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RESEARCH REPORT

A Scorecard to Assess the Enabling Environment for Water and Climate Innovations in Agriculture

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March 2026

Acknowledgments

This work was conducted under the CGIAR Scaling for Impact Program. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund (www.cgiar.org/funders).

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Suggested Citation

Ires, Idil. 2026. *A Scorecard to Assess the Enabling Environment for Water and Climate Innovations in Agriculture.* International Water Management Institute (IWMI).

Front and back cover photo: Sven Torfinn, Panos Pictures/IFPRI

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Acronyms and Abbreviations

ABC Plan – Plano ABC–Agricultura de Baixa Emissão de Carbono (Low-Carbon Agriculture Plan, Brazil)

AICCRA – Accelerating Impacts of CGIAR Climate Research for Africa

ASALs – Arid and Semi-Arid Lands

BII – British International Investment

DFIs – Development Finance Institutions

EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)

EPRA – Energy and Petroleum Regulatory Authority (Kenya)

ESG – Environmental, Social, and Governance

FSD Kenya – Financial Sector Deepening Kenya

GOGLA – Global Off-Grid Lighting Association

GSMA – GSM Association

ICT – Information and Communications Technology

IFPRI – International Food Policy Research Institute

IoT – Internet of Things

IWMI – International Water Management Institute

KIAMIS – Kenya Integrated Agriculture Management Information System

NCCAP – National Climate Change Action Plan (Kenya)

NBC – National Bank of Cambodia

NIE – New Institutional Economics

OECD – Organisation for Economic Co-operation and Development

PAYG – Pay-As-You-Go

PIDG – Private Infrastructure Development Group

PPP – Public–Private Partnership

PURE – Productive Use of Renewable Energy

REEEP – Renewable Energy and Energy Efficiency Partnership

SIWA+ – Scale-Invariant Water Accounting Plus

SPI – Solar-Powered Irrigation

VAT – Value Added Tax

WRA – Water Resources Authority (Kenya)

Summary

This paper offers an enabling environment scorecard to assess the institutional and political economy constraints that prevent agricultural and climate-relevant innovations from scaling and to inform targeted reform and investment decisions. It argues that persistent scaling failures stem less from gaps in technology or finance alone than from institutional conditions that fail to provide predictable rules, credible enforcement, and coordinated risk management necessary for sustained private investment. Grounded in New Institutional Economics and political economy analysis, the scorecard assesses seven institutional pillars—policy coherence and credibility; legal foundations and rights security; regulatory frameworks; finance and investment architecture; partnership capacity; market linkages; and governance conditions—together with seven cross-cutting levers—incentives, interests, trust, ideas and narratives, information, capacity, and affordability—and links them to staged scaling pathways from agenda setting through design, implementation, adoption, and adaptation. The illustrative application to solar irrigation in Kenya shows a mixed profile: strong digital finance and information systems enable pay-as-you-go and carbon-linked models, while gaps in contract enforcement, regulatory coordination, and policy stability raise costs and require firms to internalize risks that more predictable public institutions would normally absorb. The scorecard thus provides a systematic approach for identifying binding constraints and informing coordinated, stage-specific reform and investment strategies to support durable, climate-resilient scaling of innovations driven by the private sector. By clarifying where institutional conditions hinder credible private commitment, it equips governments, development partners, and investors with a shared basis for prioritizing action, aligning interventions, and reducing avoidable risk in agricultural markets

1. Introduction

Despite decades of investment in agricultural research, policy reform, and development finance, the scaling of agricultural and climate-relevant innovations remains uneven and fragile, particularly in low- and middle-income countries. A substantial literature documents how promising technologies and business models repeatedly stall at pilot stage or fail to achieve durable, market-based scale (Hall et al., 2005; Spielman and Birner, 2008; Cooley and Linn, 2014; Byerlee et al., 2020). These outcomes are often attributed to weak policies, limited finance, or low farmer adoption, yet such explanations have proven insufficient. Increasingly, research emphasizes that innovation outcomes are shaped not only by technologies or incentives, but by broader enabling environments comprising institutions, governance arrangements, market structures, and political economy dynamics (North, 1990; Acemoglu and Robinson, 2012; Resnick et al., 2018). While the importance of enabling environments is now widely recognized, approaches to assessing them remain analytically fragmented. Many existing diagnostics rely on static inventories of reforms, high-level governance indicators, or sectoral checklists that offer limited insight into how institutional arrangements shape investment risk, coordination, and scaling behavior in practice. This gap between conceptual recognition and operational diagnosis motivates the need for a more rigorous, investment-relevant framework for assessing enabling environments for agribusiness-driven innovation scaling.

The objective of this paper is to develop and demonstrate an enabling environment scorecard that diagnoses whether institutional conditions are conducive to private-sector-led scaling of agricultural and climate-relevant innovations. The specific objective of the scorecard is to provide a structured diagnostic tool that identifies binding institutional and political economy constraints to scaling, links these constraints to different stages of the innovation process, and supports the design of coordinated reform–investment responses. The central research question guiding the paper is: under what institutional and political economy conditions do agribusiness-driven innovations move from policy intent and pilot interventions to durable, market-based scale? The paper introduces a scorecard structured around core institutional pillars and cross-cutting political economy levers, explicitly linked to staged pathways of innovation scaling. The framework draws on New Institutional Economics to examine how rules, rights, and enforcement shape incentives and credible commitment (North, 1990; Williamson, 2000), and on political economy analysis to explain how power, interests, ideas, and capacity condition institutional performance (Khan, 2010; Pritchett et al., 2013). The scorecard is designed for use by governments, donors, development finance institutions, researchers, and private investors, with the explicit aim of supporting diagnosis, prioritization, and coordination across policy reform and investment decisions.

The paper builds on existing scorecards and diagnostic tools but departs from them in three important ways. First, it centers investment readiness rather than reform presence as the primary lens for assessing enabling environments. Second, it integrates political economy explicitly into institutional diagnosis, rather than treating implementation failures as residual or context-specific deviations. Third, it links institutional conditions to staged innovation scaling pathways, allowing constraints to be interpreted dynamically rather than as static deficiencies. Widely used governance and investment climate indicators—such as World Bank investment climate diagnostics, regulatory quality measures, and agricultural policy monitoring frameworks—have supported comparative analysis and reform dialogue, but typically assess institutional quality in aggregate or de jure terms, with limited connection to private investment behavior or scaling dynamics (World Bank, 2017; OECD, 2015). Innovation systems frameworks, meanwhile, emphasize networks, learning, and coordination, yet often lack operational tools for diagnosing institutional credibility, risk allocation, and political economy constraints that shape movement from pilots to market-based scale (Hall et al., 2005; Klerkx et al., 2012). By contrast, the scorecard developed here integrates these perspectives within a single diagnostic architecture that centers investment risk, institutional performance in practice, and stage-specific constraints to scaling. Its contribution lies not in generating new indicators, but in reorganizing existing insights into a framework that renders institutional bottlenecks, trade-offs, and sequencing challenges visible and actionable.

A central contribution of this paper to the literature on agricultural innovation, institutional economics, and development practice is to shift the assessment of enabling environments away from policy reform toward investment readiness. An enabling environment for the private sector is not necessarily one in which risks are eliminated, but one in which risks are legible, rules are credible, and returns are plausibly capturable over time. This distinction is critical in agriculture, where production, price, and policy risks are inherent and increasingly amplified by climate stress. The framework conceptualizes investment readiness as depending on whether risks are appropriately *allocated* (clarity over who bears climate, price, and policy risk), *mitigated* (through instruments such as insurance, guarantees, and contracts), *priced* (reflected transparently in financing terms), and *governed* (through predictable rules, enforcement, and dispute resolution). By explicitly linking institutional pillars to behavioral and political economy levers and to different stages of the scaling process, the scorecard clarifies how specific combinations of reforms and investments can transform thin agricultural markets into more predictable and investable systems. In doing so, it also explains why piecemeal interventions, such as standalone finance facilities, isolated regulatory reforms, or pilot projects, rarely deliver durable scaling outcomes when they are not embedded within broader institutional configurations that manage risk coherently across the system.

The remainder of the paper is structured as follows. Section 2 presents the conceptual framework, grounding the scorecard in institutional and political economy theory and articulating the logic of staged scaling pathways. Section 3 outlines the methodology and scorecard design, including pillar selection, indicator logic, scoring, and data sources. Section 4 explains how the scorecard is used diagnostically, focusing on pattern recognition, binding constraints, and reform–investment bundles. Section 5 provides an illustrative application to demonstrate how the scorecard operates in practice. Section 6 concludes by summarizing the paper's contributions, limitations, and avenues for future research. Section 7 discusses implications for governments, donors, and private investors.

2. Conceptual Framework: An Enabling Environment for Scaling

The concept of an "enabling environment" is widely used across agricultural development, climate policy, and private sector engagement, yet it remains analytically imprecise. In much of the literature and policy discourse, enabling environments are treated as broad constellations of policies, institutions, and market conditions assumed to support investment and innovation. As a result, assessments of enabling environments often devolve into descriptive inventories of reforms or institutional gaps, offering limited insight into why agricultural and climate-relevant innovations so frequently fail to scale and attract sustained private investment. This paper advances a more precise conceptualization by anchoring the enabling environment explicitly to the context of private-sector-led innovation scaling. Scaling is understood here not simply as adoption, but as the process through which innovations become commercially viable, institutionally embedded, and resilient over time, supported by repeated transactions, durable investment, and credible expectations of future returns. From this perspective, the enabling environment is not a static backdrop, but a system of rules, incentives, and coordination mechanisms that evolve and determine whether private actors can credibly invest capital, form durable contracts, and engage in repeated transactions over time (Hartmann and Linn, 2008; Cooley and Linn, 2014).

The conceptual framework developed in this paper is grounded in a synthesis of New Institutional Economics (NIE) and political economy analysis. NIE provides a foundational account of how institutions—defined as the formal and informal "rules of the game"—structure economic behavior by shaping incentives, clarifying rights and obligations, and reducing transaction costs (North, 1990; Williamson, 1985, 2000). In agricultural systems, where production is exposed to climatic variability, returns are uncertain, and assets are highly location-specific, institutional quality is especially consequential. Secure property and use rights, enforceable contracts, predictable regulations, and functioning financial systems lower uncertainty and enable investment in capital-intensive technologies such as irrigation, improved seed systems, and post-harvest infrastructure that require long payback periods. NIE thus explains why agribusinesses and financiers are often reluctant to invest in environments characterized by policy volatility, weak contract enforcement, fragmented regulation, or thin markets, even when technologies are technically viable or supported by donor programs (Dorward et al., 2009; Byerlee et al., 2020). From an NIE perspective, innovation scaling depends on whether institutional arrangements provide predictability through stable policies and enforceable contracts; enable credible commitments through secure property and use rights; reduce coordination failures through standards, partnerships, and market infrastructure; and lower transaction costs related to information, enforcement, and risk. However, NIE alone offers limited explanatory power for understanding why institutions that appear sound on paper frequently fail to operate as intended in practice.

To explain why institutions solid on paper fail in practice, this paper integrates the political economy perspective into the scorecard, which complements NIE by foregrounding the role of power, interests, and incentives in shaping how institutions are implemented, enforced, or selectively ignored. Rather than treating institutions as neutral or self-enforcing, political economy approaches emphasize that institutional outcomes reflect bargaining among actors with unequal power and divergent interests (Acemoglu and Robinson, 2012; Khan, 2010). In agriculture and climate governance, formal rules frequently diverge from practice due to elite capture of subsidies and licenses, politically motivated policy reversals during food crises, selective enforcement of regulations, and uneven administrative capacity across national and sub-national levels (Poulton et al., 2006; Resnick et al., 2018). Climate stress further intensifies these dynamics by heightening distributional conflict and increasing incentives for governments to override long-term commitments in favor of short-term political stabilization, such as export bans or ad hoc subsidies. Political economy analysis is therefore essential for explaining not only why institutions fail, but why they fail in patterned ways that systematically undermine private investment and scaling in high-risk sectors such as agriculture (North et al., 2009; Pritchett et al., 2013).

By combining NIE and political economy, the framework conceptualizes the enabling environment as a system with two analytically distinct but interdependent layers. The first layer consists of structural institutional domains—**policy coherence and credibility; legal foundations and rights security; regulatory frameworks; finance and investment architecture; partnership and coordination capacity; market and value chain linkages; and governance and political economy conditions**—that shape incentives, risks, and coordination possibilities for private investment. These domains reflect long-standing concerns in the literature on institutions, investment, and uncertainty. The second layer consists of cross-cutting political economy and behavioral levers—**incentives,**

interests, trust, ideas and narratives, information, capacity, and affordability—that determine how these institutional arrangements operate in practice. These levers explain why similar institutional designs can produce divergent outcomes across contexts, and why technically sound reforms may fail to alter behavior or unlock investment when underlying incentives and power relations remain unchanged.

The specification of institutional categories and subcategories draws primarily on NIE and related analyses of investment under uncertainty, complemented by insights from the agricultural innovation systems and value chain literatures. NIE informs subcategories related to policy durability, fiscal anchoring, rights security, contract enforceability, regulatory predictability, and risk allocation, all of which shape the credibility of long-term commitments. The agricultural innovation systems literature contributes an emphasis on coordination, intermediation, and learning, highlighting that innovation and scaling are collective processes involving networks of actors rather than isolated firms or technologies (Hall et al., 2005; Spielman and Birner, 2008; Klerkx et al., 2012). This perspective underpins subcategories related to partnerships, research–industry linkages, embedded services, aggregation, and market access. The framework also draws selectively on applied institutional and investment diagnostic literatures developed in policy and donor contexts, including work on regulatory governance, investment climate diagnostics, and sectoral institutional assessments. While this literature does not constitute a theoretical strand, it provides empirically grounded insights into how firms and investors experience institutional environments in practice. Rather than reproducing existing diagnostic tools, the framework embeds these applied insights within a coherent analytical structure grounded in NIE and political economy, ensuring that operational categories are theoretically informed rather than ad hoc.

Table 1 summarizes the institutional foundations and political economy levers underpinning agribusiness-driven innovation scaling. The framework identifies seven institutional pillars that collectively structure investment readiness. Each pillar represents a domain in which institutional arrangements influence risk, incentives, and transaction costs, and no single pillar is sufficient for scaling. Strong policies without finance, finance without enforceable contracts, or markets without regulatory credibility all produce partial or fragile outcomes. Scaling requires systemic alignment across pillars rather than isolated reforms. Importantly, political economy levers do not operate independently of institutions; they are activated through them. For example, a subsidy creates incentives, but whether those incentives reach intended actors depends on interests, enforcement capacity, and trust. Similarly, contracts only reduce risk when enforcement is credible and compliance costs are affordable.

Table 1. Enabling environment foundations and levers for private-sector-led innovation scaling

Category	Subcategory	Definition and Contribution to Investment Readiness / Contextual Relevance
Policy Coherence and Credibility	Strategic alignment	Degree to which agricultural, climate, industrial, and investment policies are mutually reinforcing, reducing policy uncertainty for long-term agribusiness investment.
	Policy durability and stability	Extent to which policies persist over time and are not frequently reversed during political or food security shocks, shaping expectations of policy risk.
	Fiscal anchoring and budget credibility	Alignment between policy commitments and multi-year public financing, affecting the credibility of state support and crowd-in potential for private capital.
	Vertical coordination	Consistency of policy objectives and implementation across national and sub-national levels, influencing predictability for location-specific investments.
	Monitoring, evaluation, and learning	Presence of systems that track implementation and outcomes, enabling adaptive policy and reducing uncertainty about future regulatory or fiscal shifts.
Legal Foundations and Rights Security	Land and resource rights security	Clarity and enforceability of land and natural resource rights, affecting willingness to invest in fixed and long-term agricultural assets.
	Contract enforceability	Reliability of contract enforcement mechanisms, shaping confidence in offtake agreements, service provision, and value chain coordination.
	Dispute resolution mechanisms	Accessibility, speed, and cost of resolving commercial disputes, influencing transaction costs and risk premiums.
	Collateral and secured transactions	Legal frameworks enabling the use of movable and immovable assets as collateral, affecting access to finance for agribusinesses and farmers.

	Seed, IP, and innovation rights	Clarity of rights governing seeds, varieties, and innovations, influencing incentives for private R&D and technology diffusion.
Regulatory Frameworks	Business entry and licensing	Predictability and cost of business registration and licensing, affecting market entry and formalization of agribusiness models.
	Input and technology approval	Efficiency and transparency of approval systems for seeds, inputs, irrigation, and climate technologies, shaping speed of innovation diffusion.
	Trade and customs procedures	Stability and efficiency of trade rules and border procedures, influencing access to regional and export markets.
	Environmental and climate compliance	Clarity and enforceability of environmental and climate regulations, affecting regulatory risk and compliance costs.
	Sub-national regulatory consistency	Degree of alignment in regulatory interpretation and enforcement across jurisdictions, influencing spatial investment decisions.
Finance & Investment Architecture	Diversity of capital sources	Availability of public, private, and blended finance instruments, shaping the feasibility of scaling capital-intensive innovations.
	Risk-sharing instruments	Presence of guarantees, insurance, and first-loss mechanisms that reduce downside risk for private investors.
	Financial infrastructure	Existence of collateral registries, credit information systems, and payment platforms that lower transaction costs.
	Project preparation and aggregation	Capacity to structure bankable projects and aggregate demand or supply, enabling scale beyond pilot investments.
	Climate-linked finance mechanisms	Integration of climate outcomes into financing structures, influencing alignment with adaptation and mitigation objectives.
Partnership & Coordination Capacity	Public–private partnership frameworks	Existence and credibility of PPP arrangements that clarify roles, risk allocation, and accountability.
	Research–industry linkages	Mechanisms translating research outputs into commercially viable applications, affecting innovation pipelines.
	Donor and public actor coordination	Degree of alignment among public and donor actors, reducing fragmentation and duplication of initiatives.
	Farmer organization integration	Inclusion of producer organizations in delivery and governance, influencing adoption and aggregation.
	Partnership governance and accountability	Clarity of decision-making, conflict resolution, and exit mechanisms within partnerships, shaping trust and longevity.
Market & Value Chain Linkages	Offtake and contracting arrangements	Reliability of market access and contracting, affecting revenue certainty and investment incentives.
	Embedded service provision	Availability of bundled inputs, finance, and extension, lowering adoption barriers for farmers.
	Aggregation and logistics	Infrastructure and systems enabling aggregation, storage, and transport, shaping economies of scale.
	Market access and standards	Access to domestic, regional, and export markets and compliance with standards, influencing returns to quality and sustainability.
	Competition and inclusion	Degree of market contestability and inclusion of smallholders, affecting scalability and political sustainability.
Governance & Political Economy	Enforcement credibility	Consistency and predictability of rule enforcement, shaping confidence in institutional commitments.
	Policy capture and rent-seeking risks	Extent to which institutions are shaped by narrow interests, influencing fairness and investment risk.
	Transparency and accountability	Availability of information and accountability mechanisms, affecting trust in public institutions.
	Crisis governance	Government responses to shocks (e.g. food crises), influencing expectations of policy override.
	State capacity and coordination	Ability of public institutions to implement and coordinate policy, shaping delivery reliability.

Source: Author's creation

The framework conceptualizes a set of enabling environment scaling pathways, understood as the sequence through which institutional conditions, incentives, and risk governance evolve as innovations move from policy intent to durable, market-based scale (Figure 1). This perspective builds explicitly on political economy analyses of policy processes, particularly Resnick et al. (2018), which examine how power, incentives, and institutional arrangements shape policy design, implementation, and durability over time. While this literature is not explicitly framed around enabling environments or private investment, it provides a robust process-oriented lens for understanding how interventions evolve and why they succeed or fail in practice. This study adapts and extends that logic to the context of agribusiness-driven innovation scaling by explicitly foregrounding investment behavior and by extending the pathways to include adoption and adaptive scaling as critical stages.

Figure 1. Enabling Environment Scaling Pathways (*Source*: Author's creation)

Within this staged perspective, innovations progress along enabling environment scaling pathways from agenda setting, through design and implementation, to adoption and ultimately evaluation and adaptive scaling. Each stage is shaped by distinct combinations of institutional pillars and political economy levers. Agenda setting is influenced primarily by policy coherence and credibility, governance arrangements, and dominant ideas and narratives that frame which problems and solutions are viewed as legitimate, investable, and politically salient (Kingdon, 1995; Schmidt, 2008). Design depends heavily on legal foundations and rights security, regulatory frameworks, and finance and investment architecture that translate policy priorities into workable delivery and investment models. Implementation hinges on the availability of finance, partnership and coordination capacity, and administrative and technical capability, as well as trust among the actors responsible for execution (Pressman and Wildavsky, 1973; Lipsky, 1980). Adoption is governed by affordability, information, and trust at the level of firms and farmers, determining whether innovations are integrated into routine practice. Finally, evaluation and adaptive scaling depend on governance and political economy conditions, information systems, and learning mechanisms that allow policies and investments to be adjusted in response to performance and changing conditions (Cooley and Linn, 2014; Pritchett et al., 2013).

Referring to these dynamics as enabling environment scaling pathways emphasizes that what evolves over time is not only the innovation itself, but the institutional environment that governs risk, coordination, and returns. Unlike generic innovation diffusion models or linear policy cycles, these pathways do not assume smooth or irreversible progression; instead, they capture how institutional credibility, coordination capacity, and risk management mechanisms are constructed, contested, and sometimes reversed as innovations move across stages. This framing highlights that scaling failures are often stage-specific rather than uniformly systemic: contexts may perform well in agenda setting yet falter at adoption due to affordability or trust constraints, or succeed in implementation only to unravel under political or climatic shocks when governance credibility and risk management mechanisms are weak. By foregrounding these dynamics, the pathway-based approach reinforces the paper's central argument that durable scaling depends not on the presence of individual reforms or instruments, but on the alignment and evolution of institutional conditions that collectively render agricultural markets predictable and investable over time.

Taken together, this framework contributes to the literature in several ways. First, it advances a more precise conceptualization of enabling environments by explicitly linking institutional arrangements to investment readiness and scaling dynamics, rather than treating them as diffuse background conditions. Second, it integrates New

Institutional Economics and political economy in a way that preserves the analytical strengths of each, distinguishing between institutional design and institutional performance without collapsing one into the other. Third, it extends policy process and scaling literatures by adapting them to the specific challenges of agribusiness-led innovation under climate and market uncertainty. Beyond innovation scaling, however, the framework also offers a more general diagnostic lens for understanding why agricultural and climate-related policies and interventions often fail to materialize as intended, or fall short of their expected impacts. By tracing how policies and interventions interact with institutional arrangements, incentives, and power relations across stages—from agenda setting through implementation and adaptation—the framework can be applied to analyze why certain policy commitments never translate into action, why implementation falters, and why well-designed interventions fail to generate durable outcomes. In this sense, the framework is not limited to innovation scaling alone, but provides a broader analytical tool for diagnosing institutional bottlenecks and political economy constraints across a range of agricultural, food, and climate policy contexts. This conceptual foundation underpins the scorecard developed in the subsequent section, which translates the framework into an operational tool for assessing enabling environments in practice.

3. Methodology: The Scorecard Design

This section translates the conceptual framework into an operational scorecard for diagnosing enabling environments for agribusiness-driven innovation scaling. The scorecard is designed as a **diagnostic tool** to assess whether institutional conditions support sustained private-sector engagement, particularly in contexts characterized by climate risk, policy uncertainty, and thin markets. Its purpose is to inform analysis, prioritization, and decision-making by identifying where and why institutional conditions constrain scaling, rather than to produce rankings or summary evaluations.

The scorecard assesses enabling environments through seven institutional pillars: policy coherence and credibility; legal foundations and rights security; regulatory frameworks; finance and investment architecture; partnership and coordination; market and value chain linkages; and governance and political economy conditions. The broad conceptualization of these pillars allows their application across countries, governance systems, and agricultural sub-sectors, while remaining sufficiently specific to guide actionable diagnosis. These pillars were selected because they consistently emerge in the literature as shaping investment behavior, coordination, and risk management in agriculture and related sectors (North, 1990; Williamson, 2000; Hall et al., 2005; Byerlee et al., 2020). Each pillar represents a necessary condition for scaling: persistent weaknesses in any one domain can undermine innovation trajectories even when other conditions appear favorable. They are treated as analytically distinct but systemically interdependent and together reflect how enabling environments function as integrated systems.

Each pillar is operationalized through a defined set of subcategories that capture the institutional dimensions most directly shaping investment readiness for business-led scaling. Subcategories were identified through a structured review of the New Institutional Economics, agricultural innovation systems, political economy, and applied institutional diagnostics literatures, focusing on institutional features shown to influence credible commitment, coordination, and risk management under uncertainty (North, 1990; Williamson, 2000; Hall et al., 2005; Byerlee et al., 2020). Selection was guided by recurring empirical findings on which institutional conditions shape investment behavior and scaling outcomes, rather than by an attempt to achieve exhaustive coverage. The objective was to retain those dimensions most consistently linked to private investment behavior and scaling outcomes in agriculture, particularly under conditions of policy uncertainty and climate risk. For example, the policy coherence and credibility pillar is disaggregated into strategic alignment, policy durability, fiscal anchoring, vertical coordination, and monitoring, evaluation, and learning. This reflects evidence that policy ambition or alignment alone has limited influence on investment unless policy commitments are stable over time, supported by predictable public financing, and implemented consistently across national and subnational levels (North, 1990; Resnick et al., 2018). Similarly, the legal foundations and rights security pillar includes land and resource rights, contract enforceability, dispute resolution mechanisms, secured transactions, and innovation-related rights, reflecting the central role of legal certainty in enabling long-horizon and asset-specific investments under conditions of uncertainty (Williamson, 1985; Dorward et al., 2009). Together, these subcategories translate institutional concepts into observable dimensions that can be systematically assessed in relation to agribusiness investment decisions and scaling trajectories.

For each of the seven institutional pillars, the scorecard specifies a set of indicators that identify the institutional conditions most relevant for assessing investment readiness and scaling feasibility (Table 2). These indicators are indicative rather than exhaustive because the institutional conditions relevant for investment and scaling vary across countries, sub-sectors, and innovations, and because the scorecard is designed to accommodate context-specific evidence and justification without constraining assessment to a fixed checklist. Specifically, the policy coherence and credibility pillar is assessed through indicators related to policy alignment across sectors, durability of policy commitments over time, fiscal anchoring through budget allocations, consistency across national and sub-national levels, and the presence of monitoring, evaluation, and learning systems. The legal foundations and rights security pillar is assessed through indicators capturing the security of land and resource use rights,

enforceability of contracts, accessibility and effectiveness of dispute resolution mechanisms, availability of secured transactions frameworks, and clarity of innovation-related rights. The regulatory frameworks pillar includes indicators related to business entry and licensing, approval processes for inputs and technologies, trade and customs procedures, environmental and climate compliance requirements, and consistency of regulatory interpretation across jurisdictions. The finance and investment architecture pillar is assessed through indicators capturing the diversity of available capital sources, availability of risk-sharing instruments, quality of financial infrastructure, capacity for project preparation and aggregation, and the integration of climate objectives into financing mechanisms. The partnership and coordination capacity pillar includes indicators related to public–private partnership arrangements, research–industry linkages, coordination among public and donor actors, integration of farmer organizations, and governance and accountability within partnerships. The market and value chain linkages pillar is assessed through indicators capturing reliability of offtake arrangements, availability of embedded services, aggregation and logistics infrastructure, access to markets and standards, and the degree of competition and inclusion. Finally, the governance and political economy conditions pillar includes indicators related to enforcement credibility, exposure to rent-seeking and policy capture, transparency and accountability, crisis governance, and overall state capacity and coordination.

Table 2. Indicative institutional indicators for the enabling environment scorecard

Institutional Pillar	Indicative Indicators
Policy Coherence and Credibility	• Consistency of agricultural, climate, and investment policy objectives • Stability of core policy commitments over time and across political or crisis cycles • Alignment between policy commitments and medium-term public budgets (fiscal anchoring) • Consistency of policy implementation across national and sub-national levels • Existence and use of monitoring, evaluation, and learning mechanisms
Legal Foundations and Rights Security	• Security and enforceability of land and natural resource use rights relevant to agribusiness investment • Reliability of contract enforcement in agricultural and commercial transactions • Accessibility, cost, and timeliness of dispute resolution mechanisms • Availability and usability of secured transactions frameworks for movable and immovable assets • Clarity and enforceability of innovation-related rights (e.g. seed, IP, licensing)
Regulatory Frameworks	• Predictability and cost of business entry and licensing procedures • Transparency and efficiency of approval processes for inputs, technologies, and services • Stability and efficiency of trade and customs procedures affecting agricultural markets • Clarity and enforceability of environmental and climate-related compliance requirements • Consistency of regulatory interpretation and enforcement across jurisdictions
Finance and Investment Architecture	• Availability and diversity of capital sources for agribusiness investment • Presence and effectiveness of risk-sharing instruments (e.g. guarantees, insurance) • Quality of financial infrastructure (e.g. credit information, collateral registries, payment systems) • Capacity for project preparation, aggregation, and pipeline development • Integration of climate objectives into financing mechanisms
Partnership and Coordination Capacity	• Existence and credibility of public–private partnership frameworks • Strength of research–industry linkages and innovation intermediation mechanisms • Degree of coordination among public agencies and development partners • Integration of farmer and producer organizations into delivery and governance arrangements • Clarity of partnership governance, accountability, and conflict resolution mechanisms
Market and Value Chain Linkages	• Reliability and enforceability of offtake and contracting arrangements • Availability of embedded services (inputs, finance, extension) supporting adoption • Adequacy of aggregation, storage, and logistics infrastructure • Access to domestic, regional, and export markets, including compliance with standards • Degree of competition and inclusion within value chains
Governance and Political Economy Conditions	• Credibility and consistency of rule enforcement by public authorities • Exposure to rent-seeking, policy capture, or discretionary intervention • Transparency and availability of information on rules, decisions, and performance • Government responses to shocks and crises affecting policy predictability • Overall state capacity for coordination and implementation

Source: Author's creation

Scoring is conducted using an ordinal scale that reflects the overall quality of institutional conditions within each subcategory, as evidenced by the set of indicative indicators associated with that domain. While the scale can be adapted to context, the suggested approach is a 0–5 qualitative band scale, with each score anchored in clearly specified descriptive criteria. Lower scores indicate institutional conditions that are unstable, inconsistently applied, or frequently overridden in practice, while higher scores indicate conditions that are broadly predictable, consistently implemented, and sufficiently trusted to support repeated transactions and capital commitments. Scores are assigned at the subcategory level based on triangulated evidence across the relevant indicators and are then interpreted holistically at the pillar level. The scorecard deliberately avoids mechanical aggregation or averaging into composite indices. Instead, pillar-level assessments rely on structured judgment that considers the

coherence of institutional conditions across indicators, highlights internal inconsistencies, and identifies binding constraints. For example, strong policy alignment alongside weak policy durability results in a cautious assessment of policy coherence and credibility, reflecting the reality that volatility undermines institutional credibility even in the presence of ambitious strategies. Scores are therefore intended to be diagnostic rather than definitive, and are accompanied by concise analytical narratives that document the evidence base, note sources of uncertainty, and explain the political economy factors shaping observed outcomes. This approach prioritizes analytical transparency and interpretability over spurious numerical precision.

Table 3. The scaling scorecard: integrated pillars and cross-cutting levers

Category	Subcategory	Definition & Contribution to Investment Readiness	Score (0-5)
Institutional Pillars			
1. Policy Coherence & Credibility	Strategic alignment; Durability; Fiscal anchoring; Vertical coordination; Monitoring & learning	Ensures that agricultural and climate policies are mutually reinforcing and resistant to sudden reversals, providing a stable horizon for private capital.	
2. Legal Foundations	Resource rights; Contract enforceability; Dispute resolution; Secured transactions; IP rights	Establishes the "rules of the game" for asset ownership and exchange; reduces the risk of default and enables the use of diverse collateral.	
3. Regulatory Frameworks	Business entry; Input/Tech approval; Trade procedures; Climate compliance; Consistency	Streamlines the path from market entry to technology diffusion; lowers the administrative "cost of doing business."	
4. Finance & Investment	Capital diversity; Risk-sharing tools; Financial infra; Project aggregation; Climate finance	Provides the liquidity and de-risking mechanisms (e.g., guarantees) necessary to move from small-scale pilots to mass-market adoption.	
5. Partnership Capacity	PPP frameworks; Research-industry links; Donor coordination; Farmer integration	Facilitates the high-level coordination required between state, private, and civil society actors to share risks and resources.	
6. Market Linkages	Offtake reliability; Embedded services; Logistics & aggregation; Standards; Inclusion	Secures the "pull" factor of the value chain, ensuring that increased production translates into reliable revenue for both firms and farmers.	
7. Governance & Political Economy	Enforcement credibility; Rent-seeking risks; Transparency; Crisis governance; State capacity	Governs the actual behavior of the state during shocks and its resistance to capture by narrow elite interests.	
Levers			
1. Incentives Drives the will to comply and innovate	Fiscal	Tax, subsidy, and expenditure structures influencing investment and adoption behavior.	
	Regulatory	How rules and standards encourage or discourage innovation and formalization.	
	Political	Alignment between electoral or leadership priorities and long-term scaling goals.	
2. Interests Determines resource allocation & behavior	Elite	Influence of powerful actors on resource allocation and institutional outcomes.	
	Sectoral	Alignment or conflict among value chain actors (e.g., importers vs. local producers).	
	Bureaucratic	Incentives facing public officials that shape "street-level" implementation behavior.	
3.Trust The social fabric of long-term contracts	Enforcement	Confidence among private actors that rules and contracts will be consistently upheld.	
	Delivery	Belief among beneficiaries that services and programs will reach them reliably.	
	State–Market	The quality of dialogue and mutual reliability between public and private sectors.	
4.Ideas & Narratives Shapes social legitimacy and appetite	Policy Narratives	Dominant framings of agriculture/climate that influence agenda setting and priority.	
	Risk Perceptions	How climate and market risks are understood, communicated, and mitigated.	
	Social Legitimacy	Public and political acceptance of private-sector-led scaling models.	
5.Information Reduces asymmetry for investors and farmers	Market Data	Availability and reliability of price, demand, supply, and performance data (e.g., IoT).	

6. Capacity The "Engine Room" of policy reality	Administrative	The procedural ability of public agencies to manage licensing and oversight.
	Technical	Availability of specialized skills for installation, repair, and innovation support.
	Coordination	Ability of different agencies (Energy vs. Water) to work toward a shared goal.
7. Affordability Bottom-line feasibility for users and SMEs	Compliance	The administrative and "hidden" costs of following regulations and permits.
	Financing	The actual terms (interest, tenor, collateral) available to the end-user or firm.
	Unit Cost	The relative cost of the innovation compared to traditional alternatives (e.g., diesel).

Source: Author's creation

Political economy levers—incentives, interests, trust, ideas and narratives, information, capacity, and affordability—are incorporated as structured interpretive dimensions rather than as standalone institutional pillars. They capture the political and behavioral mechanisms through which formal institutional arrangements operate in practice. Each lever is disaggregated into clearly specified sub-dimensions (for example, fiscal, regulatory, and political incentives; administrative versus technical capacity; compliance versus financing affordability), which serve as indicative assessment criteria. These sub-dimensions are assessed using the same ordinal logic applied elsewhere in the scorecard, providing a consistent basis for judging the strength or weakness of each lever. For each institutional pillar, assessors identify which political economy levers most strongly influence observed performance and assign scores based on how these levers shape implementation, enforcement, and behavior. This approach allows the scorecard to distinguish among different sources of institutional weakness. For example, weak regulatory outcomes may stem from limited administrative capacity, misaligned political incentives, affordability constraints that discourage compliance, or selective non-enforcement driven by elite interests. Political economy levers are treated as explanatory rather than additional, ensuring that while institutional weaknesses are scored, their underlying drivers are identified explicitly.

The scorecard is intended as a practical diagnostic tool that can be used by different actors to identify institutional constraints to agribusiness-driven innovation scaling, depending on their role and objectives. Researchers can apply the scorecard in comparative analysis or repeated assessments over time to examine how institutional conditions evolve and how these changes affect scaling outcomes. Government agencies, such as ministries responsible for agriculture, energy, or climate policy, can use the scorecard as a self-assessment tool to identify regulatory gaps, coordination failures, or credibility issues that weaken investment readiness and undermine implementation. Private firms and agribusinesses can use the scorecard to inform market entry and risk assessment, helping them understand which institutional gaps may need to be managed internally and which require engagement with public actors. Development partners and donors can use the scorecard to inform the design of coordinated reform and investment packages, identifying where policy reform, technical assistance, or risk-sharing instruments are most likely to unlock private investment.

Data collection for the scorecard combines multiple sources of evidence to capture both the formal institutional framework (*de jure*) and how it operates in practice (*de facto*). The depth of data collection can be adjusted to the purpose and resources of a given application, but typically draws on two complementary sources. First, documentary and market evidence can be used to establish the formal and structural features of the enabling environment. This includes national laws, regulations, policy strategies, and budget and expenditure data, complemented by financial sector diagnostics, value chain studies, market assessments, and official statistics. Together, these sources provide a baseline understanding of institutional design, policy commitments, and market conditions. Second, stakeholder interviews can be used to assess how institutions function in practice. Semi-structured interviews with public officials, agribusiness firms, financial institutions, and producer organizations provide insight into enforcement, implementation, coordination, and trust. These perspectives are essential for understanding gaps between formal rules and actual practice, as well as the political and administrative factors shaping institutional performance that are not visible in documentary sources alone. They can be triangulated with documentary and market evidence to identify consistent patterns, discrepancies, and sources of uncertainty, and to understand the political and administrative factors shaping the enabling environment.

Results generated by the scorecard are presented as enabling environment profiles rather than rankings or comparative scores. Visual tools such as heatmaps or matrices may be used to summarize patterns across pillars and subcategories, but their purpose is interpretive rather than comparative. The scorecard is designed to reveal institutional bottlenecks, internal misalignments, and trade-offs that constrain scaling. While developed to assess conditions for agribusiness-driven innovation scaling, the methodology has broader diagnostic relevance. By tracing how institutional arrangements and political economy dynamics interact across stages of policy design,

implementation, and adaptation, the scorecard provides insight into why policy commitments often fail to translate into effective action, why interventions stall during delivery, and why intended impacts fall short. This broader applicability underscores the scorecard's value as a general diagnostic approach for understanding institutional constraints in agricultural and climate-related policy contexts.

4. Using the Scorecard: Diagnostic Logic

This enabling environment scorecard functions as a structured diagnostic instrument for analyzing how institutional conditions shape the scaling of business-driven innovation. Its purpose is to support systematic interpretation of how institutional arrangements and political economy dynamics influence investment risk, coordination, and the feasibility of sustained private-sector engagement. Consistent with New Institutional Economics, which emphasizes that economic performance depends on the formal and informal rules governing exchange (North, 1990), the scorecard examines how the enabling environment informed by rules and power dynamics affects the ability of firms to enter markets, form contracts, secure finance, manage risk, and engage in repeated transactions over time. These institutional conditions determine whether innovations can move beyond pilot initiatives and become commercially viable and durable at scale. The scorecard is interpreted relationally, with attention to patterns across pillars and their interaction with different stages of scaling. This diagnostic logic recognizes that scaling outcomes are shaped by configurations of institutional conditions that jointly determine incentives, risk allocation, and transaction costs, and that weaknesses often arise from misalignment across these domains.

Interpretation of the scorecard focuses on how institutional pillars operate together in shaping scaling outcomes. In practical terms, it provides systematic guidance for diagnosing how enabling conditions and constraints coexist in diverse innovation scaling environments. Because institutional domains are interdependent, the combination of strengths and weaknesses across pillars, rather than assessing whether individual institutional domains are strong or weak, often provides a more accurate explanation of scaling outcomes than scores considered in isolation. The scorecard, therefore, offers a structured way to assess how policy credibility, legal security, regulatory stability, finance, market linkages, and governance conditions jointly influence private investment decisions. By organizing evidence across these domains, the scorecard helps identify which institutional constraints are binding, which are secondary, and which reforms or investments are likely to have the greatest leverage in a given context. Based on the literature, some of the most common institutional interplays that would require a combined systematic reading of scores, are as follows:

- An example of a common interplay between institutional pillars and levers in Africa and Asia is where policy coherence is strong, but market and value chain linkages are weak. For example, in Ethiopia, the Agricultural Development Led Industrialization strategy demonstrated substantial policy coordination at the federal level, yet the absence of reliable private-sector offtake arrangements and efficient logistics limited the scaling of improved cereal varieties such as maize and tef (Spielman, Byerlee, & Alemu, 2010; Assefa et al., 2011). Similarly, in India, national promotion of Climate-Smart Agriculture has often achieved alignment between central and state-level policies, but fragmented value chains and limited embedded services for non-staple crops have constrained commercial uptake (Aggarwal et al., 2018; ICAR, 2023). The application of the scorecard to such contexts can simplify diagnosing such an interplay and highlights that additional policy formulation is unlikely to advance scaling unless accompanied by investments in market infrastructure, service delivery systems, and partnership arrangements that support commercial viability.
- A second common institutional interplay is where financial instruments are available, yet legal foundations or regulatory stability are weak. In Cambodia, for example, significant expansion of agricultural credit under the Rectangular Strategy coincided with continued uncertainty over land tenure and limited confidence in contract enforcement, constraining uptake of capital-intensive irrigation technologies (World Bank, 2022; NBC, 2023). In such cases, strengthening property rights and regulatory predictability becomes a necessary condition for effective capital deployment (North, 1990; Dixit, 2009). This scorecard can help distinguish between an evident shortage of finance and a bigger institutional risk that discourages investment.
- A further example of institutional interaction commonly observed in the evidence is where technical implementation capacity is strong, but governance credibility and policy durability are unstable. This configuration is often documented in Brazil, for instance, particularly regarding the scaling of the low-carbon agriculture plan called the ABC Plan (Plano ABC–Agricultura de Baixa Emissão de Carbono). While Brazil possesses technically capable organizations, including the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária–EMBRAPA), and implementing bodies, the scaling of carbon-neutral innovations has often been disrupted by volatile political cycles and shifting fiscal priorities that undermine long-term farmer commitments (OECD, 2022). In such cases, the use of the scorecard makes explicit that the binding constraint lies not in technical implementation capacity, but in the durability and credibility of policy commitments. By assessing governance credibility and policy stability alongside technical capacity, the scorecard can help distinguish between implementation gaps and commitment problems, clarifying that sustained private investment depends less on technical competence than on predictable and enforceable institutional arrangements.

A critical tenet of this diagnostic logic is that the lowest-scoring pillar is not necessarily the primary obstacle; rather, the decisive factor is where an institutional weakness intersects with a specific stage of scaling—agenda setting, design, implementation, or adoption. For instance, in Vietnam, weaknesses in policy coherence and dominant narratives bound at the agenda-setting stage for organic fertilizer adoption; while technically viable, the innovation struggled for political legitimacy against a long-standing state narrative favoring chemical intensification (World Bank, 2021; Schmidt, 2008). In contrast, constraints in legal frameworks and financial architecture tend to bind at the design stage, as seen in Ghana, where the intent to scale warehouse receipt systems was limited by the lack of clear regulatory guidelines for collateral management, preventing the translation of policy into a workable delivery model (IFPRI, 2023). During the implementation phase, coordination failures and limited administrative capacity frequently emerge as the primary barriers. A notable case is found in Malawi, where the scaling of integrated soil fertility management was hampered not by farmer interest, but by the last-mile delivery failures of agricultural extension services and administrative bottlenecks in input distribution (Pritchett et al., 2013; Snapp et al., 2018). Finally, adoption at the farmer and firm level is most often constrained by affordability, information, and market access. By identifying where a constraint binds within the scaling pathway, the scorecard supports tailored interventions that address stage-specific barriers.

The integration of political economy levers into the scorecard is essential for distinguishing between the disparate underlying sources of these constraints. This distinction is vital because identical institutional symptoms often require vastly different remedies. For example, a low score in regulatory performance for pesticide safety standards might stem from limited administrative capacity in one country, but from deliberate non-enforcement driven by elite interests in another. By explicitly documenting which levers, such as interests, trust, or information, are at play, the scorecard moves beyond treating institutional shortcomings as purely technical gaps to be filled. Instead, it supports more realistic, politically informed responses that account for the underlying power dynamics, ensuring that reform-investment bundles are not just technically sound but politically feasible within the specific national context.

The final stage of the diagnostic logic involves the translation of scorecard findings into reform–investment bundles. This approach is rooted in the recognition that institutional reform, public investment, and private capital mobilization are complementary and must be coordinated in order to address constraints effectively and sustain investment over time (North, 1990; Williamson, 2000; Rodrik, 2008). Unlike fragmented sectoral interventions, these bundles are sequenced to reflect the specific scaling stage of the innovation and are designed to address both the formal institutional structure (the pillar) and the underlying behavioral driver (the lever). For instance, in contexts where weak contract enforcement and low trust constrain the adoption of outgrower schemes or contract farming, an effective reform bundle might combine improvements to collateral laws and secured lending systems with clearer and more enforceable contract templates that define rights, obligations, and dispute resolution mechanisms. These are then paired with risk-sharing instruments, like partial credit guarantees, alongside investments in decentralized dispute resolution mechanisms to lower the perceived risk for both firms and smallholders. In Kenya, for instance, the bundling of mobile-enabled crop insurance with credit facilities successfully mitigated the trust and risk barriers that previously prevented the adoption of high-value inputs (FSD Kenya, 2024; World Bank, 2023). Where affordability constitutes the primary barrier to the scaling of technologies like solar-powered cold storage, the bundle could integrate regulatory adjustments to lower technology costs (e.g., duty remissions) with concessional finance and producer aggregation models. In this way, the diagnostic process translates into coordinated, stage-appropriate reform and investment packages that directly address the institutional weaknesses identified by the scorecard.

Finally, the scorecard is designed for iterative application, acknowledging that enabling environments are dynamic systems that evolve in response to reforms, investment cycles, and external shocks. In the framework of New Institutional Economics, institutions are not static end-states but are subject to constant feedback loops between players and the "rules of the game" (North, 1990). Repeated application of the diagnostic tool allows stakeholders to track whether a specific reform–investment bundle is successfully shifting a binding constraint or if new, unforeseen obstacles have emerged as the innovation moves into more advanced stages of scaling. For example, a successful intervention that resolves an affordability constraint in the early adoption phase may lead to a secondary bottleneck in regulatory compliance or market competition as the volume of private actors increases. This iterative process is particularly vital in the context of climate-smart agriculture, where shifting environmental conditions and international carbon market standards require policies that are both stable and adaptive. In this sense, the scorecard can function as a learning device that supports adaptive policy and investment strategies.

By structuring analysis around institutional patterns, temporal binding constraints, and coordinated responses, the diagnostic logic provides a rigorous bridge between theoretical institutional assessment and practical, site-specific action. This approach ensures that the scaling of agribusiness innovations is treated not as a linear technical exercise, but as a managed transition within a complex and often uncertain political economy. Ultimately, the scorecard tool empowers users to navigate these complexities, turning institutional diagnostics into a roadmap for resilient, large-scale impact.

5. Case Study: Diagnosing Enabling Environment Constraints for Solar Irrigation in Kenya

This section applies the enabling environment scorecard to the case of solar irrigation in Kenya, drawing on a structured literature review (i.e., academic studies, policy documents, industry reports, and market evidence). This innovation is selected to assess how the institutional conditions identified in the scorecard shape its scaling trajectory in practice. In Kenya, firms such as SunCulture have developed solar irrigation technologies bundled with pay-as-you-go (PAYG) financing models to expand access among smallholder farmers. Although solar irrigation is technically viable and commercially active, its scaling trajectory is hereby assessed against the interplay between business strategy and the broader institutional environment defined in the seven pillars of the scorecard. This section, therefore, applies the scorecard framework to examine how policy coherence, legal and regulatory structures, financial architecture, market linkages, and governance conditions jointly influence the prospects for sustained, market-based scaling of solar irrigation. The section proceeds in three parts. First, it presents an overview of the enabling environment assessment for SPI in Kenya based on the scorecard criteria. Second, it analyzes each institutional pillar and associated political economy levers in detail, drawing on the literature to interpret observed strengths and constraints. Third, it derives targeted reform and investment implications consistent with the diagnostic findings.

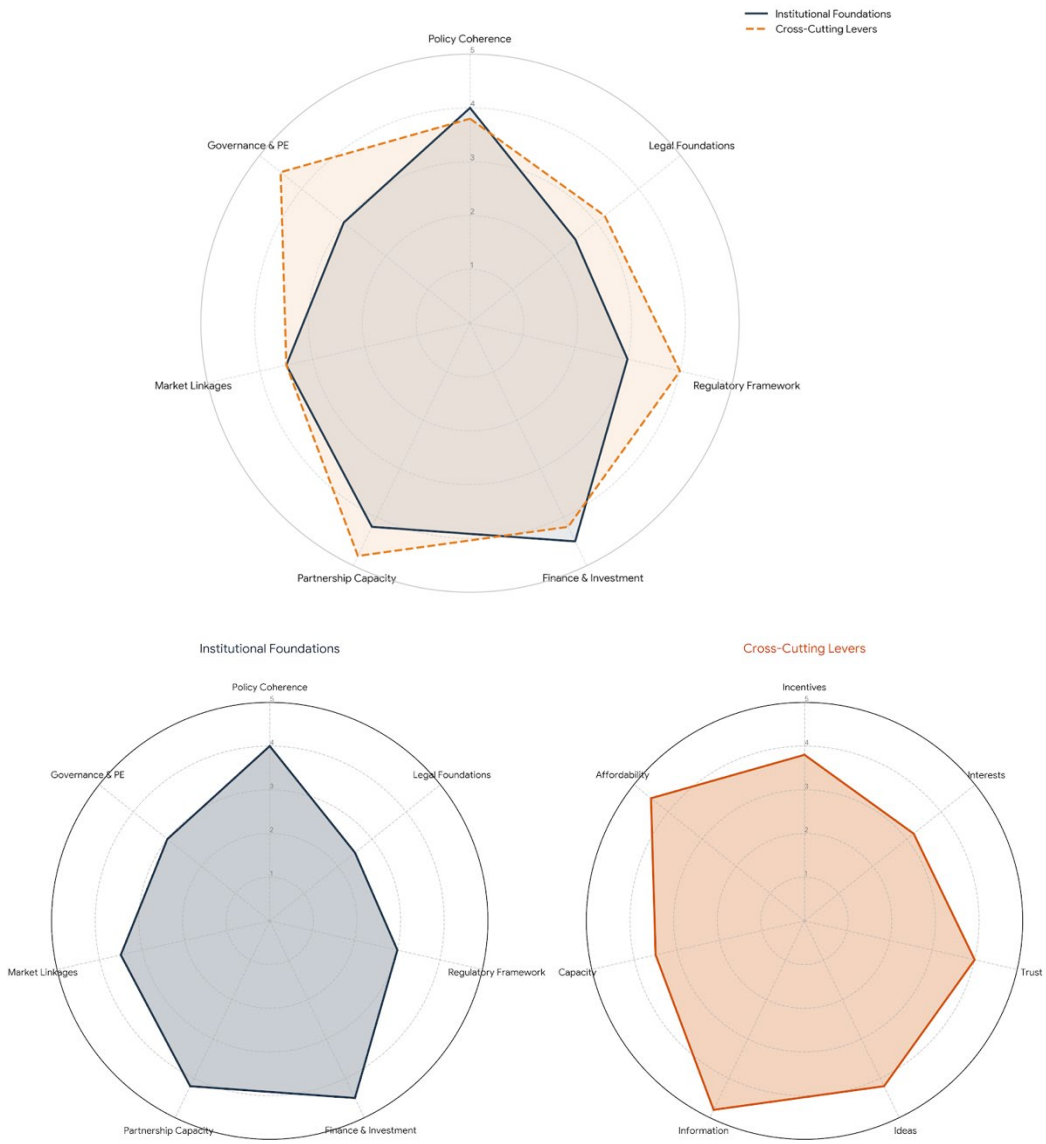
5.1 Overview of the Enabling Environment Score for Scaling Solar Irrigation in Kenya

The results of the Scorecard applied to solar irrigation in Kenya reveal a high-potential but structurally uneven environment that dictates the pace of business-led scaling. The scores presented below summarize the enabling environment for solar-powered irrigation in Kenya, especially focusing on the case of Sunculture, and are unpacked in detail in the sections that follow (Figure 2). Taken together, they reveal a pronounced asymmetry between strengths in digital finance and information systems and weaknesses in legal and regulatory foundations. The Finance and Investment pillar (4.5) and the Information lever (4.8) score strongly, reflecting Kenya's well-developed mobile money ecosystem and digital infrastructure, which reduce transaction costs and enable innovative pay-as-you-go financing models (World Bank, 2024; GSMA, 2025). In contrast, the Legal Foundations (2.5) and Regulatory Framework (3.0) pillars remain comparatively weak. Fragmented permitting processes between energy and water authorities, regulatory uncertainty, and shifts in fiscal policy—such as proposed reintroductions of value-added tax on renewable energy components—contribute to compliance costs and inventory risks estimated at 12–15 percent of total unit costs (GOGLA, 2025; Ministry of Energy, 2025). This uneven institutional profile compels firms to compensate for gaps in public legal and regulatory systems by internalizing functions that would otherwise be supported institutionally, including contract enforcement mechanisms, customer screening, and risk management systems. As a result, scaling remains possible but more costly and firm-dependent, relying on private organizational capacity to manage risks that would ideally be mitigated through predictable and coordinated public institutions (BII, 2024; REEEP, 2025).

Policy Coherence and Credibility (Score 4.0): Kenya's policy environment for solar-powered irrigation reflects strong strategic alignment combined with periodic fiscal volatility. National frameworks—including the Kenya Climate Smart Agriculture Strategy (2017–2026), the National Climate Change Action Plan (2023–2027), the National Energy Policy (2025–2034), and the Kenya National Energy Compact (2025–2030)—consistently identify solar energy and the Productive Use of Renewable Energy (PURE) as central to food security, rural transformation, and climate mitigation (Ministry of Energy, 2025). This alignment reduces long-term strategic uncertainty and signals political support for private-sector participation in solar irrigation.

However, policy durability remains a moderate constraint. Recurrent fiscal adjustments, such as revisions to Value Added Tax (VAT) and import duty exemptions on solar components under the Finance Bill 2025 and the Tax Laws (Amendment) Act 2025, have introduced short-term uncertainty (World Bank, 2024; GOGLA, 2025). Industry estimates suggest that such shifts could significantly reduce the addressable market for standalone solar if not mitigated by subsidies. For SunCulture, this means that while the strategic direction of policy is clear, periodic fiscal reversals increase compliance costs and pricing risk, affecting affordability for smallholders and complicating long-term scaling decisions.

Figure 2. Enabling Environment Profile for Solar Irrigation Scaling (Kenya 2025-2026)



This radar chart illustrates the asymmetry in Kenya's institutional landscape. The outward vertices in Finance and Partnership Capacity reflect the maturity of mobile money and the 2025 IWMI partnership. The inward retreat in Legal Foundations highlights the persistent collateral gap in rural areas. The Levers (Information/Affordability) act as the primary engines driving SunCulture's business-led scaling, effectively de-risking the environment for private capital despite underlying legal and regulatory frictions. (*Source:* Author's creation)

Legal Foundations and Rights Security (Score 2.5): A primary barrier to scaling is the collateral gap for smallholders. The Movable Property Security Rights (Amendment) Bill 2024 and the operationalization of the Movable Assets Registry (2025) have been game-changers, allowing farmers to register non-traditional assets like the SunCulture pump or even livestock as formal collateral (Kenya Business Registration Service, 2025). However, a persistent legal challenge remains: the hire-purchase nature of PAYG contracts. Under the new 2024 amendments, all hire-purchase businesses must be licensed by the Registrar, adding an administrative layer that firms must navigate to remain compliant (Cliffe Dekker Hofmeyr, 2024).[1] This complexity, paired with the slow resolution of commercial disputes in rural courts, keeps risk premiums high for domestic commercial banks, who remain hesitant to lend to smallholders without formal landholding titles without heavy de-risking (Akuja et al., 2024).

Although the Movable Property Security Rights Act (2017) established a registry for using assets (like solar pumps) as collateral, the maturity of this system in rural agribusiness remains low. For SunCulture, this results in

[1] Hire-purchase agreements are financing arrangements in which the buyer takes possession of an asset and repays its cost in installments over time, with legal ownership transferring only upon full repayment.

a vertically integrated model in which the firm supplies the irrigation technology while also extending credit and managing repayment risk internally. Furthermore, Land and Resource Rights Security limits scaling; in many Arid and Semi-Arid Lands (ASALs), the lack of formal land titles prevents farmers from accessing traditional bank loans to complement SunCulture's PAYG financing, effectively capping the addressable market to regions with more modernized tenure (Akuja et al., 2024).

Regulatory Frameworks (Score 3.0): Regulatory friction arises from the intersection of energy and water mandates. While the Energy and Petroleum Regulatory Authority (EPRA) has standardized off-grid solar hardware, there is often a regulatory vacuum regarding water abstraction limits for small-scale solar pumps. SunCulture must comply with Water Resources Authority (WRA) permits, which were designed for large-scale diesel irrigation and can be prohibitively expensive for a farmer with a single-acre plot. Sunculture's commercialization timeline for newer product iterations, such as the ClimateSmart Battery 2 (CSB2), is affected by trade bottlenecks at the Port of Mombasa, where inconsistent customs classification of specialized ag-tech components leads to clearance delays (CLASP, 2023; SunCulture, 2024).

Finance and Investment Architecture (Score: 4.5): A significant development in SunCulture's business model has been the integration of carbon finance. In 2024–2025, the company partnered with British International Investment (BII) and the Shell Foundation to establish a facility that pre-finances anticipated carbon credit revenues (BII, 2024). Using Internet of Things (IoT)-enabled telemetry systems, SunCulture is able to monitor pump usage and verify emissions reductions in real time, with each solar irrigation system estimated to displace approximately 2.9 tons of CO_2 annually. This traceability allows the firm to generate and monetize carbon credits as payments for verified emissions reductions. According to the Financial Sector Deepening Kenya (2025), channeling carbon revenues toward subsidizing upfront system costs can increase sales volumes by two- to threefold, improving affordability for lower-income smallholders who would otherwise face prohibitive commercial lending rates exceeding 15 percent.

Partnership and Coordination (Score 4.2): To address concerns regarding groundwater sustainability, SunCulture entered into a partnership with the International Water Management Institute (IWMI) in February 2025. The collaboration applies IWMI's Scale-Invariant Water Accounting Plus (SIWA+) methodology to monitor groundwater abstraction and aquifer conditions across the company's operational areas (IWMI, 2025). This institutional arrangement is significant for investment readiness, as it generates independently verified environmental data required by institutional investors, such as InfraCo Africa and the Private Infrastructure Development Group (PIDG), to assess environmental risk exposure. By integrating systematic water accounting into its operations, SunCulture reduces the risk that expanded irrigation could contribute to groundwater over-extraction, thereby strengthening the environmental credibility of its scaling model (SunCulture, 2025).

Market and Value Chain Linkages (Score 3.5): SunCulture's scaling strategy recognizes that irrigation technology only generates sustainable returns if farmers can manage production and market risks. In late 2024, the company introduced "SunCulture Protect," a climate insurance product developed in partnership with APA Insurance and Humanity Insured (SunCulture, 2024). By integrating insurance coverage with the irrigation system and financing model, the firm reduces farmers' exposure to catastrophic weather shocks and lowers the probability of loan default during drought conditions. This risk-sharing mechanism strengthens repayment performance and enhances the financial viability of the pay-as-you-go model. Embedding technology provision within complementary financial risk management instruments illustrates how scaling requires institutional integration across finance, insurance, and production systems rather than reliance on technical performance alone.

SunCulture also addresses market risk through bundled digital advisory services ("AgOptimized") intended to support productivity and market planning. However, broader aggregation and logistics infrastructure in Kenya remains uneven, particularly in remote regions. In thin markets characterized by limited storage, weak aggregation, and volatile prices, increased production can depress farm-gate prices if output is not matched by reliable offtake channels. Evidence from agricultural value chain studies in Kenya highlights how such constraints contribute to loan default risk and investment instability (Mercy Corps AgriFin, 2020). These dynamics underscore that market and value chain linkages constitute a binding condition for scaling: without reliable aggregation, storage, and market access, productivity gains may translate into heightened financial exposure rather than sustained income growth.

Governance and Political Economy (Score 3.0): The political economy of irrigation in Kenya is gradually shifting from centralized, state-led irrigation schemes toward more decentralized, business-led delivery models. Within this evolving landscape, the scaling of solar-powered irrigation depends not only on technical and financial viability but also on social and political legitimacy. Evidence suggesting that a high proportion of participating farmers have increased production and incomes has strengthened the credibility of pay-as-you-go irrigation models among county governments and development partners (BII, 2024; SunCulture, 2023). Demonstrated livelihood impacts contribute to policy support at the sub-national level and position private providers as viable partners in agricultural development initiatives.

However, risks of policy capture persist. Public irrigation investments in Kenya have historically been shaped by political incentives, and large-scale infrastructure projects can attract resources even when decentralized models may deliver higher returns for smallholders (World Bank, 2024). In such contexts, institutional support may shift in response to political priorities rather than performance evidence. This dynamic underscores the relevance of governance and political economy conditions within the scorecard: sustained scaling depends not only on market performance, but also on the alignment between political incentives, institutional credibility, and demonstrable developmental outcomes.

While the institutional pillars define the structural conditions for scaling, the cross-cutting political economy levers explain how and why these conditions operate in practice. In the case of SunCulture's RainMaker in Kenya, the levers shape whether institutional arrangements translate into effective support for business-led innovation or remain formal commitments with limited practical impact. They influence how incentives are structured, how interests are aligned or contested, and how risks are perceived and managed across the scaling pathway.

Incentives are particularly central in aligning private profitability with public policy objectives related to food security and climate resilience. SunCulture's expansion has been supported by fiscal measures such as zero-rated value-added tax and import duty exemptions on renewable energy technologies, where periods of policy stability have corresponded with stronger sales growth. Regulatory frameworks promoting the Productive Use of Energy (PURE) have also encouraged investment in productive agricultural assets, including solar irrigation systems. At the county level, political incentives further reinforce adoption, as local governments associate irrigation expansion with visible gains in agricultural productivity, employment, and food security outcomes. In this way, fiscal, regulatory, and political incentives interact to shape the pace and direction of scaling.

Interests shape power relations and resource allocation within the agricultural sector and often determine whether an innovation encounters resistance or institutional support. Historically, irrigation development in Kenya has been associated with centralized, state-led schemes and, in some cases, politically connected large-scale estates (Mwangi, 2007; Kanyinga, 2014; World Bank, 2020). SunCulture's business-led model shifts the locus of investment and service delivery toward a decentralized, smallholder-oriented pathway, which can create friction with established hydraulic bureaucracies and interest groups that favor large public schemes—such as dams and centralized irrigation infrastructure—over distributed systems. In this context, the alignment of bureaucratic interests becomes a decisive lever. Coordination between the Ministry of Energy's clean energy targets and the Ministry of Agriculture's food security objectives is particularly important, as misalignment can generate redundant regulatory requirements, fragmented permitting, and budget competition that raise transaction costs and delay scaling.

Trust is a core condition for the viability of the pay-as-you-grow (PAYG) model because long-term repayment requires confidence in the institutional and commercial arrangements that govern the asset. At the macro level, state–market trust is essential: SunCulture's financing model depends on predictable protection of asset rights under legal frameworks such as the Movable Property Security Rights Act; weak enforcement would raise perceived credit risk and increase the cost of private capital. At the micro level, trust in delivery systems is equally important for overcoming farmer skepticism toward new technology and installment-based finance. SunCulture builds credibility through "social proof" and partnerships with established institutions such as Equity Bank, whose microfinance reputation can reassure smallholders that the "Lipa Pole Pole" ("pay slowly") model is a legitimate pathway to asset ownership and income generation rather than a predatory debt arrangement (REEEP, 2025; SunCulture, 2024).

Ideas and narratives shape agenda-setting, social legitimacy, and investor appetite by influencing how private-sector-led scaling is interpreted by public actors and communities. SunCulture's positioning of the smallholder as an "agri-entrepreneur" rather than a subsistence producer reframes solar irrigation as a commercially oriented adaptation strategy, aligning with the Vision 2030 narrative of modernizing agriculture and promoting rural wealth creation. This framing can increase acceptability among conservative rural communities while also resonating with international Environmental, Social, and Governance (ESG) investors who seek market-based, high-impact solutions (Mercy Corps AgriFin, 2020; IWMI, 2025). In practical terms, such narratives can strengthen coalitions for scale by linking firm-level growth to national development objectives and climate resilience goals.

Information reduces asymmetries and strengthens evidence for financing, performance monitoring, and environmental accountability. SunCulture employs Internet of Things (IoT)-enabled sensors and telemetry to generate real-time data on pump performance and water use, creating an information base that serves multiple purposes. First, performance data can be used to demonstrate productivity and cash-flow potential to lenders, functioning as a proxy for creditworthiness based on observed output rather than relying solely on conventional collateral such as land titles. Second, traceability supports verification requirements for carbon credit generation, linking operational data to claims of emissions reductions. Third, partnerships with information and communications technology (ICT) platforms and services provide farmers with timely weather and market price information, reducing information gaps that contribute to poor planning and post-harvest losses (GSMA, 2025; BII,

2024; AICCRA, 2024). Together, these information systems support both financing innovation and stronger due diligence for impact-oriented capital.

Capacity represents the engine room of delivery, determining whether an innovation can actually be sustained in the field. In rural settings, inadequate maintenance and after-sales support are common reasons that technically viable technologies fail to persist. SunCulture addresses this constraint by investing in administrative and technical capacity, including the training of a decentralized network of local technicians and the use of digital applications for remote diagnostics. The firm's 48-hour repair guarantee is designed to reduce downtime and protect both farmer confidence and repayment performance (Energy Alliance, 2025; SunCulture, 2025). Without such investment in local human capital and service delivery systems, solar irrigation would be more likely to remain concentrated in accessible, higher-income zones—effectively a "Nairobi-only" product—rather than reaching remote farmers at scale.

Affordability is the final threshold for mass adoption and is often the most binding lever in smallholder markets. In the Kenyan case, affordability is addressed primarily through the PAYG "Lipa Pole Pole" financing model, which converts a high upfront cost into manageable monthly payments. By spreading the cost of an approximately US$500 system over time—often framed as comparable to prior expenditures on diesel—SunCulture reduces entry barriers for farmers who cannot absorb large capital costs. Affordability is further strengthened through carbon-linked finance, where expected carbon credit revenues are used to subsidize upfront costs by up to 30 percent. Financial Sector Deepening (FSD) Kenya (2025) reports that such subsidies, combined with flexible repayment terms, can increase sales velocity by approximately threefold among the most credit-constrained farmer segments (FSD Kenya, 2025; BII, 2024). These mechanisms expand access while also supporting commercial sustainability by improving repayment feasibility and lowering default risk.

Overall, the enabling environment assessment by using the scorecard shows that solar irrigation scaling in Kenya is shaped by a mix of strong and weak institutional conditions. Strong digital finance systems, information infrastructure, partnership capacity, and targeted incentives partially compensate for weaknesses in legal foundations, regulatory coordination, and governance credibility. The case demonstrates that scaling outcomes are shaped by the interplay between institutional pillars and political economy drivers across stages, not by isolated institutional conditions. In Kenya, gaps in legal enforcement, regulatory coordination, and rural credit systems mean that firms such as SunCulture must manage risks internally that would ordinarily be reduced through stable and effective public institutions. Through vertically integrated financing models, carbon-linked subsidies, digital monitoring systems, and strategic partnerships, the firm assumes responsibility for credit risk, contract enforcement, environmental verification, and after-sales service—functions that, in more institutionally mature environments, would be supported by public regulatory and financial systems. Yet this firm-dependent scaling model is more costly and potentially less resilient than one grounded in coherent legal enforcement, streamlined regulation, and durable policy commitments. The diagnostic, therefore, suggests that Kenya's environment is investment-capable but institutionally incomplete. Strengthening legal enforcement, regulatory harmonization, and governance stability would reduce systemic risk and diminish the need for private substitution of public functions. In this way, the case demonstrates the value of the scorecard in distinguishing catalytic strengths from binding constraints and in guiding coordinated reform–investment strategies for climate-resilient agribusiness scaling.

5.2 Policy Recommendations for Scaling Solar Irrigation in Kenya

The Institutional Foundation Scorecard indicates that scaling solar irrigation in Kenya requires targeted structural reforms to address binding weaknesses in legal and regulatory domains. Although Kenya benefits from a robust digital finance ecosystem and relatively strong partnership capacity, gaps in collateral frameworks, regulatory coordination, and fiscal predictability continue to generate risk premiums that slow broader diffusion. Reducing these frictions would lower the cost of capital, improve market confidence, and shift scaling from firm-dependent risk absorption toward institutionally supported investment. The policy objective, therefore, is not to redesign the system wholesale but to strengthen specific institutional domains that currently constrain expansion.

A central constraint is the persistent collateral gap for smallholders. Despite progress under the Movable Property Security Rights framework, creditworthiness remains closely tied to formal land titles, limiting access to commercial lending in regions characterized by informal tenure. One policy option is to clarify and expand statutory recognition of digitally verified asset performance data, such as IoT telemetry, as admissible evidence of productive capacity in secured lending arrangements. While this would not replace traditional collateral regimes, formal acknowledgment of performance-based credit assessment could help decouple lending decisions from land ownership alone, potentially lowering borrowing costs for farmers without titled assets. Complementary reforms could include strengthening rural commercial dispute resolution mechanisms to reduce uncertainty in asset recovery and contract enforcement.

Regulatory fragmentation constitutes a second binding constraint. Energy and water permitting processes remain institutionally divided between the Energy and Petroleum Regulatory Authority and the Water Resources Authority, increasing compliance costs and prolonging deployment timelines. Establishing an integrated digital one-stop mechanism for productive use of renewable energy (PURE) technologies would streamline licensing, clarify water abstraction thresholds for small-scale solar pumps, and reduce administrative duplication. Such coordination would shorten commercialization timelines for new product iterations and lower transaction costs for firms and farmers alike. At the same time, enhancing policy durability through medium-term fiscal commitments, such as codified VAT and duty exemptions for climate-smart agricultural technologies, would provide price stability beyond annual budget cycles, strengthening long-term investment planning.

A reorientation of public support mechanisms could further improve governance and resource allocation. Shifting irrigation subsidies from centralized infrastructure projects toward decentralized, digitally administered e-voucher systems—potentially integrated through the Kenya Integrated Agriculture Management Information System—would allow farmers to select technologies that align with their needs while reducing risks of centralized procurement bias. This approach would better align public expenditure with smallholder demand and support competitive private-sector provision of SPI systems.

Finally, the case highlights the strategic role of information systems in strengthening investment readiness. High-frequency telemetry data enable firms to demonstrate asset performance, repayment behavior, and emissions reductions to international investors, partially compensating for incomplete domestic legal and financial systems. In emerging market contexts, digital transparency can therefore serve as a transitional mechanism that facilitates capital mobilization while longer-term institutional reforms mature (GSMA, 2025; FSD Kenya, 2025). Consolidating legal, regulatory, and fiscal reforms alongside existing informational strengths would move Kenya's enabling environment from firm-dependent scaling toward a more predictable, lower-risk institutional equilibrium capable of sustaining climate-resilient agribusiness growth.

6. Conclusion

Persistent failures to scale agricultural and climate-relevant innovations stem less from technological or financial gaps than from enabling environments that are not investment-ready. Although reforms are often assessed through policy inventories and best-practice checklists, such approaches provide limited insight into how risks are allocated, enforced, and managed in practice. This paper responds to that gap by developing an enabling environment scorecard that reframes agricultural systems as investable institutional configurations. Grounded in New Institutional Economics and political economy analysis, the scorecard offers a structured diagnostic tool for assessing whether institutional arrangements, market conditions, and governance dynamics jointly create credible conditions for sustained private-sector engagement. By distinguishing between institutional design and institutional performance, and by incorporating cross-cutting levers—such as incentives, interests, trust, capacity, and affordability—the framework clarifies why formal reforms often fail to alter behavior and how political and distributional forces shape investment risk, coordination, and scaling trajectories across stages.

The framework advances the literature by treating scaling as a staged process rather than as a simple diffusion outcome. By linking institutional domains and political economy drivers to agenda setting, policy design, implementation, adoption, and adjustment over time, the scorecard explains why contexts that enable pilot projects often fail to support sustained commercial uptake and repeated investment. Different constraints limit progress at different stages, and targeted actions in finance, regulation, or technology rarely succeed when underlying legal enforcement gaps, fragmented mandates, or unstable policy commitments remain unresolved. The illustrative application makes this dynamic visible in practice: instead of providing a broad assessment of the enabling environment, the scorecard identifies how strong digital finance systems, information infrastructure, and partnership arrangements can offset weaknesses in contract enforcement, regulatory coordination, and policy stability. At the same time, it shows that firm-level strategies, such as combining technology provision with in-house financing, digital monitoring, and risk-sharing partnerships, can reduce exposure to these weaknesses but cannot replace stable legal enforcement, coordinated regulation, and predictable policy commitments without raising costs and increasing vulnerability over time.

Beyond agribusiness innovation, the scorecard offers a broader diagnostic framework for understanding why agricultural and climate policies often fail to move from agenda setting to effective implementation and sustained results. By tracing how institutional arrangements and political economy dynamics interact across stages—agenda setting, design, implementation, adoption, and adaptation—the framework helps explain why reforms stall, why implementation is inconsistent, and why gains are reversed during political or climatic shocks. Its contribution lies not in ranking countries or prescribing standardized reforms, but in identifying stage-specific constraints and clarifying where legal enforcement gaps, regulatory fragmentation, fiscal instability, or misaligned incentives limit progress. Scaling climate-resilient agribusiness innovation is therefore not primarily a matter of expanding finance or multiplying pilot projects, but of ensuring that legal, regulatory, financial, and governance systems provide predictable conditions for repeated investment and long-term operation. Treating enabling

environments as investable systems offers a more precise and practically relevant basis for translating isolated successes into sustained agricultural transformation.

7. Implications

The enabling environment scorecard has implications beyond its function as a diagnostic tool for business-driven innovation. By organizing institutional analysis around binding constraints and scaling stages, it clarifies how legal, regulatory, financial, and governance conditions shape investment decisions. It provides a systematic framework for governments, development partners, and investors to assess where constraints lie, how different institutional and political economy conditions interact, and what types of action are most relevant.

For governments, the scorecard underscores that private investment responds primarily to predictability and enforcement rather than to the breadth of policy strategies. Comprehensive plans aligned with global agendas are insufficient if policies are frequently revised, weakly enforced, or fiscally unstable. Low scores in policy durability, enforcement credibility, or crisis governance signal that investors will discount official commitments. The implication is that governments seeking to mobilize private capital should prioritize measures that strengthen predictable implementation—such as embedding policies in medium-term budget frameworks, clarifying mandates across ministries, and formalizing rules for crisis response—before expanding new programs or pilot initiatives. The scorecard also supports prioritization: instead of pursuing reform across all domains simultaneously, governments can focus on the institutional constraints that bind at specific stages of scaling.

For donors and development finance institutions, the scorecard provides a structured basis for guiding what types of technical assistance, policy engagement, concessional finance, and private investment are needed to address the diagnosed institutional constraints. It helps determine whether limited scaling stems from insufficient investment or from weaknesses in enforcement, regulatory stability, or governance credibility. Where contract enforcement is unreliable or policy volatility is high, increasing the volume of available investment is unlikely to translate into sustained firm entry, long-term asset deployment, or expanded service provision. Investors may commit short-term or highly collateralized capital, but they will avoid longer-horizon investments that require stable rules and predictable returns. Conversely, where legal and regulatory systems function predictably but adoption is constrained by affordability or coordination gaps, risk-sharing instruments or aggregation support may be more effective. In this way, the scorecard clarifies which types of intervention are likely to influence investment behavior under given enabling environment conditions.

For private investors, the scorecard offers a structured way to interpret institutional risk. By breaking the enabling environment into clearly defined institutional pillars and relating them to specific stages of scaling, the scorecard helps investors distinguish between risks that are embedded in the broader legal and regulatory system and risks that can be managed through contract terms, partnerships, insurance, or financing structures. For example, unclear water permitting rules may require policy engagement, whereas repayment risk may be addressed through guarantees or revised payment schedules. The scorecard also enables more focused dialogue with public authorities by identifying concrete constraints, such as inconsistent enforcement, delayed licensing, or overlapping mandates, rather than relying on broader assessments of the investment climate. Overall, the scorecard's contribution lies in linking institutional conditions, political economy dynamics, and investment behavior within a single analytical framework. By focusing on binding constraints and stage-specific barriers, it supports tailored strategies for scaling climate-resilient agricultural innovations.

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