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UNVEILING THE ROLE OF STATE INTERVENTION IN GREEN TRANSFORMATIONS WITHIN COSTA RICA'S FORESTRY AND AGRICULTURE LAND USE SECTORS

By

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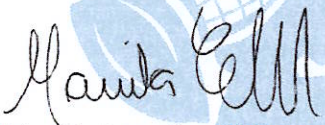

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ABSTRACT

This thesis presents a comprehensive evaluation of the influence of state policies on Costa Rica's forestry and agricultural land use sector within the overarching context of pursuing a green transformation. The main goal is to unravel the intricate interplay whereby the state's actions have either propelled or impeded the nation's strides towards a more sustainable and just trajectory. By analysing the multiple repercussions encompassing economic, social, and environmental dimensions, we extract insights that can shape policy directions within Costa Rica and guide similar decisions across other developing nations.

First, we identified and defined indicators that encapsulate the transformative processes embedded within Costa Rica's forestry and agriculture sectors. These indicators enabled us to gauge the progression of the targeted transformations. Next, we assessed the efficacy of the public policies executed by the Costa Rican state from 1997 to 2017. Specifically, we assessed the impacts of these policies and the extent to which Costa Rica's land use sector has effectively embraced a green transformation, while simultaneously identifying the hurdles in aligning key aspects such as social justice and environmental conservation.

We developed a framework to understand these dynamics. First, a meticulous review and selection process allowed us to identify the suite of land use sector policies and extract their associated indicators. Subsequently, we distilled the set of indicators to ensure their direct relationship with Costa Rica’s green transformation. We then quantified the impacts of these policies by comparing the intended objectives outlined in the policies' official documents against the tangible outcomes observed on the ground, relying on historical indicator trends as the primary evidentiary foundation. This assessment allowed for an analysis of policy impacts and identification of challenges and gaps that could prompt actionable solutions.

Our findings clarify a complex tapestry in Costa Rica's land use sector, marked by an intricate web of information that has thwarted efficient, transparent, and result-oriented monitoring frameworks. Amid these challenges, three pivotal insights emerged. First, while political commitment to indicator definition has been evident over the past decades, efforts often falter due to a lack of accessible information, shared measurement objectives, technical knowledge, and adequate resources. Second, the divergence among state institutions in defining and implementing monitoring frameworks introduces inconsistencies about what indicators to measure and the methodologies employed for measurement, despite interrelated scales and measurement objects. Last, the role of non-state actors in monitoring, such as civil society organisations and Indigenous groups, and transparency in data management remains ambiguously integrated into the process.

When scrutinising the state's endeavours to foster green transformations, particularly within forestry and agriculture, this study exposes commendable achievements intertwined with prevailing challenges. Notably, Costa Rica has made significant strides in forest conservation, garnering international attention by successfully reversing deforestation. The introduction of innovative programs such as payments for environmental services and steady commitments to climate action exemplify the state's dedication to sustainability. Yet, the narrative is not devoid of challenges, particularly when it comes to addressing social

inequalities, fostering rural development, and curbing environmentally detrimental practices.

The pursuit of a harmonious environmental agenda entwined with equitable social progress entails many challenges. The state is confronted with the daunting task of not only cultivating sustainable employment opportunities but ensuring unbiased income distribution, all while addressing the enduring issue of rural poverty. The aspiration to achieve a fairer distribution of forest goods and services, amplify economic prospects in rural communities, and establish environmentally conscious management practices within agroforestry landscapes adds another layer of complexity.

Furthermore, the complex power dynamics within major corporate entities involved in monoculture practices and pesticide use call for careful attention. It requires not only vigilance but also the implementation of tangible solutions at the local level. These power dynamics take place within the context of a capitalist model that hinders a comprehensive approach to the needs of vulnerable populations in rural territories.

Our study concludes by outlining a roadmap for realising a green transformation, rooted in five pivotal variables encompassing the environmental, social, rural, economic, and institutional domains. This roadmap provides a practical blueprint that closely mirrors the current trajectory of the land use sector, elucidating the range of actions that diverse social, economic, and state institutions can implement to address the sector's most urgent imperatives.

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DEDICATION

I wholeheartedly dedicate this work to my family, both the one I was born into and the one I have chosen, as they have been my true pillars that have guided me on the paths I have traversed to reach this moment. Their boundless love, support, and encouragement have been the driving forces behind my life journey.

Also, I extend this dedication to the remarkable individuals from countless rural communities that I have had the honour of working with and encountering in various corners of the tropics. Their profound influence has been transformative, shaping my perspective over the years. Witnessing first-hand the fundamental values of solidarity, collective effort, and harmony that thrive within these communities has left an indelible mark on my worldview. These experiences have become the very bedrock of my motivation throughout my personal and professional voyage.

A Mati. Mi sentido de pertenencia, mi dedicación, mi identidad. Por una vida juntos.

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From sustainable development to green economy and green growth

The international community has pursued the objective of sustainable development as its overarching goal since the 1960s, influencing several milestones, such as environmental conservation efforts, poverty reduction strategies, renewable energy adoption, biodiversity protection, climate change mitigation measures, sustainable agriculture practices, and the establishment of international agreements and frameworks to address global challenges. Environmental movements highlighted the connection between economic growth, development, and environmental deterioration (Carson *et al.* 1962). *The Tragedy of the Commons* presented an example of the interplay between economic growth and environmental preservation (Hardin 1968), and the Club of Rome report *Limits to Growth* described the desirable state of global equilibrium (Meadows *et al.* 1972). Later, *the Our Common Future* report, often referred to as the Brundtland Report, commissioned by the United Nations World Commission on Environment and Development (WCED), included what is now considered one of the most widely acknowledged definitions of sustainable development, which stipulates meeting current needs while safeguarding the capacity of future generations to fulfil their own requirements (WCED 1987). Since then, multiple countries and other actors have adopted a large body of international environmental laws, policies (i.e., multilateral agreements, treaties, and declarations), and agreements and outcomes from numerous international environmental conferences and summits that have influenced the development and mainstreaming of sustainable development and conservation globally (Table 1).

Table 1. Key international events, agreements, and legal documents that promoted and supported the mainstreaming of sustainable development and conservation globally between 1960 and 2015

Event/Agreement	Main Outcomes	Year	Country Promoting
Silent Spring by Rachel Carson	Book on the interlink between economic growth and environmental degradation	1962	United States
The Tragedy of the Commons by Garrett Hardin	Essay on the interlink between economic growth and environmental protection	1968	United States
Limits to Growth by the Club of Rome	Report describing the desirable state of global equilibrium	1972	International
Our Common Future / The Brundtland Report	Definition of sustainable development	1987	United Nations
United Nations Conference on Environment and Development (Earth Summit/Rio Summit)	Development of national strategies for sustainable development and multiple agreements and treaties, including: the Rio Declaration, Agenda 21, Statement of Forest Principles, UNFCCC, and CBD	1992	Brazil
Kyoto Protocol	International treaty to reduce greenhouse gas emissions	1997	Japan
Millennium Development Goals	Eight international development goals, including environmental sustainability	2000	United Nations

The Stern Review	Report on the economics of climate change	2006	United Kingdom
United Nations Conference on Sustainable Development (Rio+20)	Development of the sustainable development goals (SDGs)	2012	Brazil
Paris Agreement	International treaty to combat climate change by limiting global warming	2015	France

Note: This is not an exhaustive list; many other important events, agreements, and outcomes have contributed to the development of environmental policies and the promotion of sustainable practices around the world.

A turning point occurred during the United Nations Conference on Environment and Development (also known as the Earth Summit or Rio Summit) hosted in Rio de Janeiro, Brazil, in 1992. Within the conference's commitments, governments were urged to formulate national strategies for sustainable development that integrated policy measures delineated within five prominent outcomes. These encompassed: 1) the Rio Declaration on Environment and Development, a comprehensive program of action featuring 27 guiding principles for the responsible management of natural resources; 2) Agenda 21, an extensive 800-page accord encompassing 115 specific programs aimed at realising sustainable development goals; 3) the Statement of Forest Principles, a document comprising 15 guiding principles intended to steer the sustainable management, conservation, and development of all forests; 4) the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty fostering global cooperation in addressing climate change by imposing limitations on greenhouse gas emissions; and 5) the Convention on Biological Diversity (CBD), a legally binding multilateral agreement aimed at the preservation of biodiversity, the sustainable utilisation of biological resources, and the equitable sharing of benefits arising from the utilisation of genetic resources.

Despite concerted government initiatives and international collaboration on a global scale to put these strategies into practice, apprehensions persist regarding the economic and environmental trajectories of numerous countries. These concerns have been exacerbated by protracted global crises in energy, food, and finance and further accentuated by ongoing alerts that society teeters on the brink of exceeding various planetary boundaries or ecological thresholds. In fact, humanity has already exceeded six boundaries: novel entities, climate change, biosphere integrity, land system change, freshwater change, and biogeochemical flows (Richardson *et al.* 2023). Some effects of the climate changes are the retreat of mountain glaciers around the world (IPCC 2007), an increased rate of sea-level rise (Church and White 2006), increased bleaching and mortality in coral reefs (Bellwood *et al.* 2004, Stone 2007), and a rise in the number of large floods (Milly *et al.* 2002, MEA 2005). The rates of biodiversity loss, both current and projected, represent the sixth significant extinction event in the annals of Earth's evolutionary history, meaning that humans have increased the rate of species extinction by 100–1000 times Earth's geological background rates (Chapin *et al.* 2000, Mace *et al.* 2005). Human activities, including industrial nitrogen fixation, agriculture, fossil fuel combustion, and biomass burning, now release more reactive nitrogen into the environment than all natural terrestrial processes combined. This pollution affects waterways, coastal regions, and the atmosphere and accumulates in the biosphere (Rockström *et al.* 2009).

Subsequently, governments and institutions globally have presented extensive potential

solutions to address sustainability goals. In 2008, the United Nations Environment Programme (UNEP) began to advance its idea of applying green stimulus packages with a high share of public investment, which several countries adopted as part of their economic recovery plans. This idea, as part of UNEP's Green Economy Initiative, provided analysis and policy guidance to promote investments in environmentally sustainable sectors while facilitating the transition of environmentally unfriendly sectors towards greener practices. As part of the initiative, the Global Green New Deal (GGND) in 2009 suggests a combination of policy measures aimed at revitalising economic recovery and enhancing the sustainability of the global economy. It also served to position UNEP as a leader in promoting a green economy within the framework of sustainable development and the goal of poverty eradication. The concept was one of the two specific themes for the UN Conference on Sustainable Development (Rio +20), that preceded the 2030 Agenda for Sustainable Development, covering a set of 17 sustainable development goals (SDGs) and 169 associated targets. Green economy was delineated as an economic system that leads to enhanced human well-being and equitable social conditions while notably mitigating environmental risks and addressing ecological scarcities. This economic model is characterised by its low carbon footprint, resource-efficient practices, and inclusive social structures (UN 2012a).

In parallel, the green growth concept was further promoted. During May 2011, the Organisation for Economic Co-operation and Development (OECD) presented its Green Growth Strategy to heads of state and ministers from more than 40 countries. This initiative was met with approval as an effective instrument aimed at fostering economic expansion and job generation by means of a more responsible use of natural resources, enhanced energy utilisation, and the assessment of ecosystem services (OECD 2011). The formulation of this strategy was prompted by the appeal of ministers from 34 countries who had endorsed the Green Growth Declaration in 2009. This commitment involved intensifying their endeavours to adopt green growth strategies, constituting a crucial component of their response not only to their economic challenges but towards a more sustainable future. This strategy emerged following other initiatives such as the launch of the Seoul Initiative on Environmentally Sustainable Economic Growth (Green Growth), which took place during the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific in 2005 (ECOSOC 2005). In 2010, the European Union had embraced the concept of green growth as a fundamental component of its EU 2020 Strategy, which prioritises intelligent, sustainable, and inclusive growth (European Commission 2010). Subsequently, in 2012, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) introduced green growth as an avenue for developing nations to leapfrog their development, emphasising the need for government-led efforts (UN 2012b).

The adoption of such concepts in the globalised world has brought strong criticism, mainly from the global South[1]. A significant concern is that mainstream interpretations of the green economy and green growth often serve as mechanisms to sustain prevailing patterns of

[1] According to de Sousa Santos (2016), "The global South is not a geographical concept, even though the great majority of its populations live in countries of the Southern hemisphere. The South is rather a metaphor for the human suffering caused by capitalism and colonialism on the global level, as well as for the resistance to overcoming or minimising such suffering. It is, therefore, an anti-capitalist, anti-colonialist, anti-patriarchal, and anti-imperialist South".

capitalist development and its associated inequalities, albeit now concealed in green rhetoric. Meanwhile, critical aspects such as justice, institutional reform, policy transformation, and more fundamental shifts in political power, aimed at fostering a green and fair economy are frequently overlooked or sidelined (Lyon and Maxwell 2011). The required innovation capacity and its accessibility by developing countries suggest that green jobs are expected to predominantly emerge within high-tech industries, which may offer limited benefits to individuals on the fringes of the mainstream economy. In addition, green discourses often favour top-down approaches relying on regulations, planning, and technical solutions, potentially limiting social transformations and policy effectiveness while missing opportunities and perpetuating injustices (Davies and Mullin 2011; Kosoy *et al.* 2012; Scholz 2012; Victor and Jackson 2012; Morgera and Savaresi 2013; Ehresman and Okereke 2014; Green Economy Coalition, cited by Schmitz 2015; Leach and Scoones 2015).

Others argue for a departure from the market's liberal growth paradigm, in which there is an implicit assumption that economic growth (e.g., growth in GDP) is synonymous with progress (OECD 2008). Scoones *et al.* (2015) indicate that, especially after 2008, UNDP, OECD, the World Bank, and other multilateral development banks have developed an extensive list of ideas about the marketisation of nature and the green economy in response to support for the private sector. As a result, there has been a deliberate promotion of a gradual transition in property rights, shifting from communal to private ownership. We argue instead that the debate needs to centre on gain/loss questions focused on justice, equity, fair transitions, the recognition of rights and livelihoods of local resource users, and avoidance of limited financial valuations of ecosystem services that disregard social and cultural values in various contexts (Fairhead *et al.* 2012, Martin *et al.* 2013, Leach 2015, Lederer *et al.* 2015).

Introducing the concept of green transformations

To provide a deeper understanding of the effects that these global solutions have on countries, this study focuses on green transformations. Here this concept refers to a profound restructuring of the economy to align with planetary boundaries, addressing environmental degradation, social inequalities, and power imbalances to create inclusive and equitable societies, prioritising historically marginalised individuals (Leach 2015, Schmitz 2015, Scoones *et al.* 2015).

A key aspect of the green transformations is focusing on the complex politics intertwined with such disruptive changes, spanning institutional shifts, policy alterations, and profound transformations in political power structures. Politics, therefore, plays a pivotal role in determining which pathways are endorsed and legitimised while others are marginalised and unable to gain traction (Scoones *et al.* 2015). These complex politics extend across various governance levels, giving rise to intricate coordination challenges. Hence, green transformations necessitate critical considerations of steering mechanisms, the array of governance actors involved, institutional frameworks, management strategies, and the scale and depth of change required.

Central to these points are questions surrounding accountability and participation. Achieving green transformations entails the integration of efforts by governments and local/global

institutions, aligning the incentives of an array of stakeholders to actively support these changes and negotiating power dynamics and authority within political alliances. Importantly, the political dimension of green transformations extends far beyond short-term policy actions. Transformations encompass the co-evolution of policies, institutions, infrastructures, and technologies, in conjunction with the allocation of material resources over the long term. They involve the politics of knowledge dissemination and behaviour change within diverse social and cultural contexts, making it essential to address a wide spectrum of interconnected political challenges (Scoones *et al.* 2015).

In the discussions surrounding green transformations and broader conversations on sustainable development, a tendency is to focus towards transitions rather than transformations. It is crucial to contextualise this preference and emphasise why transformations represent a crucial and much-needed pathway to addressing challenges posed by sustainability and equitable development.

Transitions offer a route of predictability and control. They follow well-established paths within the existing system, guided by structured knowledge systems and predefined goals. Such orderliness can be reassuring, particularly for decision-makers and policymakers, as it seemingly allows for a smoother and more manageable trajectory towards sustainability. However, this can potentially limit the ability to address issues of development. Transition-oriented approaches tend to rely heavily on technological innovations and may overlook the profound structural and systemic changes required for addressing root causes. Additionally, transitions often presume a consensus on the desired outcomes, which may not exist (Stirling 2015).

Conversely, transformations offer a more holistic and adaptive framework. They embrace the idea that sustainability challenges involve diverse, emergent, and often-contentious political dynamics. Transformations prioritise social innovations and have the potential to challenge and disrupt current power structures, making them more agile in addressing complex issues. They acknowledge the coexistence of various knowledge systems and recognise that the desired ends may not be predetermined or universally agreed upon (Stirling 2015).

A successful adoption of green transformations necessitates varied approaches that encompass both political strategies and robust public-policy frameworks. While the initiation of transformations is critical, sustaining them over extended periods hinges on several key factors. One is the formation of diverse coalitions around distinct transformation objectives (Newell 2015, Schmitz 2015). These coalitions serve as the driving force behind implementing policy, advocating for change, and building momentum for transformation efforts.

However, it is imperative to recognise that instigating green transformations and assembling coalitions are just the initial steps. To ensure the enduring sustainability of these transformations, effective public policies are essential. Public policy plays a pivotal role in providing the necessary guidance and governance to steer transformations towards their intended goals. Furthermore, the political effects of policies have a profound impact on their overall success. These effects are influenced not only by policy design but also by the broader institutional frameworks and dominant ideas within each country. Since different nations

possess unique systems of social and economic institutions that evolve over time, these varying institutional contexts inevitably shape the trajectory and pace of green transformations (Lockwood 2015).

The prospects for advancing a green transformation, the effectiveness of alliances, and the alignment of public policies with social considerations are also closely intertwined with local dynamics. At the grassroots level, the origin of green transformations often emerges from spontaneous responses to specific environmental and social challenges. These movements harness collective efforts, uniting individuals from various backgrounds, and may not always initially carry explicit "green" labels. Nevertheless, they hold immense value due to their non-market and socially beneficial aspects. In many cases, practices adopted by individuals such as small-scale producers, forest dwellers, and residents of informal settlements yield positive environmental impacts, even when not explicitly aligned with green objectives. These locally rooted pathways, though not always conspicuous, significantly contribute to the broader goals of green transformations (Leach and Scoones 2015).

The effectiveness of such mobilisation centres on the capacity of local actions and agendas to connect with and challenge global forces. Mobilisation assumes diverse forms, with no universal approach. Some movements directly engage the state, while others strategically align with it. Concurrently, networks and movements must strike a balance between global awareness and local action, placing a premium on safeguarding local perspectives in the face of global initiatives. In addition, grassroots movements rely on support from institutions, often larger organisations, to influence change within bureaucratic and policy structures. These three components—movements, networks, and institutions—complement each other, and their collaboration is essential for the success of green transformations (Leach and Scoones 2015).

However, the diversity among groups pursuing green transformation goals, coupled with varying organisational forms, issue framings, strategies, and tactics, can lead to fragmentation within local movements. This fragmentation presents challenges for coordinated action and maintaining productive relationships among movements, networks, and institutions. From the grassroots level and upwards, preventing new institutions from becoming detached from their grassroots base and ensuring that networks remain active and innovative rather than being co-opted by mainstream institutions plays a critical role in propelling green transformations (Leach and Scoones 2015).

Green transformations in the context of the land use sector

In this research, the land use sector is defined as comprising the diverse arrangements, activities, purposes, and inputs conducted within the six land use categories delineated by the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2006, Lambin and Geist 2006, Lambin and Meyfroidt 2010). It encompasses a wide range of activities and practices that involve the utilisation and management of land resources, such as agriculture, forestry, urban development, and conservation and thus holds immense importance in the context of a green transformation. The way land is used and managed directly impacts the environment, society, and economy, making it a crucial focal point for achieving sustainability goals.

Understanding the land use sector is essential for promoting a green transformation because it allows for a comprehensive analysis of the interplay between human activities and the environment. By examining the various arrangements, activities, purposes, and inputs within the land use sector, we can gain insights into the drivers of environmental degradation, social inequalities, and economic inefficiencies. Moreover, the land use sector assumes a crucial role in tackling urgent global issues such as climate change, biodiversity decline, and the exhaustion of natural resources. It is a significant contributor to greenhouse gas emissions, habitat destruction, and soil degradation. Therefore, transforming the land use sector towards more sustainable practices and approaches is crucial to mitigating environmental impacts and promoting ecological resilience.

The land use sector also has important implications for social and economic development. It affects livelihoods, food security, and the well-being of communities, particularly in rural areas where land-based activities are often the main source of income and employment. By promoting sustainable land use practices, we can enhance the resilience and inclusiveness of rural economies, reduce poverty and inequality, and safeguard the rights and well-being of local communities.

By analysing the land use sector in the context of green transformations, this research addresses a critical gap in understanding the implications of states promoting and adopting green policies in global South countries. Our objective is to discern whether these policies align with the principles and goals of a green transformation. Across many global South nations, the adoption of green policies has gained increasing significance in addressing environmental challenges, advancing social equity, and achieving enduring economic sustainability. However, a comprehensive understanding of the specific implications and outcomes of these policies within the unique context of the land use sector, where socioeconomic and environmental factors are paramount, is essential.

Through an examination of state-implemented policies, this research strives to assess the extent to which these measures contribute to addressing environmental concerns, promoting social equity, and fostering economically sustainable growth within ecological limits—all fundamental tenets of a green transformation. By doing so, it enriches the broader discourse on sustainable development and provides invaluable insights for policymakers, researchers, and practitioners committed to forging a more sustainable future.

Costa Rica, with its unique context and land use sector, serves as an exceptional case study for understanding the challenges related to a green transformation; it offers valuable insights into the relationship between economic growth, environmental protection, and social progress. By examining Costa Rica's experience, we can address important questions about measuring progress towards a green transformation and ensuring a fair distribution of the benefits derived from natural resources. Costa Rica's land use sector allows us to explore how its policies and practices can contribute to or hinder a green transformation. We can thus assess its effectiveness in achieving sustainable and inclusive outcomes by asking questions such as: Does it adequately address social and environmental challenges? Are there any trade-offs or gaps that need to be addressed?

While Costa Rica is widely recognised as a global leader in conservation and has experienced continuous macro-economic growth (Langhansa *et al.* 2022), it is important to acknowledge that this progress has been marred by a consistent disregard for social advancement, particularly in rural regions. This oversight has led to a systematic neglect of critical aspects such as employment opportunities, poverty eradication, and inequality reduction within initiatives focused on rural development (PEN 2018, Rivera and Porras 2018, Barboza *et al.* 2020). This deficiency in emphasising social development hampers the generation of capacities, opportunities, and mechanisms necessary for fostering sustainable enhancements in social well-being (Licha 2007).

A significant implication of the green transformation concept is the urgent need to integrate social considerations into sustainable development endeavours. Concurrently, conflicts emerge as the state's conservation policies clash with a development paradigm marked by social marginalisation, economic disparity, and environmental unsustainability. This incongruity underscores the inherent tensions between conservation actions and the wider socioeconomic and environmental backdrop, highlighting the necessity for a more comprehensive and nuanced approach to achieving a green transformation in Costa Rica.

Costa Rica has forged ahead in its commitment to conservation, building on the establishment of 169 protected areas since 1955, covering 26% of the national territory. In 1994 the establishment of the National Conservation Areas System (SINAC) brought together three formerly distinct entities responsible for supervising national parks, wildlife, and forestry management. The country's trajectory of land conservation and restoration has evolved over time, initially employing mechanisms such as tax incentives and financial programs to encourage reforestation and sustainable forest practices. More recently, Costa Rica has embarked on a path of low-carbon development, exemplified by initiatives such as payment for environmental services (PES), the REDD+[2] strategy, and Nationally Appropriate Mitigation Actions (NAMA) outlined in the National Decarbonisation Plan 2018–2050.

Costa Rican development since the early 1980s has been shaped by political elites, business entities, and both national and international bureaucratic institutions (Villasuso 2000). This development paradigm, centred on export-oriented expansion, diversification, and foreign investment attraction, fostered the establishment of public institutions, policy frameworks, and specialised zones to facilitate large-scale production for non-traditional exports.

[2] REDD, which stands for Reducing Emissions from Deforestation and Forest Degradation, is an international initiative aimed at mitigating climate change by curbing deforestation and forest degradation in developing countries. It originated as a climate change mitigation strategy within the UNFCCC. The main goal of REDD was to incentivise developing countries to reduce carbon emissions from deforestation and forest degradation by providing financial compensation for the carbon sequestered in their forests. Over time, the REDD initiative has evolved to include additional objectives and components, such as the conservation of biodiversity, the sustainable management of forests, and the enhancement of forest carbon stocks. This evolution has led to the adoption of the term REDD+ (REDD-Plus), which signifies a more comprehensive and holistic approach to forest conservation and sustainable management. REDD+ explicitly links to the concept of green transformation by recognising the pivotal role of forests in addressing not only climate change but broader sustainability and development challenges. It emphasises the need to transform traditional land use practices, promote sustainable forest management, and support local communities in their efforts to protect and restore forests. National REDD+ programmes incorporate social and environmental safeguards, prioritising both environmental integrity and social equity.

Nevertheless, the consequences of this model, after four decades of implementation, have raised considerable concerns across environmental and social domains. Alarming indicators include heightened pesticide consumption and ensuing health issues in certain regions (UNDP 2022), escalating soil degradation and water contamination (Castillo *et al*. 2000, García 2013, Montiel-Segura 2015, Mendez *et al*. 2018, Montero 2018, Córdoba *et al*. 2020), and persistently rising rates of unemployment, rural poverty, and inequality (PEN 2022).

Narratives that define a green transformation in Costa Rica's land use sector

This study builds upon the analysis of Scoones *et al*. (2015), which presents four narratives of green transformation: technocentric, marketised, state-led, and citizen-led. By adopting these narratives, our analysis of Costa Rica's land use sector green transformations, becomes more comprehensive. These narratives provide a lens through which to examine the approaches and perspectives in driving sustainability transitions and enable a more nuanced understanding of the various actors, mechanisms, and ideologies that shape the green transformations in Costa Rica. This approach allows for a more holistic assessment of the country's progress towards sustainable development and provides insights into the strengths, weaknesses, and potential pathways for further improvement within the land use sector.

First, in **technocentric transformations,** challenges revolve around identifying the optimal blend of technologies to address increasing demands in more environmentally sustainable ways, with robust international cooperation that facilitates trade and the transfer of technology. In this approach, the goal is to diminish ecological footprints through technological advancements without fundamentally reshaping existing systems. It aligns with a fundamentally liberal perspective of power, wherein trust in global institutions and state/policy elites hinges on their perceived independence from vested interests and social classes, along with their commitment to upholding the rule of law (OECD 2011, UNEP 2011, Levidow 2014, Scoones *et al*. 2015). Positions against this narrative indicate that technological and innovation capabilities are possible only in the global North or in emerging economies such as China, India, and Brazil, while techno-scientific innovation that emerges from the global South is devalued (Ely *et al*. 2013, Scoones *et al*. 2015).

Marketised transformations emphasise the market as the driving force for change, using mechanisms such as pricing, the establishment of trading systems, and the definition of property rights regimes. This approach initiates cycles of accruing benefits from economic activities and initiatives that leverage natural resources. This type of transformation is supported by the OECD Green Growth Strategy and UNEP Green Economy Agenda. This is done in terms of embracing the importance of acknowledging and assigning economic value to the natural capital that underpins economic growth (OECD 2011, UNEP 2011, Scoones *et al*. 2015,). Market schemes in this narrative include the offsetting emissions in key sectors like transportation, infrastructure, energy, forestry, and agriculture under international mechanisms such as the Clean Development Mechanism (CDM), the United Nations and World Bank initiatives on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD), and some carbon voluntary schemes, such as the Verified Carbon Standard and the Gold Standard. Critics of this concept argue that when ecosystems and landscapes are subjected to financial valuation, alternative social and cultural values tend to be disregarded.

This includes values that have developed over extended periods of coexistence between human communities and diverse ecological environments. They assert that such approaches can inadvertently reinforce capitalist structures of dominance and resource exploitation (McAfee 2012, Martin *et al.* 2013, Sullivan 2013).

The **state-led transformations** underscore the importance of re-establishing markets within more robust structures of social regulation while acknowledging the historical significance of states in previous phases of innovation and technology-driven growth. In this transformative process, terms such as the "green entrepreneurial state," "green industrial policy," and "green state" represent various avenues to emphasise the pivotal role of state intervention. It also underscores the potential of state-led Keynesian or developmental states as essential correctives to address some of the naivety and ideological aspects present in certain market-based approaches to green transformations (Chang 2002, Fine *et al.* 2013, Scoones *et al.* 2015). Nevertheless, questions on who sets the direction of change, how the overall goals of green transformations are set, and how matters of distribution, accountability, and persistent power imbalances will be tackled remain unanswered.

The **citizen-led transformations** challenge the notion that the state or market alone can effectively drive profound green transformations in society. Instead, emphasis is on the importance of de-growth and bottom-up transitions towards alternative economies based on solidarity. This approach encompasses movements such as transition towns, alternative agri-food initiatives, and the pursuit of "good living"—or "*el buen vivir*" in Spanish (Dobson 2009, Leach and Scoones 2015). The concept of *el buen vivir* has gained significant symbolic and political significance in countries like Ecuador and Bolivia, been enshrined in their national constitutions, as well as adopted through informal customary rules among Amazonian Indigenous groups. For many, this marks a historic juncture in which Indigenous knowledge has played a fundamental role in bringing together diverse discussions, challenging the prevailing neo-liberal model of wealth generation and political governance (Escobar 2010, Walsh 2010, Florentin 2016).

Doubts, however, linger about the citizen-led approach. Some question its ability to diminish the influence of powerful actors who control sectors that require transformation. Another concern is about the organisational capacity of civil society groups to effectively communicate and enforce their demands (Scoones *et al.* 2015). While the citizen-led transformation offers a promising alternative to mainstream models, critical perspectives remind us to remain cautious about its inherent potential limitations and challenges for navigating complex power dynamics at local levels and ensuring that the voices of marginalised communities are not manipulated and marginalised further in the pursuit of a green transformation. Nevertheless, this perspective sparks important debates and pushes for a more inclusive and participatory approach to creating sustainable and just societies.

These four narratives offer distinct lenses through which we can analyse the complex dynamics of change within the framework of the social, political, and economic structures that underlie capitalist development. Importantly, these narratives are not mutually exclusive; they can coexist and mutually reinforce one another. Indeed, it is often the interplay of diverse political interests, economic partnerships, and civil society demands that gives rise to various pathways for advancing green transformations.

It is, however, crucial to recognise that progress within any or all these narratives does not automatically equate to a genuine shift towards a green transformation. This distinction is significant because analysing these narratives provides us with valuable insights into how issues of social justice are frequently side-lined in conventional development paradigms, including those encompassed by these narratives themselves. Implicitly, pathways explained by these narratives assume that justice will naturally be realised within the confines of their proposed frameworks. For instance, technocentric approaches envision benevolent elites as custodians of global public goods, market-oriented transformations hinge on consumer support for equitable changes driven by their purchasing power, while state-led transformations predicate justice on the authority and legitimacy of governments (Scoones *et al.* 2015).

Within the land use sector of Costa Rica, we contend that different dynamics have led to the emergence of at least four distinct transformations. The first pertains to the forestry sector. While it has made significant efforts to increase and preserve forest cover through the establishment of a national system of conservation areas and the implementation of a PES program, it has been less effective in promoting the competitiveness of forests compared to other land uses. To date, sustainable forest management as an alternative for local timber production and sustainable consumption has not been adequately promoted. Public policies aimed at consolidating community-led forest enterprises, which could foster forest employment, equitable business opportunities, and profitable value chains of forest products, have not yet been successfully designed and implemented. These examples highlight the limited inclusion of social aspects, specifically the welfare of rural families who rely on forest resources for their sustenance, in both private and public conservation mechanisms.

Costa Rica's second transformation centres on the agriculture sector, which has long served as a key driver of the national economy. This sector witnessed rapid growth at the beginning of the 2000s, particularly in the production of non-traditional high-value crops such as pineapple and bananas, thereby bolstering Costa Rica's global standing in the agricultural export market and enhancing its international reputation as a major producer of these commodities. However, this growth has not been without its drawbacks. The intensive use of pesticides, resulting in potential environmental and health risks, coupled with increased carbon dioxide emissions, present significant challenges. Furthermore, there is a lack of support for family farming initiatives (Rivera 2011), which can hinder food security and local livelihoods, particularly in rural areas. The agricultural sector also struggles with persistent issues of unemployment and job insecurity (OECD 2017, 2018). Addressing these challenges and ensuring the sustainability of the agricultural sector are crucial to fostering a more balanced and inclusive green transformation within the land use sector of Costa Rica.

The third transformation revolves around the tourism sector, which serves as one of the country's primary economic activities and is built upon the principles of ecotourism and sustainable tourism (Pan *et al.* 2018). Costa Rica has positioned itself as a renowned global green brand, attracting foreign investments and tourists seeking experiences linked to biodiversity. The establishment of some 3100 accommodation facilities as of 2022 (ICT 2022) has provided essential services for both national and international visitors. Despite these positive aspects, negative trade-offs persist. Evidence underscores the detrimental

effects of tourism and related infrastructure advancements on the integrity of natural resources. Concerns encompass inadequate sewage and solid waste disposal; contamination of river, stream, beach, and ocean waters; deforestation and mangrove elimination; wetland degradation; soil and spring deterioration; habitat degradation impacting biodiversity; and insufficiency in the availability of water resources, particularly in regions susceptible to scarcity (Fonseca 2010, Honey *et al.* 2010). These challenges may indicate a need for more comprehensive strategies to ensure that the growth of the tourism sector aligns harmoniously with the principles of sustainability, preserving the very resources that attract visitors while mitigating the negative impacts on the environment and local communities.

The fourth transformation pertains to the energy sector, which has undergone significant changes in the processes of energy production, distribution, and consumption, particularly in electricity generation and transportation. The establishment of the Costa Rican Electricity Institute (ICE) in 1949 was driven by the principles of national sovereignty and the pursuit of sustainable energy sources. Costa Rica aims to develop a national energy system with minimal greenhouse gas (GHG) emissions by relying on clean and renewable sources. Most of these renewable energy sources come from natural resources and transformed into electricity through various types of power plants. Costa Rica has achieved international recognition for its high proportion of renewable energy used for electricity generation, consistently exceeding 90% in recent decades, with hydroelectric power being the primary source. However, electricity production contributed to only 0.4% of overall emissions in the energy sector in 2017 (MINAE 2021). On the other hand, net GHG emissions in the sector have increased since 1990, with the energy sector representing 67% of the total CO_2e emissions in the country as of 2017, with transportation accounting for 75% within the sector (MINAE 2021). Also, it is worth noting that the process of hydroelectric power privatisation has raised concerns regarding its social impacts, especially when viewed through the perspective of green capitalism (Gutiérrez 2020).

For this research, we concentrated on the forestry and agriculture transformations in Costa Rica because they have significant implications for economic development as key contributors to the national economy. Understanding the dynamics and challenges within these sectors is crucial to comprehending the overall green transformation trajectory of the country, and both sectors are intimately connected to environmental conservation efforts. Their practices and policies have direct impacts on land use, biodiversity, and ecosystem health, making them essential areas when examining the intersection of sustainability and land management. These sectors also have profound social implications, particularly in terms of rural livelihoods, income distribution, and social equity. By focusing on forestry and agriculture, we can delve deeper into the intricate relationships between economic growth, environmental sustainability, and social well-being in Costa Rica.

The tourism transformation in Costa Rica has been very important in recent history and requires an independent study to fully understand its impacts on sustainable development. In fact, we have conducted a parallel study examining the interconnections between Costa Rica and Vietnam in the tourism sector. That study followed a similar methodology to our current research, involving the selection of indicators and the analysis of state policy outcomes within the context of green transformation (Milla *et al.* 2019). As for the energy sector, Urban *et al.* (2018) offers a valuable resource in understanding the opportunities, challenges, and

compromises associated with green transformations within the energy sector, all viewed through the lens of energy justice.

In this research, we propose environmental, rural, social, economic, and institutional variables to analyse green transformation inductively. These categories were derived from discussions among relevant stakeholders, analysis of the historical context of the land use sector, and our own expertise in the field. By examining existing frameworks and considering the specific context of our study, we identified these variables as crucial factors for understanding the complexities of the land use sector and its green transformations. Integrating these variables in our analysis allows for a comprehensive examination of the multiple dimensions and interdependencies within the land use sector.

The environmental variable relates to the state's duty to protect every individual's right to a healthful and ecologically balanced environment, including the conservation of robust ecosystems and biodiversity. We define this variable as one that advocates for conservation practices and the sustainable use of natural resources under a rights-based approach. Within the context of a green transformation, we understand this approach as one that recognises the rights of Indigenous Peoples and other rural populations to nature, in contrast to traditional fortress conservation and other stringent conservation measures.

The rural variable is characterised by the social relations that unfold within a given territory. These are based on principles of solidarity and are oriented towards social action. Rurality extends beyond mere geographical boundaries and refers to the entire economic and social context that encompasses diverse activities, relatively independent of direct urban influence. Examples of such activities include forestry, agriculture, crafts, small and medium industries, commerce, and services. We consider forest and farming communities as central to the social and economic dynamics within the rural variable.

The social variable encompasses a wide range of social services provided by the state and the opportunities available to state and non-state actors to enhance access to these services. Its focus is on reducing social and economic risks, vulnerabilities, inequalities and poverty. We emphasise the recognition and promotion of human-rights-based approaches, specifically acknowledging the rights and contributions of local communities, rural women, rural youth, Indigenous Peoples, Afro-descendants, and peasants.

The economic variable revolves around the economic performance in the production of goods and services derived from natural resources. This includes an assessment of potential human rights and environmental risks associated with economic operations and supply chains within the land use sector. Our perspective acknowledges that focusing solely on economic growth without ensuring a fair distribution of economic benefits at the individual and collective levels would lead to unsustainable and unjust development goals. Thus, we recognise the significant value that local communities and other rural-rights holders possess in protecting and restoring nature, and we acknowledge that any transformative process should prioritise economic inclusivity.

The institutional variable relates to the established rules that structure social interactions within a given context. It encompasses formal rules (laws and regulations), informal

constraints (self-imposed norms of behaviour and codes of conduct), and the mechanisms for implementing both. Within the land use sector, our focus lies on the rules associated with accessing and using forest and agricultural resources based on various land use types, locations, purposes, and forms of individual or collective action. These rules also involve corresponding sanctions and the distribution of benefits. State institutions (political parties, municipalities, regulatory agencies, courts), economic institutions (cooperatives, associations, private companies), social institutions (local communities, rural women, rural youth, Indigenous Peoples, Afro-descendants, peasants), and educational institutions (professional bodies, academic centres, technical schools, agricultural extension centres), all play crucial and diverse roles in organising solutions to the sector's challenges. Understanding the range of interests and responsibilities held by these institutions allows a better appreciation of the sector's complexities and underscores how important collaboration and coordination among stakeholders is to ensure the success of policy interventions.

The state as an agent of change in the land use green transformation in Costa Rica

The assumption that social democratic welfare states have the capacity to drive and legitimise green strategies and reforms has predominantly been associated with developed economies (Meadowcroft 2005, 2012; Gough and Meadowcroft 2011). However, it remains unclear how this translates for developing countries, especially in contexts where state structures tend to prioritise externalising ecological costs and align with established modes of capitalist development (Lederer *et al.* 2015). It is particularly crucial to delve more deeply into the analysis of the impacts of green policies within the context of contemporary welfare states that have bolstered an unsustainable economic model (Gough and Meadowcroft 2011, Lederer *et al.* 2015).

In our analysis, we pay special attention to the transformative processes initiated by state actors, such as the elite represented in the government as well as the powerful and autonomous bureaucracy that operates independently from domestic pressures. We also recognise the significant role played by non-state actors, as emphasised by Lederer *et al.* (2015, 2019), including key capitalists, transnational multi-actor governance networks, multi-stakeholder partnerships, business actors, and international bureaucracies. By adopting this approach, our objective is to examine the transformative dynamics within the context of a state-led narrative.

To enhance our research, we provide a detailed understanding of the land use characteristics that have shaped its trajectory over the years by considering the specific activities within the sector, as defined by the IPCC for Agriculture, Forestry, and Other Land Use (AFOLU). These include forest land (including woody vegetation meeting official thresholds for forest land), cropland (including cultivated fields and agroforestry systems), grassland (including rangelands and non-cropland pastureland), and wetlands (including peatlands) (IPCC 2006, Lambin and Geist 2006, Lambin and Meyfroidt 2010). These represent the primary land uses within the country's land use sector.

Cropland and grassland are key components of the agricultural sector, covering a substantial 47.1% of the nation's land area. Within the cropland category, two main segments exist: 1)

permanent crops, which include coffee, bananas, oil palm, and pineapple, accounting for 15.7% of the total area, and 2) arable lands, where annual crops like rice, beans, and maize flourish, representing 6.9% of the land. Meanwhile, grasslands account for 43.4% of the agricultural sector's total expanse, playing an essential role in supporting livestock activities that extend across approximately a million hectares. Beef cattle make up 42% of the livestock; purpose-specific livestock, 32%; and dairy cattle, 26%. These livestock endeavours make substantial contributions to rural economies and the overall national economy (Chacón *et al.* 2015, INEC 2015). In 2020, agriculture and livestock activities contributed 4.4% to the national gross domestic product (GDP), amounting to approximately USD 2.4 billion. Agricultural exports constitute 42.2% of Costa Rica's total exports, reaching USD 4.9 billion in 2020 (SEPSA 2022). Bananas and pineapples remain the main economically important crops, accounting for 41% of the total value added in the agricultural sector. The agricultural sector employs 11.7% of the country's total workforce, providing employment for 247 262 individuals.

Forest land and wetlands cover 52.4% of the territory (MINAE 2015). These ecosystems harbour about 95 157 known species, representing approximately 5% of the world's known biodiversity (Rojas and Obando 2021). The total carbon stock stored in the country's forests amounts to more than 8 million tons of carbon, and timber production and consumption contribute 2% to the GDP (REDD/CCAD-GIZ-SINAC Program 2015, BCCR 2016b). Approximately half of the forest area is designated as state protected areas, while the other half consists of privately owned forests. The PES program, established in 1997, plays a significant role in the management of privately owned forests. As of 2018, the program covered some 1.2 million hectares, with nearly 90% of this designated under forest protection contracts, while the remaining portions were for activities such as agroforestry, reforestation, and ecological regeneration efforts (Brownson *et al.* 2020).

However, despite these ecological and productive assets, state effectiveness in addressing social inequalities, particularly in rural areas, has yielded negative results. From 2010 to 2020, poverty rates increased from 19 to 26.4%. Rural areas experienced an average 7.6% higher poverty rate than urban areas, peaking at 10.8% in 2014. The Gini coefficient, a measure of inequality, has remained relatively constant, moving from 0.507 to 0.514 over the same period. (INEC 2021).

Understanding the complexity: our approach to analyse Costa Rica's forestry and agriculture land use sector

Our study delves into the overarching global discourse on sustainable development, revealing a lack of effective solutions for addressing equity and social justice concerns in the global South, as proposed by mainstream approaches such as green economy and green growth. The concept of green transformation emerges as a critical perspective, offering an alternative vision that challenges the dominant capitalist development paradigm. Such transformations can originate from state intervention, citizen-led initiatives, market forces, or techno-centric approaches, often comprising a blend of these narratives. On a national scale, the situation in Costa Rica presents a complex interplay of contrasting institutional arrangements. While the state has actively promoted green policies and the country has sustained economic growth,

persistent rural poverty, environmental degradation, and inequality remain pressing issues. Focusing on the land use sector, specifically the forestry and agricultural transformations, we consider five cross-sectoral variables. Our approach involves a policy review and indicator selection phase followed by an impact analysis of public policies, shedding light on the trajectories of the chosen transformations (Figure 1).

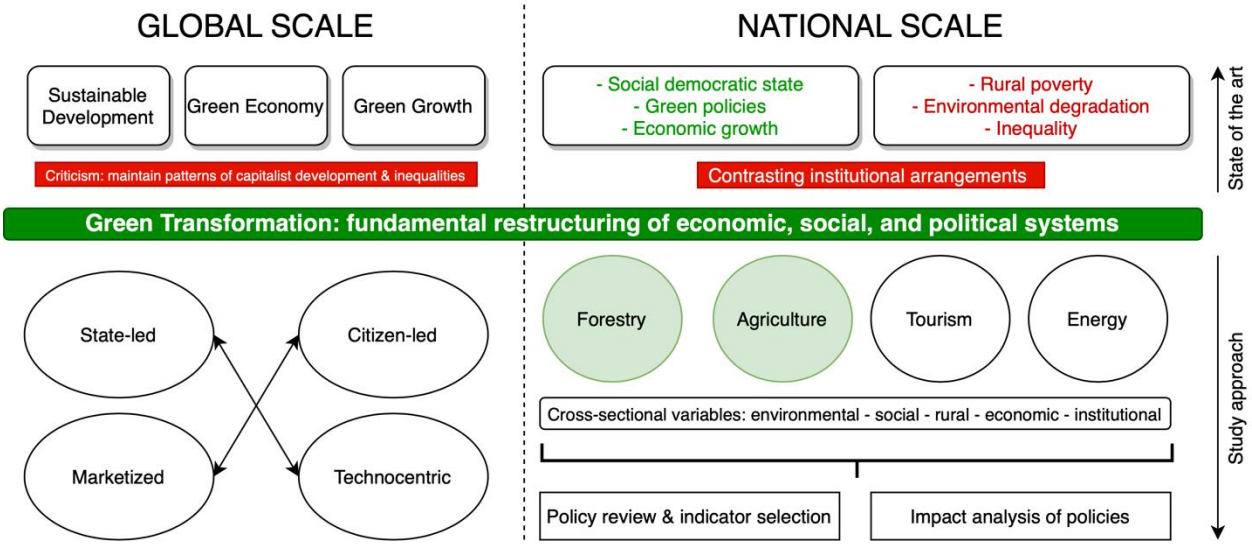

Figure 1. Conceptual framework for analysing the green transformations in the land use sector of Costa Rica.

To address these dynamics, **our primary objective is to examine the impacts and implications of state policies on the performance of Costa Rica's land use sector.** Our aim is to scrutinise the multifaceted impacts that these policies have had, encompassing various dimensions of the country's development, including its economic, social, and environmental aspects.

By "state policies", we refer to decisions made by political actors to define and pursue specific goals and means, often formalised through instruments such as laws, regulations, guidelines, and action plans. These policies address distinct issues systematically, involving interactions among various actors and organisations across time and space that occur at multiple levels, from abstract concepts to concrete programs and on-the-ground implementations (Jenkins 1978, Liefferink *et al.* 2006).

By "impacts", we refer to the observable and measurable effects resulting from the implementation of state policies in the land use sector. These effects encompass changes and outcomes that influence diverse aspects of Costa Rica's society and environment.

This study discerns how these policies have influenced economic indicators such as added value and trade balances, and we unravel their effects on social dimensions, including poverty and employment rates indicators. The analysis also investigates into the environmental implications of these policies, considering shifts in land cover, biodiversity conservation, and carbon emissions. In essence, our research endeavours to offer a comprehensive understanding of how state policies in the land use sector contribute to or hinder the country's

green transformation. This entails examining both intended and unintended consequences, assessing trade-offs and synergies among different dimensions, and contributing to a holistic perspective on Costa Rica's sustainable development trajectory.

By analysing a vast number of indicators, this research provides a comprehensive and organised way to measure and evaluate policy implementation in the forestry and agricultural sectors, shedding light on the interplay between economic growth, environmental conservation, and social equity. It offers valuable insights into how public policy can be formulated and implemented in ways that prioritise the inclusion of the most vulnerable communities, contributing to a more equitable land use sector. Overall, this work presents a well-grounded methodology that can serve as a valuable resource for policymakers and researchers seeking to understand the complexities and opportunities in pursuing a green transformation.

This dissertation document is structured as follows: Chapter I (the current chapter) introduces our conceptual framework, which encompasses green transformations, their narratives, the land use sector, and the specific transformations occurring in Costa Rica that we will analyse. Chapter II provides a detailed overview of the monitoring frameworks of seven land use sector policies in Costa Rica. From these frameworks, we select 11 integrated indicators to measure the impact of these policies on the sector. Chapter III analyses the implementation of the seven policies in depth, using the selected indicators to understand the performance of the land use sector and its relationship with these policies. Based on this analysis, we identify gaps and propose actionable measures to address them. Chapter IV summarises the research findings and draws general conclusions based on the study.

Concluding remarks

Approaches such as sustainable development, green economy, and green growth have fallen short in adequately addressing concerns of equity and social justice in the global South. The concept of green transformation offers a critical perspective, suggesting the need for a more holistic and alternative vision that moves away from the mainstream capitalist development paradigm and includes a greater focus on the social impacts of development.

The land use sector plays a pivotal role in a green transformation. Understanding its complexities requires examining the politics and narratives of green transformations to provide valuable insights into the role of the state and its policy frameworks. Costa Rica’s land use sector exhibits a conflicting nature, with commendable achievements in areas such as forest cover and the inclusion of agricultural products in global markets but a clear underperformance in social and environmental indicators, particularly in rural areas. This study offers important insights for policymakers and stakeholders in addressing the existing conflicts, fostering sustainable development, and promoting social justice in the land use sector and beyond.

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Chapter II. Indicators of a green transformation in the forestry and agriculture land use sector in Costa Rica

Introduction

Indicators serve as valuable tools for policy evaluation, enabling decision-makers and important stakeholders to effectively identify areas of concern, facilitate policy formulation, establish specific targets, and gauge the effectiveness of policy responses by measuring their impacts. Selection of indicators can serve as social mobilisation instruments and facilitate decision-making processes through community political engagement. Indicators also act as communication instruments on how countries are delivering on their environmental, social, and economic commitments (Meadows 1972; UN 2007, 2017; Silva *et al.* 2020).

Classical indicators and indices have been extensively used to measure various dimensions of sustainability and growth. They are widely adopted by governments and global organisations to illuminate the strengths and limitations of the paths countries have taken. Some iconic examples include the Human Development Index (HDI) (Anand and Sen 1994), which assesses a nation's well-being based on health, education, and income, and the Gini coefficient (Gini 1921), which quantifies income inequality within a population. These indices have played a crucial role in shaping policy discussions and international comparisons. However, it is important to recognise that these indicators and indices also come with their own set of advantages and disadvantages in their application, which vary based on the context and purpose they serve (Table 2).

Table 2. Principal indices and indicators used globally to measure environmental, social, and economic dimensions of development

Indicator/Index	Main Characteristics and Features	Advantages	Disadvantages	Source
Human Development Index	Measures human well-being based on health, education, and income indicators	Comprehensive view of human development	Ignores environmental sustainability aspects	Anand and Sen (1994), Sagar and Najam (1998)
Index of Sustainable and Economic Welfare	Adjusts GDP by accounting for environmental and social factors	Reflects economic welfare beyond GDP	Complex calculation method	Castañeda(1999), Lawn (2003)
GDP per capita	Measures economic output per person	Commonly used and easily calculated	Fails to consider environmental and social aspects	Kuznets (1955)
Gini coefficient	Measures income inequality among a population	Simple and widely understood measure	Focuses solely on income distribution	Gini (1921)
Environmental Performance Index	Ranks countries based on environmental performance	Covers multiple environmental aspects	Ignores economic and social dimensions	Wendling *et al.* (2020)

Green Growth Index	Assesses countries' green growth performance	Integrates economic and environmental dimensions	Limited scope, may not capture all dimensions	Acosta *et al.* (2019)
Global Green Economy Index	Measures countries' green economy performance	Highlights economic and environmental aspects	May lack comprehensive social considerations	Tamanini (2016)
Climate Change Performance Index	Evaluates countries' efforts to combat climate change	Focuses on climate action	Does not consider broader sustainability aspects	Burk *et al.* (2016)
Index of Economic Freedom	Ranks countries based on economic freedom measures	Reflects economic freedom and regulations	Ignores environmental and social aspects	Miller *et al.* (2020)
Doing Business Index	Ranks countries based on business regulations	Useful for assessing business climate	Does not account for broader development aspects	World Bank (2020)
Travel and Tourism Competitiveness Index	Evaluates tourism sector competitiveness	Useful for tourism planning and policy	Limited scope beyond tourism	WEF (2019)

A growing number of academics have also proposed methodologies and monitoring instruments. Eustachio *et al.* (2019) produced a systemic indicator of sustainable development using factorial analysis on sustainable development goals (SDGs) data extracted from the World Bank. Silva *et al.* (2020) proposed four criteria for sustainability indicator selection: 1) foster social engagement; 2) facilitate planning, execution, and monitoring of sustainable development; 3) rely on accessible and validated data; and 4) maintain a favourable cost-benefit ratio. Londoño and Cruz (2019) developed a composite index to evaluate local-level sustainable development by including defining a conceptual framework, selecting pertinent indicators for assessment, conducting multivariate analysis to streamline the indicators, standardising the data, assigning weights to the indicators through the analytical hierarchy process, and finally, aggregating the indicators. Steiniger *et al.* (2020) identified a set of indicators intended to depict urban sustainability in a manner that is pertinent to cities in the global South, where poverty and inequality are widespread.

Despite the efforts of the international community (including governments, UN agencies, and international NGOs) to have effective instruments to measure progress towards more inclusive and sustainable societies, and to correct the course of policies when necessary, monitoring systems and their applicability have also been widely criticised. Indicator limitations reduce their ability to provide information beyond a particular system, for example in explaining causal links between elements being studied. Morrison and Pearce (2000) contend that indicators rely on existing data to elucidate various phenomena, which often suffer from inadequate quality and limitations in terms of time and location. Komeily and Srinivasan (2016) indicate that combination of variables to design sustainability indicators presents a significant challenge owing to the complexity stemming from various data types, criteria variations, information gaps, ambiguity, imprecise definitions, and uncertainties. Silva *et al.* (2020) and Pissourios (2013) propose that the intricacy of indicator

systems for sustainable development might result in imprecisions and a restricted ability to provide insights into cause-and-effect relationships.

Measuring progress towards a green transformation also faces some of these challenges. In fact, there is limited literature available on the utilisation of indicators to construct empirical evidence regarding transformations stemming from critical sectors, including agriculture, construction, energy supply, fisheries, forestry, industry, tourism, transportation, waste management, and water resources (UNEP 2011). Two studies have attempted to identify and analyse indicators within the context of green transformation narratives, highlighting the risk of inappropriate decision-making in the translation of public policies and the potential misallocation of public resources due to the lack of clear indicators. For example, Lederer *et al.* (2015) identify eight indicators to measure the economic, ecological, and social dimension of land use systems when assessing causes for sustainability transformations and green economy initiatives in developmental states. Lederer *et al.* (2019) propose indicators included in the Bertelsmann Transformation Index, such as stateness, economic performance, steering capability, resource efficiency, rule of law, and political participation when discussing the state-led narrative on green transformations in Costa Rica and Vietnam.

In Costa Rica, responsible institutions have created and implemented public policies for the land use sector, incorporating elements of monitoring and evaluation systems, such as lists of indicators, baselines, and impact goals. For example, the National Institute of Statistics and Censuses (INEC), as an advisory body to the National Technical Secretariat for monitoring the SDGs, coordinates the monitoring of 232 national indicators to measure the progress of the 17 SDGs and 169 associated goals (INEC 2022). The National Decarbonisation Plan 2018–2050 has 52 indicators distributed in its 10 decarbonisation actions (Government of Costa Rica 2018). The Action Plan of the National Climate Change Strategy (ENCC) included 106 indicators to measure progress in four main sectors—energy, transport, agriculture, water resources (MINAE 2015a). The Forestry National Development Plan (2011-2020) included 98 indicators distributed in its seven strategic topics (MINAET 2011). And the Sectorial Plan for the Agricultural and Rural Development 2015-2018 incorporated 128 indicators (SEPSA 2015).

The findings of this study, presented in the following sections, highlight the common challenges associated with monitoring and measuring progress in public policies. These challenges include the fragmented nature of indicator development, limited inter-institutional coordination, and the lack of clear methods for measuring progress. The findings emerge from our analysis of the indicators proposed in the context of Costa Rica's green transformation narrative in the land use sector. Despite the existence of multiple measurement instruments, there is a lack of consistency and coherence in their application, which hinders the ability to effectively demonstrate the impact of green policies.

Our examination of specific policies reveals inconsistencies and challenges in the measurement of progress towards a sustainable and equitable society. The National Decarbonisation Plan (Government of Costa Rica 2018) and the ENCC's Action Plan (MINAE 2015a), both targeting similar goals in the land use sector, propose different sets of indicators, leading to a lack of harmonisation and coherence. Moreover, the Low-Carbon Livestock Strategy (MINAE and MAG 2015) does not incorporate indicators to effectively

monitor progress during interventions, hindering the ability to assess its impact. The institutions responsible for implementing the National Forestry Development Plan 2011-2020 (MINAET 2011) have not published public reports on the progress of their indicators, impeding transparency and accountability. Similarly, despite the implementation in 1997 of the PES program by the National Forestry Financing Fund (FONAFIFO), it was not until 2019 that the document Vision of the Future 2040 and Institutional Strategic Plan 2020-2025 (FONAFIFO 2019) was published, which includes program indicators.

To bridge this existing gap, we have identified a set of pertinent indicators that capture the progress made towards achieving a green transformation in Costa Rica's land use sector. As detailed in Chapter I, a green transformation denotes the comprehensive restructuring of economies and societies to operate within planetary boundaries, necessitating a shift in discourse towards transformation that highlights fundamental structural changes beyond the scope of terms such as green economy, green growth, or sustainable development alone (Schmitz 2015). Our study adopts the land use sector definition provided by the IPCC (2006), encompassing the entirety of activities, arrangements, and inputs undertaken within specific land use categories such as forest land, cropland, grassland, livestock, managed soils, and harvested wood products.

Our primary objectives in this chapter are 1) What are the defining characteristics of indicators that are most suitable for measuring the transformative processes within the forestry and agriculture sectors in Costa Rica's land use sector? and 2) To what extent have the public policies implemented by the Costa Rican state succeeded in providing effective indicators to measure progress a in the selected transformations? By addressing these questions, we intend to provide further insight into the status and efficacy of the indicators used to monitor and evaluate the desired sustainable changes in Costa Rica's land use practices.

In selecting indicators to measure a green transformation, it is essential to recognise the significant influence of various transformations on land use in Costa Rica, particularly in forestry and agriculture areas. These two transformations exemplify the core focus of our study because they highlight the existence of conflicting institutional arrangements within the country's development model in the pursuit of a green transformation. Despite Costa Rica's reputation as a global sustainability leader and its expanding economy, observers note a systemic neglect of social development, particularly in rural areas. It is crucial to empirically verify this assertion.

To precisely assess the influence of policies in the land use sector and monitor the advancement of these changes, we have established five distinct variables: environmental, rural, social, economic, and institutional. These variables have been outlined in Chapter I, providing a comprehensive structure for evaluating policy effects on various aspects of the land use sector. Our definition of these variables contributes to the comprehension of the concept of a green transformation and narrows the focus for analysing the proposed indicators. Through our study, we can evaluate how policies impact the environment, rural communities, social services, economic growth, and institutional frameworks in Costa Rica's land use sector. This approach helps identify the primary dimensions of green

transformations and facilitates an all-encompassing assessment of the effectiveness and progress of policy interventions in promoting sustainable and inclusive development.

Methods

The following section first presents a description of the study area, providing important contextual information for the analysis. Then it describes the process to select the different policies considered in this study, ensuring a representative and diverse range of interventions in the land use sector. Finally, we detail the two-step approach employed to identify and determine the most relevant indicators for evaluating the effectiveness of these policies.

Study area

Our study focused on Costa Rica's land use sector. Particularly, we include activities in forest land (including woody vegetation consistent with official thresholds used to define forest land), cropland (including cropped fields and agroforestry systems), grassland (including rangelands and pasture land that are not considered cropland), and wetlands (including peatlands) (IPCC 2006).

The agriculture transformation includes croplands and grasslands, covering 47.1% of Costa Rica territory (INEC 2015). Within the grassland category, livestock is one of the main activities, representing one of the main sources of income in rural territories and contributing visibly to the national economy (Chacón *et al*. 2015, INEC 2015).

The production of agricultural crops and livestock contributed 4.4% of the national GDP in 2020. Agricultural exports accounted for 42.3% of the total value exported by the country in the same year, generating USD 4.9 billion. The main exported products were bananas, pineapple, syrups and concentrates, coffee, and palm oil. Together, they accounted for 59% of the agricultural exports (SEPSA 2022).

In 2020, agricultural activities generated employment opportunities for 247 262 people, constituting 11.7% of the employed workforce in Costa Rica. However, the open unemployment rate was estimated at 11.2%, higher for women at 18.6%, nearly double that for men (9.7%). Also, a considerable proportion of the employed population, 57.4%, held informal jobs, and 46% of those employed were 45 years and older. These figures highlight the social dimensions of the agriculture sector and underscore the need to consider social justice and inclusivity in the context of a green transformation.

As part of this transformation, agricultural monocultures have experienced significant expansion in Costa Rica, leading to a notable economic boost. However, this expansion has also brought about adverse environmental consequences. Between 2005 and 2017, pineapple exports grew from USD 326 million to USD 941 million, while banana exports went from USD 477 million to more than USD 1 billion, and palm oil exports from USD 69 million to almost USD 1.3 billion (PROCOMER 2007, 2017). This coincides with an increase in carbon-dioxide-equivalent emissions in the agriculture sector for the same period, increasing from 2882.0 Gg in 2005 to 2962.8 Gg in 2017 (MINAE and IMN 2017). It also coincides

with a high consumption of pesticides in agriculture; between 2012 and 2020, 34.45 kg of active ingredients per hectare each year were used, ranking Costa Rica as the world's largest consumer per unit area (UNDP 2022).

The forestry transformation includes forest land and wetlands, which cover 52.4% of Costa Rican territory. Approximately half of this area corresponds to state-protected areas and the other half to privately owned forests. Furthermore, between 60 and 70% of national forest cover has structural characteristics similar to mature forests, providing ecosystem services such as carbon sequestration, scenic beauty, and protection of water resources (Calvo 2008, MINAE 2015b).

As of 2014, these forests provided shelter for approximately 95 157 known species, or about 5% of the world's known biodiversity (Rojas and Obando 2021). This constitutes a tourist attraction that promotes the conservation and rehabilitation of the forest landscape in rural territories and generates 5% of the total GDP (BCCR 2016a). The permanence of these forests also contributes to hydroelectric generation that represents 75.3% of the total electricity supply (CENCE-ICE 2015; BCCR 2016b; MINAE, CONAGEBIO, and SINAC 2016). Moreover, the total carbon stock contained in the country's forests is equivalent to 8 million tons of carbon, and the timber production and consumption contribute 2% to the GDP (REDD/CCAD-GIZ-SINAC Program 2015, BCCR 2016b).

An important aspect in forested areas has been the stability of the PES program since 1997. By 2018, it had registered nearly 90% of its 1.2 million hectares of private lands under forest protection contracts (Brownson *et al.* 2020)—a total of USD 416.4 million were invested in this program between 1995 and 2019. Nevertheless, the PES program has been the centre of discussion due to conflicting evidence about whether the program has led to improvements in the well-being of participants (Arriagada *et al.* 2012, 2015) beyond its conservation focus and effectiveness to reduce deforestation rates in the country (Chomitz *et al.* 1998, Ferraro 2001, Rojas *et al.* 2003, Sierra and Russman 2006, Robalino *et al.* 2021). Moreover, extensive regulations and high legal operating costs for forestry activities, as well as a strong state impulse to agricultural exports, has contributed to the expansion of the agro-export model in the country, to the detriment of other forest uses.

Policy selection

The selection of policies to measure the performance of the land use sector in Costa Rica involved two main steps (Annex 1). First, we chose to use the period from 1997 to 2017 because it marked the establishment of numerous environmental policies and institutions in Costa Rica, including the enactment of the latest forestry law and creation of the National System of Conservation Areas (SINAC), FONAFIFO, and the PES program and broadly covers the development and implementation of key policies in the land use sector, providing insights into the context of these transformations and their long-term impact on forestry and agriculture. By analysing this timeframe, we can identify trends, successes, failures, and adaptations in policies and their impacts and make meaningful policy comparisons, helping to determine the most effective approaches and informing future green transformation interventions in the land use sector.

Second, we extracted the objectives of each policy to assess their relevance in the context of a green transformation of the land use sector, focusing on environmental, rural, social, economic, and institutional variables. Identification of the state agencies responsible for implementing each policy was essential to providing insight into the level of institutional support and helping evaluate the policy's significance and potential impact. By considering the responsible institutions, we were also able to assess the governance and coordination mechanisms in place for each policy, further illuminating understanding of how relevant they were in driving the desired transformations.

Indicator extraction

We extracted all indicators from each policy and compiled them into a comprehensive database. We then devised a two-step process for extracting the final indicators (Annex 1). In the initial step, we employed a two-tier mechanism, each incorporating distinct criteria. The primary tier encompassed four criteria: practicality, scientific validity, relevance, and understandability/communicability. We evaluated the alignment of each indicator with these criteria. Factors such as the indicator's focus on outcomes, cost-effective measurability, scientific validity, relevance to nationally recognised issues, and potential to provide clear understanding and communication to the public were considered (Table 3). This evaluation led to the refinement of the indicator set, excluding those that failed to meet the criteria.

The second tier focused on the measurability and duplication. Indicators from the previous list underwent further examination to ensure the availability of necessary data, with a focus on its quality, accessibility, and suitability for the study period. This tier also discarded any redundancy among indicators sharing identical definitions. The resulting indicator list comprised those that satisfied all six selection criteria (Table 3).

Table 3. Tiers and criteria used for selecting indicators in policy documents to measure a green transformation in the forestry and agriculture land use sector of Costa Rica

Criteria		Description
(to use as a first tier before compilation)		
1	Practicability	It is outcome-oriented and not related to an activity or output
		It is measurable in a cost-effective way
2	Scientific soundness	It has an underlying methodology that is sound, clear, and relatively simple
		It is relevant and well-suited to address a nationally recognised issue of concern
3	Relevance and usefulness	It preferably refers to a long-term state policy and is not restricted to a short period of time
		It supports monitoring of the policy decision-making process
4	Understandability and communicability	It is not based on concepts too abstract or complex
		It refers to scales/units that are readily comprehensible to users
(to use as a second tier for the compilation)		
5	Measurability	It is based on available, quality, and accessible and editable information for the study period
6	Duplication	It does not have the same definition as any other indicator

Source: Adapted from Monetti (2021)

In the second step, we procured data from 1997 to 2017 for all retained indicators. Our data collection process used information available from state institutions, including online databases, annual reports, white papers, in-house journals, technical reports, national development plans, surveys, census records, and periodical publications. The selection of these sources was based on their reliability, authority, and ease of access. For every indicator, we identified the necessary data elements, including the government agency responsible for reporting, the measurement unit, publication year, and geographic scope. We then gathered the relevant data from these sources and organised it in a consistent format, streamlining for future analysis. To bolster the information obtained, we complemented our dataset with data from international monitoring frameworks and databases (Annex 2). This approach bridged existing information gaps and ensured alignment and comparability with international indicators.

Results and discussion

In this section, we present the results of the analysed policies, including their objectives, responsible state agencies, and the number of indicators considered. Additionally, we describe the two-step process used for indicator selection, providing insights into the rigorous methodology employed to identify relevant and informative indicators.

Policy selection

The land use sector of Costa Rica plays a pivotal role in the nation's economy, society, and environment, encompassing both forestry and agriculture land uses. These sectors are fundamental for rural development, food security, biodiversity conservation, and the ongoing efforts to mitigate and adapt to climate change. To assess and promote a green transformation within this sector, various public policies and policy instruments have been implemented by successive government administrations. These policies address an array of challenges, including deforestation, biodiversity loss, competitiveness, poverty, and social inequality. Our categorisation places these policies into two primary groups: forestry and agricultural policies, each with distinct focuses on different aspects of the land use sector. Certain policies were not included for reasons analysed in detail later. Within the framework of each policy, we discovered a variety of monitoring mechanisms that encompass indicators designed to measure and evaluate the outcomes of the proposed actions (Table 4).

Table 4. Public policies relevant to the forestry and agriculture land use sector in Costa Rica, enacted from 1997 to 2017

	Policy	Starting Year	Number of Indicators	Source
Forestry				
1	Action Plan of the National Climate Change Strategy (ENCC)	2013	23	MINAE 2015a
2	National Biodiversity Strategy 2016-2025	2016	99	MINAE *et al*. 2016
3	Forestry National Development Plan 2001-2010	2001	134	MINAE 2001
4	Forestry National Development Plan 2011-2021	2011	46	MINAET 2011

5	REDD+ Strategy	2017	55	MINAE 2019
Agriculture				
6	Sector Plan for Agricultural and Rural Development 2015-2018	2015	127	SEPSA 2015
7	State Policy for the Territorial Rural Development of Costa Rica (PEDRT) 2015-2030	2015	8	SEPSA 2016
Not included				
8	Payments for Environmental Services Program	1997	0	-
9	Policies for the Costa Rican Agricultural Sector 1998-2002	1998	0	SEPSA 1998
10	Policies for the Costa Rican Agricultural Sector 2002-2006	2002	0	SEPSA 2002
11	Climate Change Strategy	2009	0	MINAE 2009
12	State Policy for the Agrifood Sector and Costa Rican Rural Development 2010-2021	2010	0	SEPSA and MAG 2011
13	Policies for the Protected Wildlife Areas (ASP) of Costa Rica's National System of Conservation Areas 2011-2015	2011	0	SINAC 2011
14	National Biodiversity Policy 2015-2030	2015	0	MINAET 2015
15	Policies for the Agricultural Sector and the Development of Rural Territories 2015-2018	2015	0	SEPSA 2014
16	Strategy for Low-Carbon Livestock	2015	0	MINAE and MAG 2015
17	National Policy on Sustainable Production and Consumption 2018-2030	2018	0	MINAE *et al*. 2018
18	Strategy and action plan for the adaptation of the Costa Rican biodiversity sector to climate change (2015-2025)	2015	9	MINAE 2015c
19	Implementation plan of the National REDD+ Strategy Costa Rica	2017	55	MINAE 2017
20	Strategic Plan 2018-2025 National Program of Biological Corridors of Costa Rica	2018	36	SINAC 2018
21	National Decarbonisation Plan 2018-2050	2018	52	MINAE 2018a
22	National Adaptation Policy to Climate Change 2018-2030	2018	50	MINAE 2018b
23	Costa Rica's Intended Nationally Determined Contribution	2020	1	MINAE 2020

Policy objectives

The ENCC's Action Plan targets promoting sustainable development through forestry, enhancing resilience to climate change, and reducing greenhouse gas emissions. This acknowledges forests' significance for carbon storage and their potential in addressing climate change (MINAE 2015a). The Forestry National Development Plans for 2001-2010 and 2011-2021 focus on advancing forest management, conservation, restoration, and sustainable utilisation. These policies recognise forests' dual role as sources of timber/non-timber products and contributors to rural development, poverty alleviation, and environmental safeguarding (MINAE 2001, MINAET 2011). Likewise, the REDD+ strategy targets emissions reduction from deforestation and forest degradation, promoting forest preservation and sustainable management. This strategy underscores forests' value as carbon

reservoirs and the necessity to prevent emissions from these activities (MINAE 2019). The National Biodiversity Strategy 2016-2025 emphasises conserving and enriching biodiversity, sustainable utilisation of natural resources, and equitable benefit sharing, pointing to forests' role as habitats for diverse species and their contribution to essential services like water regulation, soil protection, and climate control (MINAE *et al.* 2016).

The Sectoral Plan for Agricultural and Rural Development 2015-2018 focuses on advancing rural progress, alleviating poverty, and bolstering food security through sustainable agricultural practices. This plan underscores agriculture's role in providing livelihoods and sustenance, along with the necessity to adopt practices that conserve natural resources and address climate change (SEPSA 2015). Similarly, the PEDRT 2015-2030 bolsters territorial development, rural growth, and well-being while mitigating inequality and poverty. This plan acknowledges rural areas' significance for cultural heritage, biodiversity, and ecosystem services, emphasising the importance of their sustainable use and development (SEPSA 2016).

State agencies and their roles

State agencies and their roles in the land use sector are established by Costa Rican regulations, including laws of the Republic and executive decrees. These mandates are further shaped through decisions made at various levels of governance, including government councils, ministerial guidelines, and other administrative measures.

For example, the Forestry National Development Plans of 2001-2010 and 2011-2021 (MINAE 2001, MINAET 2011) fall under the jurisdiction of the National Forestry Office (ONF), which operates under the Ministry of Environment and Energy (MINAE). The ONF's responsibilities encompass sustainable forestry practices, forest conservation, and restoration.

Similarly, the National Biodiversity Strategy 2016-2025 (MINAE *et al.* 2016) is managed by SINAC, another entity within MINAE, overseeing the management of protected areas and promoting biodiversity conservation.

The National Climate Change Directorate (DCC) of MINAE administers the ENCC's Action Plan (MINAE 2015a), focusing on coordinating national climate change policies and monitoring greenhouse gas emissions. Additionally, the REDD+ strategy (MINAE 2019) falls under the purview of MINAE, specifically managed by FONAFIFO, which coordinates efforts to reduce emissions from deforestation and enhance forest carbon stocks.

The Ministry of Agriculture and Livestock (MAG) is primarily responsible for overseeing the Sector Plan for Agricultural and Rural Development 2015-2018 (SEPSA 2015) and the PEDRT 2015-2030 (SEPSA 2016). However, as part of a broader structure within the agricultural public sector, the Executive Secretariat for Agricultural Sector Planning (SEPSA), as a sectoral entity, plays a pivotal role in supporting and advising the minister in charge of MAG in the formulation and implementation of these public policies. Institutions within this structure, such as the Institute of Rural Development (INDER) and the National Production Council (CNP), also contribute to these efforts.

Indicators proposed by each policy

There is significant variation in the number of indicators proposed by each policy, specifying from eight to 134 indicators. Notably, the PEDRT 2015-2030 (SEPSA 2016) presents the lowest count, with only eight indicators, while the Forestry National Development Plan 2001-2010 (MINAET 2015) features the highest, with134 indicators (Table 4).

The variation in the number of indicators proposed by each policy suggests the performance of the land use sector in Costa Rica is measured through an expansive set of priorities and objectives. Policies that incorporate a greater number of indicators can offer a more comprehensive assessment of the land use sector's performance but may also face challenges in data collection, monitoring, and reporting on all the indicators. Policies with fewer indicators may provide a more focused and targeted approach but may not capture all the relevant aspects of the land use sector. However, the number of indicators proposed by a policy does not necessarily reflect the quality or effectiveness of the policy. This depends also on its objectives, resources, implementation, and the relevance and accuracy of its indicators. Therefore, policies should be evaluated based on their overall effectiveness in promoting sustainable land use practices, rather than solely on the number of proposed indicators.

Policies not included

Policies not included in our analysis are those that have no indicators and/or fall outside the analysis period. We assumed that the absence of indicators indicates a lack of concrete objectives or results to be achieved. However, the lack of indicators does not necessarily mean that these policies are not relevant since they have been designed to tackle important issues such as climate change, carbon neutrality, sustainable production, and biodiversity protection. As an example, we did not find indicators for the PES program. It was established in 1997, when Costa Rica became one of the first developing country to promote the conservation of forests and the protection of natural resources through financial incentives (Langhansa *et al*. 2022). The Climate Change strategy, launched in 2009, provides another example. It outlined a series of actions and measures to mitigate and adapt to climate change, including the promotion of renewable energy, sustainable land use, and biodiversity protection. However, none of these had indicators in the study's timeframe.

The State Policy for the Agrifood Sector and Costa Rican Rural Development 2010-2021 (SEPSA 2011) similarly falls short. It is aimed at promoting the competitiveness and sustainability of the agricultural sector. Although it proposes to improve key areas in the sector, such as agricultural productivity, while promoting sustainable land use, biodiversity conservation, and the well-being of rural communities, we could not find official indicators for their measurement.

The National Biodiversity Policy 2015-2030, developed by MINAE (MINAE *et al*. 2016), promotes the conservation and sustainable use of biodiversity in Costa Rica. This policy outlines a series of actions to address the main threats to biodiversity, such as deforestation, pollution, and invasive species, and to promote the integration of biodiversity considerations

in different sectors of the economy. However, we were unable to identify official indicators for their measurement.

Some policies, despite their lack of indicators, are relevant to promoting a green transformation in Costa Rica. They address the complex challenges related to land use and natural resource management and involve the participation of multiple stakeholders, including government agencies, civil society organisations, and local communities. Moreover, the implementation of these policies requires allocating significant financial and human resources and a strong political will to ensure their effective implementation. The absence of indicators should not diminish the importance of these policies but rather serve as an opportunity to strengthen their monitoring and evaluation mechanisms.

Indicator selection

First-tier indicators

The number of indicators retained varied across the policies we analysed. The Forestry National Development Plan 2011-2021 (MINAET 2015) stood out with the highest number of retained indicators, encompassing 27 out of 46 proposed indicators (59% of the total). Conversely, the PEDRT 2015-2030 (SEPSA 2016) had the lowest retention rate, with only four out of eight indicators selected, constituting 50% of the total indicators. The ENCC's Action Plan and the REDD+ strategy featured a relatively low number of retained indicators, accounting for 35% and 16% of the total indicators retained, respectively. The Forestry National Development Plan 2001-2010 exhibited the lowest percentage of retained indicators, with merely 8% of the initially proposed indicators being selected. Conversely, the National Biodiversity Strategy 2016-2025 presented a notable number of retained indicators at 20 out of 99 proposed, though the retention rate was relatively lower at 20%. The Sector Plan for Agricultural and Rural Development 2015-2018, while contributing the third-highest number of retained indicators overall, only included 21 indicators, representing 17% of the proposed total (Table 5).

The varying numbers and percentages of retained indicators across policies can be attributed to several assumptions, shedding light on potential insights for policymakers and researchers to improve the formulation and execution of land use policies. One assumption posits that the technical complexity inherent in the development of a policy may necessitate more stringent criteria for indicator selection, resulting in a lower count of retained indicators. In fact, such policies could necessitate more precise indicators that might face challenges in meeting the selection criteria. This scenario can be exemplified by the REDD+ strategy, which exhibited the lowest percentage of retained indicators (16%) among the total set.

Alternatively, a policy with a larger array of indicators is more likely to yield a higher number of indicators meeting the selection criteria, irrespective of the quality and intricacy of the policy's proposals. The National Biodiversity Strategy 2016-2025 offers a case in point, with a high number of indicators (99) and a considerable number of retained indicators (20) in comparison to other policies.

Another key assumption is that policies effectively integrated into existing data and information systems of state agencies are more likely to include reliable indicators that can pass through the selection tier, ensuring their usefulness and relevance. When indicators have been consistently measured over the years using standardised methodologies within a single institution, along with periodic publications, this further enhances the consolidation of indicators. The indicators of the Forestry National Development Plan 2011-2021 provide such a case.

Indicators such as the contribution of the forestry sector to GDP, trade balance of forest products, wood consumption, employment generation and value added from the use of wood, have been integral to the work of the ONF since the early 2000s. This institution has consistently published the Report on Uses and Contributions of Wood in Costa Rica annually since 2006, providing systematically published data ever since. This integration has allowed these indicators to be showcased and emphasised for their significance in platforms like the Environmental Accounts of the Central Bank of Costa Rica (BCCR 2016b) and several national development plans (e.g., MIDEPLAN 2006, 2011).

Table 5. Retained and discarded indicators from Costa Rica's land use sector policies after applying the first tier of criteria

Policy	**Total indicators**	**Retained Indicators**	**Discarded indicators**				
		N (%)	**N (%)**	**Reason - Criteria 1 to 4* N (%)**			
				1	2	3	4
Action Plan of the National Climate Change Strategy (ENCC)	23	8 (35)	15 (65)	6 (40)	3 (20)	1 (7)	5 (33)
National Biodiversity Strategy 2016-2025	99	20 (20)	79 (80)	45 (57)	7 (9)	18 (23)	9 (11)
Forestry National Development Plan 2001-2010	134	11 (8)	123 (92)	123 (100)			
Forestry National Development Plan 2011-2021	46	27 (59)	19 (41)	11 (58)	3 (16)		5 (26)
REDD+ Strategy	55	9 (16)	46 (84)	44 (96)	1 (2)		1 (2)
Sector Plan for Agricultural and Rural Development 2015-2018	127	21 (17)	106 (83)	106 (100)			
State Policy for the Territorial Rural Development of Costa Rica (PEDRT) 2015-2030	8	4 (50)	4 (50)	3 (75)			1 (25)
Total	492	100 (20)	392 (80)	338 (86)	14 (4)	19 (5)	21 (5)

Source: Author's own work

* 1: Practicability. 2: Scientific soundness. 3: Relevance and usefulness. 4: Understandability and communicability

The first indicator selection discarded 392 indicators, representing 80% of the total 492 indicators. Most of these indicators (86%) were discarded due to their lack of practicality (Criterion 1). These indicators were related mostly to activities or outputs, meaning they did not provide information on the results or outcomes of forest- and agriculture-related policies

or programs. Activities and outputs are actions carried out and are not true indicators of success or failure since they do not provide a direct assessment of the policy's effectiveness in attaining its objectives. This high percentage of indicators discarded underscores the need to focus on outcome-oriented indicators to truly measure the impacts of policies and programs.

For example, the ENCC's Action Plan included an indicator named "design and implementation of mitigation program" (MINAE 2015a), and the National Biodiversity Strategy 2016-2025 included the indicator "development of a national education program for life" (MINAE *et al.* 2016). However, these metrics does not provide a direct assessment of the policy's effectiveness in attaining its objectives. Also, indicators that are not cost-effective to measure are often excluded due to the significant time, resources, and financial investment needed for data collection and analysis. There are instances where data collection costs are prohibitively high, or the necessary data is simply not accessible. Such indicators can lead to misleading results because they might rely on assumptions or subjective viewpoints rather than accurate and dependable data.

The second reason for excluding indicators was their lack of understandability and communicability (Criterion 4); 5% of the total indicators were discarded due to this factor. For example, the "cantonal environmental sustainability index" in the PEDRT 2015-2030 (SEPSA 2016) was discarded because it requires specific technical knowledge to be interpreted correctly, making it challenging to use as a broader communication tool for monitoring and evaluating the policy's progress, and for widespread analysis and inferences. Interpreting this index involves understanding concepts related to environmental systems, environmental stress, human vulnerability, social and institutional capacity, and responsibility. Moreover, it is complex in itself, disaggregated into 11 indicators and 26 variables (SCIJ 2017).

Similarly, the indicator "mechanisms for promoting the increase of sustainable sources of timber and non-timber goods" in the Forestry National Development Plan 2011-2021 was excluded due to its lack of clarity in communicating what it aims to measure. It fails to specify the types of mechanisms it refers to, the extent of the intended increase, the specific sources it addresses, or the type of sustainability it targets. It is also linked to an expected impact seeking "better conditions for the sustainability of forests and other forest ecosystems" (MINAET 2011), which leaves room for interpretation among different user groups.

The third reason for excluding indicators was their lack of relevance and usefulness (Criterion 3), pinpointing indicators that did not refer to a long-term state policy and were restricted to a short period or did not support the monitoring of the policy decision-making process. Five percent of the indicators were discarded due to this criterion. Two such indicators are "% of biological corridors with strategic plans" and "number of scientific studies on the impacts of fishing and aquaculture", both part of the National Biodiversity Strategy 2016-2025 (MINAE *et al.* 2016). The first was considered irrelevant since it did not refer to a long-term policy but to short-term projects. Although the preservation and maintenance of biological corridors are crucial to the conservation of ecosystems, they need to be part of a long-term policy to ensure their sustainability. Similarly, the second indicator mentioned was discarded because it did not support the monitoring of the policy decision-making process. While scientific

studies are important in determining the impact of fishing and aquaculture, the indicator did not provide any information on how the policy was implemented or how their goals were to be achieved.

The fourth reason for discarding indicators was their limited scientific soundness (Criterion 2). Indicators were discarded if they did not have an underlying methodology that was sound, clear, and relatively simple. Additionally, indicators were also discarded if they were not relevant or suitable to addressing a nationally recognised issue. This means that even if the methodology were sound, the indicator would still not be retained if not relevant to broader policy goals at the national level: 4% of the indicators were discarded because of this reason. Examples were "compliance with the National Forestry Development Plan" in the Forestry National Development Plan 2011-2021 (MINAET 2011) and "sustainable production technologies inventory" in the ENCC's Action Plan (MINAE 2015a), which were not deemed significant for tackling a well-recognised national issue in the plan. In this case, having an inventory itself is not seen as crucial for gauging the policy's impact in achieving its goals.

Second-tier indicators

Arriving at the second tier of indicators involved two additional criteria. First, "measurability" was applied to the 100 indicators previously retained, resulting in the selection of 22 indicators. This criterion ensures that chosen indicators offer quantitative meaningful insight into the policy's effectiveness in achieving its objectives. It focuses on the practicality and relevance of the indicators, assessing whether they are easily measurable and whether the collected data is valuable for analysing policy impact. Measurability plays a crucial role in ensuring that the selected indicators accurately reflect policy outcomes. For instance, indicators like "level of emissions from activities in the national inventory" in the ENCC's Action Plan (MINAE 2015a) and "per capita rate of consumption of national wood from legal and sustainable sources" in the Forestry National Development Plan 2011-2021 (MINAET 2011) were retained under this criterion. These indicators are not only practical and measurable but directly relevant in showcasing how policies are progressing towards their goals (Table 6).

Indicators were also excluded for being impractical or not useful for gauging policy impact, such as "number of associated producers in more vulnerable territories" in the ENCC's Action Plan (MINAE 2015a) and '"percentage of women producers in agriculture and livestock" in the PEDRT 2015-2030 (SEPSA 2016). They lacked sufficient data to analyse the long-term effectiveness of the policies in achieving their goals (e.g., how associations of producers can influence policy decisions or how these associations are developed and sustained based on good governance mechanisms), and often required excessive resources to measure. Although these indicators passed the first tier, their exclusion highlights their importance for tracking specific activities or outputs rather than comprehensively assessing policy impact on long-term goals.

The "duplication" criterion served that very purpose: merge indicators with similar or identical meanings with different names, due to being sourced from various places, into one single indicator. The application of this criterion is key to avoiding repetition of information,

which leads to confusion and errors in analysing policy impact. It also ensures that each indicator is unique and conveys specific and relevant information, minimising redundancy. While merging indicators, it is important to acknowledge that even though they might have minor differences in wording or measurement units, they represent the same core concept or phenomenon. By merging such indicators, the resulting one offers a more accurate depiction of policy impact. This process also simplifies complexity, resulting in a more efficient set of indicators that are easier to track, monitor, and report on.

For instance, indicators like "area under environmental services recognition systems" (MINAET 2011) and "number of hectares under PES (accumulated)" (MINAE 2019) were combined into "area under payment for environmental services". Similarly, "per capita consumption of wood from forest plantations increasing", "consumption of legal and sustainable national wood by public institutions" and ‘"per capita rate of consumption of legal and sustainable national wood" (MINAET 2011) were all merged into "wood consumption" (Table 6). Applying this criterion resulted in the reduction of the original 22 indicators to a final set of 11.

Table 6. Merged indicators from Costa Rica's land-use-sector policies after applying the second tier of criteria

	Indicator retained after applying "Measurability" criterion		**Resultant indicator after applying "Duplication" criterion**
1	Level of emissions from activities in the National Inventory	1	Agricultural emissions
2	Amount of carbon retained by forest ecosystems		
3	Number of species of fauna and flora seized (including products and byproducts, particularly CITES)	2	Number of seized fauna and flora species
4	Number of hectares affected by forest fires within PWA* per year	3	Area affected by forest fires
5	Number of hectares affected by forest fires outside PWA per year		
6	Number of forest fires attended within the State Natural Heritage		
7	Per capita consumption of wood from forest plantations	4	Wood consumption
8	Consumption of national wood from legal and sustainable sources by public institutions		
9	Per capita rate of consumption of national wood from legal and sustainable sources		
10	Volume of wood from legal and sustainable sources produced in the country		
11	Raw material from natural forests quantified and qualified		
12	Area under environmental services recognition systems	5	Area under payment for environmental services
13	Number of hectares under PES (accumulated)		
14	Commercial balance of forest products	6	Trade balance of forest products
15	Generation of forest employment	7	Forestry employment

16	Percentage of the total surface area of forest ecosystems in the country in relation to a. the total land area of the country; b. the surface area of forest land; c. the surface area of forests within protected wilderness areas; d. the rate of forest conversion to other land uses	8	Forest area
17	Percentage of national territory with forest cover		
18	Added value of the use of wood, non-wood products, and environmental services	9	Added value from the use of wood
19	Value added from the use of wood		
20	Value added by the use of wood		
21	Number of new quality jobs	10	Agricultural employment
22	Percentage of territories with lower poverty incidence	11	Rural poverty

Source: Author's own work

*PWA stands for protected wildlife area

Data collection

Out of the 11 retained indicators, four were found to have information available for all years in the study. When considering the entire study period and all indicators, there was a data gap of 19%. This highlights that even though the retained indicators pass through all six criteria, data availability is not necessarily guaranteed for the entire study period—rather for specific years. As a result, some indicators have data covering most of the study period, while others exhibit significant data gaps (Annex 2).

For instance, "agricultural emissions", "forest area", "agriculture employment", and "rural poverty" have data available for all years. These indicators have been extensively studied in Costa Rica for many years, and the institutions responsible for their measurement have specialised in furthering their studies and methodologies, leading to periodic specialised publications and dedicated websites to disseminate their findings. Notable examples include the National Inventory of Greenhouse Gas Emissions and Removals by the Meteorological Institute of Costa Rica (IMN), the Agricultural and Livestock Statistical Bulletins by SEPSA, and the National Household Survey by INEC. On the other hand, indicators such as "area under payment for environmental services", "trade balance of forest products", and "added value from the use of wood" had data available for only a few years, with considerable gaps throughout the study period. Other indicators, such as "wood consumption" and "area affected by forest fires", have some gaps but generally encompass data available for most years (Annex 2).

Indicators with a lot of missing data might not offer a comprehensive view of the policy's impact, making it difficult to accurately assess the effectiveness of certain policies. A main reason for the lack of data is the limited resources state institutions provide for data collection. In other cases, data may not be collected because the importance of the indicator has not been recognised yet, or the data was not considered essential. Additionally, data can also be collected but not published or made available to the public because of confidentiality or the lack of financial and human resources to publish it. In some cases, the lack of data availability might be due to limitations in the methodology of data collection, which can produce incomplete or biased data, limiting the availability of quality data.

At times, the lack of data availability can be related to the complexity of the indicator. Some indicators might be very difficult to measure, and costs to collect data high, especially if the data must be collected over a long period. For example, it is challenging to measure the area affected by forest fires over several years, especially if there are limited resources available for data collection. Some indicators might be more difficult to measure in certain regions, and therefore data might not be available for specific areas or countries. Another factor that can affect data availability is the lack of standardisation in data collection, making it difficult to compare data across countries and regions.

Nevertheless, despite the variation in data availability, access to as much data as possible for each indicator it is still valuable. Even if some data is missing, available data can still provide insights into trends over time and help identify areas that need more focus from policymakers. These findings, based on our own analysis and conclusions, highlight the limitations and challenges of conducting such studies and contribute to the broader understanding of data availability in policy impact assessments.

Indicators retained

The set of indicators in this study offer a comprehensive perspective on the impact of policy interventions in the land use sector. They cover a broad range of environmental, social, rural, economic, and institutional variables, allowing for a holistic assessment of the effectiveness of policy interventions (Table 7). This multidimensional approach ensures that many important aspects of the land use sector are considered and evaluated, providing a thorough analysis of the impact of policies on the ground. The indicators provide a useful basis for evaluating policy interventions in green transformations. By measuring environmental variables such as agricultural emissions and forest area, the indicators offer insights into the extent to which policies are promoting sustainable practices and contributing to the protection and conservation of natural resources. These measurements can help policymakers determine whether the policies are working effectively and what modifications may be necessary to achieve their goals.

Relevant indicators also offer valuable guidance for the development of monitoring frameworks for state institutions in charge of implementing the policies. By providing clear and measurable criteria for assessing policy impact, the indicators enable state institutions to track progress and make necessary adjustments to achieve a more effective and efficient implementation of policies, ensuring that resources are used in the most appropriate manner. Within the context of a green transformation, the indicators offer a multifaceted perspective on the social and economic impact of policy interventions in the land use sector, primarily in rural regions of the country. By measuring variables such as forestry employment and rural poverty, we can gain insights into the extent to which policies are promoting social equity and contributing to the improvement of livelihoods. This aspect is particularly relevant for Costa Rica, where rural communities are often the most vulnerable and in need of targeted policy interventions.

Table 7. Proposed indicators relevant to measure a green transformation in the forestry and agriculture land use sector of Costa Rica

Indicator	Explanation
Agricultural emissions	Measures emissions from activities in the national inventory, offering insights into the environmental impact of policies targeting GHG reduction.
Area affected by forest fires	Measures forest-fire-affected hectares within protected areas yearly, reflecting the effectiveness of policies addressing forest fire challenges and the use of fire in agricultural systems.
Number of seized fauna and flora species	Measures the number of confiscated species, revealing the effectiveness of biodiversity protection policies by monitoring seizures of fauna and flora species, including those protected by CITES.
Wood consumption	Measures per capita wood consumption, accounting for various wood types and trade flows. Provides insights into policies promoting reforestation, sustainable forest management, and wood product use.
Added value from the use of wood	Measures added value generated by sectors utilising wood, indicating economic impact of forestry policies.
Trade balance of forest products	Measures trade balance between exports and imports of forest products under HS codes 44 and 9403[3]. Offers insights into policies encouraging wood consumption and sustainable management of ecosystems.
Forestry employment	Measures forest-related job generation, indicating the social and economic impact of forestry policies, especially in rural areas.
Forest area	Measures percentage of national land covered by forests, indicating the impact of policies on forest conservation.
Area under PES	Measures total contract area in the PES program, evaluating state interventions' success in boosting forest cover in private lands and enhancing livelihoods in vulnerable communities.
Agriculture employment	Measures agricultural job count, reflecting the social and economic impact of the agricultural sector.
Rural poverty	Measures rural households below the poverty line, assessing rural, social, economic, and institutional impacts of rural sector policies.

Source: Author's own work

The proposed indicators in this study underscore the importance of incorporating the five defined variables—environmental, rural, social, economic, and institutional—to provide insights into the significance of these factors within our analysis. By examining policy objectives and indicators, we emphasise the significance of integrating the environmental variable to evaluate ecological impacts and resource management contributions. Addressing

[3] The term "forest products under HS Code 44" refers to products categorized under the Harmonized System (HS) Code 44, which includes wood and wood-based products, such as timber, lumber, and wood articles. Similarly, HS Code 9403 refers to a specific category within the HS that covers furniture and other articles related to the wood industry, including items such as wooden furniture and parts.

rural needs distinct from urban areas, considering socioeconomic dimensions, and valuing rural communities becomes evident through the rural variable. Inclusion of the social variable assesses policy impacts on services, equity, and societal well-being. The economic variable reflects sector performance, encompassing productivity, profitability, and rural improvement for vulnerable populations. The institutional variable acknowledges governance's role in shaping land use practices.

Our study highlights the significance of four essential elements that state agencies must prioritise to develop effective monitoring frameworks. To begin with, it is crucial to have a clear understanding of the policy objectives and the specific areas of focus in the land use sector. This requires coordination and collaboration among different state agencies to ensure that policies are complementary and aligned towards a common goal and possess financial resources to operate.

Next, state agencies should prioritise the development of a comprehensive set of indicators that captures relevant aspects of the land use sector, including not only environmental indicators but indicators focusing on economic, social, rural, and institutional aspects. These indicators should be well-defined, measurable, and aligned with the policy objectives. Third, the implementation of any indicator system should be supported by robust monitoring and reporting mechanisms. This includes the development of data collection protocols, regular data analysis, and the establishment of reporting frameworks that enable the analysis of information, tracking of progress, and identification of policy challenges. State agencies should also ensure that the indicator system is transparent and accessible to the public. This includes the publication of data and reports in a timely and accessible manner, as well as the engagement of stakeholders in the design and implementation of the indicator system. The involvement of civil society organisations, local communities, and other stakeholders is crucial to ensure that the indicator system is relevant and open and reflects of the needs and priorities of different actors in the land use sector.

Conclusions

Accurate measurement of indicators is essential to identifying pivotal factors, evaluating policy impacts, and steering policy development within the land use sector. However, in Costa Rica's land use sector, the complexity of the existing information system has hindered the establishment of concrete, coordinated, efficient, and transparent monitoring frameworks in state institutions. To address this challenge, we conducted an extensive analysis of indicators from public policies and identified a final set that can effectively measure forest and agriculture green transformations. These indicators serve as a valuable model for other developing countries facing similar challenges, providing guidance for the adoption of effective monitoring frameworks.

Furthermore, we have established a set of criteria to steer the indicator selection process. These criteria prioritise the indicators' significance, measurability, comprehensiveness, actionability, contextual relevance, and transparency. The indicators chosen must encapsulate the fundamental aspects of the transformations, have well-defined data sources and measurement techniques, span various dimensions of the sector, furnish meaningful

insights for decision-making, align with national priorities, and remain accessible to a wide array of stakeholders. However, despite our adherence to these criteria in indicator selection, certain indicators were omitted for reasons beyond their failure to meet the filters. This omission does not imply that these indicators are irrelevant for measuring a green transformation. Instead, it may indicate the need to enhance institutional capacities for measurement, allocate additional resources for management, or integrate these indicators into state policies beyond a single administration, ensuring their long-term sustainability and alignment with broader national measurement systems.

Our findings underscore several fundamental facts concerning the existing information on land use sector indicators in Costa Rica. While there has been a significant political commitment to formulating indicators over the past two decades, deficiency remains in the fundamental understanding of indicator theory and monitoring and evaluation practices. This knowledge gap hinders the effective development and application of indicators. Additionally, a lack of coherence exists among state institutions in defining and executing their monitoring frameworks. Multiple sets of indicators are present within policies, often pertaining to similar measurement aspects or interconnected scales managed by diverse state agencies, leading to a lack of standardised reporting. Finally, the degree of transparency and accessibility in reporting indicators, methodologies, and data sources is insufficient. Policy documents seldom delineate how their engagement is integrated into the monitoring process.

These insights emphasise the need for greater knowledge, coordination, and transparency in the development and implementation of monitoring frameworks for the land use sector in Costa Rica. By addressing these needs, the state can improve national indicator systems, reporting mechanisms and better inform decision-making processes related to green transformations.

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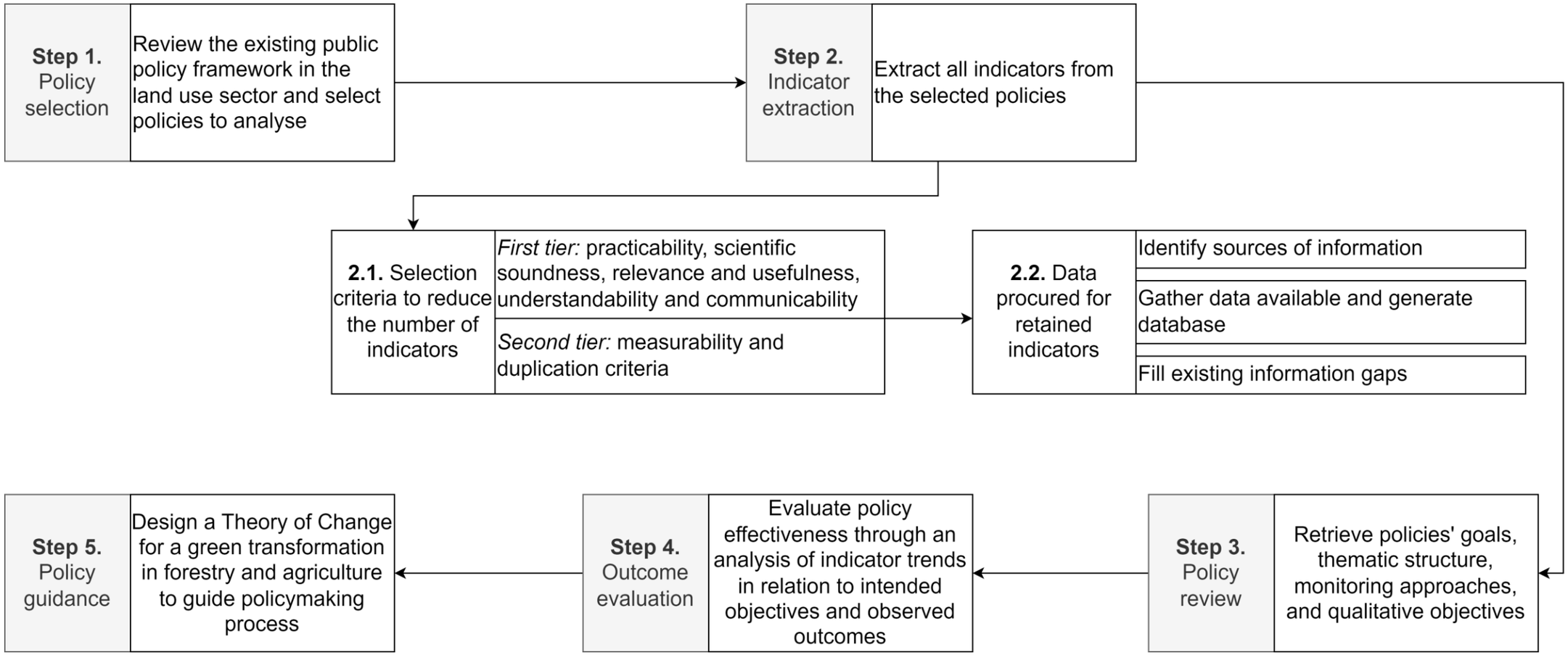
Annex 1. Steps for developing an integrated monitoring framework for measuring a green transformation in Costa Rica's land use sector



Source: Author's own work

Annex 2. Quantitative information for the proposed set of indicators to measure a green transformation in the forestry and agricultural land use sector of Costa Rica, for the period 1997-2017

Indicator	ID	Source	Unit	Year																		
				1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural emissions	1	SINAMECC	Gg CO_2e	3098	3024	2976	2900	2865	2908	2906	2914	2882	2838	2897	2875	2971	3058	3084	3099	2976	2843	2867	2916	2963
Number of seized fauna and flora species	2	SINAC	#							258	231	413	368	331	235	417	320	587	428	565	860	947	337	1160
Area affected by forest fires	3	SINAC	ha				36 896	57 511	50 337	32 783	35 228	14 822	15 192	32 422	23 417	13 795	3739	2049	3487	5979	2183	4368	6271	1172
Wood consumption	4	ONF	m^3		834.9	612.4	740.5	949.5	743.2	713.6	828.0		1130.2	1339.1	1229.3	1048.1	1079.7	680.8	680.7	637.9	650.9	633.2	689.6	672.7
Area under PES	5	FONAFIFO	ha														70 250	72 734	68 337	67 984	48 896	69 370	48 510	45 045
Trade balance of forest products	6	ONF	Million USD										- 3.3	-21.6	-40.0	-10.0	-16.0	- 3.5	-17.1	-26.1	-21.0	-25.5	-43.5	-37.1
Forestry employment	7	ONF	#		12 893			18 247	12 528	16 899	17 542	19 730	19 236	23 730	20 900	17 928	18 871	15 890	14 676	14 226	14 500	14 806	14 576	14 545
Forest area	8	WB	km^2	28 723	28 673	28 622	28 572	28 586	28 600	28 614	28 628	28 642	28 656	28 670	28 684	28 698	28 712	28 876	29 039	29 203	29 367	29 530	29 694	29 858
Added value from the use of wood	9	ONF	Million USD								163.1		230.0	293.4	309.3	257.0	289.4	284.8	247.0	257.5	249.6	240.7	236.0	227.6
Agriculture employment	10	SEPSA	#	252 700	261 600	256 129	251 828	241 896	251 508	248 378	245 328	269 975	256 171	254 598	241 632	281 070	285 076	198 573	203 816	200 067	229 902	252 801	243 197	256423
Rural poverty	11	INEC	%	24.1	22.4	23.5	25.4	25.2	25.4	23.1	26.0	24.9	23.0	18.3	18.7	19.2	27.4	27.1	27.1	27.8	30.3	27.9	25.7	24.1

Chapter III. The role of the state in driving green transformations in the forestry and agriculture land use sector in Costa Rica

Introduction

Towards the end of the 20th century and beginning of the 21st century, Costa Rica garnered recognition as a social democratic developmental state with a strong commitment to poverty reduction and social inclusion, all while achieving significant economic growth. This sets it apart from many global South countries that have witnessed a decline in their social achievements since the dominance of neoliberalism in the 1980s. In many of these nations, issues such as poverty, inequality, illiteracy, hunger, and systemic problems of authoritarianism and corruption have become pervasive (Sandbrook *et al.* 2007).

More recently, Costa Rica continues to be acknowledged as a robust democracy with high levels of political rights and civil liberties (Freedom House 2023). It has also maintained a positive trajectory in critical dimensions of human development, including fostering long and healthy lives, promoting knowledge, and ensuring a decent standard of living (UNDP 2023). This progress has been made possible through the concerted efforts of various state actors, including the government, a capable bureaucracy, and influential multi-sectoral economic stakeholders, collaborating closely with organised civil society groups. These stakeholders have harnessed technological, economic, and ideational drivers of change to advance the cause of a green transformation (Lederer *et al.* 2015).

The Costa Rican state has played a central role in shaping the trajectory of the land use sector, recognising its pivotal importance in economic development. Key economic elements such as agriculture, forestry, tourism, and water have been integrated into various development mechanisms and policies aimed at attaining what can be considered green transformation's objectives (e.g., expanding forest area coverage and stimulating renewable energy). Moreover, the state has implemented a range of policies and regulations to promote sustainable land use practices. Measures have been enacted to protect forests and biodiversity (e.g., a public system of protected areas), prevent deforestation (e.g., the PES program) and encourage the adoption of sustainable agricultural practices (e.g., agroforestry and low-carbon livestock approaches) (SEPSA 1998, 2002, 2011a, 2014, 2015a, 2016; MINAE 2001, 2011b, 2014a, 2016, 2019; MINAE and MAG 2015).

Costa Rica's commitment to sustainability has earned global recognition as a trail-blazer in environmental achievements. A remarkable achievement lies in its success to forest conservation, positioning it as one of the pioneering tropical nations globally to successfully reverse the trend of deforestation during the late 1980s and beginning of the 1990s. The country's rainforests now cover nearly 60% of its land, a significant increase from the 40% observed in 1987 (World Bank 2022). Costa Rica was granted with the Champion of the Earth Award in 2019, the highest environmental honour bestowed by the United Nations. This acknowledges the nation's steadfast dedication to nature preservation and its ambitious policies to combat climate change (UNFCCC 2019).

Costa Rica's commitment to sustainability is also reflected in its national policies and in its active participation in international agreements and partnerships (Table 8). These

commitments exemplify the nation's endeavours to champion a green transformation and global environmental protection.

Table 8. Costa Rica's international environmental agreements signed since 1975 demonstrating commitment to global sustainability and cooperation

Treaty Name	Date Signed	Aim of Treaty
Minamata Convention	19/01/2017	Reducing the use and release of mercury in different forms
Paris Agreement	13/10/2016	Combating climate change and adapting to its effects
Rotterdam Convention	13/08/2009	Promoting shared responsibility and cooperative efforts
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	01/08/2007	Conservation and management of migratory species
Stockholm Convention	06/02/2007	Protecting human health and the environment from Persistent Organic Pollutants (POPs)
Cartagena Protocol on Biosafety	06/02/2007	Safety of biotechnology and the transfer, handling, and use of living modified organisms
Treaty on Plant Genetic Resources for Food and Agriculture	14/11/2006	Conservation and sustainable use of plant genetic resources
Kyoto Protocol	09/08/2002	Reducing greenhouse gas emissions
United Nations Convention to Combat Desertification (UNCCD)	05/01/1998	Combating desertification and mitigating the effects of drought
Basel Convention	07/03/1995	Reducing the movement of hazardous waste between nations
United Nations Framework Convention on Climate Change (UNFCCC)	26/08/1994	Reducing greenhouse gas concentrations in the atmosphere
Convention on Biological Diversity (CBD)	26/08/1994	Conservation of biodiversity
Vienna Convention for the Protection of the Ozone Layer	30/07/1991	Protecting the ozone layer
Montreal Protocol on Substances that Deplete the Ozone Layer	30/07/1991	Protecting the ozone layer
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	30/06/1975	Protecting endangered species
Escazú Agreement	27/09/2018*	Promoting access to information, participation, and justice in environmental matters for citizens of Latin America and the Caribbean

Source: Author's own work

*As of October 2023, Costa Rica has signed the agreement but has not ratified it. Signing the Escazú Agreement means that a country agrees with the principles of the treaty, but ratifying it is the formal process of making it legally binding.

Despite this progress, there are also several challenges and drawbacks that remain obscured at higher policy levels and macro scales, and these issues have become increasingly evident since the early 2000s. The country has witnessed political, social, economic, and environmental deterioration, which has manifested in aspects of the daily lives of Costa Ricans and their institutions (PEN 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022). The decline of the welfare state and the consequences of the political parties' shift from socio-democratic to neoliberal principles have heightened political dissatisfaction among the citizens (Barrera *et al.* 2021). The concept of Costa

Rican democracy is often associated with a myth that dominant elite groups use to legitimise their agendas and political power, which does not necessarily align with the country's current reality (Alvarez 2011, 2019).

In the land use sector, one of the primary challenges is the intricate administrative governance structure that has emerged from the country's policy framework. While the state has played a key role in shaping the land use sector, creating a substantial degree of state bureaucracy. This complex administrative governance structure results in a slowdown of decision-making processes (OECD 2017) and poses challenges to effectively implementing policies and monitoring their impact to make corrections and mitigate negative effects. While the complex administrative governance structure can be considered a contributing factor to these challenges, there are likely multiple underlying causes that warrant further investigation and attention to better understand a green transformation in the land use sector.

The dynamics within the agricultural sector serve as a prime example of this complexity and the resulting consequences for society. Since the late 1980s, this sector has been crucial in driving Costa Rica's agro-export growth, expanding from a value of USD 0.9 billion in 1989 to USD 4.9 billion in 2017 (SEPSA 1990, 2017). This integration into the global economy has undeniably had a significant impact on the nation's economic fabric; however, it has also engendered impediments to social development. Within the trajectory of economic liberalisation, the impact of social policies becomes apparent as they failed to exclusively address the needs of the most marginalised groups over the long term. This oversight has led to an increased demand for skilled labour, while simultaneous dampening the vitality of job creation and limiting access to education. Consequently, despite the existing institutional framework and the allocation of public resources towards these objectives, progress in reducing poverty and inequality remained only incremental (Trejos 2012).

The escalating dominance of monocultural agricultural landscapes by major transnational corporations also has given rise to many adverse consequences. Beyond the heightened pesticide exposure experienced by labourers and the compromised job security that undocumented workers face (Acuña-González 2004, ILRF 2008, Shaver 2014), there has been a notable transition within the agricultural sector, moving away from smallholder farming towards more intensive, large-scale production systems centred around agribusiness (Shaver *et al.* 2015). This transition has been widely promoted. The prevailing market structure, which favours economies of scale, poses considerable risks for smallholders, rendering them vulnerable to competition from larger enterprises (Piñero and Díaz Ríos 2007, Lee *et al.* 2012) resulting in particularly dire consequences for rural areas, where the most vulnerable families reside.

The evident rural-urban divide in Costa Rica underscores the disparities in the state's approach to addressing different regions, thereby engendering spatial challenges and imbalances in accessing employment opportunities, public services, and productive resources. Research has consistently highlighted significant disparities between urban and rural areas in key socioeconomic indicators: poverty rates, income distribution, formal employment rates, healthcare access, and educational opportunities (Arias *et al.* 2020).

Despite the economic growth observed in the agricultural sector, the state struggles with the effective distribution of generated income to a broader spectrum of stakeholders,

perpetuating deep-rooted inequalities that have persisted for decades (ECLAC 2000). So while the sector's economic expansion has elevated the country's global position, it has concurrently accentuated the imperative of addressing the complex challenges that accompany such growth.

Given these challenges around inequalities and wealth distribution, which entail the task of balancing economic growth with the imperative of ensuring favourable social and environmental conditions, the objective of this study is to examine the effects of the state's institutional approach in promoting a green transformation in Costa Rica's land use sector. This transformation entails restructuring the economy to operate within planetary boundaries (Schmitz 2015) while prioritising social justice, paying particular attention to social inequalities and power dynamics that hinder access to essential resources for many individuals (Leach 2015).

Drawing on the insights of Lederer *et al.* (2015), which emphasise the role of the state in sustainability transformations in the global South, our study examines policy documents, rules, regulations, and domestic laws pertaining to land use practices. Our analysis specifically focuses on assessing the impact of these regulatory measures on various sectoral parameters, encompassing environmental, social, rural, economic, and institutional aspects. Through this investigation, we delve into the challenges faced by the state as it strives to promote a fairer society while simultaneously implementing sustainable land use practices across a range of policy domains. By scrutinising the state's endeavours to address the complex issues associated with the land use sector, we can offer valuable insights into the potential for a green transformation that effectively reconciles economic, social, and environmental considerations.

Our study focuses on the period from 1997 and 2017 and utilises key indicators (see Chapter II) as the foundation for our analysis, enabling us to answer two key questions: 1) To what extent has the state effectively promoted a green transformation in Costa Rica's land use sector, particularly within the forestry and agriculture domains? and 2) What challenges does the state confront in its efforts to foster a more equitable society while implementing environmental policies?

The incorporation of indicators into our study plays a key role in bridging the gap between Chapter II and Chapter III. While Chapter II laid the groundwork by establishing the contextual monitoring framework of public policies and served as the primary source for selecting the indicators, it did not deeply explore the qualitative and quantitative analysis necessary to comprehend the green transformations. Chapter III acts as a complement to Chapter II by placing a laser focus on these specific outcomes. This examination enables us to thoroughly assess the degree to which the state has effectively propelled a green transformation and provides the answers to our two central research questions.

Answering these two questions contributes to the existing literature by offering a comprehensive and data-driven analysis of the state's efforts in promoting a green transformation. Moreover, understanding the challenges the state faces in fostering a more equitable society while implementing environmental policies is crucial for policymakers and stakeholders. It sheds light on areas that require attention and improvement to achieve proposed green transformations. Of paramount importance, this research can inform future policy decisions and serve as a basis for discussions on the

effectiveness of environmental policies and their implications for any given transformation.

Methods

In this section, we provide an overview of the methodology used to assess the effects of a specific set of policies using a predefined set of indicators. We detail the process of policy selection, our analytical approach, and our insights into guiding the sector's journey towards achieving a green transformation.

We used a three-step methodology and multidisciplinary approach to evaluate the performance of Costa Rica's forestry and agriculture land use sector to assess the country's progress towards achieving a green transformation in these sectors. As a first step, we examined the policies previously selected (refer to Chapter II), analysing their goals, thematic structure, monitoring systems, and/or indicators, as well as any qualitative objectives. The chosen policies were drawn from a comprehensive review of all policies developed by relevant ministries responsible for the land use sector (i.e., MINAE and MAG), their technical secretariats (i.e., SEPSA and the Secretary of Sectorial Planning for Environment and Energy, or SEPLASA), and other public and semi-public institutions (i.e., SINAC, ONF, FONAFIFO, INDER). In total, we analysed five forestry-related policies and two agriculture-related policies (Table 9).

Table 9. Policies analysed for measuring the performance of the forestry and agriculture land use sector transformations in Costa Rica, implemented from 1997 to 2017

ID	POLICY
	Forestry
1	National Climate Change Strategy (ENCC) Action Plan
2	National Biodiversity Strategy 2016-2025
3	Forestry National Development Plan 2001-2010
4	Forestry National Development Plan 2011-2021
5	REDD+ Strategy
	Agriculture
6	Sector Plan for Agricultural and Rural Development 2015-2018
7	State Policy for the Territorial Rural Development of Costa Rica (PEDRT) 2015-2030

Second, we evaluated the achievement of the specified goals within all of the policies by comparing them with the historical trends of 11 indicators (refer to Chapter II). We scrutinised the patterns of these indicators using the data collected from 1997 to 2017, aiming to ascertain whether the policy goals were effectively achieved. In this context, achievement of these objectives implies a substantial and consistent alignment between intended policy outcomes and actual observed changes in the indicators over the specified period.

This evaluation also incorporated the five essential variables for understanding green transformations: environmental, rural, social, economic, and institutional. The environmental variable pertains to ensuring a healthy and ecologically balanced environment, including the conservation practices and sustainable use of natural resources. The rural variable focuses on social relations in a territory that promotes social action and solidarity, with forestry and agriculture communities at the centre of social and

economic dynamics. The social variable encompasses the delivery of state-sponsored social services and the accessibility of these services by both state and non-state entities, emphasising human-rights-based approaches. It also underscores the rights and contributions of various groups, including local communities, rural women, rural youth, Indigenous Peoples, Afro-descendants, and peasants. The economic variable covers the production of goods and services from natural resources, with a recognition that any transformative process should be economically inclusive. The institutional variable refers to established sector rules that structure social interactions, including state, economic, social, and educational institutions, which are fundamental units for proposing equitable solutions to sector challenges.

Incorporating these variables into our analyses involved a systematic examination of each policy through the lens of these dimensions. We carefully assessed the impact of the policies on the environment, their effects on rural areas, their social implications, economic outcomes, and their alignment with effective institutional frameworks. This approach required associating each policy with one or more indicators that closely aligned with their thematic focus (e.g., linking the ENCC's Action Plan with CO_2e emissions from the agriculture sector or the REDD+ strategy with the area under the PES program). In turn, this relationship illuminated how one or more of these five variables have advanced or remained unchanged.

To quantify the findings of the transformations analysed, we rated each of the five variables, using a numerical categorisation system to describe whether the indicators linked to each variable showed low achievement, moderate achievement, or high achievement. A score of 1 was assigned to indicators showing low achievement, signifying that policies fell short of realising their anticipated outcomes. A score of 2 was given to indicators showing moderate achievement, indicating that policies had made noteworthy progress but had not fully realised their potential or desired results. A score of 3 went to indicators showing high achievement, denoting that policies in this category demonstrated robust performance in attaining their intended objectives.

This integration of methodological steps, encompassing policy selection, indicator selection, and the inclusion of green transformation variables, draws upon the conceptual foundation introduced in Chapter I and the methodological framework outlined in Chapter II. Throughout this research, the green transformation variables have been consistently employed as a valuable tool for understanding the process of green transformations within the land use sector. The policy and indicator selection process detailed in Chapter II serves as the basis for guiding the evaluation of these policies' impacts. These three pivotal components—policies, indicators, and green transformation variables—constitute the central focus of Chapter III.

Third, we outlined concrete steps through a Theory of Change (TOC) designed for the forestry and agriculture land use sector, aimed to expedite its transition towards a green transformation. The components within the TOC offer targeted guidance to both state and non-state actors, advocating for a more comprehensive state engagement strategy. The objective is to cultivate a holistic and impactful approach that enables the achievement of a green transformation within land use.

Results

In this section we first present an overview of historical trends of specific variables under each policy selected (Table 9) to understand their impact on the land use sector. We compare the objectives proposed by each policy with a series of impact indicators to determine their magnitude of achievement. Following this, we craft a concrete policy route intended to address enduring challenges that necessitate the focus of state and non-state institutions. These suggestions are informed by the insights gathered from the comprehensive policy assessment.

National policies and strategies of the land use sector

The National Climate Change Strategy (ENCC) Action Plan

The ENCC's objective called for a transformation of the country's development model in response to global climate change. It aimed to channel early actions in mitigation and adaptation, creating enabling conditions to meet the country commitments by 2021. The overarching goal of the ENCC was to mitigate the adverse social, environmental, and economic consequences of climate change while harnessing opportunities for sustainable development, encompassing economic growth, social advancement, and environmental preservation (MINAE 2014a). This shared responsibility involved developing capacities and influencing both the national and international agendas.

The ENCC Action Plan emerged from collaborative efforts spanning two governmental administrations (2006-2010, 2010-2014) and was formally published during a subsequent administration (2014-2018). The plan's objectives aspired to contribute to the reduction of GHG emissions within prioritised sectors and to enhance the resilience of the most vulnerable populations against the impacts of climate change. It focused on prioritising interventions within the energy and agricultural sectors, which accounted for a substantial 76% of the country's total emissions in 2014 (IMN 2021).

In the context of the agricultural sector, the plan put forth the goal of decreasing GHG emissions originating from agriculture while simultaneously upholding or enhancing productivity in key products such as bananas, sugarcane, coffee, livestock, pineapple, and flooded rice. To achieve this, it intended to move towards greater productive efficiency within the sector through the application of climate-smart technologies. It set out an ambitious target of annually reducing emissions by 3.2 million tonnes of CO_2e across all sectors by 2021, with the agricultural sector contributing about 706 Gg CO_2e to that collective objective (MINAE 2014a).

Furthermore, the plan sought to diminish the vulnerability of agricultural producers, particularly those most exposed to the impacts of climate change. Strategies were formulated to increase the availability of physical, human, financial, and social resources accessible to the most susceptible producers. Strategies included fostering increased social engagement, providing information on the consequences of climate change and relevant coping mechanisms, and facilitating improved credit access (MINAE 2014a). Particular attention was directed towards small-scale agricultural producers, especially those engaged in staple crop production such as rice, beans, and maize, due to their heightened vulnerability to climate change impacts.

Despite its ambitious aspirations, the plan lacked comprehensive documentation and detailed descriptions of concrete actions to be undertaken by state institutions. For instance, the supporting studies underpinning alternative technologies were not referenced, and their validation remained pending. Also, the adoption of new technologies relied on expanding agricultural land from 5000 hectares in 2014 to 400 000 hectares by 2021 (MINAE 2014a), yet critical specifics such as action plans, geographic allocations, responsible entities, and other pertinent details were absent.

The plan's lack of a well-structured framework for measurement and evaluation obstructs the capacity to appraise the advancement and efficacy of policy objectives in these domains. A deficiency in clear indicators exists for pivotal elements such as the proliferation of new technologies, their specific scopes and geographical realms, methodologies to enhance social engagement, modalities for disseminating information about climate change repercussions and coping mechanisms, and the enhancement of credit access. The sole discernible indicator pertains to emission reduction within the agricultural sector, but ambiguities surround the timeline for achieving this decrease, the precise agricultural activities involved, and the rationale for setting this target. Furthermore, an examination of official data available up to 2017 reveals that this objective has gone unattained. In fact, GHG emissions from the agricultural sector escalated by 120 Gg CO_2e between 2014 and 2017, underscoring the challenges encountered in effectively curtailing emissions and attaining specified benchmarks within the agricultural domain.

Agriculture sector GHG emissions gradually declined from 3098 Gg CO_2e in 1997 to 2875 Gg CO_2e in 2008 (SINAMECC 2017),[4] However, starting in 2008, they increased again, reaching their highest peak of 3099 Gg CO_2e in 2012, only to decline again to 2843 Gg CO_2e in 2014. Since then, emissions consistently increased, reaching 2963 Gg CO_2e in 2017 (Figure 2). This upwards trend can be attributed to specific activities within the agricultural sector. Official data (IMN 2021) shows emissions from activities such as enteric fermentation, manure management, biomass burning in croplands and pastures, liming, and rice cultivation increased between 1996 and 2017 (Figure 3).

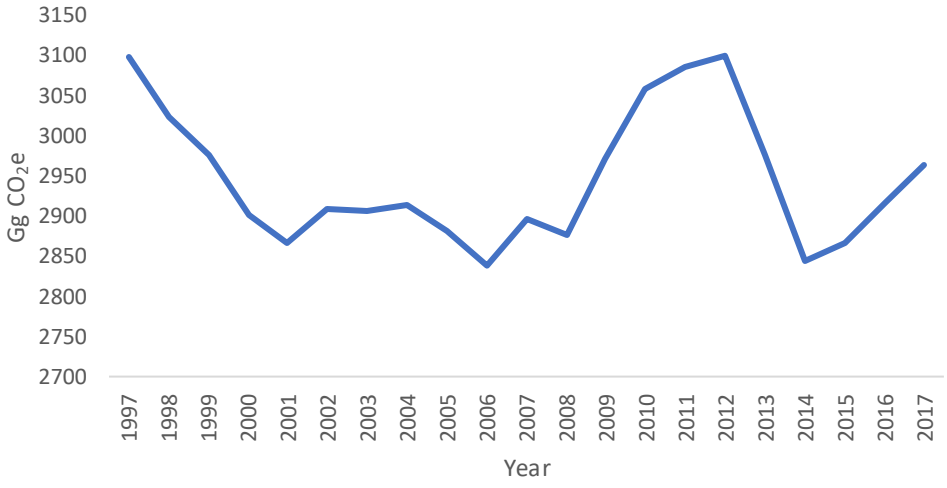


Figure 2. CO_2e emissions from the agriculture sector of Costa Rica from 1997 to 2017.

[4] These numbers are from SINAMECC, which retrieves information from the officially recognised National Inventory of Greenhouse Gas Emissions in the country, provided by IMN.

The country's inability to meet the proposed goals can be attributed to various factors. The absence of a well-defined measurement framework hindered the assessment of progress and effectiveness in key areas such as the adoption of new technologies, social participation, access to information, and credit. This limitation made it challenging to accurately track and evaluate the outcomes of the policy.

The extensive use of pesticides in the country also obstructs the achievement of a valid green transformation. According to FAO (2018), Costa Rica ranked 35th out of 169 countries globally in volume of pesticides used. Moreover, according to UNDP (2022), Costa Rica exhibits an average of 34.45 kg of active ingredient per hectare per year, higher than other countries in the Americas with similar agricultural conditions such as Colombia, Ecuador, and Guatemala. It also exceeds pesticide use in OECD countries, including Belgium (8.48 kg/ha between 2002 and 2012); Israel, Japan, and Korea (20.63 kg/ha, 11.8 kg/ha, and 10.9 kg/ha, respectively, between 2011 and 2015) (Sharma *et al.* 2019).

The use of pesticides poses significant challenges that public policy must address, with a particular emphasis on safeguarding the health of residents. Pesticides can be toxic to humans and cause both acute and chronic health effects. They also lead to contamination of water, soil, and air. Part of the problem lies in the persistence of these substances: some of the oldest pesticides can remain in the soil and water for years. Their health effects on individuals are related to the type of pesticide, the quantity, mode of exposure, and the individual's health status. These effects include dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine issues (Pacheco and Itriago 2022).

In agricultural production in Costa Rica, pesticide use has been identified as a significant health concern, with these substances found in up to 65% of fruits, and vegetables, with up to 19.5% exceeding the national regulatory limits. Furthermore, in the northern region of the country, more than 120 active pesticide ingredients have been found in samples of groundwater (Núñez 2020), with Bromacil[5] as one of the pesticides associated with rural communities near monoculture agricultural production such as pineapple (Ulate 2019).

Of the 22 pesticides used in the country from 2012 to 2020, 21 of them qualify as highly hazardous pesticides (HHPs), according to FAO standards (UNDP 2022). Their social and environmental impacts translate into high economic and fiscal costs for the country, estimated at up to USD 9.5 million per year, between 2018 and 2020, distributed among clinical care, production losses, and disabilities (Pacheco and Itriago 2022). This situation raises serious questions about the green transformation model adopted by the agricultural sector, where economic growth and the promotion of agricultural exports have not aligned with respect for people's health and labour conditions, indicating a negative aspect in the transformation.

[5] According to EPA (1996), Bromacil has been linked to adverse health effects, including thyroid, adrenal, eye, and thymus effects, as demonstrated in animal studies. Additionally, it has been classified as a Group C substance, indicating its potential as a human carcinogen.

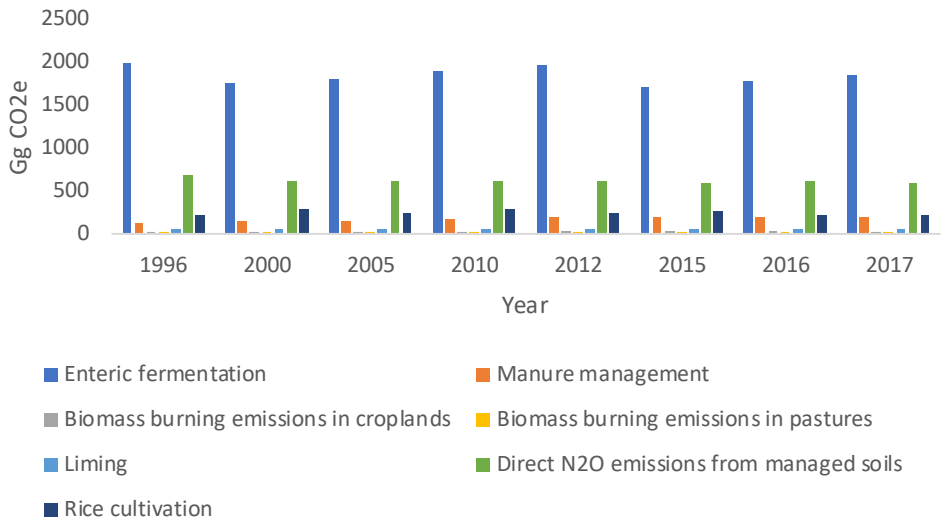


Figure 3. CO_2e emissions from specific activities of the agriculture sector in Costa Rica from 1997 to 2017.

The National Biodiversity Strategy and Action Plan 2016-2025 (ENB2)

Costa Rica's National Biodiversity Strategy and Action Plan 2016-2025 (ENB2) builds on the challenges identified in the country's first National Biodiversity Strategy, implemented between 2000 and 2005. This updated plan acknowledges and addresses the evolving needs and priorities in biodiversity conservation and management, allowing Costa Rica to effectively respond to challenges and ensure the sustainable protection of its rich biodiversity.

Aligned with the National Biodiversity Policy, the ENB2 serves as the instrumental framework to start implementing the policy between 2015 to 2030. It contributes to national development, poverty reduction, and sectoral initiatives and emphasises the critical interplay between biodiversity conservation and climate change. The plan draws upon a rich legacy of conservation initiatives championed by the government, reflecting a deep-rooted cultural commitment to biodiversity preservation. This longstanding tradition exemplifies a collective societal engagement, where biodiversity conservation is ingrained in the very fabric of citizen identity (MINAE 2016).

The ENB2 establishes seven strategic themes, 23 medium-term global goals to be accomplished by 2025, along with 98 national goals that were initially targeted for completion by 2020. It emphasises collaboration among governmental institutions, academia, municipalities, civil society, and the private sector, with particular attention given to vulnerable populations such as local communities, Indigenous Peoples, women, and youth (MINAE 2016). The plan's implementation is supported by state investment, and a portfolio of programs and projects has been developed, securing USD 506 million in funding from various sources as of 2022 (MINAE 2023).

The strategic themes cover key topics such as conservation, restoration and protection, the state's natural heritage and marine spatial planning, inclusive sustainable landscapes, governance and participation, biodiversity information management, and capacity building and institutional arrangements. Each theme targets key aspects of biodiversity

preservation and management and proposes specific actions to effectively address the challenges and opportunities within each domain (Table 10).

Table 10. Strategic themes, goals and specific actions included in Costa Rica's National Biodiversity Strategy and Action Plan (ENB2)

Theme Name	Broader Goals	Specific actions
In-situ Conservation	Ensure sustainability, connectivity, and resilience of National System of Protected Areas	Consolidate and expand protected areas system, improve management effectiveness, and enhance financial sustainability
Restoration and Biodiversity Protection	Restore and reduce loss or deterioration of key biodiversity elements	Enhance protection and restoration of key terrestrial ecosystems, prevent adverse impacts from productive activities, and strengthen environmental legislation compliance
State's Natural Heritage and Marine Spatial Planning	Establish rules and limits for utilisation, and prevent harm to ecosystem services	Resolve state's natural heritage processes, incorporate ecosystem approach into spatial planning, and ensure participatory planning
Inclusive Sustainable Landscapes	Apply ecosystem-based approach, promote restoration, and extend benefits to vulnerable sectors	Integrate ecosystem approach into planning, promote biodiversity-friendly practices, and develop inclusive economic incentives
Governance, Participation, Education, and Culture	Strengthen governance, citizen participation, education, and cultural practices	Enhance societal appreciation of biodiversity, diversify governance models, and improve legislation compliance
Biodiversity Information Management	Develop comprehensive information systems and support decision-making	Consolidate National Biodiversity Information System and enhance research and monitoring
Capacity Building and Institutional Arrangements	Increase financial resources and human capacities and establish effective institutional arrangements	Enhance resource utilisation efficiency and enable National Biodiversity Strategy implementation

Source: MINAE, 2016

The plan sets goals that are mostly linked to specific activities rather than long-term impacts that could show whether the proposed measures have positively impacted the country. Despite this, two indicators could serve as starting points for evaluation: forest fires and the number of seized fauna and flora species. The ENB2 sets forth actions to prevent and reduce the adverse impacts of productive activities, including forest fires, by 2025. The plan includes a goal to decrease forest fires by 10% outside of protected areas and 5% within protected areas by the year 2020. This commitment translates to reducing the initial extent of 25 690 hectares of forest fires beyond protected areas by 10% and minimising the initial extent of 4402 hectares of fires within protected areas by 5%.

Between 2000 and 2010, forest fires decreased significantly, particularly outside of protected areas (MINAE 2009, 2010, 2011a, 2012, 2013, 2014b, 2015). The affected area decreased from 34 505 hectares in 2000 to 12 856 hectares in 2009. However, a different trend was observed for fires within protected areas, where the reported area increased from 2391 hectares in 2000 to 7895 hectares in 2008. Starting in 2010, SINAC's reporting concentrated exclusively on fires occurring within protected areas, reflecting a strategic shift in focus. However, this approach could potentially divert attention from the broader landscape-level conservation efforts needed to prevent and mitigate fires outside these designated zones, which also contribute to overall biodiversity protection and ecosystem health. From 2010 to 2017, the average affected area was 3656 hectares, with 2016 recording most, at 6271 hectares. Nevertheless, the subsequent year witnessed a significant decrease, reporting 1172 hectares, one of the lowest values during the entire period, (Figure 4).

Although the goals were set for 2020, these data indicate that, at least by 2017 and within protected areas, the target was surpassed and reached a 27% reduction relative to the baseline. There is no evidence of the ENB2 achieving its fire suppression target outside protected areas due to the lack of data. However, the trend until 2009 showed promising results, with a 50% decrease compared to the plan's baseline.

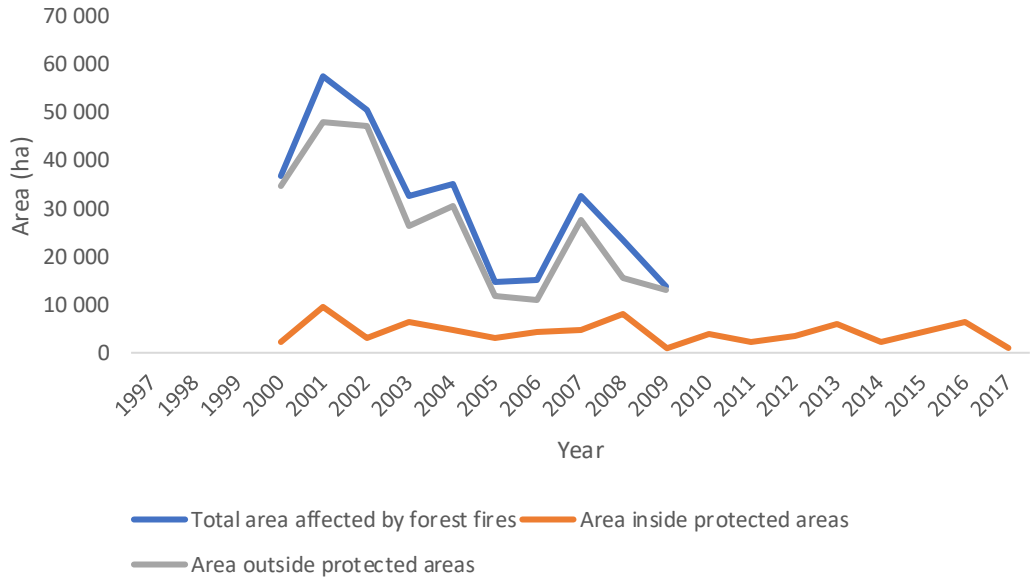


Figure 4. Total area affected by forest fires in Costa Rica, including areas both inside and outside of protected zones, from 1997 to 2017.

The ENB2 aimed to decrease the number of seized flora and fauna species by 2020, with a specific focus on products and byproducts regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Despite this objective, the policy lacked a baseline or quantitative value for measuring progress. Data from MINAE (2009, 2010, 2011a, 2012, 2013, 2014, 2015) reveal a concerning trend of increasing species seizures. Between 2003 and 2010, the number of species seized remained relatively stable, fluctuating between 231 and 417. However, starting in 2011, a consistent upward trend emerged, with species seizures reaching 587 in 2011 and continuing to rise steadily. This trend peaked at 1160 species by the end of the study period in 2017 (Figure 5). Despite a dip in 2016, where only 337 species were seized, an overall failure to achieve the goal of reducing seizures is evident despite the 2016

decrease, which could be attributed to a combination of factors, including changes in enforcement efforts, shifts in illegal wildlife trade patterns, and potential inaccuracies in data standardisation or availability.

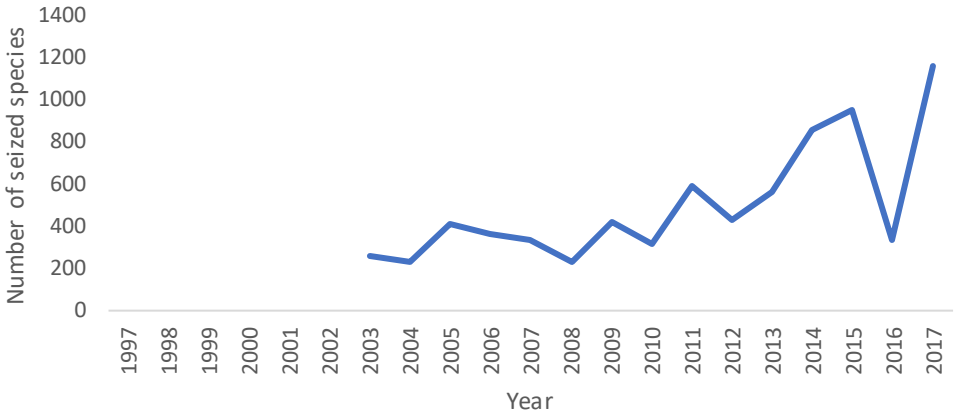


Figure 5. Number of seized flora and fauna species in Costa Rica from 1997 and 2017.

National Forestry Development Plan 2001-2010 and 2011-2020

In 2001, the Costa Rican forestry sector outlined its decade-long National Forestry Development Plan 2001-2010. It was developed with input from the public, private, and civil society sectors and aimed to ensure the sustainable management and development of the country's forest resources (MINAE 2001). The plan revolved around six primary action areas: land planning, sector competitiveness, sustainability monitoring, financial instruments, information systems, and institutional strengthening. These areas formed the foundation for the forestry sector's technical, conceptual, and commercial objectives.

Subsequently, an extensive action plan was designed to operationalise the initial plan. The Action Plan 2004-2010 encompassed nine components, 34 goals, and 134 indicators. It served as a roadmap from 2004 to 2010 to drive the sector's growth and achieve strategic aims. These included heightening competitiveness in national and global markets, sharing knowledge, safeguarding biodiversity, meeting wood demand, accessing markets with quality products, and establishing an environmental services market (MINAE 2004).

Recognising the challenges posed by the preceding plan, a new National Forestry Development Plan was formulated for the years 2011 to 2020. This plan emerged as a fundamental strategic instrument to guide the new forestry sector's trajectory. It was designed to build upon the lessons learned from its predecessor, effectively shaping a comprehensive framework for the sector's advancement. The plan's structure took into account distinct elements, namely policies, thematic priorities, strategies, and monitoring plans, each serving as a critical component contributing to the realisation of its overarching objectives (Table 11).

Table 11. Structure of the National Forestry Development Plan 2011-2020 in Costa Rica

Component	Main aspects
Forestry Policies	Twelve policies addressing challenges and opportunities in the sector: sustainable forest cover, integrated land management, climate change adaptation, supply of timber and non-timber products, competitiveness, capacity building, transparent regulations, innovative financing, domestic wood consumption, renewable energy, international influence, and sustainable forest management.
Thematic Priorities	Six pillars: 1) land management, 2) strategic positioning of the sector, 3) sustainable supply of timber and non-timber forest products, 4) enhancing competitiveness, 5) capacity building, and 6) transparent legal frameworks and innovative financial instruments. Included 46 indicators to measure progress and track performance.
Strategies	Forty-nine strategies providing guidelines for institutions involved in the plan's implementation, addressing: policy development, capacity building, institutional coordination, research and knowledge generation, and international engagement. Focus areas include strengthening legal frameworks, innovative financial instruments, capacity building, research, and international engagement.
Strategic Plan for Evaluation and Monitoring	Four strategic objectives with seven accompanying actions for evaluation and monitoring. Objectives include annual assessments of goal compliance, recognition by government oversight institutions, formation of subcommittees, and plan harmonisation with government plans. Efforts to consolidate the plan around the forestry sector's long-term objectives.

Source: MINAE 2011b

Though both plans proposed a significant number of elements (e.g., policies, components, pillars, strategies, and indicators, among others), they shared common goals related to two central themes: 1) increasing the consumption of domestically produced wood, linked to improving the value added of forest products and enhancing the trade balance of forest products and 2) expanding the forest area and increasing forestry employment.

Although indicators for these goals were implicitly proposed in the documents, the most recent plan includes only one quantitative measure to assess the expected impact of these goals: a 10% annual increase in the consumption of locally produced wood for long-term uses (MINAE 2011b). Nonetheless, no baseline or specific timeframe is established to measure progress nor are the sources from which this wood should come specified. As for the other goals, the expected impacts are too general and lack quantitative values for measurement. For instance, expected impacts include sentences such as "significantly increasing the value added through wood utilisation", "improving the trade balance of forest products", "significantly increasing employment generation", and "significantly expanding the forest area" (MINAE 2011b).

Overall, the forestry sector lost its competitiveness during the study period. The consumption of nationally produced wood, which peaked at 1.3 million cubic meters harvested in 2007, has declined, reaching 0.7 million cubic meters in 2017 (Figure 6A). The value added in domestically produced wood products followed a similar trend

reaching its highest value in 2008 at USD 309 million but steadily decreasing to USD 228 million in 2017 (Figure 6B). This has led to an increased consumption of imported wood. The trade balance of wood products illustrates this trend, going from USD -3 million in 2006 to USD -40 million in 2008, and it remained relatively stable at USD -37 million by 2017 (ONF 2007, 2008, 2009, 2010; 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018) (Figure 6C).

Another significant measure of the implications of a struggling forestry sector is employment. Data from the ONF reveals that after reaching a peak in 2007 with 23 730 people employed in the sector, the number of forestry workers has continuously declined, dropping to 14 545 in 2017 (ONF 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018), showing no signs of recovery (Figure 6D).

Numerous elements have played a role in preventing the realisation of these goals. Policy orientation and the allocation of public funds do not align with the specific needs of the forestry sector. Conservation strategies have historically involved displacing local communities to create national parks and protected zones, driven by the belief that isolating biodiversity from human activity is optimal for protection (Colchester 2004, Büscher *et al.* 2007, Hummel *et al.* 2019). Although these efforts hold value in conserving biodiversity in the immediate term, they may not directly address the social and economic dimensions of the forestry sector, including the needs of vulnerable communities residing in and around forested areas. Unfortunately, this approach has led to rural areas in regions like Huetar Norte experiencing both large protected areas and elevated poverty levels compared to other regions (Andam *et al.* 2010). Re-evaluating this conservation model as a social process that values community involvement and well-being is a challenging but essential (Brockington 2002, Karanth 2003, Brockington and Duffy 2010).

Another contributing factor is the shift in economic priorities and market demand—for instance, decreased demand for certain wood products or a move towards alternative materials. If the sector fails to adapt and diversify its offerings to align with evolving market demands, employment opportunities can diminish. Additionally, economic policies and incentives have favoured other sectors, redirecting investment and resources away from forestry. This affects the sector's overarching expansion, employment opportunities, and the capacity to offer wood products. This is evidenced by the inclination of government entities towards alternative materials such as metal, cement, gypsum panels, and fibre cement in public procurement (Santamaria 2015). A complex regulatory framework also currently discourages forest operations for many forest owners and organisations. This, in turn, contributes to a decrease in the supply of wood and its derivative products and contributes indirectly to high levels of illegal logging, estimated at 36% (Muñoz 2015).

Regarding the expansion of forest area, the most recent plan would attain this goal by valuing forests and other forest ecosystems and lands. It would involve ensuring legal protection, effective land tenure systems, and upholding the rights of property owners to use their lands in securing goods and services for the population's well-being (MINAE 2011b).

The country recovered slightly more than 1000 km^2 of forest land between 2011 and 2017, going from 28 876 km^2 to 29 858 km^2 (World Bank 2020) (Figure 6E). These findings align with several studies that have consistently shown an increase in forest cover over

the past decades. In 1997, forest cover accounted for 40.3%, rising to 45.4% in 2000, 48% in 2005, 51.4% in 2010, 52.4% in 2013, and 59% in 2020 (Sader and Joyce 1988; Sánchez-Azofeifa 1996, 2000, 2015; CCT and CIEDES 1998; Sánchez-Azofeifa *et al.* 2002; Calvo-Alvarado *et al.* 2009; CONARE 2021).

While it is evident that the goal of expanding forested areas has been widely achieved, particularly in terms of land area, other critical factors indicated in the plan and related to competitiveness and tenure rights for the sustainable utilisation of forest resources have not been successfully addressed, as indicated by the indicators mentioned.

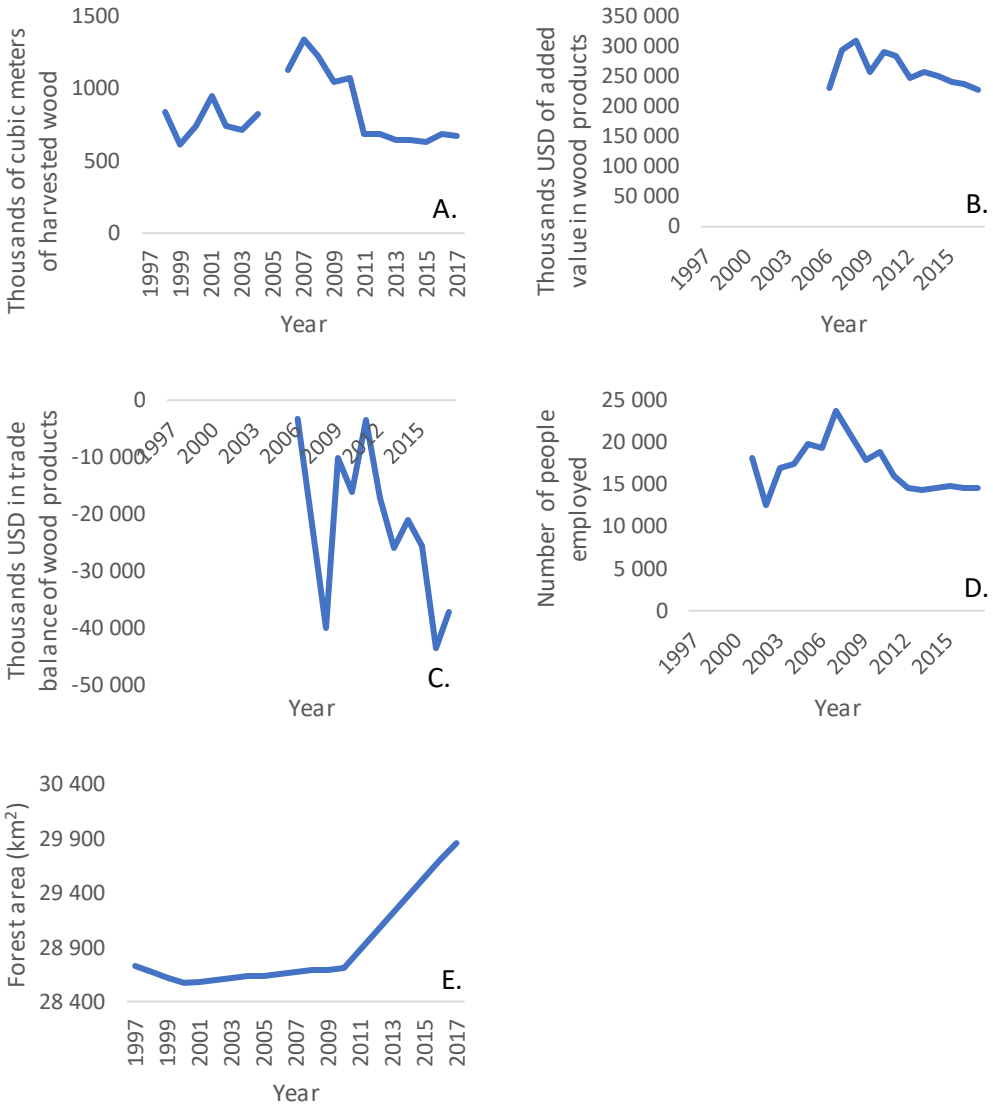


Figure 6. Performance of Costa Rica's forestry sector from 1997 to 2017: A. Wood consumption; B. Added value from the use of wood; C. Trade balance of forest products; D. Forestry employment; E. Forest area.

REDD+ Strategy

Parallel to starting the National Forest Development Plan 2011–2020, the Costa Rican government embarked on what came to be known as the fourth generation of financial environmental services mechanisms (i.e., first, tax credits; second, subsidies; third, the

PES program), by consolidating the REDD+ strategy (ENREDD+) in the late 2000s. The ENREDD+ went through a systematic assessment of social, political, and environmental risks, as well as the commitments derived from applicable safeguards. It was then reorganised and adjusted to simplify and align with the legal framework, operational procedures, and budgeting of responsible institutions and to complement the official planning framework for the Costa Rican forestry sector (the National Forestry Development Plan 2011-2020 and the National Development Plan of government administrations) (MINAE 2019).

The ENREDD+ included eight cross-cutting principles that underpin the national REDD+ approach. These principles were 1) the integration of REDD+ into the Forests and Rural Development Program, 2) voluntary engagement in REDD+ to contribute to convention goals, 3) alignment with national planning frameworks and respect for national sovereignty, 4) gradual nationwide implementation, 4) alignment with social and environmental objectives, 5) stakeholder engagement on a voluntary basis, 6) exclusive authorisation of the national entity for managing payments linked to outcomes, 7) a mechanism for distributing benefits from REDD+ investments, 8) utilisation of the PES program as the primary distribution tool for benefits on private lands, execution and monitoring by pertinent public bodies, and adherence to safeguards outlined in the convention and other pertinent operational policies (MINAE 2019).

Furthermore, the strategy included an implementation plan with six distinct policy instruments. These instruments serve as a guiding framework for targeted plans aimed at addressing the root causes of deforestation while overcoming barriers to effective REDD+ actions. Each of these policy instruments was accompanied by a set of well-defined goals, shedding light on the specific measures and initiatives designed to drive sustainable forest management and emissions reduction (Table 12).

Table 12. Proposed policies and corresponding goals in Costa Rica's REDD+ Strategy

Policy Name	Main goals
Promotion of Low Carbon Emission Productive Systems	Aims to expand silvopastoral and agroforestry systems by 69 522 hectares, enhancing biomass production and soil profitability, thus curbing deforestation incentives.
Strengthening Programs for Land Use Change and Fire Control	Addresses illegal logging and forest fires, targeting 90% of forest fires, combating deforestation-regeneration dynamics, and enhancing governance for fire control.
Incentives for Conservation and Sustainable Forest Management	Seeks to secure 640 000 hectares under Forest Emission Reduction Contracts (CREF), encouraging private owners to conserve their forests and adopt sustainable forest management practices.
Restoration of Landscapes and Forest Ecosystems	Aims to expand reforested area under PES contracts to 6500 hectares, promoting forest plantations and regenerating degraded lands to restore overused forested areas.
Participation of Indigenous Peoples	Emphasises consultation and participation of Indigenous communities in REDD+ processes, aiming for 65 000 hectares annually tailored to Indigenous Peoples.
Enabling Conditions	Involves setting up the Safeguards Information System (SIS), conducting at least 549 tenure studies and ensuring compliance with safeguards requirements.

Source: MINAE (2019)

In addition to establishing this framework, the ENREDD+ was the culmination of an extensive prior process that involved developing a forest reference emission level, a system for national forest monitoring, a consultation process with Indigenous Peoples, a safeguard system, a benefit-sharing plan, and a gender action plan, among other key components. Costa Rica also has implemented a large-scale emission reductions program (ERP) with the World Bank's Forest Carbon Partnership Facility (FCPF). This program is intended to amplify the impact of existing public policies and instruments to halt deforestation (e.g., the PES program) (FAO 2020).

The PES program plays a significant role in evaluating the impact of the ENREDD+. Sustaining and expanding the program's coverage area has consistently been a prominent goal and indicator within the forestry sector. The formal establishment of this initiative occurred in 1996 when it was officially recognised in Forest Law 7575. This law acknowledged four key environmental services offered by forest ecosystems, which include: 1 mitigating greenhouse gas emissions, 2) providing hydrological services such as supplying water for human consumption, irrigation, and energy generation, 3) conserving biodiversity, and 4) offering scenic beauty for recreational and ecotourism purposes (Ley Forestal 1996). Since then, the program has established itself as a state policy, a significant contributing factor being the allocation of funds obtained from a 3.5% mandatory tax on fossil fuels. This aspect of the policy holds unique importance as outlined in Article 5 of Law n. 8114 on Tax Simplification and Efficiency. According to this law, 48.7% of the total annual revenue generated from the collection of the single fuel tax is allocated to the Ministry of Finance, which then channels 3.5% exclusively to the PES program in support of FONAFIFO (SCIJ 2001).

Data from FONAFIFO show that the preservation of the area under PES contracts has been consistently maintained at approximately 125 000 hectares per year from 1997 to 2012, including two notable instances in 1998 and 2012 when the preserved area exceeded 250 000 hectares. However, a decline in the covered area has become apparent since then, falling from 250 389 hectares in 2012 to 133 462 hectares in 2016 (FONAFIFO 2017), marking a setback in the PES program's goal of sustaining its commitment forward (Figure 7).

This decline was identified through a direct inquiry we made to FONAFIFO for the relevant data. However, an executive director's report found on the institution's website[6] indicates that the area under PES contracts has been increasing, reaching 297 978 hectares in 2017, following sustained growth since 2015 (Rodríguez 2019). These discrepancies may emerge due to differences in data collection methodologies, reporting procedures, or the inclusion/exclusion of specific contracts or time periods in the analysis.

These differences demonstrate that the relative richness of scientific literature on PES contrasts with the scarcity of official open data addressing these mechanisms. In fact, much of the available quantitative data on PES in Costa Rica is found in grey literature, such as conference proceedings, working papers, government reports, and unpublished research studies. This limited availability of comprehensive and publicly accessible data may contribute to discrepancies and misinterpretations and hamper broader opportunities

[6] Available at FONAFIFO's website: https://www.fonafifo.go.cr/es/servicios/estadisticas-de-psa.

for independent review and analysis. The absence of comprehensive open data on the FONAFIFO website adds to the challenge of transparency and information accessibility.

Establishing a standardised and well-documented data collection process across all relevant entities holds the potential to mitigate such types of discrepancies stemming from varying data collection methodologies. This could entail the formulation of precise guidelines for the measurement and reporting of PES contract areas, ensuring uniform criteria for the inclusion and exclusion of contracts, and providing comprehensive details about the covered time periods.

An avenue for resolving these inconsistencies is presented through the official climate-change-related information and knowledge management platforms of the state. SINAMECC[7] (Costa Rica's National Climate Change Metrics System) and SINIA[8] (National Environmental Information System of Costa Rica) offer opportunities for streamlined coordination and institutional linkage, fostering efficient knowledge distribution regarding environmental matters at the national level.

Leveraging these technological advancements necessitates effective inter-institutional coordination, harnessing the potential of information technology to enhance transparency within public entities and uphold their obligations. Furthermore, coupling such digital platforms with real-time data entry and validation features ensures the precision and accuracy of recorded information before dissemination. This approach not only elevates data reliability but expedites reporting procedures while minimising the likelihood of errors in data interpretation.

As for the observed decline in the program's coverage area, this may be a consequence of a reduction in the national budget allocated for the program. In 2021, the PES budget was cut by 83% compared with 2020 (PEN 2022), adversely affecting the achievement of the ENREDD+ goal of expanding the PES area.

However, to contextualise the discussion within the framework of a green transformation, we argue that social impacts generated by the program should also be used to evaluate services (Pattanayak *et al.* 2010), mitigate the effects of climate change through avoided deforestation mechanisms (Engel *et al.* 2008, Zilberman *et al.* 2008, Robalino and Pfaff 2013), and the economic profitability necessary for their sustainability (Pagiola 2008, Pagiola *et al.* 2016, Rasch *et al.* 2021). However, information is limited on PES effects on social issues such as benefits for participation, effective poverty reduction, social inequalities reduction, and overall improvement in participants' welfare.

Alongside this information gap, criticisms of PES programs have grown in recent years. These critiques are based on the notion that PES can lead to nature commodification and green neoliberalism, negatively impacting socioecological system resilience (van Hecken *et al.* 2015), replicating colonial and neo-colonial resource alienation (Fairhead *et al.* 2012), and acting as a form of commodity fetishism that erodes the social bonds within the production of ecosystem services (Kosoy and Corbera 2010). In Costa Rica, some studies also indicate that the program has not improved household well-being and has had negative effects on the size of the cattle herd, the likelihood of hiring farm labour and the

[7] Available at http://www.sinamecc.go.cr/.

[8] Available at https://sinia.go.cr/.

likelihood of earning off-farm income (Arriagada *et al.* 2015). And while the program has had positive environmental impacts, it also tends to exclude small landowners (Legrand *et al.* 2013), with many participating landowners deriving their income from non-farm sources since most additional work required is typically undertaken by family labour, primarily due to the conservation focus being the main activity (Miranda *et al.* 2004, Porras *et al.* 2008).

In light of these findings, it is questionable how the program improved the well-being of its participants, particularly concerning given the persistent rates of poverty and inequality in rural areas, where the majority of PES contracts have been located. The substantial financial investment made by the program since 1997 has not effectively addressed these social challenges. While the sustained participation of families in previous years may be attributed in part to FONAFIFO having the necessary funds, it may also be due to landowners having higher levels of environmental consciousness for contributing to forest conservation (Arriagada *et al.* 2009). But, beyond the program's limited capacity to enhance economic well-being, this reality calls for a more comprehensive design of conservation policies that address the basic needs of many families seeking to participate in the program—considerations such as job creation, inclusion of productive alternatives that generate a supply of forest and agroforestry products, and better coordination with state social programs responsible for stimulating local rural economies. All of these are considered within the framework of this research as crucial elements to a green transformation.

Figure 7. Area of forests covered by Costa Rica's PES program between 1997 and 2017.

Sectoral Agricultural and Rural Development Plan 2015-2018

The plan served as the planning instrument for the agricultural and rural development sector and included actions and goals outlined in the National Development Plan for the same period. These responded to various demands expressed by the private sector and the institutional offerings resulting from multiple working sessions with both the public and private sectors. It provided a shared vision to the authorities of the agricultural and rural sector, the technical levels of the public sector, the private sector, academia, international cooperation, and civil society, outlining the objectives, indicators, actions, goals, and specific outcomes that the public institutions would carry out to implement it efficiently and effectively (SEPSA 2015a).

The plan's main objective was to generate results that would have an impact on the added value of the agricultural sector, promoting economic and social growth, ensuring food security and sovereignty, and reducing poverty and unemployment rates, especially in rural territories. It also addressed environmental concerns such as GHG emissions reduction, improved climate risk management, and reaching the country's goal of carbon neutrality by 2021, as established early in the decade beginning in 2010 (SEPSA 2015a).

The plan was designed around five pillars, forming a comprehensive framework to guide its implementation and achieve the desired outcomes in the agricultural sector. These pillars encompassed critical aspects crucial for boosting rural development, enhancing productivity, and addressing pressing demands such as climate change adaptation and mitigation (Table 13).

Table 13. Pillars and main goals of the Sectoral Agricultural and Rural Development Plan of Costa Rica for 2015-2018

Pillar	Objective
Food Security and Sovereignty	Enhance productivity, commercialisation, and value added for key agricultural products and foster projects in non-traditional and Indigenous activities to ensure food security and sovereignty
Opportunities for Youth in Agriculture and Rural Territories	Generate employment and entrepreneurial prospects for the youth residing in rural areas, thereby contributing to their engagement in agricultural and rural activities
Rural Territorial Development	Integrate rural communities into the nation's territorial development processes by investing in initiatives that create added value and improve livelihoods
Adaptation and Mitigation to Climate Change in Agriculture	Implement measures for climate change adaptation, mitigation, and risk management, emphasising the promotion of green businesses, eco-friendly enterprises, and technologies that reduce greenhouse gas emissions while maintaining or increasing agricultural productivity
Strengthening the Agro-Export Sector	Enhance the productivity, quality, traceability, and adherence to social and environmental regulations of exportable products, with the aim of improving market positioning and boosting the agro-export sector's contribution to the national economy

Source: SEPSA 2015a

Its complex monitoring and evaluation framework encompassed 127 indicators linked to 127 corresponding goals across five pillars and 27 strategic areas. The plan allocated a budget of more than USD 600 million for implementation, with a major focus on food security and sovereignty. This pillar received the largest share of the budget, 74%. This allocation was driven by the global recognition of the agricultural sector's responsibility in ensuring the availability and access to food and its involvement in all stages of the production chain, encompassing pre-production, primary production, value-added generation, and product distribution (Porter *et al.* 2014, FAO 2017a). This food-security pillar encompassed aspects such as food quality, safety, the preservation of national heritage, and the promotion of plant, animal, and human health (SEPSA 2015a). To further strengthen it, collaborative efforts were pursued with sectors such as health, culture, education, and economy to establish a comprehensive national policy and plan.

The plan was adopted in 2015, just two years before the end of the study period, making it practically impossible to analyse whether it had the expected impacts. Nevertheless, it is worth highlighting that this policy builds upon a long history of support for the Costa Rican agricultural sector by the Costa Rican state. Within the study period alone, five significant policies were officially established: the Policies for the Costa Rican Agricultural Sector 1998-2002 (SEPSA 1998), Policies for the Costa Rican Agricultural Sector 2002-2006 (SEPSA 2002), Policies for the Agricultural Sector and the Development of Rural Territories 2015-2018 (SEPSA 2014), State Policy for the Agrifood Sector and Costa Rican Rural Development 2010-2021 (SEPSA 2011a), and the Strategy for Low-Carbon Livestock (MINAE and MAG 2015).

Collectively, these policies have been implemented with the overarching goal of sustaining the prominence of the agricultural sector as a key driver of the country's economy. These measures have sought to foster technological advancements, boost production levels, and facilitate economic liberalisation, all in a bid to enhance the export potential of specific agricultural products. Employment generation within the sector has always been regarded as a vital gauge, underscoring its substantial influence on the national labour market. Despite a decrease in the share of agriculture in overall employment, the agricultural sector in Costa Rica maintains a significant position as the second largest employer in the country (INEC-ECE 2016), reaffirming its crucial role in providing livelihoods and economic opportunities

Criticism has arisen in the national debate regarding the impacts that economic liberalisation has had on the agricultural sector and its ability to generate more and higher-quality employment. As part of the state's efforts to promote such model, two key institutions were established in 1996: the Ministry of Foreign Trade (COMEX) and the Foreign Trade Promotion Agency (PROCOMER). These institutions define and direct foreign trade and foreign investment policies, provide support to special export regimes, and coordinate programs related to exports and investments. Since 1999, Costa Rica has signed 15 free trade agreements (FTAs) and several bilateral and multilateral agreements to promote exports and attract foreign investment.

As a result, the export of agricultural products has grown exponentially, and private investment has led to the establishment of numerous companies specialising in the production and export of non-traditional agricultural products. However, despite the dynamism of non-traditional agricultural production, its employment capacity has not been sufficient to compensate for the jobs lost in traditional agricultural production. While agricultural products have been successful in entering global markets and generating economic growth, they have not been able to absorb a significant portion of the rural labour force, exacerbating issues of rural poverty, inequality, and unemployment.

Although agriculture continues to represent a substantial workforce in the country, consistently employing an average of 246 794 individuals from 1997 to 2017, the nearly stagnant employment figures during this period do not correspond with the significant revenues generated by agricultural exports. This disparity is further underscored by the rise in the open unemployment rate within the sector, which increased from 3.4% to 8.8% (SEPSA 2005, 2009, 2011b, 2013, 2015b, 2017, 2019) (Figure 8). As of 2017, agricultural employees also had the lowest average income among different social classes,

with a value close to USD 360 per month, even lower than the minimum wage. The agricultural sector has shown limited progress in complying with labour guarantees established in the Labour Code, with a reported 20% non-compliance rate between 2010 and 2017 regarding benefits such as holiday pay, sick leave, and overtime compensation (PEN 2018).

This situation underscores a notable underperformance of the state's economic model in addressing social aspects. In contrast, the support extended to private entities, exemplified by the Costa Rican Investment Promotion Agency (CINDE), which is tasked with attracting foreign direct investment (FDI) to the country, has yielded considerable success in luring more than 280 high-tech companies. This achievement has resulted in the establishment of more than 118 245 job opportunities. However, most of these employment prospects have been concentrated in sectors other than agriculture, with a notable focus on the Greater Metropolitan Area (GMA). Sectors such as services, advanced manufacturing, and life sciences have garnered substantial investment, while a mere 2.7% of the jobs have materialised outside the boundaries of the GMA (CINDE 2019).

What is more, the benefits of this economic growth have remained concentrated among a select few power groups (Vargas 2010). In fact, data from PROCOMER paint a stark reality for most small businesses in the country. In 2017, the number of companies with an export range exceeding USD 25 million was 79, accounting for only 2.1% of the total number of companies, yet they represented 68.4% of total exports. In contrast, businesses with export ranges equal to or below USD 100 000 numbered 2376 and contributed a mere 0.004% to total exports (PROCOMER 2017).

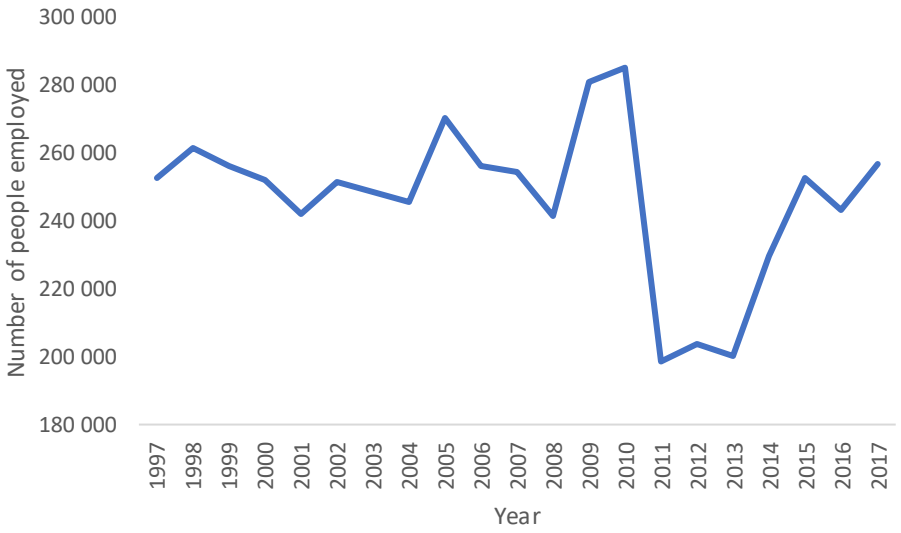


Figure 8. Agriculture employment in Costa Rica from 1997 to 2017.

State Policy for the Territorial Rural Development of Costa Rica (PEDRT) 2015-2030

The PEDRT was strategically devised to facilitate the holistic advancement of rural territories, respecting their distinct characteristics and cultural identity. This policy emerged through a participatory process, uniting the objectives of public institutions and territorial stakeholders to establish a framework for effective public-private collaboration. The creation of this policy involved SEPSA, the Interinstitutional Technical Committee

(CTI), and INDER, with technical support from the Inter-American Institute for Cooperation on Agriculture (IICA). The PEDRT set a 2030 vision for integrated and participatory development in rural territories, involving cooperation among public institutions, private entities, and civil society (SEPSA 2016).

The policy was structured around five strategic themes that guided the coordinated actions of public institutions in close collaboration with the private sector, civil society, and local governments. Each of these strategic themes was accompanied by up to three impact indicators, designed to assess the policy's progress and effectiveness in achieving its intended goals. These impact indicators served as valuable metrics to gauge the policy's outcomes and adapt strategies for optimal developmental impact (Table 14).

Table 14. Strategic approach defined in the State Policy for the Territorial Rural Development of Costa Rica (PEDRT) for 2015-2030

Strategic Theme	Focus and Objectives	Indicators
Infrastructure of Services for Development	Promote investments in goods and services to stimulate economic and social growth, especially in areas with unsatisfied basic needs	• Percentage of rural territories improving the satisfaction of unsatisfied basic needs
Equity and Inclusion in Territorial Development	Foster population integration and participation in developmental decisions, with a focus on marginalised groups to mitigate inequalities	• Percentage of the population aged 18 and above completing secondary education • Percentage of selective institutional programs implemented in the territories • Percentage of female agricultural producers
Institutional and Organisational Management for Development	Strengthen the governance and organisational structure of rural territories, empowering their integration into regional and national processes	• Percentage of budget execution within the framework of rural territorial development plans • Percentage of progress in the implementation of budgeted programs and projects in the territory
Rural Territorial Economy	Enhance territorial economies based on their unique strengths, providing financial and non-financial support to encourage production, wealth generation, and employment opportunities	• Percentage of territories with lower poverty incidence
Territorial Ecosystems	Encourage ecologically sustainable practices, including environmentally friendly production, climate risk management, and responsible use of natural resources	• The cantonal environmental sustainability index (ISAC)

Source: SEPSA (2016)

Despite this policy's relatively less complex monitoring system compared with other policies and impact indicators that theoretically would be easy to measure, the policy does not include baselines or quantitative goals that help evaluate the progress of actions. Like other policies, it was officially implemented at the end of the study period (2016), so its evaluation in 2017 cannot be realistically measured. However, this does not mean that the issues addressed by the policy are new to the Costa Rican state. In our perspective, this policy encompasses two elements derived from the recent history of the country that shed light on the role of the state in promoting the livelihoods of communities living in rural territories and provide insights into the outcomes resulting from this approach. Their description follows.

The economic model shift in the 1980s

In the early 1980s, Costa Rica faced a significant economic and productive crisis, characterised by deteriorating terms of trade, rising real interest rates, reduced foreign lending, and soaring hydrocarbon prices. This led to a high fiscal deficit, a surge in internal and external debt, a decline in productive capacity, and a contraction of the gross domestic product (GDP) (Cattaneo *et al*. 1999, Villasuso 2000, León 2012). After a change of government in 1982, Costa Rica embarked on an economic liberalisation process by entering into stabilisation and structural adjustment agreements with the International Monetary Fund (IMF), the World Bank, and the United States government. This marked the emergence of neoliberalism in the country (Poulantzas 2000, Soederberg 2001; Panitch 2003), with the argument that greater exposure to the free market can potentially resolve all social, political, and ecological issues. This approach has become an increasingly ingrained element of capitalism's structural framework (Clarke 1988, Duménil and Lévy 2002, Marois 2005). This process was justified by the export-led growth hypothesis, which asserts that exports stimulate economic growth, enhance competitiveness, and increase productivity, ultimately leading to poverty reduction and overall economic development in developing countries (Hidalgo 2000, Dollar and Kraay 2001, Gabrielle 2004, Abou-Stait 2005, Gokmenoglu *et al*. 2015).

From 1982 to the early 1990s, the United States Agency for International Development (USAID) provided aid to Costa Rica through the Economic Support Fund (ESF), contingent upon compliance with Stabilisation and Economic Recovery Programs (EREs). The EREs included various requirements, such as an IMF contingency agreement (ERE II, 1983), privatisation of the Costa Rican Development Corporation (CODESA) (ERE V, 1986), freezing of subsidised credit for agriculture and industry, customs system modifications to facilitate exports (ERE VI, 1987), separate administration of foreign exchange, and the presentation of annual economic plans (ERE VII and VIII, 1988 and 1989). Subsequently, when these recommendations were implemented, the reduction in ESF volume signified the gradual withdrawal of AID from Costa Rica in the early 1990s, which culminated in 1995 with the closure of USAID offices and the establishment of the CRUSA Foundation (Sojo 1991).

While receiving the EREs, Costa Rica entered into three structural adjustment programs (SAPs) as a condition imposed by the World Bank for structural adjustment loans (SAL). SAP I (1985) aimed to restructure the productive apparatus, diversify industrial production, and promote non-traditional exports to markets beyond Central America. Agricultural policy was redefined to include incentives for the production and export of new crops such as coconut oil, pineapple, citrus juices, macadamia nuts, and cashew nuts.

SAP II (1989) entailed a deep restructuring of the CNP, the elimination of subsidies for rice, corn, and beans, liberalisation of basic grain imports, and a gradual convergence of CNP guarantee prices with international prices. And SAP III (1995) focused on modernising, rationalising, and comprehensively reforming the state, marking a clear departure from previous SAPs that primarily centred on trade liberalisation. Under this SAP, agreements were signed with the Inter-American Development Bank (IDB) for a Public Sector Adjustment Program, Sectoral Investment Program, and Multisectoral Credit Program (Sojo 1991).

The evolution of institutions responsible for rural territories

In parallel, as the new economic model gained traction, the Costa Rican government underwent a restructuring of its institutional framework to address rural territories in the country. Since 1961, the Institute of Lands and Colonisation (ITCO) had been working towards fair land distribution and improving the living conditions of peasant workers in the land use sector. During 21 years, the institute achieved significant milestones, including settling 1222 families in 11 colonies covering a total area of 35 412 hectares, titling 2093 farms, formalising 17 communal companies (particularly cooperatives) benefiting 517 families across 6505 hectares, and establishing 10 individual plots spanning 24 942 hectares, benefiting 835 families (Seligson 1978).

However, despite these significant advances, Costa Rica was still characterised by considerable inequality in land distribution. According to Taylor and Hudson (1972), the Gini coefficient for land distribution in 1972 was 0.83, ranking Costa Rica as the sixth most unequal country among the 54 nations analysed. While ITCO had made efforts to improve the conditions of beneficiary families through its programs, the issue of land distribution remained unresolved. This and the displacement of thousands of workers due to the modernisation of banana areas highlighted the need for a more comprehensive approach to addressing territoriality, particularly regarding land tenure and inequality reduction in the land use sector.

In response to these challenges, the Institute of Agrarian Development (IDA) was established in 1982 to promote the development of rural and agricultural areas through mandatory coordination among state institutions, for investments in agricultural production, education, infrastructure construction, health works, and more. The establishment of settlements yielded significant results for the new institution, including the granting of 5921 new land titles, construction of roads and agricultural credits, development of 3900 hectares of palm oil plantations and 500 hectares of cocoa plantations, rehabilitation and construction of agricultural drainage systems and roads, the foundation of the cooperative Coopeagropal R.L, and individualised assistance to 450 small-scale producers. Additionally, two major projects were undertaken: the Arenal Tempisque Irrigation Project I and II, which involved an investment of approximately USD 40 million between 1986 and 2001, and the National Food Plan, which promoted 26 integrated projects in family farming settlements with the participation of the MAG, the Mixed Institute of Social Aid (IMAS), CNP, and the Bank of Costa Rica, among others (FAO 2017b).

Nevertheless, over the course of nearly three decades, IDA faced the challenges posed by the strong economic liberalisation model, which diverted support away from small-scale producers and led to significant benefits for agro-export companies. This situation

highlighted a conflict of interests within the Costa Rican state and its institutional framework. According to Ávila (2013), this paradox created significant obstacles for the institution, eventually resulting in a crisis in 2007. The lack of effective mechanisms for coordinating actions between agricultural sector institutions and the private sector, the environmental impacts of non-traditional activities in rural areas, inconsistencies between territorial planning policies and land concentration in the hands of private owners with large capital, and the absence of effective mechanisms for incorporating local governments and organised civil society in development processes all contributed to the request from the general comptroller of Costa Rica to close IDA and redistribute its functions among other public institutions.

This marked the third institutional change. The transformation of IDA became effective on 22 March 2012, when INDER replaced it. Through this transformation, the official introduction of the rural territorial development approach was initiated. INDER defined mechanisms for planning, coordinating, and executing rural development in the country, with a particular emphasis on the least developed territories (FAO 2017b).

But, like t IDA, INDER also had to confront the consequences of an economic model that did not effectively address inequalities, wealth concentration, and poverty, particularly in rural areas. For instance, in 2013, just one year after its establishment, despite the country's overall improvement in macro indicators such as the Human Development Index (HDI), government effectiveness, GDP per capita, and GDP per person employed, 285 467 households, equivalent to 20.6% of all households, were living in poverty. Among these, 18.2% were urban households and 27.1% were rural households. Additionally, agricultural unemployment stood at 6.6%, lower than the national average of 8.3%, and the Gini Index reached 0.52, the highest recorded since the beginning of the century (INEC 2013).

In response to this reality, INDER renewed its efforts to find effective solutions to social problems. The institution began to promote a new institutional framework, seeking external support from international organisations and establishing governance instruments for organising the territories. This included the formation and operation of rural development territories (CTDR) and the preparation of rural development territorial plans for 26 defined territories. As an example of a territorial approach, the *Tejiendo Desarrollo* (Weaving Development) program was launched, aiming to promote endogenous development in 12 prioritised territories, in collaboration with the Ministry of National Planning and Economic Policy (MIDEPLAN), the Institute for Municipal Promotion and Advice (IFAM), and the National Directorate for Community Development (DINADECO). Other significant actions included the creation of the Technical Secretariat for Rural Development (SETEDER), developing a permanent evaluation and monitoring instrument for the execution of state rural development policies, the approval of regulations for land acquisition and rural credits, and the approval of 10 rural territorial development plans.

In 2016, four territories were constituted, 17 rural development plans were prepared and approved, a new INDER organic structure was approved, an evaluation process to measure the impact of public policies in rural areas was initiated, and the National Plan for Rural Territorial Development (PNDRT) 2017-2022 was developed as a strategy for implementing the State Policy for Rural Territorial Development (PEDRT) 2015-2030.

Additionally, the transfer regulation for private and public entities in rural territories to access more finance was approved.

However, assessment of outcomes shows that these actions have fallen short of anticipated results. Analysing rural poverty, a key metric in this study and extensively explored within the realm of the state's social programs in vulnerable regions, reveals a consistent picture. Despite some fluctuations, it largely remained around 24% between 1997 and 2017, with a peak of 30.3% in 2014 (Figure 9). This situation becomes even clearer when comparing urban and rural contexts using The National Household Survey data from 2010 to 2017, revealing an average rural poverty rate 8.2% higher than its urban counterpart (INEC 2022a). A similar pattern emerges in inequality analysis, where the Gini coefficient per person has not changed significantly, remaining relatively stable at 0.514 between 2010 and 2017 (INEC 2022b).

The limited employment and income-generation avenues within agriculture, as evidenced by the agricultural employment data, compound the difficulties experienced by rural populations. Despite the establishment of entities like IDA and INDER, the persistent challenges of land distribution, wealth concentration, and social disparities in rural domains persist. The evidence of an unchanged Gini coefficient over time signifies that wealth disparities have not been reduced, and distribution of resources, opportunities, and access to basic services in rural settings impedes upward mobility and contributes to the perpetuation of poverty. These observations underscore that the efforts aimed at transforming rural territories through institutional shifts have not comprehensively addressed the underlying structural complexities sustaining poverty and inequality.

This situation has continued to deteriorate since 2017. The 2022 State of the Nation Report highlights a regression in social conditions. Despite the country's average poverty rate being 23%, deficiencies have affected 35% of the population, and this number could escalate to 45% depending on the criteria used for assessment. More than 350 000 households struggle to meet their basic needs, and this predicament is even more pronounced in rural regions, where the official poverty rate exceeds 28% (PEN 2022). State investments are also under threat across various sectors. A 12% increase in debt has amplified interest payments, accounting for 41% of the government's expenditure surge in 2021. Consequently, the government faces constraints in effectively assisting the socially vulnerable population, which is further affected by the considerable escalation in the costs of essential commodities and services. For example, social investment via the Social Development and Family Allowance Fund (FODESAF) witnessed a 7% decline between 2020 and 2021. In comparison to 2019, FODESAF has lost a significant portion of the essential funding required to aid the most disadvantaged communities, particularly those residing in rural areas (PEN 2022).

As for the land use sector, between 2020 and 2021, SINAC suffered a 33% decrease in revenue, affecting the PES program, which experienced an 83% reduction in coverage in 2021. Moreover, the state lacked the institutional capacity and resources necessary for the effective preservation of protected areas. As of 2021, the ratio of park rangers to land area had surged six-fold in comparison to 2020, resulting in one park ranger for every 32 700 hectares. This situation has the potential to trigger adverse outcomes, including ecological degradation, a rise in endangered species, and a decline in wildlife populations (PEN 2022).

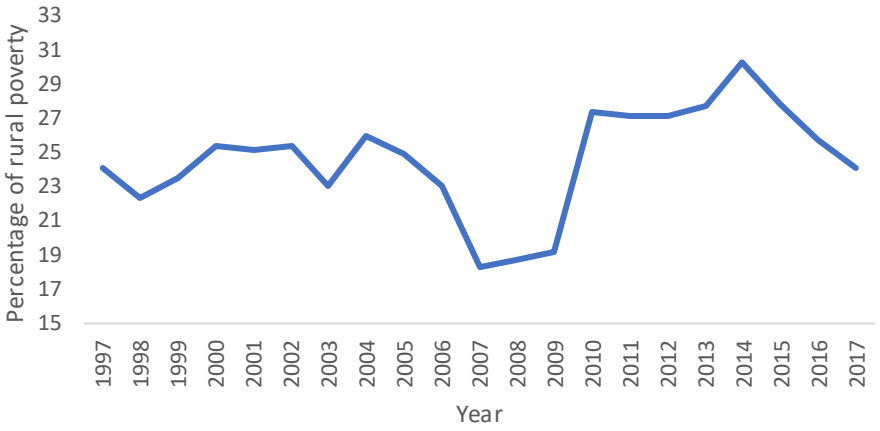


Figure 9. Rural poverty in Costa Rica from 1997 to 2017.

Variables that explain the path towards a green transformation

The research outcomes highlight the influence of policy measures on various aspects of the environmental, rural, social, economic, and institutional variables of a green transformation. An examination of these five variables unveils a prevailing trend where most analysed indicators point to inadequate focus on these aspects. This situation raises uncertainties regarding the advancement towards a green transformation within the forest and agricultural land use sectors.

Despite specific environmental challenges facing the land use sector, the environmental variable stands out with the highest score among all the variables, achieving a positive 72% in comparison to the rest of the variables. This score is substantiated by six key indicators associated with this variable. The "area under PES" indicator earned a high achievement rating, given its effective preservation of the program's covered area, at least until 2012 when it reached its peak (FONAFIFO 2017). Similarly, the "forest area" indicator received a high rating due to the continuous expansion of forest cover since the study's inception in 1997, a trend that has been consistently observed since the 1980s (Sader and Joyce 1988, Sánchez-Azofeifa, 1996, 2000, 2015; CCT and CIEDES 1998; Sánchez-Azofeifa *et al.*, 2002; Calvo-Alvarado *et al.* 2009; CONARE 2021). The "area affected by forest fires" indicator earned a high achievement rating, reflecting the remarkable reduction in forest fires, both within and outside protected areas (MINAE 2009, 2010, 2011a, 2012, 2013, 2014b, 2015).

However, to provide a more balanced assessment of the transformation in the lens of this variable, it is crucial to acknowledge negative exceptions, such as the rising emissions from the agricultural sector (IMN 2021) and an increase in seized flora and fauna species (MINAE 2009, 2010, 2011a, 2012, 2013, 2014, 2015), which challenges the state's commitment to maintaining a healthy environment. Additionally, the evaluation highlights concern about adverse trends in wood consumption, revealing consistently low rates of domestically consumed wood over the years (ONF 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). This situation is further exacerbated by alarming volumes of illegal timber consumption (Muñoz 2015), which directly impacts forest integrity (Figure 10).

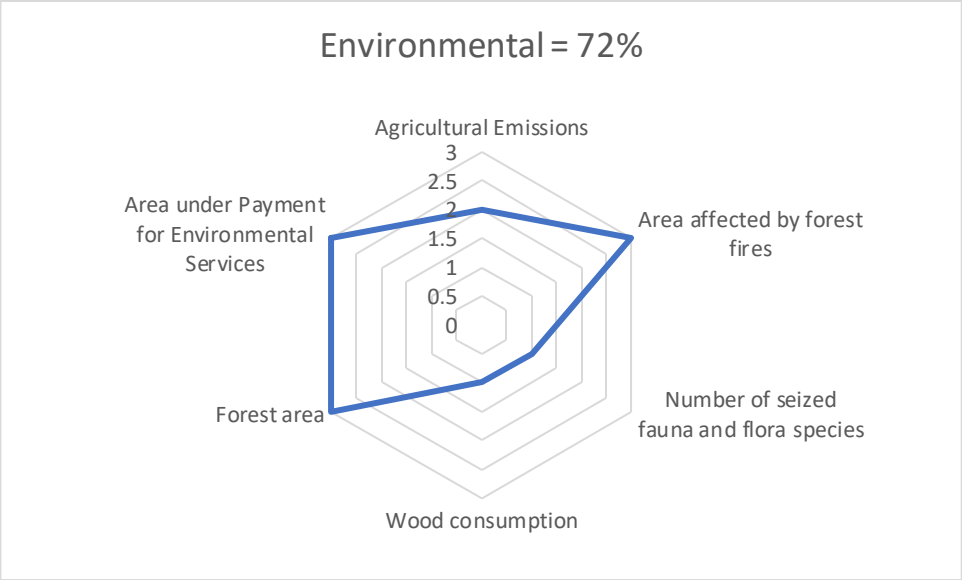


Figure 10. Assessment of indicators explaining the performance of policies related to the environmental variable in the green transformations of land use in Costa Rica.

The rural variable achieved a score of 60%, based on an assessment involving 10 indicators. Notably, the area indicators, such as the PES program area and forest area, demonstrated a high achievement rating due to the direct connection of these areas within rural regions, where forests have either been sustained or regenerated. Agricultural employment also attained a high achievement rating. Despite ongoing challenges, including a rise in unemployment rates, questionable labour conditions for agricultural workers, and an unequal distribution of wealth in the agro-export sector, agricultural employment remains the economic pillar for more than 250 000 individuals, primarily located in rural areas (SEPSA 2005, 2009, 2011b, 2013, 2015b, 2017, 2019).

In contrast to agricultural employment, forestry employment and the rest of the forestry indicators received a low achievement rating, mirroring the general underperformance of the forestry sector (ONF 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). The rural variable's underperformance can be attributed to the fact that these activities are primarily situated in rural areas, and their impact on the broader socioeconomic landscape is relatively limited. Additionally, both rural poverty and agricultural emissions were rated as low achievement, primarily due to their prevalence in rural areas. This is evident in the disparity in poverty rates compared with urban areas and the concentration of agricultural activities in rural regions, which leads to emissions and pesticide use conflicts in these areas (IMN 2021; INEC 2022a, 2022b; UNDP 2022) and undermines the advancement to a green transformation in the rural variable (Figure 11).

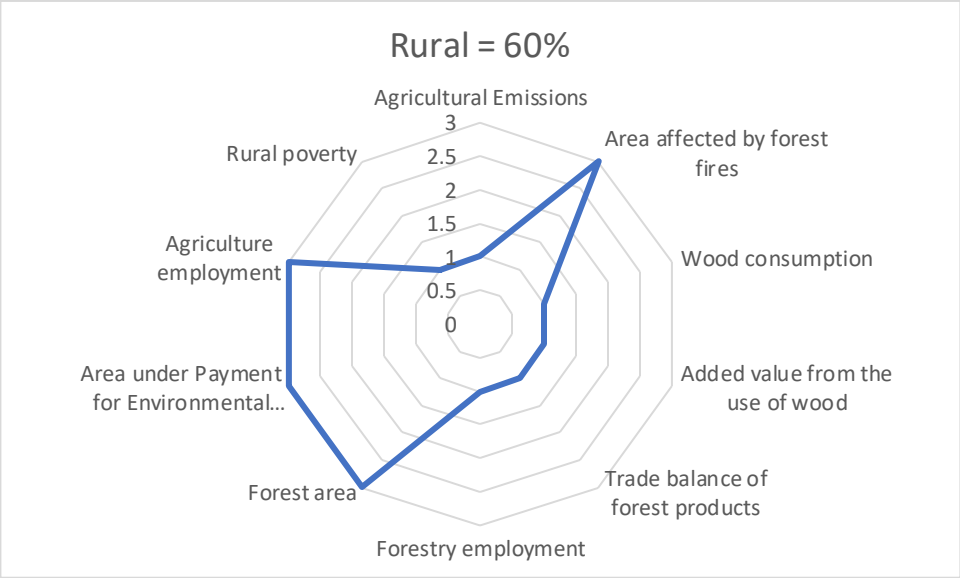


Figure 11. Assessment of indicators explaining the performance of policies related to the rural variable in the green transformations of land use in Costa Rica.

The social variable achieved a score of 52% across nine indicators. Agricultural employment emerged with a high achievement rating, as it serves as the primary income source for thousands of people in rural areas (SEPSA 2005, 2009 2011b, 2013, 2015b, 2017, 2019). Despite its limitations in directly addressing poverty and inequality, the PES area received a moderate achievement rating, only because of its continuous investment in numerous families through formal contracts, at least between 1997 and 2012. Forest area also garnered a moderate achievement rating, as forests continue to sustain families either as owners or residents in proximity to protected areas, supporting activities like tourism and essential services provision.

Nevertheless, this should not obscure the significant challenges that exist in striving for fairer ways to distribute the profits that these forests yield for the country's economy in its pathway to a green transformation. Rural poverty remained a low achievement concern, with stagnant conditions over the past decades and inadequate inclusion of historically marginalised groups in the formal economy (INEC 2022a, 2022b). Forest indicators performed poorly, reflecting the sector's struggle to integrate individual producers and organisations into the economy, limiting access to services and benefits, which are often captured by economically powerful elites. Agricultural emissions were rated as low achievement due to their direct impact on people's health, particularly in areas with high agricultural production, where emissions, exacerbated by heavy pesticide use, pose significant health risks to the population (IMN 2021, Pacheco and Itriago 2022, UNDP 2022) (Figure 12).

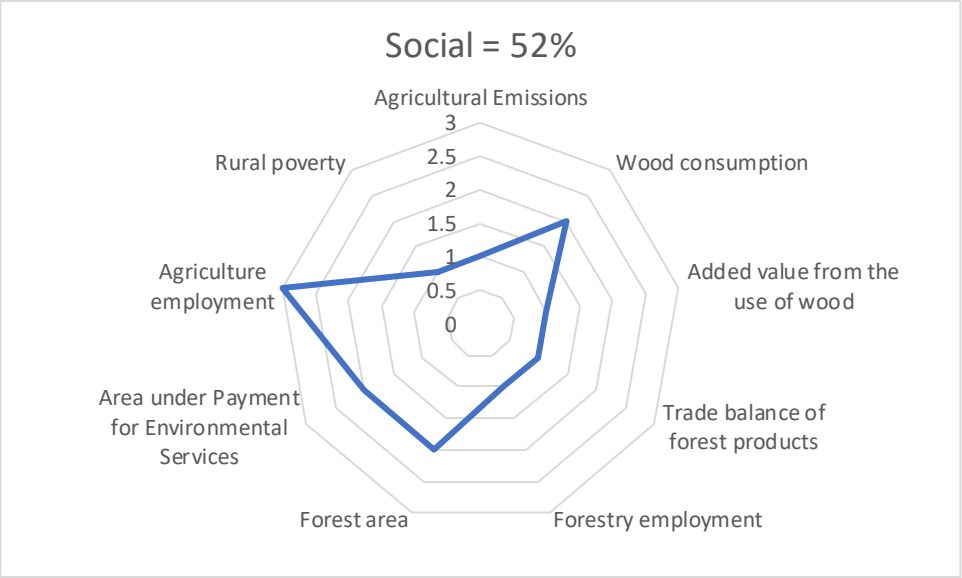


Figure 12. Assessment of indicators explaining the performance of policies related to the social variable in the green transformations of land use in Costa Rica.

The economic variable earned the lowest score, a mere 42%, considering a total of 11 indicators. This rating underscores the persistent challenge of moving to a green transformative path in broader terms and effectively integrating the forestry sector into Costa Rica's economy. This underperformance is evident in the negative trends of indicators such as wood consumption, forest employment, forest value added, and the trade balance of wood products (ONF 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). The economic competitiveness of the PES program pales in comparison to alternative productive land uses such as livestock or agriculture, further contributing to the variable's low rating. Moreover, the institutional financial risks of the PES program contribute to a difficult economic situation in the sector, exacerbated by FONAFIFO's limited capacity to include a greater number of individuals in the program (PEN 2022).

Although agricultural employment plays a pivotal role in providing income to thousands of families (SEPSA 2005, 2009, 2011b, 2013, 2015b, 2017, 2019), it yields relatively low individual economic benefits for many employed in the sector (PEN 2018). Moreover, CO^2 emissions resulting from agricultural activities impose additional costs on the national economy, including associated healthcare expenses in the treatment of individuals poisoned by pesticides, amounting to USD 9.5 million annually (Pacheco and Itriago 2022) (Figure 13).

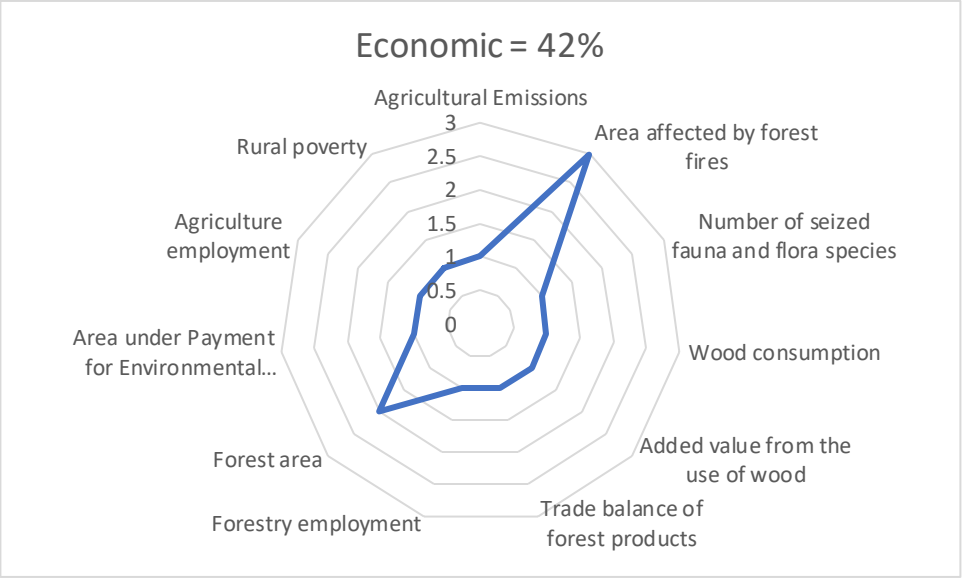


Figure 13. Assessment of indicators explaining the performance of policies related to the economic variable in the green transformations of land use in Costa Rica.

The institutional variable received a score of 48%, assessed across 11 indicators. While there are positive experiences, such as the effective response to reduce forest fires (MINAE 2009, 2010, 2011a, 2012, 2013, 2014b, 2015) resulting from the coordinated efforts of various institutions such as firefighters, SINAC's conservation offices, and organised civil society groups, the overarching issue lies in the lack of coordination among different social, economic, and state entities. Despite the country's small size and the relatively modest land use sector, a complex institutional structure and weak coordination among political, social, and economic actors affect institutional efficiency and capacity (OECD 2017), compromising the green transformation. This shortcoming is evident in various indicators, including the failure to address rural poverty and inequality (INEC 2022a, 2022b; PEN 2022).

Furthermore, there is a notable disconnect between many of the conservation benefits the country enjoys, such as tourism revenues and income from agricultural exports, and the well-being of rural families. The institutional variable's performance also mirrors the challenges encountered by the forestry sector, where forest dwellers and small- to medium-sized organisations face substantial hurdles to access and use forest resources. This complexity often results in high transaction costs for obtaining the necessary permits. Individuals confront significant barriers to complying with legal requirements, even when they hold rights to forest use (Brown 2010). (Figure 14).

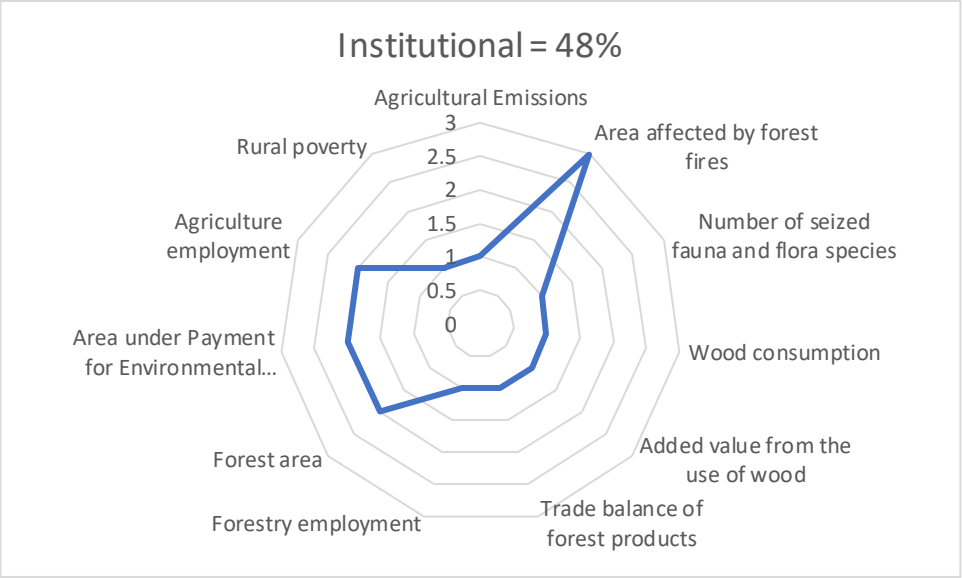


Figure 14. Assessment of indicators explaining the performance of policies related to the institutional variable in the green transformations of land use in Costa Rica.

A look into the future, recommendations for achieving a green transformation in the forestry and agriculture land use sector

To steer discussions and considerations about how to move towards a green transformation, we propose a road map with a series of actions that should be addressed within the forestry and agriculture sectors to move in this direction. This proposition is depicted using a TOC (Annex 3). This methodological approach facilitates a step-by-step analysis, aiding in the identification of objectives, assumptions, and potential impacts of reforms while also helping to mitigate risks and leverage opportunities. Additionally, it provides the groundwork for evaluating performance (Stachowiak 2010, Taplin *et al.* 2013, Thornton *et al.* 2017, Garrick *et al.* 2020).

We divide interventions across each of the five variables we consider essential to a green transformation (e.g., environmental, rural, social, economic, and institutional). Altogether, we have identified 11 initial preconditions necessary to initiate tangible changes in the sector. These preconditions are based on strategies, policies, policy instruments, coordination mechanisms, and other necessary outputs required to unlock the onset of a green transformation.

These preconditions, in turn, ensure 11 short- and medium-term outcomes, which are anticipated in the initial transition phase. For instance, at this level, we suggest envisioning outcomes such as agricultural activities adhering to sustainability standards, formulation of regulatory and development plans driven by citizens and local actors, empowered producer organisations equipped with enhanced tools and technical knowledge for livelihood sustainability, and accessible climate financing mechanisms for most stakeholders.

The mid-term to long-term outcomes encompass 13 proposed results, reflecting a consolidated sector with stable organisational foundations, state support evident across different political levels, and high competitiveness in productive activities, particularly benefiting small-scale farmers and forestry organisations.

Lastly, we propose five ultimate long-term impacts that would signify the achievement of a green transformation in the land use sector. These impacts are rooted in the dominance of low-carbon practices, reduction of inequalities in rural areas, inclusive family farming interconnected with markets and nurtured by a healthy ecosystem, contributions to the country's sustainable and inclusive economic growth, and a collective institutional framework ensuring the sustainability, legitimacy, and equity of both forestry and agricultural practices.

Conclusions

When evaluating the extent to which the state has effectively promoted a green transformation in Costa Rica's land use sector, particularly within the forestry and agriculture domains, it becomes clear that the country has made significant progress from an environmental perspective. Costa Rica has achieved remarkable success in forest conservation, reversing deforestation trends, and gaining international recognition for its environmental accomplishments. Programs such as the PES and ambitious policies aimed at addressing climate change demonstrate the state's commitment to sustainability.

However, when considering rural, social, economic, and institutional aspects, the green transformation has faced significant challenges and even negative consequences. It is evident that the state has struggled to coordinate effectively among various state, social, and economic institutions to address persistent rural poverty, wealth distribution disparities primarily originating from the agriculture sector, the integration of the forestry sector into the national economy with transparent and equitable governance among diverse stakeholders, the generation of employment in both agriculture and forestry, and the excessive use of pesticides.

To overcome these challenges, transformative strategies are needed that not only challenge existing power dynamics but disrupt them in both sectors. These strategies should shift the focus towards providing greater support for local producer associations; promoting diversified farming practices; offering knowledge, tools, and financing to adopt sustainable practices; and, most importantly, integrating a more socially conscious vision into the policymaking process. Addressing these issues comprehensively is essential to fostering a green transformation that benefits both the environment and society in Costa Rica's land use sector.

Through recognition of these challenges and the adoption of an inclusive approach within the existing institutional framework of the land use sector, Costa Rica can embark on a more definitive path towards a green transformation. Our proposed road map yields invaluable recommendations, drawing from lessons learned in the sector and offering a holistic approach that addresses social, economic, and environmental facets. Implementation of these measures would not only benefit Costa Rica but stand as a valuable guide for other nations grappling with similar issues in their own land use sectors.

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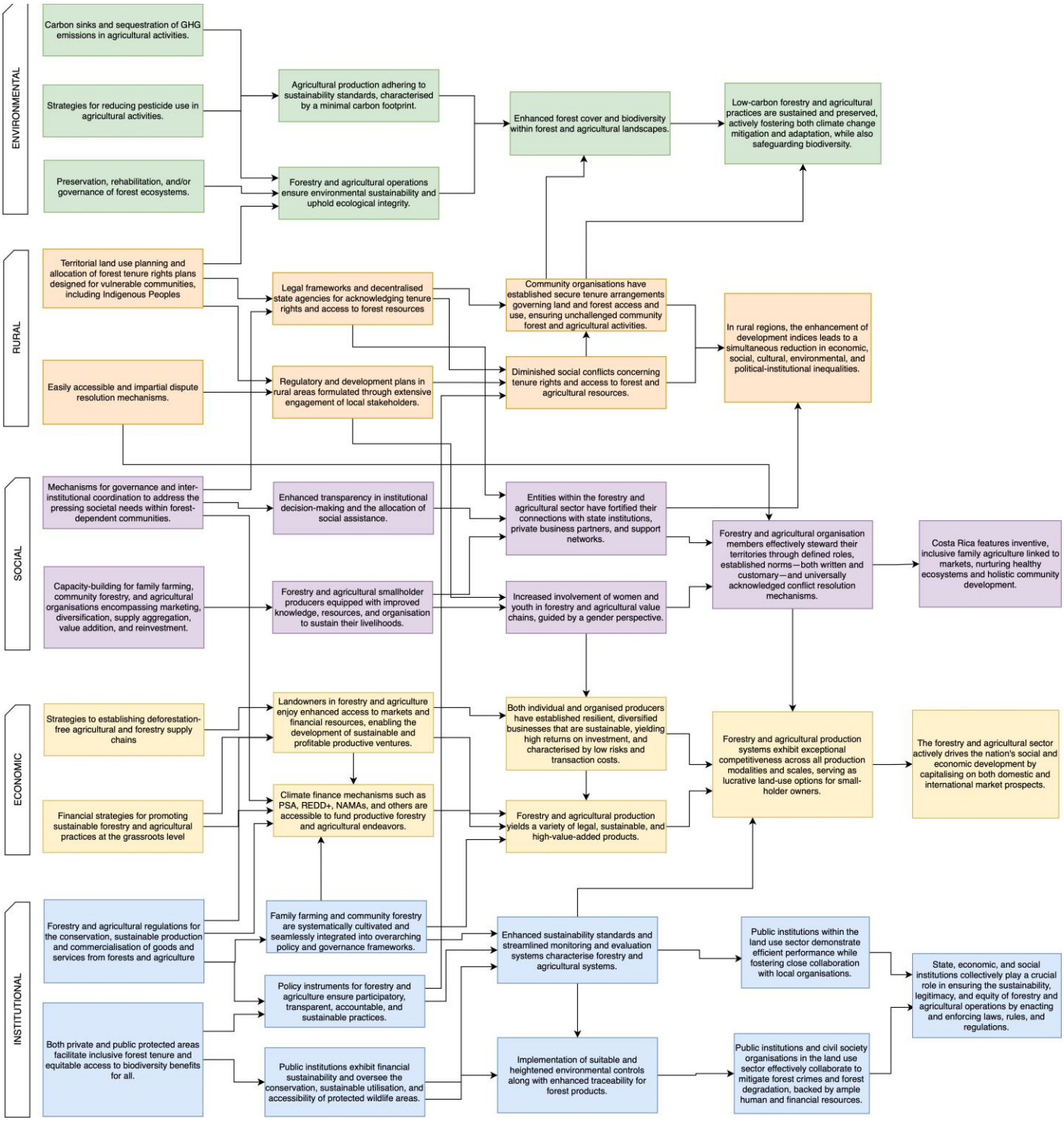
Annex 3. Theory of Change for the forestry and agricultural land use sector of Costa Rica to move towards a green transformation



Chapter IV: Final remarks

This dissertation examines the role of the state as an agent of change in driving green transformations (Leach 2015, Schmitz 2015, Scoones *et al.* 2015) within Costa Rica's land use sector, with a specific focus on the forestry and agriculture sectors. The study sheds light on the complexities and challenges that the state faces in pursuing sustainability goals while addressing social inequalities and promoting economic development.

Costa Rica is often hailed as a model for environmental conservation, having made significant efforts to reverse deforestation and promote sustainable practices. The PES program and ambitious climate change policies exemplify the state's commitment to sustainability (MINAE 2001, 2011, 2014, 2016, 2019; MINAE and MAG 2015; SEPSA 1998 2002, 2011, 2014, 2015, 2016). However, it is important to recognise the persistent social inequalities and the need to promote more inclusive and equitable development within the land use sector.

This situation is further compounded by a potential conflict of interests within the Costa Rican state that emerged in the 1980s. During that period, efforts were made to promote ecosystem conservation through the introduction of financial mechanisms for forest conservation, which later paved the way for the PES. However, parallel to these conservation initiatives, there was a strong push for trade liberalisation, mainly centred on boosting agricultural exports as a replacement for imported goods (Villasuso 2000). Persistent rates of rural poverty continue, particularly in geographic areas with extensive forests and agricultural production, and is also linked to issues of inequality and poor working conditions for agricultural workers that have yet to be addressed by existing institutional frameworks (PEN 2018, 2022). A small number of agro-exporting companies have amassed significant economic power, taking advantage of the existing economic model (PROCOMER 2017).

Through this study, we identified a set of indicators that serve as a foundation for a comprehensive analysis of the significant impacts resulting from the state's chosen trajectory. These indicators stem from a novel methodology we developed through an exhaustive analysis of numerous public policies, their monitoring frameworks, goals, indicators, and other monitoring and evaluation elements. This approach has also provided us with greater evidence of the conflict of interests mentioned. For example, while there has been notable progress in policies supporting forest cover and the relative maintenance of the PES (Sader and Joyce 1988; Sánchez-Azofeifa 1996, 2000, 2015; Sánchez-Azofeifa *et al.*, 2002; Calvo-Alvarado *et al.* 2009; CONARE 2021), it has not been accompanied by an improvement in the competitiveness of the forestry sector. This is evidenced by a negative trade balance for forest products, a decline in forest employment, and a decrease in the value added of forest products (ONF 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). Additionally, the agriculture sector continues to generate high emissions that have not decreased in two decades, along with concerning levels of pesticide use in agricultural activities (IMN 2021, UNDP 2022).

In the pursuit of steering Costa Rica's land use sector towards a green transformation, our study proposes a road map including a series of measures that can significantly shape its trajectory. These measures are grounded in a thorough comprehension of the long-term outcomes and impacts that would emanate from their successful implementation.

One of the pivotal long-term outcomes we anticipate is the augmentation of forest cover and biodiversity across both forested and agricultural landscapes. This sought-after result would manifest through the enduring application of low-carbon forestry and agricultural practices, which stand as steadfast bastions against the adverse effects of climate change. These practices not only contribute to climate change mitigation and adaptation but engender the preservation of Costa Rica's abundant biodiversity and the nation's steadfast commitments to conservation. We also acknowledge that for any conservation endeavour to truly succeed within the framework of a green transformation, it must consider its impact on the communities dependent on these regions. This entails adopting a more community-oriented approach to forest preservation, departing from the traditional fortress conservation mind-set that often leaves many individuals and families excluded from conservation efforts.

A compelling long-term outcome lies in the mitigation of social conflicts associated with tenure rights and access to forest and agricultural resources. Achieving this, coupled with the establishment of secure land use arrangements overseen by community organisations, has the potential to usher rural areas into a higher realm of development indices. This transformation, in turn, can pave the way for mitigating various inequalities, spanning economic, social, cultural, environmental, and political-institutional domains. Such a shift must also receive support from state institutions and other entities within the Costa Rican economy. This would entail improving access to knowledge, climate financing, and protecting fundamental rights such as a balanced environment and the protection of environmental defenders.

The effective stewardship of rural territories, orchestrated by smallholders and members of forestry and agricultural organisations, serves as an essential component in assessing the social dimensions of a green transformation. Facilitated by well-defined roles, norms, and conflict resolution mechanisms, this stewardship cultivates a space of innovative and inclusive family agriculture, interlinked with market dynamics. Such practices not only nurture ecosystems but facilitate holistic community development, further reflecting Costa Rica's resolute commitment to social progress and a broader transformative approach in the land use sector.

The aspiration for forestry and agricultural production systems to attain exceptional competitiveness across diverse scales and modalities is a cornerstone of economic transformation. As these sectors evolve into profitable avenues, with a focus for smallholder owners, established small- to medium-sized community enterprises, and a socially responsible private sector, the nation can derive significant economic and social benefits. These sectors play an instrumental role in both boosting the domestic economy and seizing international market opportunities.

The promise of transformative impacts emanates from the synergy and efficiency of public institutions within the land use sector, operating in tandem with local organisations. This symbiotic collaboration ensures the curbing of forest crimes and degradation, fortified by substantial human and financial resources. The collective endeavours of state, economic, and social institutions assume a pivotal role in upholding the authenticity, equity, and environmental integrity of forest and agricultural activities through the enforcement of comprehensive laws, rules, and regulations.

Moreover, the strengthening of institutional integration within the land use sector emerges as a pivotal imperative for a green transformation. Avenues include reinforcing the capacity of sectoral planning secretariats, empowering the implementation of localised land use programs through grassroots organisations in vulnerable regions, and integrating robust social considerations into both bilateral and multilateral funding mechanisms. Such an approach not only fosters collaborative synergy and streamlines efforts but ensures the alignment of land use policies with the specific context and requirements of local communities. This concerted commitment materialises as a shared endeavour among state, economic, and social institutions, collectively safeguarding the sustainability, legitimacy, and equitable nature of forest and agricultural activities. Furthermore, it would find tangible expression in the establishment and rigorous enforcement of comprehensive legal frameworks and regulatory mechanisms.

In assessing the progress of such actions, our research has shown the indispensable role of integrated monitoring and evaluation systems, which are fundamental for evidence-based decision-making and the efficacy of policies. Through investments in data collection and management systems, standardised measurement methodologies, and capacity-building initiatives, Costa Rica can ensure transparency, accountability, and adaptive management within the land use sector.

The insights derived from monitoring frameworks should serve as a primary input for policymaking, designed to address the distinct requirements and circumstances of rural populations. However, the responsibility for this cannot solely rest on the shoulders of state agencies. Various institutions from civil society, academia, local organisations, and Indigenous communities must also play a role in upholding forestry and agricultural regulations. This necessitates the reinforcement of spaces for education and technical training, dialogues and social cohesion, an independent and impartial judiciary, citizen participation and transparency, and secure platforms that effectively counterbalance legislative administration. Such an approach guarantees the presence of a socially inclusive system that holds legal compliance accountable and confronts power imbalances.

By embracing this approach, policies can be tailored to the unique challenges faced by rural communities, engendering a more context-specific and inclusive vision for a green transformation. By embedding efficient, transparent, participatory, and inclusive monitoring and evaluation systems within land-use-sector institutions, decision-makers can make informed choices, allocate resources judiciously, and effectively address the needs of rural populations. Ultimately, this approach fosters targeted and impactful interventions, steering the trajectory of the land use sector towards a more sustainable and equitable future.

In conclusion, our research has highlighted the foremost challenges confronting the forestry and agricultural sectors as they strive to advance towards a transformative land use paradigm. Through a comprehensive examination of these challenges, we have formulated a strategic road map to guide this transformation. By adopting an inclusive and multifaceted strategy, Costa Rica can persist in its role as an environmental steward while simultaneously addressing social disparities and propelling a green transformation. This transformation encapsulates ecological resilience, socioeconomic parity, and environmental fidelity—a transformative trajectory that vividly reflects Costa Rica's resolute dedication to a prosperous and inclusive future.

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