'economic' and 'political' in the EU Forestry Strategy. Direct policies for AFS often include aspects of biodiversity, soil health and improved animal health and welfare, but minimal inclusion of social aspects such as land tenure or access. Additionally, most policies focus on the farm or plot level. There is limited indication to suggest that the policies are transformative or have an agroecological leaning.

3.2.2 United States

Farmers in the U.S.A have typically received very high levels of federal support, not dissimilar to the EU. US agricultural policy follows a 5-year legislative cycle that is commonly known as the US 'Farm Bill'. The Farm Bill governs farming, food and nutrition, and rural communities, as well as aspects of bioenergy and forestry. In the 2014 Farm Bill however, direct payments and subsidies were completely removed, though price support still exists for some products, such as dairy. The Farm Bill instead moved toward providing subsidized insurance for yield and loss.

Policy support for AF is found at the federal level, mainly through the USDA Farm Service Agency (FSA) and the National Agroforestry Centre (NAC). However, there is no direct federal or state policy for AF. The FSA's support comes mainly in the Conservation Reserve Program (CRP), which started in the 1985 Farm Bill (Smith et al., 2022). Windbreaks, shelter belts, living snow fences and riparian buffers all fall under the CRP. Given that most of the public funds for AF systems come from the CRP, a common misconception in the US is that AF is a conservation practice with additional benefits, as opposed to a production practice (Chenyang et al., 2021). In 2011, the USDA launched its Agroforestry Strategic Framework 2011–2016 which outlines the mission, goals, and approach to AF with contributions from 8 agency members of the USDA AF Executive Steering Committee (AESC), the USDA Interagency Agroforestry Team (IAT) and the National Agroforestry Centre (NAC). However, there is limited policy information or details on the financing of AF, and a formal AF policy in the US is still lacking. The USDA budget for AF (2011–2012) was \$333 million, less than 1% of the total USDA budget. In addition to minimal financial support, the dominance of leased land (39%) represents a key barrier to farmers wanting to convert to AFS.

The NAC defines AF in the Agroforestry Strategic Framework as "the intentional integration of trees or shrubs with crop and animal production to create environmental, economic, and social benefits" (National Agroforestry Centre, 2019, p. 2), going on to say, "agroforestry provides opportunities to integrate productivity and profitability with environmental stewardship to support healthy, sustainable agriculture systems, economies, and communities" (P3). However, this is not benchmarked in any way and is left to the reader to define for themselves what 'healthy, sustainable agriculture systems, economies, and communities' might be. This is tacitly echoed by the omission of many of the *subject* attributes related to the socio-economic such as 'HLPE social', 'land tenure' or 'fair employment' or policy goals such as UN SDGs, scoring '0' (Figure 2). The stated goals within the Agroforestry Strategic Framework are broad and not quantifiable.

In terms of *policy coherence*, the policies reviewed for the US score very low (Figure 2). There appears to be minimal alignment of national and international targets. Only one policy, 'Agricultural Resilience Act' (2021) scores a '1' for 'Links to climate goals'. There are no links to biodiversity priorities or other agricultural and

environmental state policies within the dataset. One policy scores '0.5' for 'Diet related health' (USDA's Food System Transformation Framework) and another (2018 Farm Bill) scores '0.5' for 'Intersectionality considered'.

The US scores are low for many of the *policy development*, *subject* and *policy goal* attributes (Figure 2). There was not enough information to score most of the policies on whether farmers or practitioners had been consulted, nor whether there was cross ministerial collaboration. Only one policy reviewed (NDC) scored '1' for the inclusion or referral to indigenous knowledge or ways of knowing. Land and water access were not mentioned across all policies. Carbon sequestration and improving air and water quality were the highest scoring attributes across the policies. The more recent Agriculture Resilience Act (2021) scored highest across attributes, in particular the *policy goals* section, omitting only an explicit goal of an agroecological transition. Seemingly the policies reviewed do not have a narrative leaning toward agroecology, instead focusing on the agronomic benefits of AFS. Only the USDA's Food System Transformation Framework (2022) partially included HLPE 'economic', 'social' and 'environmental' themes but not 'political'.

3.2.3 India

In line with Indian federalism, individual states hold considerable constitutional responsibility for the agricultural sector policies. Nonetheless, the central government develops national approaches to policy and provides funds for implementation at state level. The central government is responsible for a few relevant policy areas, like international trade. In 2020, the Government of India (GOI) amended three key trade and farming bills with an ambition of doubling farmers' income by the year 2022 and securing supply. However, these amendments were met with huge resistance by farmers, protesting from August 2020 until December 2021. The three amendments essentially aimed at deregulating the agricultural sector and to encourage farmers to sell directly to large buyers (companies, retailers, etc.). The strong resistance to these amendments led the government to suspend the laws for 18 months and form a new committee with representatives from the government and farmers to discuss the concerns.

In 2014, India became the first country in the world to issue a nationwide policy for AF, the *National Agroforestry Policy, NAP* (2014). The Ministry of Agriculture has the mandate for AF in India with an Agroforestry Mission located within the Department of Agriculture and Cooperation. AF is defined in the NAP as "a land use system which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity, and ecosystem sustainability." However, most Indian farmers have been hesitant to adopt AFS on a large scale due to financial issues, tenure, delayed incomes and increasing legal complications which hinder complexity, especially with regards mixing 'agriculture' and 'forestry' (Chavan et al., 2015). Considering India has been investing into AF research for over 30 years and has a substantial national AF policy in place since 2014, the lack of uptake and overall land use is noteworthy. This could be explained by the minimal inclusion of knowledge and training, financing or farm succession as subjects included within policies. Land tenure, a known hurdle in AFS is included within the National Farmers Policy (2007), the Forest Rights Act (2006) and is referred to as 'critical issue' within the NAP (2014), whereby states should "simplify regulations related to forestry, land use and land tenure" (page 11).

In terms of *policy coherence*, four of the more recent policies National Policy for Farmers (2007), National Biodiversity Action Plan (2008), National Environmental Policy (2006) and the NAP (2014) make direct links to other agricultural and environmental state policies. For example, the NAP is recognized as a critical pathway to meeting the National Forestry Policy (1988) ambition of increasing forest or tree cover to 33% from the present level of less than 25% (National Agroforestry Policy, NAP, 2014, page 1). There is little substantial reference to climate change despite the relevance for food security of the country (IFPRI, International Food Policy Research Institute, 2022). Only the Green India Mission (2010) establishes direct links directly to climate goals or the NDCs.

India's policies could be said to have an agroecological leaning, especially the more recent policies such as Forest Rights Act (2006) and the National Policy for Farmers (2007). Many of the 'sign post' attributes such as cultural ecosystem services, territorial or landscape approach, access to land and water, land tenure and food security and nutrition are included fully or partially across Forest Rights Act (2006), National Policy for Farmers (2007), National Biodiversity Action Plan (2008) and Green India Mission (2010). Additionally, indigenous knowledge or ways of knowing is also included or referred to in just over half of the policies.

3.2.4 Brazil

In the Brazilian federalism, the central government possesses the authority to formulate national policies, and to create funding mechanisms for their implementation in states. Historically, support for the agricultural sector and policymaking itself has mirrored the priorities or agenda of elected officials. In the early 1950s, the National Agricultural Policy Commission (CNA, 2024) was created, during the presidency of Getulio Vargas (Brasil, 1951). Over a decade later, in 1964, the Land Statute (*Estatuto da Terra*) came to govern national agricultural policies (Brasil, 1964), and provided the foundation for important sector developments. Namely, the establishment of a national credit system, the development of minimum prices policies, and the creation of two public institutions, one for agricultural research (Embrapa), and the other for technical assistance (Emater). In 1991, the reformulation of agricultural policies culminated in the Agricultural Policy Law, that defines guidelines, objectives and the institutional competencies of the national agricultural policy to this day (Brasil, 1991).

During a 13-year period with the Worker's Party (PT) in power (2003–2016), financial support for the agricultural sector has seen its highest figures, following a tendency that started in 1995, with strong vein to subsidized credit, especially for small-scale and family farming. During the presidency of Lula, the Agroecology and Organic Farming policy (Brasil, 2003) was passed, and the National Plan for Agriculture and Livestock "*Plano Safra*" was created. The plan plays a fundamental role in guaranteeing agricultural production and development in the country by financing small-, medium- and large-scale farmers. During the presidency of Dilma Rousseff, the amount of funding has peaked in 2014 (de Souza et al., 2020), and the National Crop-Livestock-Forest Integration Policy was passed, representing the first step toward policies on integrated land-use systems. That AFS doubled almost between 2006 and 2017 is seen as a result of supporting policies and public recognition of agroforestry (Manzatto et al., 2019).

Despite general criticism over low levels of support and protection for agriculture, the *Plano Safra* 2022/2023 has increased the maximum resources for family farming by 36%, and better agricultural insurance

conditions, compared to the previous plan (OECD, 2020; Brasil, 2022a, 2022c). However, the largest part of funding is given to agribusiness, while family farming represent less than 18% of the total amount. In theory, the plan supports 'sustainable' practices, but the budget for Agroecology and Organic Agriculture was considerably reduced by about 75% (Brasil, 2022b), decision that can be associated with the agenda of the elected president Bolsonaro. The *Plano Safra* 2023/2024 has reached the largest volume of resources in the history of agricultural policy, introducing measures to enhance the socio-environmental aspects of agricultural production and deter illegitimate practices in credit allocation (Harfuch and Lobo, 2024; Brasil, 2024). The latest plan provides the cheapest loans for day-to-day expenses in agroecological based farming or systems shifting to organic methods (Brasil, 2024).

Although there exists no direct national policy on agroforestry, AFS are supported through different policies, across levels and sectors but are predominantly subject to forest legislation. For example, the Brazilian Forest Code considers AFSs as beneficial for society, if practiced by farm-based agriculture or by traditional peoples in small-scale farms, and if the cultivation practice does not compromise the ecological function of the area (Brasil, 2012, Article 3). Under the law, AFSs are listed as a management practice for degraded land restoration, eligible for funding (Forest Code Article 42), accepted to be implemented in the Legal Reserve (Forest Code, Article 66), and incentivized to be implemented in degraded and expropriated land (Brasil, 2013). Moreover, AFSs are listed as a fundable item in the National Program for Strengthening Family Farming under the funding program Pronaf ABC+ Bioeconomia. Under the term "farming-livestock-forest integration" funding is available for restoring degraded pasture (Brasil, 2024, 2022a,b,c). Accordingly, family-based farmers may apply to finance investment projects that aim to implement, utilize and/or recover AFSs. Listed also as a restoration strategy, AFSs have legal basis to be used in the restoration of part of the permanent preservation areas (APP), and in the totality of the legal reserves (RL; Brasil, 2012).

Brazil ranks highest among the four regions assessed in this study with regard to *policy coherence*. 15 states of the country have public policy interfacing with the National Plan for Agroecology and Organic Production (PNAPO; IPEA, 2017). AF is a technique that benefits pollinators and other types of beneficial fauna, according to the National rules for Organic Production Systems. Brazil's legal framework is robust and, in principle, operates synergistically. The connection between policies pertaining to agroforestry lies more in how these policies are put into practice and executed rather than their conceptualization. To exemplify, the PNAPO is directly linked to the National Farming Policy, prioritizing the beneficiaries of the latter for the implementation of agroecological and organic practices. For Agroforestry, the National Low Carbon Agricultural Plan (*Plano ABC*) is at the forefront, having scored the highest among all policies in the country. The *Plano ABC* stands alone nationwide with the link to the UN SDGs, and alongside the National Adaptation Plan to Climate Change 2016 are the two policies with links to Climate Goals and the country's NDC.

With dedicated policies for agroecology and organic production systems, Brazil's policies do seem to have a narrative leaning toward agroecology, unique from the other regions. Of the 10 policies analyzed, seven presented partial or full compliance with the HLPE attributes. Policies advocate for the provisioning of food through agroecological practices among small-holder farmers. The law mandates that a minimum of 30% of the food in school programs must come from

small-scale farmers (Brasil, 2009). Farmers must be registered in the Environmental Rural Registry (CAR) to be able to access any funding lines for agricultural production, which is a topic addressed in half of the policies analyzed in our study. A resilient food system rooted in agroecological practices is both a solution and a counterpoint to the dominant food production system, a major contributor to the country's GEEs and negative externalities (Brasil, 2016).

3.3 What can we learn from the four regions?

Taken together, the results from the four regions offer an interesting snapshot of current policies relating to AFS. It is not possible to compare across regions directly, given the diverse contexts, policies and scope, but it is possible to draw some insight when considering the results as a whole.

3.3.1 Collaboration may lead to greater policy coherence

From the attributes chosen, the two categories of *policy development* and *coherence* score lower than *content* or *goals*, with *goals* seemingly scoring the highest out of the four and *coherence* the lowest (Figure 3). This is perhaps unsurprising given that policies, by their nature, are often trying to achieve specific goals and are frequently developed in sectoral silos, with little cross-ministerial collaboration (Muscat et al., 2021). However, policy coherence is critical if we are to address the negative externalities of the food system (De Schutter et al., 2020) and successfully integrate land and climate issues which have risen in part, due to the siloed ways policies have been developed (Buckwell et al., 2017). There is perhaps a slight trend toward greater policy coherence in the more recent policies (Figure 2), which is encouraging and should be built on. It is not possible to say from the data whether increased cross-ministerial collaboration and the inclusion of farmers, practitioners and food-system experts directly leads to greater policy integration, however for the U.S.A, low scores within *policy development* match with low scores for *coherence*. The results for Brazil on the other hand could highlight how increased cross-ministerial collaboration results in greater coherence, particularly when looking at links to other agricultural and environmental state policies (Figure 2). Brazil was also unique in taking a food systems approach in the development of The National Food Acquisition Program, which addresses affordability, supply chains and human health. Further, Brazil carried out consultations with relevant actors in all the policies assessed. This would be in line with thinking that inclusion of a greater diversity of stakeholders within the policy process results in more effective policies (IPCC, 2019; Parsons and Barling, 2022). In contrast, in the EU, knowledge co-creation across sectors and ministries played no role beyond limited consultation with relevant stakeholders. A surprisingly small number of policies link directly to climate goals or NDCs; some of the more recent policies make direct links, but overall this integration is not explicit. As for diet-related health, most regions do not make the link between AFS and the potential for improved nutrition or health, except the EU, where three of the five policies do include diet-related health objectives.

3.3.2 Policy inconsistencies may hinder AFS uptake

Despite regions scoring higher for *coherence*, inconsistencies and contradictions exist both within and across policies reviewed. For

example, while CAP direct payments (under Pillar 1) follow a per-hectare income support, CAP Rural Development funding (under Pillar 2), is based on the provision of public goods, a direct contradiction. Specifically, for AFS, up until the most recent CAP, there were official guidelines for how many trees could be planted per hectare, which have remained in MS RDP's when defining AF. Therefore, although AF is in theory supported, it is within an environment that creates challenges for entry and experimentation, which makes it harder for the expansion of AFS championed within the Biodiversity and Forestry Strategies, for example. In Brazil, the integrated crop-livestock-forestry systems (ILPF) and agroforestry have been addressed as if they were interchangeable, however, in practice, the integration of trees and agriculture within ILPF systems are mostly separated spatially and temporally, not configuring an AFS (AFS), leading to overestimations. In the US, the 2018 Farm Bill did not address controversial issues related to pesticide use and regulation which have been linked to environmental and public health concerns. While the 2018 Farm Bill included some provisions for climate change and the promotion of soil health and carbon sequestration practices, there was no cohesive approach to address the sector's significant contributions of GHGE. Provisions made within the 2021 Agricultural Resilience Act however, are much more ambitious and robust, including setting specific targets for farmland preservation and reducing agricultural land conversion to development. However, depending on how these goals are implemented, the possibility of this conflicting with the 2018 Farm Bill's provisions for land-use decisions and property rights is high.

These examples of policy inconsistencies confirm the need for better mechanisms to balance trade-offs and competing policy goals in complex, so-called 'wicked problems' (Candel and Biesbroek, 2016; Holt et al., 2016). Only with better ways to reconcile competing objectives and see across multiple policy domains, will we be able to address the whole and see opportunities for co-benefits across policy objectives. More broadly—these inconsistencies might allude to the different and contesting voices, ideas and philosophies often hidden in published policy documents, made evident in Anderson and Maughan's mapping of the HLPE process for agroecology (Anderson and Maughan, 2021), who highlighted how our positionalities and philosophies shape divergent understandings and ultimately, end up in policy, financing, decision making and methods.

3.3.3 Policies for agroforestry lean toward agronomic reading of NbS concept

The majority of policies included in this review lean toward an agronomic understanding of AFS as a NbS, favoring policy goals and subjects linked to environmental objectives such as carbon sequestration, biodiversity preservation and conservation, air and water quality and flood mitigation. Objectives linked to diet, health, access to land and water are less frequently included as a possible co-benefit of AFS. This could be explained in part by the predominant focus in the literature of 'provisioning' ecosystem services AFS offer (Jose and Udawatta, 2021) and the prevailing methods used to measure and assess land use systems, which often favor direct, tangible benefits such as yield, biodiversity, carbon sequestration etc., often leaving out the intangible social co-benefits.

Many of the policies reviewed contain specific and obvious biases toward classic neo-liberal growth strategies and the dominant corporate agri-food sector. Despite the Farm to Fork Strategy stating that "The EU will support the global transition to sustainable agri-food systems, in line with the objectives of this strategy and the SDGs.

Through its external policies, including international cooperation and trade policy, the EU will pursue the development of Green Alliances on sustainable food systems with all its partners in bilateral, regional, and multilateral fora” (page 18), the EU has not shown willing to fundamentally reassess supply-side policies or re-negotiate Free Trade Agreements. Likewise in the USDA’s Food System Transformation Framework (2022), a pledge of up to \$300 million toward an “Organic Transition Initiative to provide comprehensive support for farmers to transition to organic production” is given. Yet, there are limited provisions given toward pesticide regulations. The 2018 Farm Bill did not address controversial issues related to pesticide use and regulation; omitting to include measures to restrict the use of certain pesticides that have been linked to environmental and public health concerns. In the context of Brazil, the decision to implement a fourfold reduction in the budget allocated to Agroecology and Organic Agriculture undermines the ambition set out in the Act (2013). Policies continue to send conflicting signals and appear to tacitly support the status-quo.

3.3.4 Lack of legal obligations may inhibit tangible action

Thirteen of the 34 policies included in this study are legally binding, meaning there is no legal obligation for the mandates in the other 21 policies to be met. Even if metrics and goals are included, governments are not legally bound to implement them. Many of the regional frameworks and strategies by definition are not designed to be legally binding, rather included or implemented by national legislation, as is the case for the EU, reflected in only one legally binding policy instrument (CAP). Given the studied countries and their combination of both federal and state (or member state for the EU) policies, it could be interesting to compare these findings with smaller countries with just national policies to see what extent they were legally binding or not.

3.3.5 People and practitioners are absent within policy

For the most part, the EU, and the U.S.A, the two ‘higher income’ regions included in this review do not include the framework of intersectionality in their policies (The U.S.A Farm Bill scores 0.5, all others 0). Taking an intersectional approach to policymaking and policy analysis requires identifying, understanding, and addressing the structural inequalities in a given context that account for these different lived experiences and inequalities (Munro et al., 2014; Mitra and Rao, 2019; Runnymede, 2017). This omission of intersectionality within the policy arena is unsurprising but noteworthy. Brazil and India, which both score higher on in terms of wealth inequalities, both have four policies that include intersectionality. This could be perhaps due to a greater recognition of the diverse countries’ demographics, including a stronger recognition of indigenous and traditional peoples and cultures. Other lowest scoring attributes include farm succession, support for new entrants and, surprisingly, links to the UN SDGs.

3.3.6 Current framing of agroforestry systems misses its transformational potential, far from radical roots of agroecology

All the attributes chosen can add up to give a ‘picture’ of how policies relating to agroforestry are being framed and the transformability of AFS as a NbS in its current conceptualization within policy. Seemingly, the policies reviewed within Brazil and the EU score higher across the four attribute categories than the US or

India (Figure 1). Given that both the EU and Brazil have in part come out in direct support for food system change and more specifically, agroecology, this is perhaps to be expected. While Brazil is the only region reviewed with a specific and direct policy for agroecology: The National Agroecology and Organic Agriculture Policy (2013), the EU has supported agroecology as a tool within other policies (i.e., the goal in the Green Deal for uptake of agroecology and as one tool out of the many offered within the CAP eco-schemes). It must be noted however, that policies included for both the EU and Brazil are overall, more recent than for the US or India. For the EU in particular, policies are from 2014 onwards, when arguably, government priorities around many of the issues included in the *policy goals* and *subject* attributes, can be said to be higher than in for example, the late 60s in the U.S.A (National Environmental Policy Act 1969). None of the EU policies make direct claims to an agroecological transition, although two of the EU policies (CAP 2014–2020 and Biodiversity Strategy 2020) are partially linked to an agroecological transition since they financially support agroecology in their legislation or include specific targets and policy goals to increase agroecology. Brazil is the region with the highest score for this attribute, with four policies committing to this as an ambition. In fact, Brazil stands alone in having a specific Agroecology and Organic Farming Policy (2013). Further, one of the purposes of the National Food Acquisition program (2021) is to “promote and produce organic and agroecological food.” Similarly, the National Low Carbon Agricultural Plan (Plano ABC) indicates the alignment between the latter with other credit lines of the Plano Safra; observing purposes, financeable items and interest rates practiced, specifically mentioning agroecology. Except for Brazil, this lack of explicit commitment to agroecology and low representation of its principles within the policies reviewed is perhaps unsurprising, given the majority of democracies included are proponents of conventional agriculture, who seemingly doubt the viability of agroecology (Bellwood-Howard and Ripoll, 2020).

3.4 Study limitations

The study faces several limitations that require acknowledgment and should be considered if the policy analysis framework is to be repeated for other regions or NbS. The authors recognize the selection of policies included is subjective and admit possible omissions due to the challenges of navigating complex and disparate government websites, as well as incomplete information on FAOLEX. The EU policies reviewed were notably more recent and fewer in number, potentially skewing the comparative analysis. The novel policy analysis framework developed in this review focusses on *positive* attributes for sustainable food system change and just transition pathways. The authors did not look for those attributes that might act as counterweights to this end goal, which could be developed in a future framework. Finally, the authors recognize their geographic locations and positionalities based in Europe and Brazil, with India and the U.S.A. being more ‘unknowns’.

4 Conclusion and recommendations

This paper set out to review agroforestry policy and policies related to agroforestry in four ‘continental’ regions, in an attempt to

give an overview of what policies have been developed for AFS and with what narratives and objectives. The framework constructed in this study proved to be insightful and can be replicated to other regions, countries or indeed other NbS. The thematic categories of policy *development*, *content*, *goals* and *coherence* highlighted: the on-going gap between land and climate policies; the apparent improvement of coherence when more stakeholders are involved; and the normative leaning of AFS to address just agronomic issues without considering broader, interconnected issues such as diet related health.

Our analysis shows that despite mounting evidence for the severity of the climate crisis and its impact on food and agriculture, policy is lagging, with inconsistencies and contradictions making scaling back the negative externalities of agriculture and scaling up promising approaches, such as AFS, increasingly difficult. The link between agriculture and climate (both in terms of its impacts to and fragility in the face of), is not sufficiently reflected in recent policies within this review. The policies do not question the basis of the conventional agri-food system and for the most part, are based on growth strategies and neo-liberal trade policies. The development of agroforestry policy, despite having decades worth of supportive evidence is lagging, with minimal care given to financial incentives, knowledge, or training. Land tenure and access rights remain unaddressed across most policies, despite this being a well-documented barrier to scaling of AFS globally. Across the regions reviewed, policies for agroforestry are increasing gradually, but appear to be confined to an agronomic understanding of the practice. The focus is primarily on the provisioning of ecosystem services these systems can offer, as opposed to seeing it as a tool for food system change or linking with other policy objectives around health and improved livelihoods.

Improving policy coherence is critical as we seek to address the multiple, interconnected crises of climate change, biodiversity loss and inequality. Assessing the degree to which key policies for agroforestry and agriculture are aligned with national and international targets, such as the UN SDGs or NDCs, revealed how few policies consider multiple aims across policy domains. The EU policies tend toward greater coherence, perhaps given their specific relevance to the subject and more recent development. Seemingly, there is a big opportunity for AFS, and agriculture more broadly, to be firmly integrated into key targets around biodiversity loss, carbon emissions and diet related health.

Proponents and practitioners of AFS must focus on the practical translation of practice into policies, while policy and decision makers need to embed AFS within a diverse set of policy domains. We recommend: greater coordination of policy instruments to achieve co-benefits; focused integration of agricultural and climate policies; greater inclusion of diverse stakeholders in policy development; and a widening of AFS objectives both in policy and practice.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

RV: Conceptualization, Data curation, Formal analysis, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. F-EM-d-O: Conceptualization, Data curation, Formal analysis, Methodology, Software, Writing – original draft, Writing – review & editing. JB-D: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. JE: Software, Visualization, Writing – review & editing. SR: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2024.1417740/full#supplementary-material>

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Appendix 1

Principle	FAO's 10 elements	Scale application*	Category
Improve resource efficiency			
1. Recycling. Preferentially use local renewable resources and close as far as possible resource cycles of nutrients and biomass.	Recycling	FI, FA	Environmental
2. Input reduction. Reduce or eliminate dependency on purchased inputs and increase self-sufficiency	Efficiency	FA, FO	Environmental
Strengthen resilience			
3. Soil health. Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and enhancing soil biological activity.		FI	Environmental
4. Animal health. Ensure animal health and welfare.		FI, FA	Environmental
5. Biodiversity. Maintain and enhance diversity of species, functional diversity and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm and landscape scales.	Part of diversity	FI, FA	Environmental
6. Synergy. Enhance positive ecological interaction, synergy, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil and water).	Synergy	FI, FA	Environmental
7. Economic diversification. Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value addition opportunities while enabling them to respond to demand from consumers.	Part of diversity	FA, FO	Economic
Secure social equity/responsibility			
8. Co-creation of knowledge. Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange.	Co-creation and sharing of knowledge	FA, FO	Social
9. Social values and diets. Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.	Parts of human and social values and culture and food traditions	FA, FO	Social
10. Fairness. Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.		FA, FO	Economic
11. Connectivity. Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks and by re-embedding food systems into local economies.	Circular and solidarity economy	FA	Economic
12. Land and natural resource governance. Strengthen institutional arrangements to improve, including the recognition and support of family farmers, smallholders and peasant food producers as sustainable managers of natural and genetic resources.	Responsible governance	FA, FO	Political
13. Participation. Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.		FO	Political

*Scale application: FI, field; FA, farm, agroecosystem; FO, food system. Source: derived from [High Level Panel of Experts \(2019\)](#).