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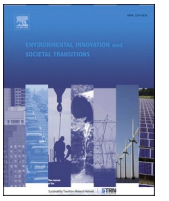

Transformative policy mix or policy pandemonium? Insights from the Climate Smart Agriculture policy mix in Costa Rica

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ABSTRACT

Transformative innovation policies are gaining currency worldwide, but have been mainly studied in a Global North context and in the energy sector. This paper focuses empirically on Costa Rica's Climate Smart Agriculture policy mix. It addresses key knowledge gaps on the dynamics of transformative policy development in the agrifood sector in a Global South policy context. Results show Costa Rica's policy mix's transformative potential was inhibited by weak implementation capacity and internal and external incoherence between sectors and governance levels, leading to tensions resulting from policy-element interactions such as conflicting goals and interventions with overlapping purposes. The broader implication for theory and practice is that successful transformative policy mixes require close scrutiny of both the balance of the mix and how to fundamentally transform the mix. This includes paying more attention to the phasing out of legacy policy instruments and to how countries' particular institutional contexts and policy cultures influence transformative policymaking and implementation.

1. Introduction

Current agricultural production systems threaten biodiversity, soil, and water, as the intensive use of inputs has significant negative effects on the environment and society (FAO et al., 2020). Thus, societal actors and governments are pushing for a change in dominant agriculture production systems, and several alternative farming systems concepts have emerged, such as agroecology and nature-inclusive farming (Schiller et al., 2020; Vermunt et al., 2020), organic farming (Shreck et al., 2006), sustainable and ecological intensification (Schut et al., 2016; Tittonell, 2014), and Climate Smart Agriculture (CSA)(Lipper et al., 2014). These alternative farming systems concepts encompass a wide range of technological and non-technological innovations that require considerable changes in local and national governance, legislation, policies, and institutional support (FAO, 2013; Klerkx and Begemann, 2020;

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Steenwerth et al., 2014).

Fostering sustainability transitions in agrifood systems is hence key (Hebinck et al., 2021) and in this paper we focus on CSA, which was proposed by FAO (2010) as an approach to transform agricultural systems by promoting more sustainable agricultural development and addressing the challenges of climate change. CSA covers a wide range of areas[1]: policy frameworks, finance interventions, practices and technologies (Steward, 2012). Some of these practices range from novel technologies, such as using mobile agro-advisory apps and climate-related information (Beza et al., 2018; Westermann et al., 2018), to longstanding practices, such as agroforestry or soil conservation (Sidibé, 2005; Wauters and Mathijs, 2006). Some technologies focus on plot or farm level, whereas others contribute to broader system transformations, e.g., landscape reconfigurations (Chicas et al., 2023; Dunnett et al., 2018; Harvey et al., 2014; Wallbott et al., 2019). Beyond being a combination of technologies and practices, the CSA approach can be considered to contain elements of transformative policy (Barton et al., 2017; Castro et al., 2000; Rosendaal et al., 2021), as not only is it focused on supporting the development and adoption of innovative CSA technologies, but also aims to mainstream sustainable and climate-change-resilient agriculture in national development strategies and plans (Scherer and Verburg, 2017; Steenwerth et al., 2014).[2]

The transformative policy idea was recently introduced, going under different terms and with different emphasis. Enacting transformative policy consists of formulating balanced policy mixes (Rogge et al., 2020; Schot and Steinmueller, 2018), which are complex arrangements with multiple goals and instruments that, in many cases, have developed incrementally over many years (Kern and Howlett, 2009, p. 395). Since the work of Rogge and Reichardt (2016) offers detailed pointers to analyze building blocks of the policy mix, we draw on it as basis for our analysis, complementing it with elements from later work on transformative policy (Rogge et al., 2020; Schot and Steinmueller, 2018). The policy mix includes three building blocks: i) the policy elements containing a policy strategy and an instrument mix, ii) the policy processes, and iii) the policy mix's characteristics (Rogge and Reichardt, 2016, p. 1623). This article aims to unravel the developments and dynamics of implementing CSA as part of a (potentially) transformative policy mix for the agricultural sector in Costa Rica.

Transformative policy and policy mixes have been examined from various angles. Studies have, for example, addressed a particular policy element such as policy instrument mixes, policy strategy and characteristics (del Río, 2009; Imbert et al., 2017; Kern et al., 2017; Rogge and Dütschke, 2018). What these previous empirical studies have in common is that they highlight the importance of context, dynamism, and temporality in analyses of policy mixes. The dynamism of interactions between new and old policy instruments and goals may lead to synergies, trade-offs, or tensions (Flanagan et al., 2011) which in some cases may reinforce existing systems rather than promote transformation (Diercks et al., 2019). Hence, how the policy goals and the instruments are combined (or not) in a consistent, coherent fashion is germane to the potential of a policy mix to meet targeted outcomes (Huttunen et al., 2014; Kern and Howlett, 2009), which thus may enable or constrain the desired transformative change.

Despite the emerging literature on transformative policy mixes, more empirical insights are needed on the evolution and dynamics of the implementation of transformative policy in interaction with the evolving and geographically embedded policy context, as work so far has focused on a limited number of sectors and countries. However, how transformative policy mixes have come about in an agricultural context has not been widely explored in a Global South (Hebinck et al., 2021; Köhler et al., 2019). In particular, Ghosh et al. (2021b) argue that the Global South context needs to be understood better in the study of transformative policy mixes, as policy elements play out in contexts where limited public financial support resources, a large influence of informal institutions, and wealth inequality represent significant barriers to enabling sociotechnical change (Chaminade and Padilla-Pérez, 2017). Furthermore, in addition to national governments, transnational actors such as donors, multinational companies, and foreign investors often play a significant role in shaping transitions (Hansen et al., 2018).

To contribute to filling these knowledge gaps, we focus on two building blocks of policy mixes: i) the policy mix elements (strategy and policy instruments, see Section 2.2.) and ii) characteristics focusing on coherence, consistency. We ask three questions: i) how have the CSA policy mix elements evolved over time?; ii) how do directionality, consistency, and coherence characterize the policy mix over time?; and iii) how does the Costa Rican context influence CSA policy mix dynamics?

The Costa Rica case study offers a setting where agricultural, environmental, and innovation policies are in place, aiming at climate change mitigation, adaptation, biodiversity conservation, and sustainable development (Araya, 2016). Important policy developments in climate action as the pledge to achieve carbon neutrality in 2050, economic incentives for payment for environmental services, and regulatory instruments on sustainable land use (e.g., reforestation and agroforestry) (Wallbott et al., 2019), in balance with the improvement of social indicators (poverty, inequality), set the enabling conditions for CSA development (Fanning et al., 2022). The Costa Rican government has enacted an integrated approach in which mitigation measures encourage adaptation and sustainable development objectives that are aligned with the country's landscape-based approach to adaptation (OECD, 2017; Rosendaal et al.,

[1] CSA interventions cover areas, such as soil and water management, carbon finance, and incentives for low-carbon agriculture (FAO, 2010). This efforts span from technology developments, climate-change models and scenarios, insurance schemes, to policy support (Gardezi et al., 2022; Khatri-Chhetri et al., 2019). CSA policies includes demand-side instruments (e.g., research and development programs on new seeds or developing early warning apps, or providing agricultural extension services) but also promoting supply-side policies which requires coordination across environmental, health and agricultural policies (Scherer & Verburg, 2017).

[2] Despite its transformative ambition, CSA is not without contestation. It is criticized, first, for its lack of clarity and consensus regarding its definition and measurement, which makes its adoption and use controversial (Neufeldt et al., 2013; Newell and Taylor, 2018; Taylor, 2018); and, second, for often being introduced as a top-down approach that, without proper local stakeholder involvement, could result in the imposition of practices not aligned with the local culture (Cavanagh et al., 2017), thereby reinforcing power dynamics and inequalities in agricultural systems.

2021). The agricultural–environmental policy domains' interrelation provides suitable conditions and necessary elements to analyze the transformative policy setting aimed at supporting the transition toward CSA.

The remainder of the paper is structured as follows. Section 2 presents a review of the literature on transformative policy mixes which feeds into our analytical framework; Section 3 introduces the research methodology; in Section 4, we present the Costa Rican context as a case study; Section 5 provides the empirical findings from the operationalization of the CSA transformative policy mix. Section 6 presents the discussion followed by the conclusion in Section 7.

2. Transformative policy mixes

The transformative policy idea includes concepts such as policy mixes for sustainability transitions (Rogge and Reichardt, 2016), mission-oriented innovation policy (Mazzucato, 2018), system-wide transformation (Grillitsch et al., 2019), and transformative change policies (Diercks et al., 2019; Schot and Steinmueller, 2018) and recently transformative policy mixes (Rogge et al., 2020). Despite the differences in terms, conceptual basis, and operational characteristics, a review by Haddad et al. (2022) indicated that these policy approaches share multiple characteristics, and all have a transformative goal (see Haddad et al., 2022, for details on similarities and differences in approaches). Transformative policy represents an emerging approach to science, technology, and innovation in response to social and environmental challenges (Schot and Steinmueller, 2018). Diercks et al., 886), conceptualize transformative policy as a "broader understanding of the innovation process and its relevant actors, activities, and modes of innovation." Schot and Steinmuellerś (2018) broad term, reflects on the need to align innovation objectives with tackling social and environmental challenges such as poverty, climate change, and resource degradation. For addressing transformative change, Weber & Rohracher (2012) argue that market and system failures are insufficient to tackle sustainable development, climate change, and social challenges. They propose four additional types of failures for policy intervention: i) policy coordination, ii) directionality, iii) demand articulation, and iv) reflexivity. Scholars have further developed these transformative failures and framed them as addressing challenges to system transition (Grillitsch et al., 2019).

Given the limitation of a single instrument to address transformative failures or challenges, it is recognized that there is a need to design policy mixes promoting transformative change (Chataway et al., 2017; Kivimaa and Rogge, 2022; Rogge et al., 2020). Policy mixes have served as an analytical and policy design framework in sustainability transitions studies, offering a holistic perspective to examine the intricate interplay among objectives, policy tools, the policymaking process, and technological change (Kern et al., 2019). This broader conceptualization aligns with prior conceptualization in environmental studies (del Río, 2010, 2009), innovation studies (Borrás and Edquist, 2013; Flanagan et al., 2011; Rosenow et al., 2017), and policy sciences (Rayner and Howlett, 2009), emphasizing the need to combine policy instruments to stimulate sociotechnical change. While one strand of research has focused on studying the characteristics, strategies, and interactions between policy instruments (Bach and Hansen, 2023; Nemet et al., 2017; Reichardt and Rogge, 2016; Rogge and Schleich, 2018), others have placed more emphasis on policy processes, highlighting the roles played by multiple actors and stakeholders (Edmondson et al., 2019; Gomel and Rogge, 2020; Haelg et al., 2020; Markard et al., 2016; Reichardt et al., 2017). This includes several actors at various levels (local, regional, national), companies, organizations, and individuals whose roles and interactions are key for effective policy formulation and implementation. These studies have focused particularly on the field of energy, with applications to mainly European cases, with some contributions from China (Chang et al., 2019; Li and Taeihagh, 2020) and lately from Latin America (Castrejon-Campos et al., 2020; Garcia Hernández et al., 2021; Gomel and Rogge, 2020; Kanda et al., 2022) with case studies from Argentina, Mexico, and Brazil.

This article mostly aligns with the former strand of research, and to inform our analytical approach on transformative policy mixes based on the transformative policy rationale in this section we first review key features of transformative policies as they emerge from

Table 1
Policy mix characteristics and conceptualization.

Characteristic	*Category*	*Explanation*
Coherence	Internal	Alignment and interactions between the policy goals and policy instruments in a single policy domain (e.g., increase the agricultural sector's competitiveness goal in relation to the goal of strengthening domestic market conditions)
		In each policy domain (agriculture and environment), regional and international guidelines are translated into concrete measures at national and local level
	External	Interactions across multiple policy domains: sectorial goals, policies, and instruments have mutually supporting/counterproductive efforts across the two policy domains (e.g., carbon neutrality goal in relation to agricultural nationally appropriate mitigation actions program)
	Temporal dimension	The interplay between policy domains' goals and instruments over time (e.g., changes in regulations over time, uncertainty, availability of resources)
Consistency	Strategy and Instrument	Overall policy mix consistency is characterized by the ability of the policy strategy and the instrument mix to work together in a unidirectional or mutually supportive fashion
	Instrument interaction: strong consistency	Strong instrument mix consistency (reinforcing rather than undermining each other in the pursuit of policy objectives) is associated with positive interactions
	Instrument interaction: weak consistency	Neutral interactions characterize weak instrument mix consistency, and the impact of the combination is lower than if the instruments are used separately
	Instrument interaction: inconsistent	A negative interaction captures inconsistency (instruments undermining each other)

Source: Based on Del Río (2014); Huttunen et al. (2014); OECD (2019); Rogge and Reichardt (2016).

the literature. As indicated in the introduction, we principally build on Rogge and Reichardt's (2016) extended concept of the policy mix for sustainability transitions developed to analyze the link between policy and technological change and apply two building blocks: i) the policy elements (instrument mix and policy strategy) and ii) the policy mix's characteristics (consistency and coherence). Although, empirical research has been undertaken on policy mixes for energy transitions, less attention has been paid to transformative policy mixes in other sectors, with a few exceptions such as bioeconomy and mobility (Grillitsch et al., 2019; Kivimaa and Rogge, 2022; Scordato et al., 2021) and one study focused on the agricultural sector (Frank and Schanz, 2022). This is coupled with insights from transitions literature (e.g., Huttunen et al., 2014; Kivimaa and Kern, 2016; Lindberg et al., 2018; Nilsson et al., 2012) and transformative policy literature (e.g., Diercks et al., 2019; Grillitsch et al., 2019; Schot and Steinmueller, 2018; Weber and Rohracher, 2012) to highlight the importance of the policy context, directionality and coordination. This review of theory in Sections 2.1 to Section 2.4 leads to our analytical framework (see Section 2.5 and Fig. 1).

2.1. Balanced policy mixes for both niche support and regime destabilization

The policy elements include the policy strategy and instrument mix. Regarding the former, Rogge and Reichardt (2016, p. 1623) define "policy strategy as a combination of policy objectives and the principal plans for achieving them". The strategy is related to directionality, which refers to the direction, orientation, guiding design, and policy intervention implementation toward the desired change (Weber and Rohracher, 2012). In the literature on transformative policies, it is argued that innovation should not be pursued only for the sake of economic growth, but also should address critical societal challenges (Bergek et al., 2023; Diercks, 2019; Grillitsch et al., 2019). Building on eco-innovation, Miedzinski and McDowall (2019) suggested that directionality can be introduced to the policy mix concept by identifying major challenges in policy visions, setting specific policy goals and targets, and translating those goals into criteria guiding policy implementation. Thus, besides identifying the challenges, aligning the policy goals with plans and guidelines may help to steer directionality for the transition process (Rogge and Reichardt, 2016). Policy goals and plans can include long-term targets with quantified levels. Moreover, framework conferences, directives, and national action plans are examples of plans that detail the intended government direction to achieve the objectives (Rogge and Reichardt, 2016). Although strategy documents are a snapshot of a larger strategic phase, they usually identify a group of governmental actors responsible for strategy development and implementation. Directionality is often contested, as there are generally multiple possible transition pathways (Klerkx and Begemann, 2020), hence policy strategies are inherently political and the management of related trade-offs is a critical policy challenge (Imbert et al., 2017; Ladu et al., 2020; Quitzow, 2015).

Concerning the latter component of the policy elements, the instrument mix contains multiple instruments to achieve the stated policy strategy (Li and Taeihagh, 2020). Policy instruments are also known as policy tools and are defined as "techniques of governance which, one way or another, involve the utilization of state resources, or their conscious limitation, in order to achieve policy goals" (Howlett and Rayner, 2007, p. 2). Rogge and Reichardt's (2016) proposed typology categorizes instruments based on type (economic, regulation and information) and primary purpose (technology push, demand pull and systemic). Others scholars such as Borrás and Edquist (2013), Smits and Kuhlmann (2004), Wieczorek and Hekkert (2012), have broader categorizations on instrumnents as follows: i) economic and financial instruments, ii) soft instruments such as standards and codes of conduct, iii) regulatory instruments such as laws, and iv) systemic instruments such as intermediation (see Appendix A, Table A1 for a detail description).

Policy instruments promoting and supporting experimentation in green niches are key to transformative policy (Schot and Steinmueller, 2018). However, it is increasingly recognized that policies should focus not only on fostering niche creation, but also on destabilizing the current regime configuration (Kivimaa and Kern, 2016; Rosenbloom and Rinscheid, 2020; van Oers et al., 2021). In the agrifood literature, conventional agrifood systems based on industrial agriculture are often denoted as food regimes (McMichael, 2009), and, as Gaitán-Cremaschi et al. (2019) indicated, this concept shows a broad resemblance to the sociotechnical regime concept as used in transition studies (though food regime is more focused on political economy aspects). Given the above, policy mixes enabling transformative change should include both instruments supporting sustainable niche innovations and instruments aimed at destabilizing the regime.

Instruments targeting niche innovations can potentially address knowledge creation (e.g., innovation platforms), contribute to market formation (e.g., regulations and taxes), and promote entrepreneurial experimentation (e.g., seed capital), among other things (Kivimaa and Kern, 2016). Experimentation means trying out new technologies and associated practices, focusing on learning about the possibilities for overcoming structures that inhibit the diffusion of technologies and practices (Grillitsch et al., 2019). Instruments and deliberate strategies aimed at regime destabilization open windows of opportunity to upscale niche innovations (Rosenbloom and Rinscheid, 2020). Instruments toward such destabilization include policies to pressure regimes, destabilize regime rules, reduce support, and change social networks (e.g., pollution taxes, restricting technologies, laws reforms, removing subsidies, including niche actors in policy offices) (Kivimaa and Kern, 2016). Regarding policy strategies, van Oers et al. (2021) explored the concept of deliberate destabilization as a political strategy (e.g., interests and motivations of policy strategies) and showed the contested nature of the destabilization process and the regime actors' vested interest in continuing business as usual.

2.2. Policy mix characteristics: coherence and consistency

To portray the policy mix descriptions, Rogge and Reichardt (2016) identified four characteristics: consistency, coherence, comprehensiveness, and credibility. Although characteristics such as credibility and comprehensiveness are recognized in the literature as describing the reliability of the policy mix and determining the extent to which different rationales for policy intervention are implemented (Bach and Hansen, 2023; Nemet et al., 2017; Rogge and Schleich, 2018; Rosenow et al., 2017), the inclusion of credibility

and comprehensiveness was outside the scope of our study. Our paper therefore focuses on consistency and coherence. By analyzing consistency we capture tensions and synergies between strategic objectives and policy instruments, while coherence allows us to analyze interactions both within and across policy domains (see Table 1). Both factors are pertinent in signaling the overall performance of the policy mix, offering a nuanced understanding of the interactions and alignment (or lack thereof) between the instruments with emerging transformative objectives.

There is no agreement on the exact meaning of coherence, as it is highly interrelated with policy interaction and integration (Rogge and Reichardt, 2016). To describe tensions and synergies better, the definition of coherence provided by Nilsson et al. (2012, p. 396): "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". Ideally, different sectors' policies and objectives are expected to work synergically to push the desired societal change. However, policies in one sector may trigger conflicts with policy objectives and implemented instruments in another sector (Huttunen et al., 2014). According to Nilsson et al. (2012), policy coherence may be examined both internally (focusing on a single policy domain) and externally (across multiple policy domains). Policy coherence can also incorporate a vertical dimension (across different spatial governance scales) and a horizontal dimension (between policy domains at the same governance level). We focus on horizontal coherence i) internally, ii) externally, iii) temporally.

Accordingly, policy mix consistency involves two main interactions: 1) consistency of the instrument and objectives, ii) consistency between instruments. To define the first one, Howlett and Rayner's (2013) relates consistency with the capacity of the policy strategy and the instrument mix to operate in a mutually supportive course. Regarding consistency of the policy instruments, del Río's (2014, 2009) conceptualizes instrument mix consistency as strong, weak, and inconsistent.

2.3. *Influence of historical and institutional context on policy mixes*

Real-world policy contexts encompass diverse policy instruments based on various rationales addressing market, system, and transformational failures (Weber and Rohracher, 2012). Over time, the inclusion of transformative elements within an existing policy mix generates a variety of dynamics in terms of how policy is designed and implemented and how new policies relate to existing policies (Diercks et al., 2019). This connects to both historical and place-related institutional influences that shape public policy formulation and enactment. Policy mixes are thus contextual, as policy frameworks and regulations are shaped by institutional dynamics, technical innovations, and cultures (Diercks, 2019; Kivimaa and Kern, 2016).

Similar to ideas in transition studies that system change can be seen as a change in institutional settings or logics (Elzen et al., 2012; Fuenfschilling and Truffer, 2016; Geels, 2020), policy design studies (Capano, 2019; Howlett and Rayner, 2013; Van Der Heijden, 2011) have drawn on institutional change mechanisms (Béland, 2007; Streeck and Thelen, 2005) to understand the dynamics of the evolution of policy mix elements and goals over time. Given such institutional change analysis, Howlett and Rayner (2013) argued that policy developments are built through incremental or reformulation processes of layering, drifting, conversion, and replacement. Policy layering involves adding elements to the existing arrangements (Capano, 2019) and is the process whereby new goals and instruments are added to old ones without discarding the previous ones. Drifting means replacing an old goal with a new one while keeping the same instruments in place (Howlett and Rayner, 2013). Conversion involves putting in place new instrument mixes while keeping the original objectives constant. Finally, a policy replacement occurs when new policies are consciously created or fundamentally restructured by replacing previous goals and instruments (Rayner and Howlett, 2009, p. 103). In the transformative policy context, Diercks et al. (2019) and Kern et al. (2017) have shown that policy developments recognize that transformative policy paradigms are rarely entirely new but built on legacies and are layered upon previous policy rationales, and Molas-Gallart et al. (2021) found that transformative policy developed through drifting and conversion processes.

Place- and sector-based aspects of transformative policy formulation and enactment should also be considered. Multiple actors and networks play an essential role in promoting transformative change (Grillitsch et al., 2019; Rogge et al., 2020), and how they co-shape and are affected by policies may differ from place to place (e.g., Global North vs. Global South) and sector to sector (e.g., agrifood vs. health), given the structures and power relations that shape political and economic systems and sectors (Coenen et al., 2012; Conti et al., 2021). The development and implementation of innovation policy goals and instruments is shaped by policy cultures (Pfotenhauer and Jasanoff, 2017) and past approaches to innovation policy (Doezema et al., 2019). Furthermore, the institutional settings in innovation systems (defined as rules, norms, incentives that shape individuals' and organizations' behavior in innovation, such as funding structures, inclination to collaborate) differ from country to country (Klerkx et al., 2017). In the context of transitions in the Global South, beyond the influence of national policy and economic contexts, scholars have pointed to the role of intergovernmental organizations, transnational cooperation agencies performing and fulfilling some of the functions of the weaker state apparatus (Sixt et al., 2018). Weaker and less effective government administrations result in unstable regimes and often pose major constraints to niche developments (Hansen et al., 2018). Moreover, the relation between the state and the private sector is contested since investments sometimes can be ineffectively shifted, thus reinforcing incumbents' positions (Garcia Hernández et al., 2021)(e.g., powerful companies with strong political links benefit from unsustainable practices and reproduce structures of social exclusion). Hence the role of the public-private in promoting new forms of engagement needed to address social pressures has been recognized by transition scholars (Chataway et al., 2017; Ghosh et al., 2021a; Ramos-Mejía et al., 2018).

2.4. *Policy coordination*

In view of the challenges in achieving policy coherence and consistency and the need to navigate complex policy contexts, coordination across actor groups, sectors, and policy domains is crucial for promoting sociotechnical systems change (Weber and

Rohracher, 2012). Therefore, transformative policy mixes need to include instruments to improve policy coherence between public policies, but also from the private sector, as well as mechanisms to promote vertical coordination between governance levels (Ghosh et al., 2021a). Thus, policy coordination is essential to integrate the frequently conflicting economic, social, and environmental objectives, maximize synergies, and minimize trade-offs in the policymaking process. Adding new instruments and goals to an existing one through a layering process may lead to coherent or incoherent policy mixes (Howlett and Rayner, 2013; OECD, 2019). For example coherent policy mixes, new elements enhance overall goals, while in incoherent mixes, added elements may conflict, emphasizing the need for careful layering to ensure effectiveness (Kivimaa and Virkamäki, 2014). Horizontal and vertical coordination becomes challenging when policies are horizontally interrelated (e.g., health, environment, and agricultural), coordination across ministries and agencies is insufficient, and efficient coordination mechanisms are missing (Carbone, 2008). Thus policy coordination tools can unravel the ongoing efforts to achieve policy coherence for implementing the desired policy changes (e.g. CSA innovations). This is crucial in navigating the complexities of the cross-sectorial policies in place and the relevance of coordination for transformative policy mixes. Thus, coordination and integration are policy mechanisms to avoid policy incoherence (Candel and Biesbroek, 2016; Reichardt et al., 2016).

2.5. *Analytical framework*

Taking the insights from theory as outlined in Sections 2.1 to 2.4 together, Fig. 1 shows our analytical framework which informs the analysis.

3. Methodology

3.1. *Policy mix: scope, dimensions, and boundaries*

We followed a top-down approach to delineate Costa Rica's CSA policy mix to set the mix's boundaries, scope, and dimensions; this implies that a policy mix has an overarching strategy implemented through a set of instruments (Ossenbrink et al., 2019) and described by a set of characteristics. The third building block – underlying policy process– was outside the scope of this paper, as we the study did not allow for in-depth and full historical reconstruction of all deliberations, decisions, and events and their causal relationships and processes of politics and power. A 2000–2022 timeframe was chosen because we wanted to explore the enabling policy framework for CSA transition before and after the CSA initiative was promoted globally by the Food and Agriculture Organization (FAO) in 2010 and because the accessibility to historical archives ensured the robustness of the data collected. Regarding the vertical and horizontal dimensions, the CSA policy mix analysis considers multilevel governance: global, Central American, and national, as it operates at different levels and involves several policy domains. Mainly the agricultural sector is responsible for promoting CSA, and its implementation is interrelated with climate action and environmental policies (as it is also about adaptation and mitigation). The main features of the policy strategy include tackling climate change, sustainable development, and increasing on-farm productivity levels (e.g., with green technologies). We included global frameworks and agreements, national strategies, targets, directives, and national

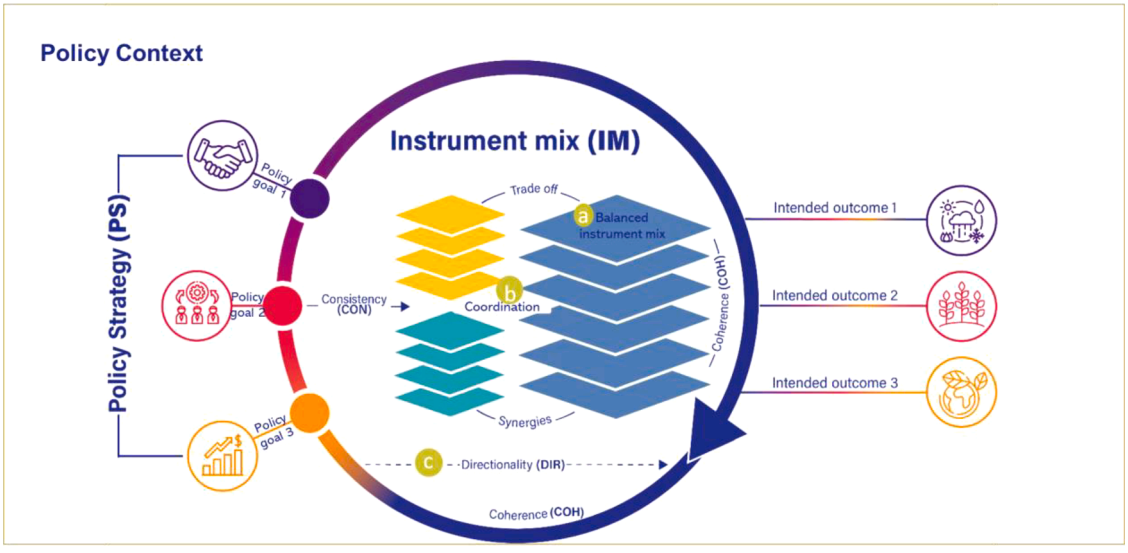

Fig. 1. Analytical framework of the policy mix and three transformative features: a) instruments targeting niche creation and regime destabilization, b) policy coordination tools, c) addressing directionality.
Source: Extended from Rogge and Reichardt (2016, p. 1630) using Schot and Steinmueller (2018) and Weber and Rohracher (2012).

development plans in effect in 2022, and the relevant policy instruments are laws, regulations, decrees, R&D support, and voluntary standards.

3.2. Data collection

We chose a qualitative research design involving a single case (Yin, 2018) to analyze the potential transformative features of the CSA policy mix. We used two types of information: policy documents and interviews. First, we collected archival data for 2000–2022 and retrieved relevant policy documents (e.g., strategies and plans, laws, decrees), newspapers, and reports with program/initiative information describing what the country and the region were doing to promote CSA. The documents were included if they related to CSA and contained at least two of CSA's three fundamental pillars: adaptation policy, mitigation policy, or productivity/competitiveness-related policies. The inclusion of food security and sustainability keywords was also considered based on the FAO (2013) definition. For this delimitation, we also reviewed CSA-related literature to define inclusion/exclusion criteria for the documents. A total of 214 relevant policy documents were reviewed (see Appendix A, Table A2).

The document analysis was complemented with 21 in-depth online interviews. The interviews were conducted between December 2020 and April 2021 with various actor groups (policymakers, academia, technicians, and experts). The participants were chosen based on their role in the formulation/implementation of climate change/agriculture policy (see Appendix A, Table A3). Further participants were chosen through a snowball sampling logic, where previous interviewees suggested whom to interview next. The number of interviews was determined by the saturation point of the responses but ensured that different perspectives were represented. The interviews were conducted using a semi-structured interview guide based on the analytical framework. Interviews lasted between 45 and 120 minutes, were conducted in Spanish, transcribed verbatim, and sent to the interviewees for validation and approval. Many respondents availed of the opportunity to provide additional remarks.

3.3. Data analysis

The 214 retrieved documents and strategies were included in an Excel database and classified using the following categories: ID, title, aim, initial date, end date, policy mix building blocks (according to Fig. 1), type of document (e.g., framework, strategy, policy, plan), description, governance level (e.g., international, national), policy domain, CSA component addressed (adaption, mitigation, productivity), type of instrument (economic, soft, regulatory, systemic), purpose (niche promotion or regime destabilization), transformative features (directionality, coordination, governance arrangements), and general comments. Using this Excel database, we illustrated the instruments and the strategies by means of a timeline to visualize the historical evolution of the policy mix.

These interviews were beneficial in validating the timeline and instrument mix, but also key for describing the policy mix characteristics (Table 1), offering interpretation of the policy changes and policy developments regarding the transformative features of the mix. Deductive coding of the interviews using Atlas.ti 22 allowed us to conduct a thematic analysis in which we focused not only on the characteristics of the policy mix, but also on the main challenges, agreements, and disagreements between actors. Identifying elements of the policymaking processes in our specific context made an important contribution to explaining the policies' continuity or lack of continuity in mix, styles, tensions, problems, and cultures (Edmondson et al., 2019; Kivimaa and Virkamäki, 2014). This process involved multiple queries between the framework elements and the quotations and notes. While the main purpose of the document analysis was to delineate the evolution of the policy mix, the interviewees information was used to analyze the characteristics of the policy mix and policy developments and provided valuable insights on their interpretation of CSA policy implementation. Both sources were triangulated to ensure internal and external validity.

4. Costa Rica as a case study: a transition toward Climate Smart Agriculture

Costa Rica has developed from a rural agriculture-based economy to one with a more diversified structure integrated into global value chains (OECD, 2017). Macroeconomic indicators show that primary agriculture accounted for 4.3 % of GDP in 2022 and comprised 43.7 % of total exports (INEC, 2021). From 1990 to date, profound changes have been made in the development model to address social shortfalls while promoting green technologies and the management of natural resources (Araya, 2020; Fanning et al., 2022). As a result, 98 % of energy produced comes from renewable sources, 25.5 % of the territory is under some category of environmental protection, and lands once dedicated to agricultural production are now forests or protected areas (MINAE, 2020).

The agricultural sector has a dual structure, with large disparities between farming systems in terms of productivity, competitiveness, and technological capabilities (SEPSA, 2022). The traditional sector supplies mainly the domestic market (e.g., grains and vegetables), with many technological barriers and low productivity levels (OECD, 2017). The export-driven sector has been oriented to achieve high productivity levels from higher yields through more efficient inputs, improved labor productivity, and innovation (SEPSA, 2022). The most important contributors to total agricultural exports (in USD) were bananas and pineapples, which accounted for 35.3 % of the total share, followed by processed foods at 12.8 % and coffee with at 6.4 % (SEPSA, 2023). United States of America represent the largest market accounting for 30.2 % of the total exports, followed by the Netherlands at 9.8 % and Guatemala at 6.3 % (SEPSA, 2023). This model has resulted in economic development and increases in the average income of the overall population;

however, some of these agricultural production systems are highly controversial because of the increasing pressures on natural resources and unsustainable production practices (Programa Estado de la Nación, 2019).

According to Harvey et al. (2014), policies favoring conventional agricultural production systems predominate over those promoting climate-smart farming practices. Moreover, farmers targeting local markets and engaged in initiatives such as agroecological, organic,[3] agroforestry, and biodynamic production are not sufficiently protected and supported (Le Coq et al., 2020; Wallbott et al., 2019). More recently, given the pressures of international agreements and the integration of some agrifood systems in the global value chain, the dominant food systems have led initiatives such as low-carbon-emission products – specifically in the case of coffee, sugar cane, bananas – (e.g., 21 % of the coffee produced is low in emissions, and 53 % of bananas are carbon neutral)(Araya, 2016; GIZ, 2020). This presents a challenge for agricultural production and provides a window of opportunity to advance CSA and alternative production systems (SEPSA, 2011).

5. Development of the transformative policy mix for Climate Smart Agriculture

Our analysis of the CSA policy mix is elaborated in this section. In Section 5.1, we present an overview of the policy mix elements in terms of policy stages and instruments. In Section 5.2, we characterize the policy mix in terms of coherence and consistency. In Section 5.3, we elaborate on the CSA policy context in Costa Rica, and in Section 5.4 we present tools for policy coordination.

5.1. Overview of the policy mix: policy elements

We mapped, counted, and categorized the instruments from 2000 to 2022 to evaluate the mix's overall balance. Laws and law amendments comprised the majority of the instrument mix (25 %), followed by decrees (22 %), programs and projects (15 %), and voluntary standards (5 %). According to the typology outlined in the analytical framework (Section 2), the instruments were categorized as follows: 36 % of them corresponded to systemic instruments, 26 % to soft instruments, 27 % to regulatory instruments, and 12 % to economic instruments (see Fig. 2).

The CSA strategy is articulated by a set of policy documents aiming to achieve sustainable development objectives and jointly address food security and climate challenges (Interview 1). The most important strategic document is the National Development Plan (NDP) prepared by the Ministry of National Planning and Economic Policy (MIDEPLAN) in collaboration with the president and his council of government. The NDP establishes strategic objectives and priorities, formulates goals, and allocates resources. Each ministry prepares its sectoral plan (e.g., Policy Guidelines 2019–2022 for the Agriculture Livestock Fisheries and Rural Sector) to align the national strategy with sectoral plans. In addition, policies emerge strategically, expressing guidelines, objectives, and actions on a topic of public interest (MIDEPLAN, 2016) (see Appendix B, Fig. B1 for the detailed historical evolution of the policy strategy).

From 2000 to 2022, in the national strategy, three phases were marked by changes in, and adjustments to, the long-term objectives. The first phase (2000–2006) was characterized by leadership from the environmental domain and a strong focus on biodiversity conservation and forest restoration (44 % of the instruments involved environmental regulations). In the second phase, 2007–2015, the country adjusted the conservation discourse and set the long-term goal of carbon neutrality by 2021. In the third phase (2016–2022), efforts toward carbon neutrality continued but were rebranded as a transition to a just and decarbonized economy by 2050, emphasizing the need for social inclusion and equity.

At national level, the efforts of the agricultural policy domain to integrate instruments promoting more sustainable agriculture and balance conservation and economic development agenda, which were pivotal to CSA (Gobierno de Costa Rica, 2018).

> "CSA is an approach that contributes to the achievement of sustainable development objectives. It integrates the three dimensions: economic, social, and environmental, thus addressing food security and climate challenges jointly. It is based on three main pillars: 1) smartly increasing agricultural productivity and income; 2) adapting and building resilience to climate change; and 3) reducing or eliminating GHG emissions." (SEPSA, 2014, p. 52)

However, CSA has a contested nature at national level with disparities between the policy content and the stakeholders perspectives. From the respondents perspective CSA is not deemed a mainstream strategy and that there is no shared vision for climate-smart policies. Thus, it is one of the many possible paths to achieving sustainable agriculture in light of climate change and food security (Interviews 1, 4, 19, 21).

> "I hardly talk about climate-smart agriculture, what I interpret in my day-to-day work is that farmers should be more sensitive in the management of resources and demonstrate to them with data that they can be more environmentally responsible while increasing their productive performance (....) Climate-smart agriculture, regenerative agriculture, carbon neutrality are very politicized concepts, we need to translate what does climate-smart entails according to farmers' reality." (Interview 19)

The interlinkages between national plans, policies, regulations, and the global climate agenda are key in policy development (Interview 4). The international frameworks adopted/aspired to by the country – the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change, the Convention on Biological Diversity, and the Convention to Combat Desertification, among others – operate as a referent and as an enabling framework to promote CSA. In addition, at regional level, through the Central

[3] For example, by 2019, organic agriculture represented 1.9% of the country's planted area (Pograma Estado Nación, 2021).

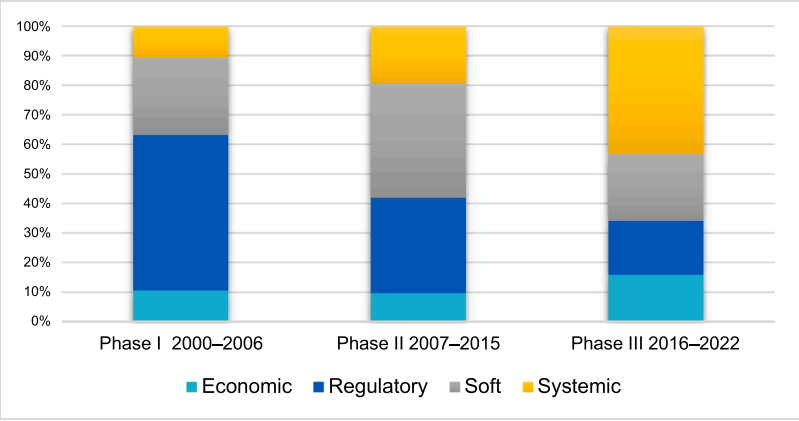

Fig. 2. Type of instruments grouped by the policy mix strategic phases.

American Integration System – formed by eight Central American countries with the objective of optimizing the region's development capacity – cooperation agreements for CSA were formulated and implemented. Examples include the Regional Climate Change Strategy and the CSA guidelines, both of which aim to provide direction and integration across the countries' national polices (FAO and IICA, 2021).

Building on the three strategic phases that emerged in our analysis, we detail the main policy objectives, plans, and instruments implemented to achieve them, and in Fig. 4 we summarize the CSA policy mix between 2000 and 2022.

5.1.1. Phase I: 2000–2006 "Matching conservation and agricultural expansion"

Before 2003 – with the implementation of the first agri-environmental agenda – there was no collaboration between the agricultural and environmental domains, but rather conflicts because of their differing and opposite goals (conservation vs. agri-export orientation). The antagonistic objectives of the agricultural and environmental sectors generated confrontation between businesses, farmers, and Ministry of Environment (MINAE). The agricultural sector was perceived as the cause of environmental degradation as a result of the expansion of monocultures, deforestation, erosion, and land degradation (Interviews 15, 16).

> "In the past, it was very tense [the relationship between agriculture and the environment] because of this 'Manichean' [cosmic struggle between the good and bad] position that was assumed by one against the other.…the agricultural sector is the 'perpetrator' of the country's deforestation and carbon emissions.…and that has led to unnecessary debate." (Interview 16)

Costa Rica's environmental and conservation policies underwent profound reforms, changing the country's development model, and focused mainly on reversing the impacts of agricultural activities (Interview 3). In the first phase, laws such as the Regulation of Use, Management, and Soil Conservation Law, Forestry Law 7575, and Environmental Law 7554 came into effect. The enabling framework for CSA was based on strong environmental regulation and trade liberalization instruments in the agricultural sector. Some agencies, such as the Institution for Innovation and Technology Transfer (INTA) and the Advisory Commission on Land Degradation, were important in promoting good agricultural practices. Most of the instruments in this phase involved niche support instruments (23 instruments), and two were aimed at regime destabilization (see Appendix C, Table C1 for more details).

The 2000–2006 strategy manifested a classical rationale, strategic goals, and plans oriented toward solving market failures, information asymmetries, externalization of cost, and systemic failures, such as the stimulation of physical infrastructure and the prevention of too weak institutions. Most of the policies aimed to increase competitiveness and rural development through productive transformation, strengthening human resources, institutional modernization, and rural development (MAG, 2013). The science, technology, and innovation plans and strategies were not central to the agenda and focused broadly on the overall economic agenda (e.g., creation and development of human capacity, stimulation and growth of production for employment generation, and increasing economic and employment growth).

5.1.2. Phase II: 2007–2015 "The radical change in climate action"

By 2009, on the road to the United Nations Climate Change Conference in Copenhagen, Costa Rica announced the goal of becoming carbon neutral by 2021. The carbon neutrality goal (C—Neutrality) shifted the paradigm and direction of the policies, plans, and projects. The redirected efforts changed the country's orientation from being a leading nation in conservation to being a country in transition to carbon neutrality (Paz con la Naturaleza Initiative, 2007). The paradigm shift was perceived as ambitious, uninformed, and unplanned, but it marked the start of a new era for climate action and agricultural policy (Interview 14).

> "When Dobles…decided to set the carbon neutrality target, it was a wise political decision because it gave a turn to the way of thinking about climate change and what had to be done in terms of climate change." (Interview 14)

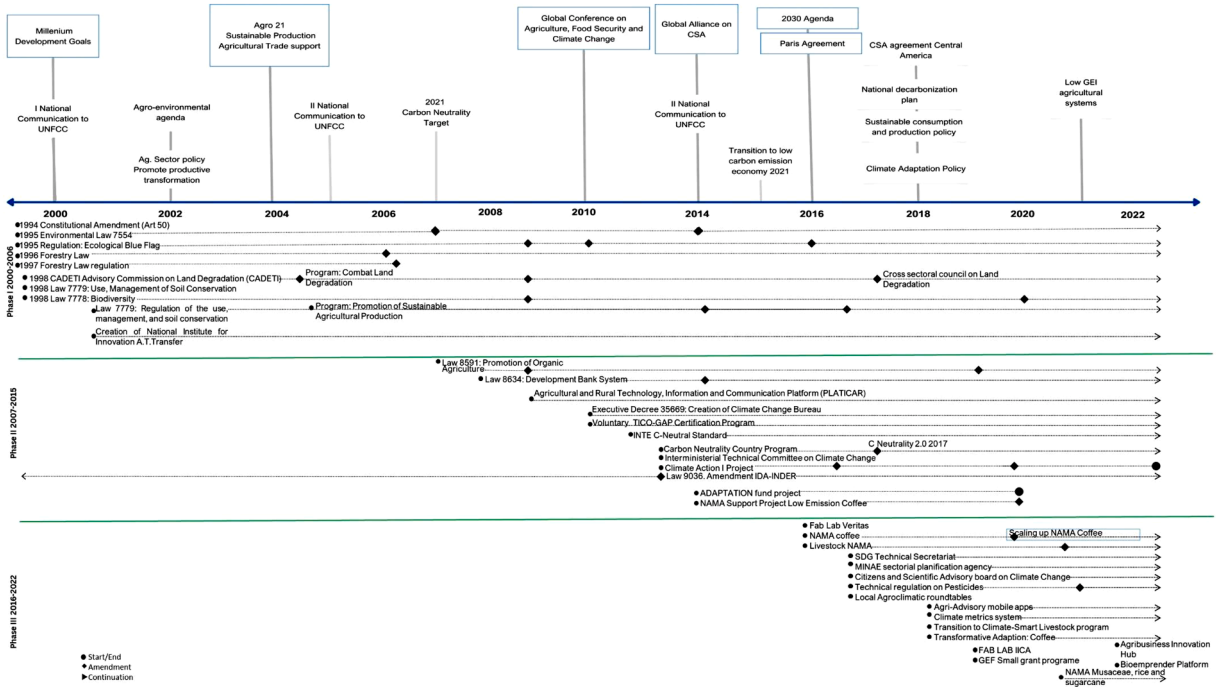

Fig. 4. Climate-smart policy mix from 2000 to 2020: Mainstream policy goals, plans, and instrument mix.

The C—Neutrality long-term goal provided direction and resulted in a sufficiently ambitious and credible goal for environmental and agricultural domains to formulate plans, guidelines, and lines of action (DCC, 2012; Interviews 1, 12).

On the global agenda, the Costa Rican government endorsed two CSA-related events: the 2010 World Conference on Agriculture, Food Security, and Climate Change and the creation of the Global United Nations Alliance for CSA, to which Costa Rica adhered in 2014. As a result, several projects and programs were designed to support CSA systems, such as INTA's research program on low-cost, low-emission, and resilient technologies.

The first set of instruments implemented related to the mitigation of greenhouse gas (GHG) emissions, for example by providing economic incentives for adopting agroforestry in coffee and cacao systems, the Nationally Appropriate Mitigation Actions (NAMA) coffee[4] registration to the United Nations Framework Convention on Climate Change, programs for converting arable land to grassland, and promoting C—Neutrality country voluntary standards. The second set of policy instruments covered actions to promote adaptation to climate change and build farmers' resilience. Several measures were in place, including climate-resistant staple crops and coffee-breeding programs, crop insurance programs, climate-related early warning apps, and climate action discussion roundtables.

In parallel, the Legislative Assembly approved the organic agriculture Law 8591, stipulating the creation of the National Commission for Organic Activity (created in 2014), allocating 0.1 % of fuel taxes to pay for agricultural and environmental services and tax exemptions for organic farmers. The interviewees reported that organic agriculture as a social movement lost strength once it was institutionalized because the core principles were drastically changed between the bill's initial proposal and final publication (Interviews 1, 16, 19). This shows how embedded regime actors are in the legislative apparatus and the policymaking process, hindering the transition toward more sustainable systems.

> "The state shall promote organic agricultural activity on equal terms with conventional agriculture and agribusiness.... INTA, without prejudice to programs aimed at other sectors, shall promote and develop research related to organic agricultural production and facilitate technology transfer among producers." (Art 1, 8591 Law, 2009)

Without a formalized transformative intention, transformative elements emerged, including new governance arrangements, multistakeholder consulting groups, protected experimentation spaces, and classic economic instruments with transformative features. First, the new governance arrangements – offices such as the Climate Change Bureau and the technical committee on climate change – were created to add dynamism and "inclusivity" to the climate agenda; second, stakeholders such as civil society, representatives of indigenous communities, and NGO representatives were included in policy formulation and the implementation of national programs

[4] CR Coffee NAMA "Toward a low emission coffee sector" was recognized as the first agricultural NAMA in the world and started as a pilot project in 2015 funded by cooperation agencies. The project was coordinated and articulated jointly by the Coffee Corporation (ICAFE), MINAE, and the Ministry of Agriculture.

(e.g., REDD+, Land Degradation programs); third, some spaces for experimentation were enabled, such as the Alliance for C—Neutrality, where private companies and the public sector met to learn and share experiences on their paths to carbon neutrality; fourth, economic instruments such as the carbon market and Development Bank System included guidelines favoring equitable access to credit for women and the most vulnerable sectors (e.g., smallholder farmers not eligible for credit in the traditional banking system).

5.1.3. Phase III: 2016–2022 "Rebranding of the carbon neutrality goal"

Global agreements such as the 2030 Agenda and the Paris Agreement provided the cornerstones of climate and agricultural policy in this phase. Based on the Nationally Determined Contributions (NDC) prepared for COP 21 and the assessment that Costa Rica would not meet the C—Neutrality goal by 2021, the carbon neutrality goal was rebranded as a "Just and decarbonized economy by 2050″ through the national decarbonization plan in 2018. The agricultural sector prioritized the strategic objective of "promoting highly efficient agrifood systems that generate low-carbon goods for export and local consumption" (Gobierno de Costa Rica, 2018, p. 56).

This phase involved restructuring and rebranding the instrument mix. The 1995 Payments for Environmental Services Program was amended to recognize the environmental services associated with agricultural activity (Asamblea Legislativa de la República de Costa Rica, 1996). The Carbon Neutral Country Program was rebranded as Carbon Neutral Country program 2.0 to align it with the country's mitigation objectives. The NDC was updated, and the Decarbonization Plan substituted the Climate Change National Strategy. International cooperation projects were executed, such as experiments with low-emission-coffee technologies and livestock practices. Other NAMAs in the agricultural sector (*Musaceae*, sugar cane, and rice) were created as a result of livestock and coffee NAMAs' learning process, all led by public corporations,[5] the public sector, and NGOs.

> "On the other hand, a great deal of research is already being done by organized corporations, such as ICAFE, CORBANA, and LAICA, where they promote biological pest control practices, develop resistant varieties, and experiment with bio-inputs. All this is led by the private initiative…most of the practices that work are developed by organized associations or corporations." (Interview 18)

The environmental policy domain led the implementation of more transformative elements (Interview 18), funded by international cooperation. Also, more interventions were explicitly related to CSA (e.g., the germplasm project for CSA in the cocoa system). New spaces for experimentation, i.e., an agricultural fablab with co-creation and social innovation components, were developed. Platforms such as Agro-Innova, Bioentrepreneurship, and Incubators programs were considered instruments with transformative elements because they included multi-actors, multi-sectors, and the tackling of societal challenges.

Regarding niche support instruments, soft and voluntary measures played a key role, as well as private standards led by third parties (RainForest, AAA Nespresso, Global GAP). The services provided by the public sector in terms of advice, technical assistance, demonstration plots, on-farm workshops, and extension services provided by public universities and Ministry of Agriculture and Livestock (MAG) operated as awareness-raising spaces and open spaces for experimentation. However, they were developed on a small scale, given extension agents' limited capacity and lack of financial resources.

Policymakers have not embraced the idea of designing tools aiming at destabilizing the regime. The policy discourse was related to achieving eco-efficiency in the farming production system. This suggests that, although transformative goals were proposed within the instruments (e.g., NAMAs, certification schemes), incremental rather than radical changes were promoted in practice.

> "The focus was to promote efficient technologies, not to ban old inefficient ones…we also worked a lot with the visualization of the potential benefits, if the new technologies are much cheaper and are much more efficient….at the end of the day, this will result in economic savings for the user." (Interview 5)

5.1.4. Directionality

Costa Rica's long-term vision – influenced primarily by global targets and goals (SDGs, 1.5 C Paris Agreement, UN Global Alliance CSA) – indicates the multilevel integration of global and national goals (Gobierno de Costa Rica, 2018). The international framework and the national policies' long-term vision were used as leverage to finance Costa Rica's objectives through international cooperation funds. The first effort (guided by international cooperation funds) to reconcile the agricultural and the environmental domain visions and to build one shared direction was the implementation of the first agri-environmental agenda in the first phase (2000–2006). The agenda was a game-changing coordination mechanism between the agricultural and environmental domains. Furthermore, it sought to resolve a systemic failure related to stimulating interactions that otherwise would have been stymied by inter-sectorial opposing rationales. In the second phase (2007–2015), the strategy positioned ambitious long-term goals with the 2021 C—Neutrality declaration. Moreover, in the third phase (2016–2022), the explicit inclusion of the 2030 agenda in the national strategic planning system and the rebranding of decarbonization of the economy by 2050 acted as key strategic developments for redirecting investments in, and focus on, climate action and social welfare.

Specifically for CSA, the lack of a mainstream strategy meant no clear direction for a transformation toward CSA-based systems (Interviews 9, 13). Two strategies that directly impacted CSA (i.e., the national adaptation policy and the decarbonization plan) were

[5] Corporations in the local context are autonomous public agencies mandated to support specific agricultural subsectors through research, trade (e.g., maintain an equitable relationship regime between producers and agro-industry) and to represent them in public consultations; for example, ICAFE, the National Rice Corporation (CONARROZ), the National Livestock Corporation (CORFOGA), the National Banana Corporation (CORBANA), and the Sugarcane Industry Association (LAICA).

formulated with a transformative vision, i.e., they aimed to phase out the conventional systems through disruptive initiatives rather than conventional regulatory measures, but mainly in principle and have not yet been implemented.

5.2. Unraveling the CSA policy mix characteristics

In this section, we unravel the characteristics of the evolving transformative policy mix to shed light on how coherent (5.2.1) and consistent (5.2.2) the policy mix is. This analytical logic is based on the theoretical framework (Table 1) in Section 2.2; a summary is presented in Table 2.

5.2.1. Coherence

We used three key aspects to describe the coherence of the policy mix: i) internal, ii) external, and iii) temporal.

The development of the agricultural policy agenda focused on supporting conventional agriculture (export-oriented systems constituting the food regime) while promoting CSA and other alternative systems (which can be considered to a greater or lesser degree as niches). This juxtaposition led to internal contradictions – incoherence – that resulted from a lack of political capacity to challenge the status quo and pursue more radical changes that could potentially destabilize the current regime (Interview 14). From 2000 to 2006, the priority was to increase agricultural productivity and the development of agribusiness and agroindustry, neglecting environmental degradation concerns. In addition, the coherence in the alignment of goals and plans was severely affected by the unexpected changes in the governance of the MAG (five minister abdications in four years). From 2007 to 2015, the CSA-supporting policies were visible mainly at the strategic level (e.g., plans and policies) but were weakened at the operational level (e.g., projects and programs). From 2016 to 2022, CSA had two key intervention areas: adaptation and mitigation; and both interventions showed the public sector's limited implementation capacity. Two types of stakeholders took the lead in promoting CSA: international agencies – the primary funding source – and national corporations (Interview 21).

Besides the lack of financial resources for translating plans into action (e.g., scaling up NAMAs), we found incoherence associated with the top-down approach to promoting CSA (Interviews 14, 18). The top-down policy implementation led to a debate on extension agents' resistance to change, since the approach does not resonate with the local reality (Interview 3).

> "The main concern is that what politicians say is one thing and reality is another. They do not know whether the CSA technologies they are promoting are going to work. For example, farmers are risking a lot to move toward more sustainable practices, and there are no complementary policies such as loans with favorable interest rates or support services for the farmer." (Interview 15)

Regarding the environmental domain, in the 2000s, a coherent alignment of policies and goals related to MINAE's leadership in orchestrating environmental policies (Interview 7). From 2007 to 2015, an essential role of international agreements and global alliances in MINAE's policy formulation was perceived as coherent by interviewees 1, 4, and 6. From 2018 onwards, the climate policy was integrative and holistic, integrating adaption and mitigation instruments (MINAE, 2020). To translate goals into instruments, like in the agriculture public sector, enforcement depended on international cooperation partners; in some cases, the strategies were restructured or renamed to match the cooperant objectives (Interview 12). For example, some partners' objectives focused mainly on mitigation and others on adaptation, and extra efforts were needed to marry both. The dependence on cooperation projects influenced the continuity of the interventions, with a potential impact on temporal coherence.

In terms of external coherence, the interactions between goals and instruments in both domains changed from "very incoherent to less incoherent" (Interview 3). At national level in early 2000, the sectors had competing purposes, as conservation objectives were not coherent with agricultural expansion goals and trade liberalization policies (Interview 7). To date, efforts have been made to align sectorial targets through implementing agri-environmental agendas, emission-reduction commitments, and instruments such as NAMAs (Interviews 1, 8). Achieving synergies between the Climate Change Bureau's GHG emission reduction goals and MAG's vision of increasing agricultural production agencies was difficult (WorldBank, CIAT, CATIE, 2014). However, considerable progress was made toward incorporating the CSA pillars thanks to enhanced cooperation among catalyst organizations (i.e., corporations, academia, NGOs, and private partners) that acted as intermediaries between the agriculture and environment domains.

Some transformative elements were proposed to improve external coherence, such as new governance arrangements to align objectives, joint plans, and projects that promoted transformational change in the coffee and livestock value chain; however, they were timebound and remained experimental (Interviews 6, 13). Moreover, the respondents noticed three tensions in implementing the emerging transformative features. The first relates to those key actors crucial to destabilizing unsustainable technologies who were not involved in, or invited to, the discussion meetings (e.g., actors from industry, logistics, or input suppliers) (Interview 20). Second, "inclusiveness" was stated only in the policy reports and was not perceived as inclusive by the organizations. "We [associations, cooperatives, corporations] are invited at the wrong time when the policy is formulated only to endorse the policy, and they [policymakers] claim that the private sector is involved" (Interview 15). Thus, stakeholders felt marginalized. Third, including a great diversity of actors made the meetings and workshops extremely diverse spaces with conflicting objectives and actions with the potential risk of losing efficiency (Interview 13).

Regarding the temporal aspect of coherence, three important issues came to light. First, the CSA transition could bring uncertainty to smallholder farmers' phase-out alternatives (Interview 15). The agricultural sector's dependence on foreign direct investments and transnational companies (e.g., Dole, Chiquita, Ecom) could lead to a lack of support for smallholder farmers implementing CSA practices, as regime actors took the lead in adopting CSA practices (e.g., carbon neutral coffee, private certification schemes, free pesticide rice, and NAMAs) in collaboration with government and NGOs.

Table 2
Summary of the policy mix characteristics: Analysis of coherence, consistency. Coherence is marked (+), incoherence is marked (-), and coherent and incoherent policies are marked (+-). Mutually supportive strategies are marked (+), and counterproductive strategies are marked (-).

Characteristic	Category	Explanation	Tensions
Coherence	Internal	*Agriculture policy domain* -Agricultural strategic objectives prioritize conventional agriculture -No institutional capacity to scale up NAMAs -High dependence on international cooperation to implement the climate agenda -Dependence on external financing limits the possibility of local and emerging innovations +-There is a robust legal framework for regulating and promoting organic activity, soil conservation, and sustainable practices (which may lead to overregulation of green technologies) -Attempts to change the governance of the public agricultural sector, but actors in the system resist *Environment policy domain* +Reforms in the institutional framework have allowed it to adapt and formulate strategies according to the country's commitments +Leadership in climate change, forestry regulations, and coherent mechanisms to help meet the country's goal toward C—Neutrality -Strong focus on mitigation, leaving aside adaptation policies +Spillovers of conservation and mitigation strategy into other sectors (agriculture and tourism)	Competing paradigms of agricultural production and climate action Tensions in temporal coherence, given the short-term nature of funding Resistance to change inhibits the effects of transformative features No institutional change to support the transformations The transformative policy entails the inclusion of new actors responsible for strategy development, thereby helping to catalyze cross-domain interactions Instability in government changes inhibits long-term policy development Important niche–regime interactions
	External	-Differences between coherence as stated in the policy documents and practice -In the early stages (1998–2000), the implementation of biodiversity and conservation policies went against the objectives of the agricultural sector (competing objectives) -The country's development model changed from an agri-export dependent model to a service-sector-dependent economy and has changed policy attention +Policies formulated under a vision of transformational change include collaborating with other policy domains +Transversal societal challenges incorporated in both domains: development goals from the Millennium Development Goals to Sustainable Development Goals	
	Temporal	-Strong strategic capacity over time thanks to the leading role of one policy domain -Uncertainty about the phase-out alternatives given the pressure of transnational companies +-Agricultural sector is highly dependent on FDI, and corporations (e.g., Dole, Chiquita) are involved in policy formulation of NAMAs and implement other voluntary sustainability standards (RainForest, Global GAP) and national standards (free of pesticides standard, carbon neutral)	
Consistency	Instrument: Synergies	+Public–private interactions: Loans for renewal of coffee plantations with climate-adapted varieties and incorporated discounts if adaption and GHG reduction technologies were adopted +NAMA project-coffee processors and DBS +-National coffee and financing policy, i.e., two complementary policies, favor sustainable technologies	No culture of reflexive evaluation Limited room for improvement as no mechanisms for policy learning are in place Institutional culture rewards individual work rather than collaborative efforts among ministries No balance between intentional vs. unintentional transformative developments
	Instrument: Neutral interaction	+-The initiatives are in place with overlapping purposes (e.g., National Coffee Institute launches an app, but the cooperatives are also working on their own app) +-There is no integration between the institution's interventions +-Within the same institution, there is no clear direction to operationalize the intervention; for example, the app is launched, but it is not integrated between departments	Transformative elements are emerging and promoted by cooperation funds
	Instrument: Trade-off	-National level: no culture of knowledge sharing and exchange; e.g., climate information -In-kind economic incentives from public institutions in favor of conventional agriculture (e.g., donation of pesticides)	

(*continued on next page*)

Table 2 (*continued*)

Characteristic	Category	Explanation	Tensions
	Strategy and Instrument	-Contradictions at different governance levels +The policies and instruments promoting CSA are in an early stage of policy implementation (immature stage as a niche) +The carbon neutral program aligned with agricultural policies (RESB in the agricultural sector), agribusiness category to PBE, and modifying organizations category to the carbon-neutral category	

Second, we observed the short-term nature of most of the CSA projects; their heavy reliance on international cooperation funds generated a gap between adaptation and mitigation initiatives that require long-term planning and implementation; transformative changes do not occur in short periods. Third, policymaking involved high levels of uncertainty in the legislative branch. As a very fragmented legislative assembly was elected in the last two government turnovers, each party could either downplay or support important issues on the agenda accordingly (Interview 8).

5.2.2. Consistency

The two interactions described in Section 2.2 are used to describe the consistency of the policy mix. The first relates to the interactions between instruments, and the second relates to the interactions between the strategy and these instruments.

The data suggest an accumulation of instruments, deriving synergies, tensions and trade-offs. The instruments' consistency can be characterized as weak (Interviews 1, 20, 21). These interactions did not create conflicts or contradictions but did not intentionally encourage synergies (Interview 19). According to interviewees, synergies were not the result of the intentional implementation of instruments. Rather, the synergic dynamics resulted from the rebranding of the existing mechanisms and the alignment with the C—Neutrality goal. For example, the Organic Agriculture Program, Recognition of Environmental Services scheme, TICO-GAP standard and the amendment to the Blue Flag Program, C—Neutral certification, and Coffee NAMA are aimed to promote behavioral change toward the adoption of greener technologies and target different actors in the agricultural system (farmers, processors, retailers). However, the programs were managed by several departments within the public sector with distinct capacities, rules, proceedings, and requirements, generating a challenge to navigate between bureaucracies (e.g., higher transaction costs for the farmers and agribusiness).

From 2007 to 2015, the data show that, although the environmental policies and the agricultural policies had different rationales and their instruments were evoked primarily on mitigation, conservation, and forest protection, they managed to align – when necessary – with the agricultural policy domain so that the instruments did not contradict each other. This indicates that conditions were not optimal for inter-institutional partnerships; thus, the institutional culture encouraged individual work over collaborative efforts between policy domains.

> "For example, the instruments could be better linked in the agricultural sector with water management problems and agrochemicals regulations or territorial planning. Evidently, there is a relationship, but the interventions are not formulated with synergic intentionality, and thus benefits can be maximized." (Interview 7)

From 2016 to 2022, instruments with transformative elements interacted with those formulated with other rationales (e.g., Hypatia network, organic markets), and the interaction is perceived as neutral (Interview 7). Moreover, as new instruments did not replace old ones, the projects and experiments sometimes had overlapping purposes (e.g., different public institutions developing apps with the same features). In this phase, we also observed trade-offs between instruments: soft instruments concretizing sustainable production, workshops on low-emission agricultural practices, and in parallel in-kind economic incentives such as fertilizers and pesticides were given to farmers in favor of conventional agriculture (MAG, 2022).

Regarding the consistency between the instruments and the strategy, there were no contradictions between the proposed strategies and the actions taken to achieve them at national level. However, we observed heterogeneous consistency at different governance levels.

> "We have an ambitious NDC, with clear goals and a decarbonization plan, a national adaptation policy, which is already doing all the processes to have an adaptation plan that comes from the communities upwards, not a top-down national plan" (Interview 18).

5.3. Climate-smart policy mix context

As is clear from the previous sections, there are several influences from the broader policy context. This plays out in different dimensions: spatial (national and international influences), sociotechnical (regime), and temporal (long-term versus short-term action).

In the spatial dimension, the sociopolitical context of Costa Rica's reliance on international cooperation funds and foreign direct investment influenced CSA development (e.g., transnational companies lobbying and powerful relations in the policy agenda). Regarding the former, the lack of financial resources and fragmented governance limited the state's capacity to upscale pilot projects

and experiments focused on promoting CSA technologies, leading to solid linkages with/dependencies on international development agencies for policy implementation. International partners provided policy support, financial support, institutional capacity building, and technical assistance, thus, shaping the policy outcomes. As for the latter, interdependency on foreign direct investment (e.g., employment opportunities, economic development) lead to state interventions merely focused on fostering eco-efficiency and demonstrating the effectiveness of adaptation practices and low-emission technologies, since banning and regulating detrimental agricultural practices (e.g., intensive use of agrochemicals, water pollution) is highly contested given the power dynamics between the agroindustry and the state (Interviews 1, 2, 11). In terms of the sociotechnical system, the embeddedness of food-regime actors in policymaking inhibited laws prohibiting unsustainable technologies to discourage unsustainable practices.

Regarding the temporal dimension, although the Costa Rica political system is a stable democracy, CSA developed within an ambivalence between pursuing ambitious long-term targets and policy discontinuity. The former relates to integrating international agreements as a mechanism for proposing direction and setting long-term goals, thereby functioning as an effective tool for legitimizing climate action and proposing ambitious targets such as decarbonization by 2050 (Interview 3). In theory, the guidelines operated as a guiding framework; in practice however, the four-yearly government changes redirected public investment priorities (e.g., allocating smaller budgets to pilot programs, pausing infrastructure developments). Thus, initiatives adopted by a government were discontinued in the following four years, causing instability and weakness in the state apparatus.

5.4. Policy coordination

Most interviewees appraised CSA policy development as a top-down approach steered mainly by international organizations (e.g., IICA, FAO, and GIZ), MAG, and the Ministry of Environment, with inputs from a plethora of national actors, including universities, research centers, and farmer cooperatives. Policy implementation was highly dependent on international cooperation funds (Interview 3). This led to challenges in implementing CSA, especially in coordination between the international, national, and local level (Interviews 7,16, 19). Coordination tools were visible mainly at the political and the strategic level but were weakened at the operational level. As respondents indicated, there was a gap between the coordination instruments from the environmental and agricultural domains and the coordination perceived by the interviewees (Interviews 1, 7, 12, 18). The main limitation was that, it was considered adequate to merely create coordination mechanisms (e.g., secretariats, steering committees, and councils) by decree. Therefore, providing formal instruments did not involve effective interactions between actors.

Coordination tensions emerged because of the complex governance arrangements in the agricultural public domain. The public agricultural sector and its institutional framework are governed by hundreds of laws and ministerial decrees, making effective governance difficult. Law 8787, on the organization of the public agricultural sector, provides the formal mechanisms to guarantee coordinated action between the regions and the strategic decisions taken at political level (e.g., Regional Sectorial Committee of the agricultural sector) and at local level (e.g., Local Sectorial Committeee of the Agricultural sector). However, communication and coordination between the national and local levels often relied on who was responsible for coordinating, thus changing from region to region (Interviews 7, 13, 20).

6. Discussion

In this paper, we aimed to contribute to the debate on transformative policy mixes by showing the developments of transformative policy mixes in practice and by identifying key features of a transformative policy mix that positively or negatively reinforce one another to promote the intended change. We asked three questions: i) how have the CSA policy mix elements evolved?; ii) how do directionality, consistency, and coherence characterize the policy mix over time?; and iii) how does the Costa Rican context influence CSA policy mix dynamics? In the following sections, we first discuss the main findings from the Costa Rican context, then elaborate on broad contributions to the literature on transformative policy mixes, and finally, reflect on limitations and future research.

6.1. Costa Rican CSA policy: a transformative policy mix in the making or stifled by inertia?

Our findings highlight a complex policy mix that theoretically has several elements of a transformative policy mix, in which some policy elements were newly introduced, and sometimes existing strategies were repurposed. Although there was an ambitious direction with clear targets and long-term strategies, this was undone through a less coordinated policy formulation and implementation approach. This observation has also been acknowledged by Edmondson et al. (2019), which highlighted how understaffed departments or resource reductions compromised pivotal policy changes, thereby influencing subsequent developments of the policy mix. Our study revealed that the Costa Rican CSA policy mix can be described as incoherent (internally and externally) and shows weak consistency, as no synergies between policy instruments were induced purposefully to achieve transformative outcomes. In the last phase (2016–2022), transformative elements were more evident than in the previous two strategic phases (2000–2006 and 2007–2015), but these were inhibited by weak implementation capacity and internal and external incoherence between sectors and governance levels.

In most phases, there was no indication of a conscious evaluation of synergies or tensions resulting from instrument interactions, so, in a sense, Costa Rica's CSA policy is a transformative policy mix in the making but, in practice, it has not come fully to fruition because of fragmentation and a lack of policy coordination and policy legacies (echoing Diercks, 2019, and Grillitsch et al., 2019) but rather leads to inertia. Throughout the evolution of the CSA policy mix, the instrument mix developed through layering (new C—Neutrality goals with new instruments without removing the old ones), drifting (a rebranding of the C—Neutrality goal without replacing the instruments aimed at conservation), and conversion (a rebranding of the goal of decarbonizing the economy and modifying the

instruments). There was no evidence of replacement processes (e.g., phasing out instruments and strategies) or careful integration of new instruments.

Regarding the sorts of instruments in terms of niche support and regime destabilization, there appeared to be more niche support strategies (e.g., voluntary carbon-neutral standard, incubator programs with low-emission and adaptation indicators, FabLabs, and agroclimatic scientific roundtables) than regime destabilization efforts (e.g., agrochemical use decree). Factors hindering such efforts include the substantial involvement of food-regime actors, such as transnational agribusiness, cooperatives, and national corporations in the agricultural and climate policy arenas. Powerful regime actors strongly embedded in agenda setting meetings, policy consultation groups advocating for sustainable practices instead of regulating their business-as-usual, which has also been pointed out in the case of the agrifood sector and Global South transitions (Conti et al., 2021; Hansen and Nygaard, 2013; Ingram, 2018; McMichael, 2009; Nygaard and Bolwig, 2017). Nonetheless, a more consistent driver of change came from corporations and cooperatives, integrated into global value chains, that opted to support sustainability transformations (e.g., carbon neutral coffee, certification schemes, free pesticide rice standard, and NAMAs) in collaboration with the government and NGOs – echoing earlier observations of Grabs and Carodenuto (2021), van Oers et al. (2021), and Vilas-Boas et al. (2022). Beyond showing the roles of incumbent food-regime actors in this transition (see also Turnheim and Sovacool, 2019) these findings also demonstrate that the policy arena for (potentially) transformative policies is not only national, and in our case, confined to Costa Rica. This supports Wieczorek's (2018) suggestion that more attention should be paid to these transnational links.

Our findings also show how the Costa Rican context influenced policy developments. Although directionality-shaping-oriented exercises (such as vision creation) provided a sense of purpose and long-term planning, the guiding effect was counteracted by discontinuity caused by radical political changes. This undermined the effectiveness of CSA initiatives and weakened the state's ability to address climate change in a consistent and sustained manner, exercising effective roles as promoter, moderator, initiator, and guarantor of change (as defined by Borrás and Edler, 2020). It is therefore essential for a country to have institutional mechanisms that ensure continuity and coherence in agricultural and climate policies across different administrations. Other features of the Costa Rican sociopolitical context that negatively impacted policy coherence and consistency relate mainly to policy legacies, fragmented legislative apparatus, lack of resources for policy implementation, distrust amongst ministry employees, and extension agents' resistance to change.

6.2. *Contributions to the transformative policy mix literature*

Our analysis makes three broad contributions to the literature on transformative policy mixes. First, our analysis of policy development confirms that emerging instruments with transformative intentions interacted with existing instruments focused on classic policy rationales, and in this sense, our findings align with those of Diercks et al. (2019) and Molas-Gallart et al. (2021). Also in our case, including instruments with a transformative intention, but without removing or restructuring earlier policies, led to a great deal of layering, drifting, and conversion of instruments and goals, creating in an extreme case what could be called policy pandemonium. We deepen this earlier work by more explicitly showing that layering, drifting, and conversion in the evolving policy mix may in some cases lead to a *neutralization phenomenon*, in which the complexity of the policy instrument mix resulting from policy legacies counteracts the newly added transformative instruments. Such a policy pandemonium thus stifles efforts to create a consistent and comprehensive but also balanced transformative policy mix. This echoes the need not only for policy learning and reflexive evaluation (Ghosh et al., 2021a; Kern et al., 2017), but also for such learning and reflexivity to lead to a certain degree of policy *unlearning* or *undoing*, terminating and phasing out legacy policies that lead to neutralization (see e.g. Bauer, 2009). A broader question is, however, whether such processes can be fully plannable and to what extent the complex interdependence between instruments can be easily addressed, as they play out across so many levels.

Second, our analysis confirms the usefulness of employing the lens of policy mix characteristics to do policy mix diagnosis, signaling synergies and tensions and creating clarity on when layering, drifting, and conversion become counterproductive. Policy mixes can create synergies between instruments, thereby logically contributing positively to transformative change (e.g., the C—Neutrality public and private platform in our case). At the same time, they often contain tensions between instruments in terms of instruments creating confusion (e.g., by layering) or not reinforcing one another. However, we show that, perhaps counterintuitively, tensions or deficiencies in the policy mix are not just negative or act only as inhibitors, which gives more nuance to the notion of tensions or deficiencies in policy mixes as signaled in earlier work (Bodas Freitas, 2020; Greco et al., 2020; Mavrot et al., 2019; Rogge and Reichardt, 2016). Our analysis shows that tensions and deficiencies can also have positive effects and become catalyzers, so that positive changes even happen thanks to them.

One observed tension and inhibitor was vagueness in the translation of ambitious directionality, i.e., good intentions not resulting in clear action (see Section 5.1.2), echoing findings by Scordato et al. (2021) that transformative rationales are often translated vaguely from the strategy to the instrument mix, i.e., weak overall consistency. Our analysis shows that vagueness may have a paralyzing effect, resulting in less substantial changes in the policy mix. A catalyzing effect of the same deficiency, vagueness, could however be observed in that it led to an open space for contestation, mediated by several intermediaries (in our case, NGOs, financing institutions, research clusters, and international cooperants). These facilitated interaction between actors in the agricultural and environmental domains and propose actions that materialize in concrete CSA implementation, which was a positive outcome. Additionally, this finding also indicates that intermediaries, whose importance has been shown in the practical facilitation of transitions (Kivimaa et al., 2019), also play a prominent role in resolving tensions in transformative policymaking (echoing Ghosh et al., 2021a).

Third, like in many other Global South countries, the findings on the temporal and the spatial context and diversity of actors – fulfilling some functions that the state does not perform – have relevance for debates on transformative policies. As our analysis indicates, beyond being public-sector driven, they are also private and third-sector driven (see also Klerkx and Begemann, 2020). However, the role of the private and the third sector also brings tensions, such as i) short-term orientation of projects and programs, ii) mismatch of intervention priorities (projects oriented toward low-emission technologies while ignoring countries' adaptation priorities), iii) the top-down approach limits the possibility of experimentation, iv) some technological solutions promoted do not necessarily work in the local context or then need to be adapted. The contested nature of CSA, being promoted as a top-down approach and a generic concept, makes the operationalization and measurement of CSA policies challenging; we argue that more context-specific interventions are needed to promote the intertwined purpose of CSA policies. Globalized transformative policies (as concepts such as CSA are implemented worldwide) thus require attention to be paid to spatial dimensions, cultural and institutional context specificity, and perhaps also links to decolonization debates (Ghosh et al., 2021b; Pfotenhauer and Jasanoff, 2017).

6.3. Limitations and future research

A limitation of our study is that it was a single case study where the policy mix characteristics were analyzed without including an evaluation of the policy mix in terms of efficiency, effectiveness, and feasibility. Also, accounting for scale interactions of a transformative policy mix at national and international level can easily become overwhelming. We acknowledge that our study could not identify the intensity of the spatial influence in the transformative policy mix. Therefore, developing strategies for cross-scale analysis would need considerable attention and could benefit the strand of spatial analysis of sustainability transitions (Binz et al., 2020; Coenen et al., 2012; Hansen and Coenen, 2015).

The lack of conscious evaluation of instrument interactions suggests a need for a more systematic approach to policy development and implementation. Whether and how policymakers can find a way to balance efficiently the emerging transformative features with existing and established policy rationales remains an open question. Our study evidenced the need for more careful integration of new instruments with potential transformative features and further evaluation of those interactions (e.g., the degree or intensity of catalyzers or inhibitors) and how they impact on changes in the sociotechnical system. Future research could investigate whether those developments are likely to unfold similarly in a Global South and a Global North context, for which work on innovation cultures (e.g., Pfotenhauer and Jasanoff, 2017) or policy styles (e.g. Howlett and Tosun, 2021) could be helpful.

While we did not look at the policy process in detail, as our research design did not allow for in-depth and full historical reconstruction of all deliberations, decisions, and events and their causal relationships and processes of politics and power. Nonetheless aspects of it inevitably emerged in interviews, especially when discussing the influence of context, but this would require deeper and dedicated study (see e.g. Kok and Klerkx, 2023). Identifying policy process related dynamics, challenges, tensions, and context-specific situations could benefit the stronger incorporation of policy process theories using institutional analysis to uncover the dynamics of the emerging transformative policy. Conceptual advances from policy mixes (Edmondson et al., 2019; Gomel and Rogge, 2020) may be useful to explain evolution of transformative features within the mix. Sustainability transitions has earlier built on policy sciences to derive entry points for analyzing the link between policy mixes and socio-technical changes research (e.g. Kern and Rogge, 2018). Exploring the contextual dynamics of policies has received considerable attention in olicy scences (Chandran et al., 2015; Hall, 1993; Howlett, 2014; Michael et al., 2018; Sewerin et al., 2020; Milhorance et al., 2020), aiming at explaining policy changes. Therefore, transformative policy mixes could draw on these policy processes theories.

7. Conclusion

This paper has addressed a gap in the literature by analyzing transformative policy mixes in the context of agriculture and the Global South. Using a transformative policy mix analytical framework helped unravel the tensions, dynamism, and evolution of Costa Rican CSA policies, which were found to be both internally and externally incoherent and inconsistent. Because of the embeddedness of food-regime actors, the unbalanced transformative policy instrument mix focused mainly on supporting niches rather than destabilizing the regime. Regarding the transformative elements (directionality, balanced policy mixes, and coordination), our findings showed that, although providing direction, ambitious goals, and setting long-term targets gave a sense of purpose, the vagueness in translating goals into concrete actions undermined the intended change. Some newly introduced policy elements contributed to a transformative policy mix, but layering, drifting, and conversion of existing policies might thwart these transformative elements and, in an extreme case, could lead to policy pandemonium. Such a situation can cause a neutralization phenomenon that renders transformative policy instruments ineffective. The main implication for theory and practice is that, if transformative policy mixes are desired, better scrutiny is needed both on the balance of catalyzing and inhibiting instrument interactions in the mix and on how to fundamentally transform the mix so that catalyzing instrument interactions prevail. This includes more attention on the factors driving the sustaining of policy legacies. It also requires better insights in under which conditions policy termination processes and phasing out of legacy policy instruments effectively occur, going beyond policy learning and instigating policy unlearning or undoing. Lastly, future research should focus on how particular countries' institutional contexts and policy cultures influence transformative policymaking and implementation.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

Table A1
Instrument mix categorization.

Type/purpose	Regulatory	Economic	Soft	Systemic
Description	Measures are undertaken to influence people through formulating rules and directives that mandate receivers to act according to what is ordered in these rules and directives	Involve the handing out or the taking away material resources, in cash or kind.	Attempts at influencing people through the transfer of knowledge, the communication of reasoned argument, and persuasion. provide recommendations, make normative appeals, or offer voluntary or contractual agreements	Tools that focus on the organization of innovation systems, support learning and experimenting, and stimulate vision, strategy, and demand articulation
Niche creation	Regulation, tax exemptions	Financial: R&D funding, deployment subsidies, low-interest loans, venture capital	Policy instruments such as certificate trading, feed-in tariffs, public procurement, deployment subsidies, and labeling training schemes, coordination	Innovation platforms, foresight exercises, public procurement and labeling to create legitimacy for new technologies, practices and visions
Regime destabilization	Policies, such as taxes, import restrictions, and regulations. Control policies, for example, may include using carbon trading, pollution taxes or road pricing to put economic pressure on current regimes. Banning certain technologies is the strongest form of regulatory pressure (eg	Withdrawing support for selected technologies (e.g. cutting R&D funding, removing subsidies for).		Balancing involvement of incumbents for example in policy advisory councils with niche actors; formation of new organizations to take on tasks linking to system change.

Source: Adapted from Kivimaa and Kern 2016.

Table A2
Types of policy documents included in the instrument mix.

Type of document	Total of documents review
Law	30
Decree	29
International Cooperation Project	19
National /Sectorial Development Plan	16
Project	13
Program	11
National/Regional Policy	10
Strategy	10
Regulation	9
Agreement	7
International Agreement	6

(*continued on next page*)

Table A2 (*continued*)

Type of document	Total of documents review
Agenda	4
Guideline	4
Platform	4
Climate Change National Communication	3
Public Private Initiative	3
Conference	2
National Determined Contributions	2
Costa Rica Constitution	1
National voluntary Standard	1
Other: News, Webapages, reports	30
Total	**214**

Table A3
Expert interviews with actors related to CSA in Costa Rica.

ID	Type of Actor	Sector	Institution	Date	Duration
4	Public Sector: Policy	Agriculture	Executive Secretariat for Agricultural and Livestock Sector Planning	02/12/2020	30:03:00
2	Public Sector: Program Manager	Agriculture	Ministry of Agriculture and Livestock	07/12/2020	84:05:00
3	Public Sector: Policy	Agriculture and Climate Change	Executive Secretariat for Agricultural and Livestock Sector Planning	08/12/2020	54:37:00
7	Multilateral cooperation Agency	Agriculture	Inter-American Institute for Cooperation on Agriculture	08/12/2020	65:38:00
6	Private Sector: Program Manager	Agriculture: Coffee sector	National Coffee Institute	08/12/2020	49:09:00
10	Public Sector: Policy	Agriculture	Ministry of Agriculture and Livestock	09/12/2020	45:08:00
9	Private Sector:	Agriculture: Coffee sector	National Coffee Institute	09/12/2020	47:03:00
8	Public Sector: Research	Agri environmental Climate change	National Institute of Agricultural Innovation and Technology Transfer	09/12/2020	44:44:00
1	Research	Agriculture	University	10/12/2020	46:43:00
11	Public Sector: Policy	Agriculture and Climate Change	Ministry of Agriculture and Livestock	11/12/2020	50:58:00
12	Public Sector: program Manager	Agriculture: Coffee sector	Ministry of Agriculture and Livestock	14/12/2020	52:07:00
13	Private Sector	Agriculture: Coffee sector	National Coffee Institute	14/12/2020	51:52:00
15	Private Sector	Agriculture	Camara Nacional Agricultura y Agroindustria	15/12/2020	51:03:00
14	NGO and Public sector	Climate change	NGO / Parlament	15/12/2020	55:24:00
4	International Agency	Climate change	German Development Agency GIZ	22/12/2020	47:16:00
17	Private Sector	Agriculture	Insurance company	03/02/2021	43:29:00
16	Research	Agriculture and Policy	University	05/02/2021	53:38:00
20	NGO	Climate change and Agriculture	Fundecooperación (NGO)	01/03/2021	50:17:00
18	Public Sector: Policy	Environment / Climate Change	Ministry of Environment	10/03/2021	60:08:00
21	Public Sector	Agriculture and Climate Change	Ministry of Agriculture and Livestock	16/04/2021	61:06:00
19	Public Sector	Agriculture	Ministry of Agriculture and Livestock	19/04/2021	120:22:00
21				**Total**	**1164:50:00**

Appendix B

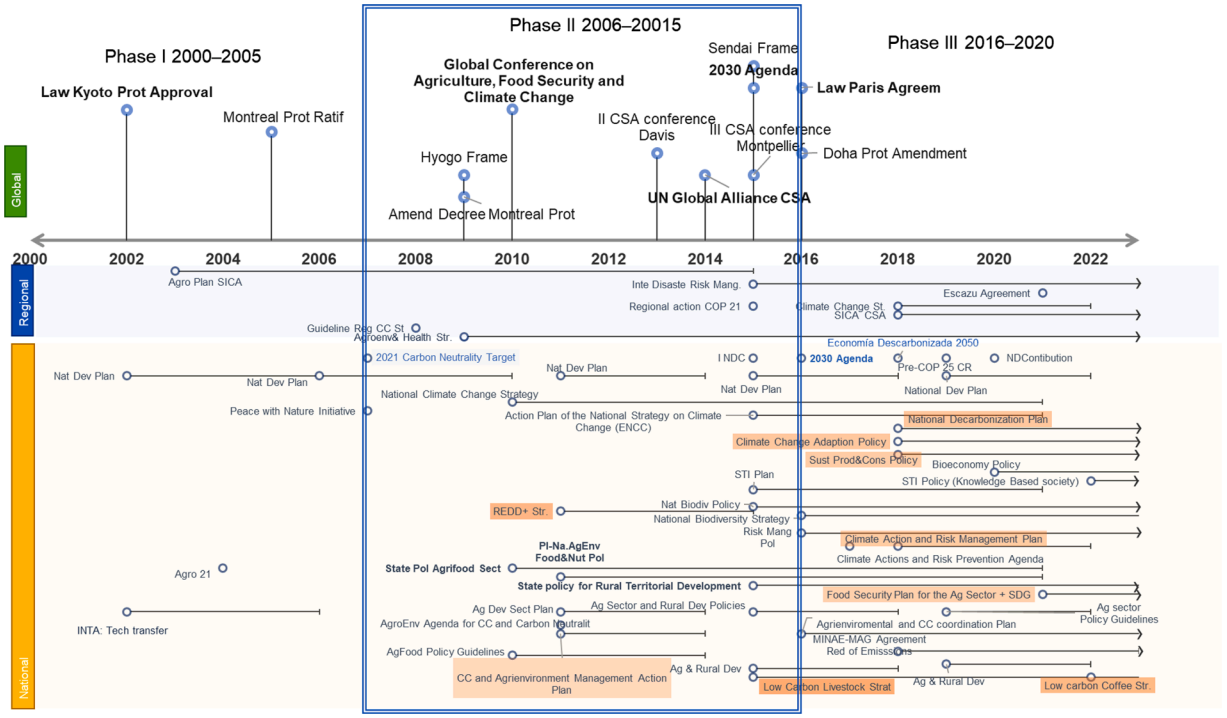

Fig. B1. Climate Smart Agriculture strategic phases: Plans and guidelines. In orange squares indicate the plans and policies with transformative features.

Appendix C

Table C1
Climate Smart agriculture key instruments divided by instrument type (regulatory, economic, informative and systemic) and purpose (niche creation and regime destabilization).

Type/Purpose	*Regulatory*	*Economic*	*Soft or informative*	*Systemic*
Niche creation	**Phase 1** (1994) Art 50. Constitutional Amendment, (1995) Environmental Law 7554, (1996) Forestry Law 7575, Regulation of the Use, Management and soil conservation law **Phase 2** Law Organic Agriculture Promotion Amendment Law 7554 Environmental Law (inclusion of Org Agriculture) Regulation 344,433 Biodiversity Law Amendment Law Soil conservation Regulation Domestic Carbon Market **Phase 3** FONASCAFE Law Amendment Law 7554 Environmental Amendment Law 7778: Biodiversity Law	**Phase 1** PES scheme **Phase 2** Law 8634: Development Bank System Benefits for Organic Production (RBAO) for organic producers Low carbon emsission agricultural technologies project (production and processing) NAMA Agricultural Insurance premiums for Adaption and Mitigation practices **Phase 3** Incubator program (low carbon and Adaptation indicators included) GEF Small Grants Program in Costa DESCUBRE program	**Phase 1** (1995) Regulations: Ecological Blue Flag Program Private standard: Rain Forest Alliance Public standard: Organic Agriculture **Phase 2** 3xAdmendment Ecological Blue Flag Program Decree No. 34,548 National Action Program to Combat Land Degradation in Costa Rica Voluntary stardard TICO-GAP (national certification program) INTE C—Neutral Standard Carbon Neutrality Country Program (Recognition)	**Phase 1** Advisory Commission on Land Degradation (CADETI) Cross-sectoral coordination: Risk Management program INTA creation (Institution for Innovation and technology transfer) Agricultural and Livestock Production Conversion Program **Phase 2** PLATICAR PLATFORM Creation of Climate Change Bureau Interministerial Technical Committee on Climate Change (CTICC) NAMA experiments Carbon Neutrality Alliance **Phase 3** Fab Lab Climate Changes Roundtables NAMA livestock experiments

(*continued on next page*)

Table C1 (*continued*)

Type/Purpose	*Regulatory*	*Economic*	*Soft or informative*	*Systemic*
			Training programs and extension on CSA NAMA coffee capacity building project **Phase 3** Amendment Carbon Neutrality 2.0 Program Germoplasm R&D program CR coffee app,riceapp Free pesticide Rice standard Agroinnova: IICA	Cross-sectoral coordination against desertification SEPLASA Agroclimatic Boards SINAMEC: Climate change and GHG database Platform (Bio/Eco Entrepreneurship) Hub for the Development of Agribusiness and Entrepreneurship in Costa Rica IICA
Regime destabilization	**Phase 2** Amendment of the regulation for prescribed agricultural burns **Phase 3** Decree Agrochemical regulation Decree on Agrochemicals (MRL)			**Phase 2**[a] REDD+ Exc Secretariat **Phase 3** SDG secretariat NAMAs governance arrangements (rice, sugar cane, and *musaceae*) Citizen's Advisory Council Climate Change and Scientific Advisory Council

[a] In Phase 2 and 3 new consultancy groups, councils and secretariats were created or amended. They all included new members of underrepresented stakeholders such as indigenous communities representatives, smallholder farmers national organization representatives. Thus, since the main aim of including new members is linked to changing and balancing the involvement of regime actors in policy decisions we categorize the instruments under regime destabilization following Kivimaa and Kern (2016) typology.

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