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RECONFIGURING THE MOROCCAN AGRICULTURAL MODEL: A SYSTEMIC AND PARADOXICAL EXPLORATION

"Water is the driving force of all nature", Leonardo da Vinci

ABDELMONIM AMACHRAA

POLICY CENTER FOR THE NEW SOUTH

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This paper examines the complexities of the Moroccan agricultural model from a systemic and paradoxical viewpoint. It highlights the fundamental contradiction facing Moroccan agriculture: balancing export-driven growth and global competitiveness with rising ecological challenges and social inequalities, especially amid increasing water scarcity. Despite a strong export performance, Morocco's agricultural sector remains fragile because of environmental and social vulnerabilities worsened by climate change and resource limitations. By reviewing national policy development and analyzing the tensions between economic, social, and environmental domains, this study proposes an integrative governance framework grounded in paradox theory. Using case studies from key value chains, including fertilizers, fruits and vegetables, sugar, and wheat, the research underscores the need for systemic governance, and questions the traditional techno-economic model. The findings indicate that Morocco's agricultural transformation must align with broader global trends in industry, technology, and geopolitics. Policies should aim to balance strategic sovereignty with global integration and ecological transitions. The paper emphasizes that Morocco's strategic assets, including its advantageous position in agricultural inputs and its emerging scientific ecosystem, can support necessary advancements in the agri-food sector, ultimately fostering a systemic model that combines economic prosperity and national sovereignty.

ABDELMONIM AMACHRAA

I dedicate this research work to Jeanne Chiche, an extraordinary woman who was my mentor. May her soul rest in peace.

I. INTRODUCTION

A quarter of the way into the twenty-first century, Morocco's agricultural sector faces a complex landscape shaped by climate change, shifting economic conditions, and fragmented value chains. Despite these challenges, Morocco has succeeded in maintaining food supply to its domestic market, and has emerged as a leading exporter to the European Union and other international markets. This success, however, is challenged by significant structural complexities that warrant deeper examination. Beneath the export success and macroeconomic resilience, are deep and ongoing tensions.

Morocco's agricultural sector demonstrates strong export performance but faces considerable ecological and social vulnerabilities. A misalignment between economic, social, and environmental priorities accompanies its integration into global value chains. By adopting a systemic approach to value chains (including fertilizers, fruits and vegetables, sugar, and wheat), this paper moves beyond narrow productivity metrics to view agriculture as a dynamic system characterized by persistent tensions, such as balancing water use with increased output, supporting exports while ensuring food sovereignty, and pursuing modernization without social exclusion.

Rather than questioning the achievements of Morocco's agricultural sector, such as its leadership in phosphates, strong horticultural exports, and major infrastructure investments, this paper focuses on identifying pathways to long-term sustainability. It emphasizes the need to view water not merely as an input, but as a central factor influencing policy, innovation, and governance. By advancing a systemic framework and a practical tool for evaluating rural development initiatives, the paper aims to help transform current vulnerabilities into resilient strengths, and to leverage ongoing tensions as opportunities to create sustainable value.

The paper is organized into sections that together analyze the complexities of Morocco's agricultural sector. The following sections focus on the sector's dual challenges, examine the paradox of sustainability, and compare different agricultural development models. The impact of climate change on agriculture is studied, along with the varied social and economic realities across Morocco. A systemic framework is introduced to address the sector's inherent paradoxes, with a case study of the OCP Group to illustrate growth strategies. The paper ends with recommendations for an integrated agricultural and food policy to tackle current challenges and support sustainable development.

II. THEORETICAL DEBATE

2.1. THE MOROCCAN AGRICULTURAL SECTOR's DOUBLE BIND

Contemporary debates on agricultural development often focus on technical diagnoses (productivity, subsidies, innovation, or infrastructure deficits), which, despite their apparent precision, struggle to explain the agriculture sector's ongoing economic, social, and environmental vulnerabilities, even after decades of proactive policies and measurable progress.

For Morocco, these sector-based perspectives often obscure a more fundamental issue: Morocco's agricultural vulnerabilities stem from systemic, persistent tensions, rather than simple performance shortfalls. Local gains, such as higher yields or expanded irrigation, can create broader imbalances elsewhere.

This analysis employs the concept of the 'double bind', in which an effort to fix one problem unintentionally creates new ones. This illustrates conflicts between competing policy goals, such as export growth and water sustainability. Technical solutions often worsen existing difficulties, rather than tackle the underlying systemic problems. Efforts to resolve conflicts with a single choice only generate new tensions, emphasizing the paradoxical nature of the system[1].

Historically a pillar of the Moroccan economy, agriculture's GDP share declined from 14% in 1977 to 11% in 2025 while its share of total employment has fluctuated between 39% and 40%. This reflects a classic structural shift toward more productive secondary and tertiary sectors, common in middle-income economies. However, Morocco is notably affected by stagnant total factor productivity (TFP), which keeps the country trapped in a 'middle-income trap', marked by moderate growth, limited value creation, and ongoing inequality (Dadush, 2017).

Paradoxically, from 2008 to 2018, agricultural GDP increased at an average annual rate of 5.25%—outpacing the national average—while agricultural exports nearly doubled in value from 15.2 billion to 36.3 billion dirhams, and the Green Morocco Plan (PMV, 2008-2020) created 340,000 jobs while supporting 19 priority sectors. These macroeconomic successes, achieved through rapid modernization and integration into global value chains, still conceal deep-rooted imbalances: a persistently negative agricultural trade balance, rural incomes below the national average, and growing volatility in production, prices, and incomes, caused by recurrent droughts and energy shocks. Between 2000 and 2025, Moroccan agriculture lost an average of 50,000 jobs annually. On a social level, this trend has worsened subjective poverty, affecting up to 45% of rural households in 2025 (HCP, 2025), despite the near eradication of extreme poverty. This discrepancy reveals a gap between aggregate indicators and local experiences, driven by short-term incentives that favor export income over sustainable value.

Water scarcity is a fundamental constraint on value creation in Moroccan agriculture, with the country ranking among the most water-stressed globally. Annual *per-capita* water availability in Morocco has plunged from approximately 2,560 cubic meters in 1960, to less than 620 cubic meters today—well below the 1,000 cubic meter threshold considered indicative of water scarcity (FAO, 2020; World Bank, 2020). Groundwater extraction in critical regions, such as Souss-Massa, now exceeds natural recharge by up to 40% annually, leading to accelerating aquifer decline (Ameur *et al*, 2017). Agriculture now accounts for over 80% of total water use. Despite investment in modern irrigation and government support programs, these efforts have often led to increased overall water use, exacerbating aquifer depletion and widening inequalities between large commercial farms and smallholders. Addressing these challenges requires a move beyond piecemeal technological solutions, to integrated strategies that balance competitiveness, sustainability, and social inclusion.

Current systems are not well-equipped to address the interlinked economic and climate crises facing agriculture. Challenges in this sector are interconnected, and isolated interventions, such as

1. The term 'double bind' was introduced by anthropologist and systems theorist Gregory Bateson, who examined the complexities of communication and social systems. It describes a situation in which an individual or system faces two contradictory commands simultaneously, with the risk of harm if either is ignored.

desalination or solar energy, can produce unintended environmental or economic consequences. Addressing each issue in isolation often creates further complications, such as pollution or increased technological dependency, rather than strengthening the overall system. Therefore, a holistic strategy is needed, which anticipates the interactions between different factors, and transforms constraints into opportunities for renewal and resilience.

2.2. THE PARADOX OF SUSTAINABILITY

The idea of paradox has deep roots in a longstanding intellectual tradition, originating in classical philosophy and dialectical thinking. Hegel, followed by Marx and Engels, laid the groundwork for understanding contradictions as essential and active parts of social and economic reality, rather than as anomalies to be fixed (Benson, 1977). This dialectical view has influenced modern social and organizational sciences, in which researchers have gradually improved the analysis of tensions in complex systems.

Diverse disciplinary contributions have enriched this approach. Communication theorists, such as Bateson, Watzlawick, and Taylor, have shown how paradoxes arise from human interactions and communication loops, in which contradictory messages create persistent logical dead ends (Putnam, 1986). At the same time, psychodynamics, through the work of Jung, Freud, Adler, and Frankl, has shed light on the internal conflicts shaping individual and collective behaviors, revealing psychological ambivalences that appear at the organizational level (Smith and Berg, 1987). These contributions converged on an organizational concept introduced by Smith and Lewis (2000, 2011, 2022), who defined paradox as the ongoing coexistence of contradictory yet interdependent elements that reinforce one another over time.

Three main characteristics distinguish this definition. First, paradoxes are based on contradictory elements that seem coherent on their own but become absurd when combined (Lewis, 2000). Second, these elements are interconnected, representing two sides of the same systemic reality. Third, they are enduring, cannot be reduced to a simple resolution, and require continuous management (Smith & Lewis, 2011). This analytical perspective has become crucial for understanding various organizational phenomena: tensions during change (stability versus transformation; Lüscher & Lewis, 2008), coopetition (cooperation versus competition; Raza-Ullah, 2020), hybridity in social enterprises (multiple institutional logics; Smith & Besharov, 2019), identity paradoxes (Sheep *et al*, 2017), exploration-exploitation ambidexterity (Andriopoulos & Lewis, 2009), and even leadership dilemmas involving authority and collaboration (Lewis *et al*, 2014).

Sustainability provides a fundamental context in which paradox theory can be applied, as it involves balancing often-conflicting economic, social, and environmental goals. The Brundtland Report from the World Commission on Environment and Development (WCED, 1987) introduced the principle of intergenerational sustainability, stating that current development should not undermine future capabilities. Originally centered on environmental issues (Shrivastava, 1995; Starik & Rands, 1995), sustainability has expanded to include Elkington's Triple Bottom Line (1998)—economic, social, and ecological—leading to unavoidable paradoxes: short-term profits versus long-term green investments, economic efficiency versus social justice, and global standardization versus local customization (Bansal, 2005; Dyllick & Hockerts, 2002).

Hahn *et al* (2014, 2015, 2018) identified two approaches to these contradictions. The instrumental approach considers them as compromises, incorporating socio-environmental issues only when

profitable (Jensen, 2001; Barnett *et al*, 2021). The paradoxical perspective, however, values the intrinsic coexistence of these aspects, and proposes managing them rather than eradicating them (Gao & Bansal, 2013). Nonetheless, empirical applications are varied: the paradox shifts between factual tensions, cognitive frameworks, and action strategies, without always clarifying the levels of analysis (individuals, organizations, systems) (Carmine & De Marchi, 2023; Van der Byl and Slawinski, 2015). Williams *et al* (2017) advocated for a systemic approach to unite these dimensions through their interactions, which is especially important for complex systems such as agriculture.

Current social and environmental challenges create complexities that lead to conflicts at various levels. The paradox theory offers a new approach to corporate sustainability, going beyond traditional perspectives focused on the business case to improve sustainability performance. However, the ambiguous use of the term 'paradox' and the lack of a systemic perspective limit its effectiveness. The systematic literature review conducted by Carmine and De March (2023) identified three main research axes: paradoxical tensions, paradoxical thinking, and paradoxical strategies. It is this framework that we subsequently used in our exploration of the agricultural model to understand the interconnections of these paradoxical meanings and to highlight a co-construction framework for agricultural development projects and managing via paradox.

Applied to the Moroccan agricultural model, this analytical framework exposes a paradoxical structural makeup. Morocco is both a competitive exporter of high-value-added products (citrus fruits, vegetables, fertilizers), and a dependent importer of staple grains. It is a supporter of technological modernization and innovation, despite rapidly deteriorating water resources; and a contributor to global food security, while also battling increasing internal insecurity. These contradictions are not merely cyclical but are embedded in the structure, pitting economic (export competitiveness), social (rural inclusion), and environmental (water sustainability) objectives against each other.

Paradoxical theory encourages us to go beyond the idea of compromise or prioritization. According to Smith and Lewis (2011), resilient systems do not resolve tensions, but learn to manage them through cognitive frameworks that accept ambivalence, and hybrid practices. For Morocco, the challenge is not to choose between competitiveness or sustainability, exports or food sovereignty, intensification or resource preservation, but to create paradoxical governance mechanisms.

To illustrate how such governance works in practice, consider a real-world example from the Douira irrigation cooperative in the Souss region. Facing severe water scarcity, the cooperative first separated its objectives: one group of farmers prioritized maximizing short-term yields of export-oriented crops. Meanwhile, another group advocated for conserving water for staple crops and long-term soil health. Rather than forcing a single solution, the cooperative tested both approaches in parallel for a season, tracking outcomes. After witnessing increased groundwater stress but also benefits from export revenues, the members reconvened to share insights, and jointly crafted a hybrid model. This involved alternating crop cycles, investing in efficient irrigation only for periods of abundance, and establishing a collective water quota system that balanced immediate income with resource conservation. In this way, the cooperative moved from a rigid confrontation of goals to a dynamic system of periodic separation and productive recombination, demystifying paradox management and turning persistent tensions into practical, locally-rooted solutions.

III. THE MOROCCAN AGRICULTURE MODEL

3.1. AGRICULTURAL DEVELOPMENT MODELS

Contemporary agricultural development models are rooted in a systemic framework characterized by productive tensions and complex interdependencies. These models are not linear; rather, they involve trade-offs between global competitiveness and local resilience, intensive productivity and environmental sustainability, and food self-sufficiency and export focus. To create a nuanced typology of agricultural paths, this section examines five interconnected pillars of the agricultural system: standards and markets, agricultural subsidies, food security, water management, and innovation systems.

The agricultural markets of the European Union and the United States—the primary overseas outlets for Moroccan fruit, vegetables, and citrus fruits—are characterized by strict sanitary and phytosanitary standards. These standards go beyond consumer protection, they act as governance tools that organize global agricultural value chains and influence the competitive environment for exporters countries. The U.S. market demands compliance with U.S. Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA) regulations, which are often even more intricate than the EU standards. These non-tariff barriers have shifted from a purely sanitary focus to include private standards that also encompass product quality, consumer health, and social and environmental considerations (Henson and Reardon, 2005; Reardon *et al*, 2001).

The globalization of agri-food trade has expanded through global value chains (GVCs), enabling developing countries to join the global economy by focusing on specific production segments, rather than making entire finished products (OECD, 2018). Although this integration leads to significant productivity gains, it also makes national actors vulnerable to recurring health scandals that expose the structural flaws of globalized supply chains: for example, fipronil contamination of eggs in 2017; horsemeat fraud in 2013; and melamine-tainted milk in China in 2008 (Gereffi and Lee, 2009; Bair, 2015). The example of the fairly frequent tensions in the tomato and fertilizer trade shows how protection barriers imposed by some of Morocco's trading partners prevent full access to the markets of the European Union and the United States.

In parallel, agricultural subsidies serve as a key policy tool, regulated by the World Trade Organization since the Uruguay Round. The WTO distinguishes between 'green box' support (research, food security: minimal effects on trade), and 'orange box' support (distortive, subject to reduction). Such subsidies aim to achieve multiple goals: maintaining production in fragile areas, supporting farmers' incomes through direct payments and guaranteed prices, stabilizing domestic prices, ensuring food independence, promoting exports, and modernizing farms. Their economic impact, however, is mixed: while they help stabilize incomes amid price fluctuations and climate change (Barrett, 2017; Reardon *et al*, 2019), they often lead to overproduction, incentive distortions, and disruptions in global markets (Anderson and Swinnen, 2008; Anderson & Martin, 2006). Subsidies tend to benefit large farms at the expense of small-scale producers, intensifying rural inequalities (Carter and Barrett, 2006). Environmentally, input subsidies (fertilizers, pesticides, irrigation) promote unsustainable practices that harm soils and water resources (Sarris & Morrison, 2019; Nelson *et al*, 2009). In Morocco, irrigation and input subsidies support the modernization of export sectors, but also contribute to groundwater depletion, illustrating a trade-off between productivity and sustainability.

Food security, defined by the FAO (1996) as the sustained access of all to sufficient, safe, and nutritious food that meets the needs for an active and healthy life, rests on four interdependent pillars: availability, access, utilization, and stability. It is a prerequisite for economic growth: "*no country has achieved its industrial revolution without a prior or simultaneous agricultural revolution*" (Timmer, 2015). Strategies to combat food insecurity combine short-term measures—such as social safety nets and cash transfers—with long-term structural approaches: promoting domestic agriculture, implementing food price controls, developing efficient supply systems, and adopting technological innovations such as blockchain and artificial intelligence (FAO, 2020; Tsakok, 2021; Klassen & Murphy, 2020). In a context of recurring climate crises, the priorities for a green and innovative agricultural policy include developing resilient systems, reducing agricultural water consumption, increasing the added value of global supply chains, supporting the well-being of small farmers, and anticipating fluctuations in prices and productivity (FAO, 2021; Kuper, 2022).

Water resource management is becoming a major challenge, especially in Morocco, where agriculture accounts for 12% of GDP and employs most of the rural population. Confronted with chronic water scarcity, worsened by recurring droughts (2022-2023), Morocco's cereal imports are soaring while vegetable exports to Europe decline. The World Bank (2020) projected a 20% rise in global freshwater demand by 2050, driven by increased climate change impacts. Morocco is responding with a comprehensive strategy: investing in desalination through public-private partnerships, developing hydraulic infrastructure (including new dams and the North-South 'water highway'), promoting drip irrigation and a system of khettaras, researching water-circular-economy solutions, and fostering regional cooperation with UNESCO's support. Successful models, such as Israel (precision irrigation, wastewater reuse), Australia (water markets), and Spain (integrated supply and demand management), provide potential templates for adaptation.

Finally, agricultural innovation systems have shifted from the traditional technology-transfer model, in which public research spreads innovations to farmers (Chambers and Jiggins, 1987), to participatory agricultural knowledge and innovation systems, which place the farmer at the center as a co-creator of knowledge (Rolling, 2009; Bawden & Packam, 1993). This systemic approach uses methods such as farmer field schools, rural Living Labs, and demonstration platforms that have no prerequisites, incorporating drones, precision agriculture, and resilient polyculture. In Morocco and Kenya, youth- and women-led cooperatives are creating good-practice labs, while agritech startups are making agricultural data more accessible through low-cost drones.

Before introducing these models, it is important to clarify the main criteria for evaluating them: equity (the fair distribution of benefits and burdens), efficiency (the productive use of resources), and resilience (the ability to adapt and sustain outcomes under changing conditions). Highlighting these criteria helps anchor the typology and establishes a shared lens for comparison.

This paper introduces a creative typology of agricultural models. The productivist-export model emphasizes competitiveness through global value chains (GVCs) and intensive irrigation, which drive growth but also cause water stress. The protectionist model seeks self-sufficiency with subsidies and quotas, though it leads to trade distortions. The technological model aims for efficiency by using digital technology and precision, but it worsens inequalities in access. Finally, a paradoxical systemic model handles multiple goals through multi-stakeholder governance and local agricultural knowledge and innovation systems.

3.2. CLIMATE CHANGE IMPACTS

Understanding how climate change impacts agriculture is crucial to ensure food security. Our knowledge of these complex interactions is still growing, mainly through observational studies of current farming methods and modeled forecasts of future scenarios. Although uncertainties remain, it is increasingly clear that the effects of climate change will likely appear at multiple levels. Recognizing these impacts is important to create effective adaptation and mitigation strategies.

Geographically, climate models forecast which regions will undergo the most significant changes, while agricultural models predict impacts on farming practices, soil health, and water resources. The effects on biodiversity and ecosystem services in agricultural landscapes remain active research areas, with many models still under development. Some effects of climate change are already becoming apparent at the crop, farm, and ecosystem levels. Farmers have reported noticeable changes, including shifted growing seasons, increased pest activity, and variations in soil moisture levels.

Among the most significant physical effects on agriculture are rising temperatures, which are already affecting crop yields and are likely to continue to do so. However, temperature increases will not be uniform across all farming regions; some areas may face extreme heat, while others might experience more moderate changes. Additionally, shifts are expected in precipitation patterns, such as changes in seasonal timing and increased variability. Some regions could face droughts, while others might experience flooding, creating challenges for traditional farming methods and requiring adaptations in water management.

Soil degradation remains a major concern. Climate change is likely to worsen soil erosion, nutrient loss, and salinization, ultimately reducing agricultural productivity. The importance of soil health will grow even more in these changing climate conditions. Additionally, warmer temperatures and shifts in rainfall can expand the ranges and persistence of pests and diseases, prompting agricultural systems to adopt integrated pest management and to diversify crops as needed. Extreme weather events, including hurricanes and droughts, are expected to become more frequent and severe, posing significant risks to crop yields and farm infrastructure.

The effects of climate change extend beyond individual crops, impacting entire ecosystems and their productivity. Major shifts in temperature and moisture can disrupt crops' specialized adaptations, affecting growth, yields, and the timing of key developmental stages, such as flowering and harvest. Food security is threatened not only by the quantity of food produced, but also by its nutritional quality. Research has shown that elevated CO2 levels may reduce protein and essential nutrient levels in certain crops, affecting human health.

Biodiversity in agricultural systems is essential for resilience, especially as climate change endangers some crop varieties and livestock breeds. This underscores the importance of conservation and sustainable practices in maintaining genetic diversity. As climates shift, the geographical range of suitable farmland may also change, prompting farmers to reconsider their crop choices and farming strategies.

In Morocco, prolonged water shortages, worsened by climate change, threaten food security and reduce the competitiveness of agricultural exports. This situation requires a comprehensive review of traditional farming methods and resource management strategies, to maintain sustainability amid rapid climate change.

The agricultural sector's vulnerability to climate change stems from its dependence on stable weather patterns and natural resources, making it highly susceptible to adverse effects such as droughts and floods. Smallholder farmers, in particular, face considerable risks because they have limited adaptation resources. Recognizing the unique vulnerabilities across different agricultural contexts, such as crop types, local climate conditions, and farming practices, is essential in order to develop tailored strategies to mitigate these impacts. Engaging local farmers to gather insights about the challenges they face will improve the development of effective adaptive measures that address both sensitivity and exposure to climate-related hazards.

Moreover, improving adaptation ability is vital to build resilience against climate change in agricultural systems. This ability relies on access to resources, technology, information, and socio-economic factors. Greater adaptation capacity allows farmers to adopt practices that not only mitigate the negative effects of climate change, but also support long-term sustainability. However, relying solely on adaptation might overlook important systemic issues, such as land rights, economic inequality, and institutional support. Therefore, implementing a comprehensive approach that takes these interconnected factors into account, and that encourages collaboration among stakeholders, is essential. By addressing immediate adaptation needs alongside transformative socio-economic changes, agricultural systems can better withstand the challenges brought on by climate change.

3.3. MULTIPLE REALITIES AND CONTEXTS

Global value chain (GVC) analysis provides a particularly insightful framework for understanding the structural paradoxes of the Moroccan agricultural model. It reveals how value is created, captured, and redistributed among actors, from inputs to end consumers (Gereffi *et al*, 2005; OECD, 2018). In the agricultural sector, GVCs are marked by increasingly strict health and environmental standards, a concentration of market power downstream that favors large distributors, and greater vulnerability to climate and geopolitical shocks. A comparative study of four value chains—fertilizers, fruits and vegetables, sugar, and wheat—conducted by Amachraa and Maad (2023) highlighted distinct yet converging configurations of paradoxical effects, in which apparent successes hide deep systemic weaknesses.

The fertilizer value chain holds a unique geostrategic position: Morocco controls nearly 70% of the world's phosphate reserves, giving it significant influence over global fertilizer markets. This dominance has been established amid price volatility, logistical disruptions, and geopolitical tensions that impact traditional suppliers. However, this structural advantage upstream of GVCs is paired with ongoing trade tensions: Moroccan exports are frequently suspected in the United States and Europe of benefiting from implicit subsidies or cost distortions, resulting in investigations, WTO proceedings, and tighter regulations. This paradox highlights a core tension within GVCs: Morocco is seen both as a key stabilizer of global food security, providing vital inputs to importing countries, and as a target of geo-economic protectionism, which constrains its ability to fully capture the value it creates (Gereffi and Lee, 2009; Amachraa and Quélin, 2022).

In a complementary manner, the fruit and vegetable value chain demonstrates Morocco's export competitiveness, driven by favorable seasonality, proximity to Europe, and competitive production costs. Morocco has become a major supplier to the EU of tomatoes, citrus fruits, and fresh vegetables—sectors less affected by price competition because of product perishability. However, this success is built on fragile foundations: heavy dependence on irrigation water, adherence to strict health standards, and a power imbalance with large distribution chains. Ongoing disputes

with Spain over tomatoes reveal deeper issues related to GVC governance, downstream value sharing, and resource pressure. Increased horticultural activity has sped up groundwater overuse in Souss and Gharb, creating a significant water paradox: the most profitable sectors are also those that threaten the sustainability of vital resources.

The sugar value chain has a unique structure, shaped by historical protectionism and significant subsidies aimed at ensuring food security and stable rural incomes. While these policies have maintained activity in vulnerable regions, they have also sustained inhenrently weak competitiveness and a structural reliance on raw sugar imports. As Anderson and Swinnen (2008) pointed out, such subsidies stabilize incomes temporarily, but lead to market distortions, inefficient resource use, and long-term negative environmental impacts. In Morocco, this sector exemplifies the limits of a protectionist approach without major reforms, especially in relation to water efficiency and the relocation of value-added activities.

Finally, the wheat value chain highlights the challenges of food sovereignty. Wheat is a strategic sector that remains vulnerable to climate hazards and global fluctuations. Recurring droughts, such as that in 2022-2023, reduce national production, leading to large-scale imports and exposing Morocco to geopolitical shocks, such as that brought about by the Ukrainian crisis. This paradox is fundamental: despite a clear political priority, current support has not been enough to build sustainable resilience; instead, it has focused on compensating for deficits, rather than fundamentally overhauling the rain-dependent system.

A cross-analysis of these four value chains reveals a systemic misalignment involving limited water resources, economic incentives focused on intensive exports, fragmented public policies, and sustainability and social-inclusion goals. GVCs intensify these pressures: Morocco excels at producing inputs and high-value-added products, such as fertilizers and horticultural products, yet remains reliant on imports for staples such as wheat and sugar, leading to an uneven value distribution that favors downstream actors.

Addressing these misalignments requires targeted policy responses and clear accountability from key stakeholders. For example, the Ministry of Agriculture is best placed to realign crop selection and irrigation policy to prioritize water-efficient value chains. The Ministry of Water and regional basin agencies should enforce coordinated resource management across value chains. The Ministry of Industry can strengthen upstream processing and value addition in agriculture, reducing reliance on raw exports. Public-private platforms involving interprofessional agricultural organizations can play a bridging role by advising on subsidies and export incentives that balance economic and ecological needs. Isolated technological fixes, such as drip irrigation and resistant or sector-specific crop varieties, are inadequate in addressing this complex situation, unless embedded in an integrated, multi-actor governance approach.

Based on these four contexts, this paper highlights a fundamental fact: the limitations of the Moroccan agricultural model do not stem from a lack of natural resources or technological innovation, but from a failure of systemic governance. The observed paradoxes (such as competitive exports versus food sovereignty, technological modernization versus water stress, macroeconomic performance versus socio-rural vulnerability) challenge simple trade-offs, or technical and sectoral adjustments. They require a shift in the strategic approach, moving from addressing isolated problems, to managing interdependencies comprehensively. Integrating into global value chains should no longer be just a reactive measure, but a strategic process of creatively balancing paradoxical constraints and tensions.

IV. SYSTEMIC PARADOXICAL FRAMEWORK FOR THE FUTURE OF MOROCCAN AGRICULTURE

4.1. A SYSTEMIC AND PARADOXICAL FRAMEWORK

This paper's main theoretical contribution lies in applying organizational paradox theory (Smith & Lewis, 2011) to the Moroccan agricultural model, moving beyond traditional sustainability approaches based on compromises or integrating into the core business. The paradoxical perspective acknowledges the unavoidable coexistence of tensions (competitiveness versus sustainability, global versus local, innovation versus subsidies) as dynamic system features to listen to and understand, rather as problems to be fixed. The paradoxical approach calls for a major overhaul of agricultural regulatory methods: replacing a sector-focused performance logic with systemic coherence that accounts for interdependencies; accepting different paths by territory and value chain; and balancing multiple timeframes (short-term economic, long-term ecological). It also needs governance at multiple levels and from various stakeholders, bringing together public authorities, private companies, researchers, and agricultural communities in forums for dialogue, experimentation, and shared learning—turning contradictions into engines of systemic innovation.

As part of this exploration, we used the paradoxical thinking framework developed by Carmine and De Marchi (2023) to understand the Moroccan agricultural sector. This frame is organized around three theoretical dimensions the paradoxical tensions themselves (persistent contradictory elements), the paradoxical cognitive frameworks (acceptance of ambiguity), and the paradoxical action strategies (simultaneous management of opposing poles). Among the key tensions, short-term economic efficiency conflicts with long-term environmental sustainability; upstream production clashes with downstream processing; public governance faces the rise of private actors; stabilizing subsidies sometimes hinder risky innovation; social innovation (short supply chains, agroecology) competes with technological priorities; dependence on food imports contradicts the strategic focus on agriculture; productivist modernization threatens rural social stability; profitable export crops undermine food sovereignty; intensive productivity damages ecosystems; and land concentration marginalizes small-scale farmers. Mechanization reduces rural employment; irrigation worsens water scarcity; and integrated supply chains exclude small producers.

The next important step is to create a framework that can turn the contradictions in the Moroccan agricultural sector into opportunities for synergy. The conceptual model of Lewis and Smith (2022) offers a comprehensive analytical structure, organized horizontally around three interconnected dimensions: paradoxical tensions, paradoxical thinking/framework, and paradoxical actions/strategies; and vertically through three levels of analysis: the individual farmer, the organization, and the entire system. To tailor this approach to the Moroccan context, we modify and build on the rural project accounting matrix developed by Jeanne Chiche (2008) for the European Union, to evaluate how well agricultural initiatives align with local realities, and to establish criteria for creating synergy across the economic, social, and environmental sectors. Before applying the compatibility matrix, practitioners and stakeholders can benefit from a moment of self-reflection: which paradox in your region feels least manageable today? For example, is it the tension between export-driven growth and water scarcity, or between technological innovation and rural social inclusion? By considering this question, users of the matrix are invited to focus on their own local realities, and to use the tool as a guide for practical diagnosis and strategic action.

A horizontal analysis of the Lewis and Smith framework highlights the dynamic connections between these aspects. The paradoxical tensions in the Moroccan agricultural system create a fertile environment for the development of paradoxical thinking by farmers and organizations, which in turn leads to synergistic actions. For example, the issue of short-term profits versus long-term resilience can be managed through "*time brokering*", allowing the simultaneous negotiation of multiple temporalities (Reinecke and Ansari, 2015). This reciprocity works both ways: individual paradoxical thinking—such as farmers accepting the ambivalence of competitiveness and frugality—promotes the development of hybrid organizational strategies, while innovative systemic practices (such as territorial agricultural knowledge and innovation systems) reinforce the fundamental paradoxical cognitive frameworks (Sharma and Bansal, 2017; Smith and Lewis, 2011).

Vertically, each dimension of the paradox requires specific analyses at its respective levels While the literature has concentrated on tensions at the individual level (perceptions of Corporate Social Responsibility (CSR) managers or social innovators; Carollo & Guerci, 2018), and organizational level (corporate or NGO strategies; Daddi *et al*, 2019), the systemic level remains underexplored despite its vital role in sustainability issues (Bansal and Song, 2017; Williams *et al*, 2017). In Morocco, water and food tensions clearly apply at the systemic level, where interactions between farmers, supply chains, and public policies create feedback loops that deepen vulnerabilities. Individual paradoxical thinking (the ability of farmers to balance productivity and soil conservation) influences organizational frameworks (interprofessional strategies), while systemic actions, such as redirecting subsidies toward resilient supply chains, in turn shape grassroots practices. Future research should accurately map these upward and downward flows, especially in semi-arid regions where the motivation of rural innovators determines the continuity of transformations (Amachraa and Maad, 2022).

To enhance our theory, we propose a compatibility matrix for paradoxical tensions tailored to the Moroccan agricultural sector. It evaluates initiatives across three interconnected domains—economic, social, and ecological—using specific operational criteria. Inspired by Chiche (2008), this unpublished matrix assesses each rural project on a graduated scale from 5 to 1 (adequate to unacceptable), based on indicators including physical conditions (facilities accessible to the population or needing municipal aid), employment requirements (family balance versus reliance on salaried labor), investments (local versus imported), production costs (low external dependence), market base (regularity and remuneration), population attitudes (spontaneous interest), activity sustainability (long-term technical viability), social impact (territorial ripple effect), ecological impact (absence of degradation), and participation of women (family empowerment). For instance, an agroecological polyculture sector in a rainfed area might score 4-5 on most criteria—such as adequate physical conditions, low investment, regular local markets, and strong social impact—whereas an irrigated citrus extension under chronic water stress could fall to 1-2 because of the prohibitive externalities it faces.

The matrix is further enhanced by an underestimation of ecological compatibility with the natural environment, emphasizing water needs (winter only versus year-round), tolerated quality (locally treated water), environmental impact (reversible degradation), initial investment (low dependence), equipment viability (flexibility for changing circumstances), local technical expertise, employment requirements, optimal farm size (<4 ha for small family farms), market type (diversified proximity versus volatile luxury), existing competition, economic benefits (population integration), and urban-rural relations (social openness). An initiative like modernized traditional khettaras for example, would excel here: limited summer water needs, low degradation, high local technical expertise,

family size, profitable local market, and strong population integration.

Finally, a summary of sustainability criteria consolidates the assessment into three categories, rated from 3 (optimal) to 0 (unacceptable): ecological (physical conditions and impact on the ecosystem), economic (employment, costs, market), and socio-technical (cultural acceptability, local skills, women's empowerment, social sustainability). A practice is considered acceptable if it scores at least 2 in each category, ensuring a minimum level of synergy. This practical and flexible framework supports the alignment of Moroccan agricultural projects (short agroecological supply chains, promotion of certified local products, rainfed diversification) that turn paradoxes into opportunities: water scarcity encourages resource-efficient and resilient sectors; the tension between productivity and sustainability drives value-added innovation focused on local areas; and GVCs are integrated with food sovereignty, strengthened through re-localization.

This systemic and paradoxical framework does more than list Moroccan agricultural contradictions. It offers a practical tool for managing them by connecting micro (agronomic practices), meso (organized value chains), and macro (public policies) levels. Instead of a sequential compromise approach, it promotes the simultaneous management of opposing forces, paving the way for resilient agriculture, in which water constraints serve as ecological safeguards, subsidies become catalysts for social innovation, and global markets act as levers for integrated territorial development. This approach, supported by the OCP experience and the analysis of global value chains, calls for a strategic shift that would see Morocco, leveraging its paradoxical strengths, developing a hybrid agricultural model that is both globally competitive and locally sustainable.

This systemic approach addresses three key challenges. First, it enhances the practical potential of paradoxical management by providing agricultural stakeholders with operational criteria for turning contradictions into tangible opportunities for territorial resilience. Second, it clarifies the nature and effects of systemic struggles—such as the rebound effect of efficient irrigation, which increases pressure on groundwater—by placing them within their multi-scale interdependencies. Third, it actively addresses the complexity of sustainability, in which social issues (rural exodus, marginalization of women) and environmental concerns (soil degradation) cannot be separated from the economic dynamics of GVCs.

While the literature mainly focuses on detecting paradoxical tensions at the individual level (managerial perceptions) or organizational level (corporate strategies), it overlooks the cognitive and action-oriented dimensions that serve as true alternatives to the instrumental approach of profitability (Hahn *et al.*, 2018). Paradoxical frameworks or thoughts (such as farmers' ability to accept ambivalence between modernization and tradition) remain underexplored in their dissemination within organizations. In contrast, paradoxical strategies (such as hybridization of technology and sufficiency) lack detailed analyses of the factors that facilitate them (power, resources), and their ambivalent effects on the triple bottom line (economic, social, ecological). The links between paradoxical thinking and strategic actions remain poorly understood: can individual awareness of tensions lead to organizational routines? Do hybrid practices, in turn, create systemic cognitive frameworks? These issues are especially evident in the Moroccan agricultural context, where rural innovators (young farmers, women's cooperatives) could spark positive cycles if their perceptions aligned with adaptive public policies (Amachraa & Maad, 2022).

To help clarify the immediate paths forward, it is helpful to distinguish two parallel sets of priorities. First, there are research gaps for scholars. For example, further investigation is needed into how

paradoxical thinking spreads within organizations, what factors enable or constrain the translation of individual tensions into systemic routines, and how hybrid practices reshape value creation over multiple scales. Second, there are policy gaps that demand direct action from agencies: these include designing support programs that encourage the adoption of paradoxical and hybrid strategies, supporting rural innovators through targeted incentives, and explicitly building mechanisms that link farmer-level experimentation to broader public policy reforms. By mapping these 'unknowns for scholars' alongside 'immediate actions for agencies', the conflation of inquiry with implementation can be prevented, and clearer next steps for both academic and policy audiences can be identified.

Adopting a systems perspective is crucial as a methodological requirement, especially when addressing interconnected socio-ecological issues such as biodiversity loss, climate change, and water scarcity. Tensions go beyond organizational boundaries: the expansion of citrus and avocado exports causes systemic externalities that affect social and environmental levels. Therefore, future research should focus on multi-level analysis, exploring how systemic tensions (such as structural water stress) influence individual and organizational practices, and how local actions (such as territorial agricultural knowledge and innovation systems) can alter global balances. The scarcity of studies on systemic responses to systemic paradoxes (such as inter-basin governance and the reallocation of subsidies toward resilience) indicates an important research area, enabling the application of paradox theory to the world's most urgent problems (Schad and Bansal, 2018).

Significant ethical questions are posed by Moroccan agricultural paradoxes: irrigated intensification boosts agricultural GDP but threatens food sovereignty. How can the legitimacy of conflicting viewpoints be evaluated when their core values clash over different timeframes and geographic scales? Paradoxical theory offers a useful alternative: paradoxical cognitive frameworks enable an internal assessment of conflicts without assuming economic dominance, while hybrid strategies create space for innovative solutions that blend ethics and efficiency. In Moroccan agriculture, this ethical view prompts us to see decision-making not just as choosing between profit and fairness, but as a process of co-creation, in which water is seen as an ethical principle of moderation, rural inequalities highlight the need for active inclusion, and global value chains serve as tools for local empowerment.

4.2. THE EXPERIENCE AND PARADOXICAL GROWTH OF THE OCP GROUP

The transformation of the OCP Group, led by Dr. Mostafa Terrab since 2006, is an example of paradoxical growth: a struggling strategic company transformed into a global leader in phosphates, while balancing immediate economic needs and long-term sustainability. Confronted with stagnant phosphate rock production at 25 million metric tons annually, a small share of fertilizer exports (4%), and a modest contribution to the national budget (700 million dirhams), Terrab launched a paradoxical overhaul. He did not simply choose between profitability and social responsibility. He redefined the strategic question: how could OCP become both highly successful financially and sustainably impactful for the Moroccan and African economies? This approach recognizes contradictory yet interconnected elements (operational excellence versus ecological and social transformation), and actively manages them through cycles of separation, connection, and reconstruction.

Between 2006 and 2018, substantial investment in infrastructure modernization and innovation boosted phosphate rock production capacity to 44 million tons, tripled fertilizer output to 12

million tons, and increased the contribution to the state budget sevenfold to five billion dirhams. Consequently, OCP established itself as the world's leading phosphate producer, creating value far beyond that of simply exporting raw materials.

This economic success did not overshadow the environmental challenges associated with intensive mining. The company addressed these through flagship initiatives, including seawater desalination, which supplies its industrial sites (Safi, El Jadida, Casablanca) and nearby cities, while also reducing pressure on overexploited groundwater. Likewise, the green hydrogen project with Peregrine Hydrogen anticipates the energy transition by transforming Morocco's energy mix, while eco-designed fertilizers improve agricultural soil productivity without worsening ecological degradation. These projects follow a paradoxical three-step management approach: redefining the problem (profitability and sustainability), temporarily separating operational and innovative strategies, and then reconnecting them through creative synergies, enabling OCP to balance resource exploitation with the exploration of new ecological pathways. The alignment of strategic goals and the coherence of the newly formed business units are key elements of this new, paradoxical perspective for the OCP Group.

On a social level, this trajectory has created thousands of direct jobs, improved access to education and healthcare in the regions where it has been established, and stimulated the innovation ecosystem through Mohammed VI Polytechnic University (UM6P). This hub trains local talent, incubates agritech startups, and diversifies the Moroccan economy beyond phosphates, thereby strengthening often-marginalized rural human capital.

Despite these advances, ongoing challenges highlight the paradoxical nature of management's temporary and iterative character. Inconsistencies among business units sometimes obstruct synergies, while the balance between intensive extraction and environmental preservation remains fragile amid climate change and the geopolitical instability of fertilizer markets. Managing mining waste and optimizing water use requires continual vigilance, as current achievements (such as modernizing plants to cut CO2 emissions and adopting clean technologies) do not prevent future innovations aimed at aligning growth with learning.

OCP's experience empirically confirms the paradoxical theory: rather than resolving tensions through hierarchical compromises, the company turned them into drivers of systemic innovation, evolving from a crisis-stricken producer to a geostrategic player supporting both Moroccan agricultural competitiveness (through UM6P and a strategic partnership for innovation and agricultural development with financial aid) and the global ecological transition. This path opens the door to a broader analysis of Moroccan agricultural value chains, in which similar dynamics call for the same management principles: recognizing ongoing contradictions, separating them to recombine more effectively, and rebuilding hybrid models in which performance and sustainability support each other.

4.3. TOWARDS AN INTEGRATED AGRICULTURAL AND FOOD POLICY FOR MOROCCO IN THE 21ST CENTURY

Analysis of the Moroccan agricultural model reveals that the country's challenges go beyond low productivity or a lack of investment; they stem from a major shift in the global agricultural landscape. Like modern industrial policies, twenty-first century agriculture exhibits a variety of trends, including integration into global value chains, growing environmental pressures, and rising social demands for territorial inclusion and food security. These trends emphasize the complexities of current agricultural systems, which must balance economic growth, social fairness, and environmental sustainability.

Morocco's agricultural experience is especially notable, highlighting its dual role as a participant in GVCs and a country with structural vulnerabilities. The strategic position of the OCP Group in the fertilizer industry, along with the competitiveness of Moroccan horticultural exports, underscores the country's potential in international markets. However, ongoing issues such as cereal dependence, increasing water stress, and regional inequalities expose the fragility of this success. This paradox illustrates the complex challenge of balancing economic growth, social equity, and environmental sustainability. Consequently, Morocco's future agricultural model relies on developing a comprehensive food and agriculture policy that fosters transformative change.

The growing importance of GVCs is central to twenty-first century agricultural policies. Gary Gereffi's theory shows that a sector's competitiveness depends not only on primary production, but also on its position within the broader value-creation system. In this context, the structure of agricultural value chains often indicates that economic value is disproportionately concentrated in downstream segments, such as processing, marketing, and distribution. Currently, Morocco faces a significant disconnect between its upstream production, especially in fruits and vegetables, and a relatively small agri-food industry. This gap limits the country's ability to capture a larger share of the value created. By examining the Moroccan fishing industry, which has successfully built a strong value chain through local valorization of marine resources, we see a potential model for agricultural sectors to become more integrated and profitable.

Furthermore, industrial policies are crucial in shaping the dynamics of GVCs, influencing both investment strategies and production methods in Morocco's agriculture sector. As major economies increasingly focus on sustainable farming practices, food production, and agritech innovations, these policies are becoming key components of both national and international supply networks. Aligning agricultural policies with global trade trends means trade agreements can significantly affect Morocco's agricultural exports, from how goods are produced to how easily they reach markets. Multinational agribusinesses are also adjusting their supply chains in response to geopolitical shifts and market challenges. They are diversifying raw material sources and enhancing regional agricultural practices to build resilience and foster innovation. This approach of 'derisking' promotes the development of secure, diverse agricultural supply chains, while encouraging international cooperation on food security and sustainability.

Finally, the transformation of Morocco's agricultural system is further boosted by the rise of innovation ecosystems. Unlike the traditional top-down model of technology spread, modern agricultural innovation depends heavily on collaboration among universities, businesses, farmers, startups, and public institutions. The scientific environment surrounding Mohammed VI Polytechnic University exemplifies this cooperation, fostering innovative solutions to both local and global

agricultural challenges. By fostering a culture of teamwork and innovation, Morocco can strengthen its agricultural resilience, and improve its position in the changing global agricultural scene.

The agricultural sector in Morocco and Africa faces complex challenges, including water scarcity, climate change, and the need for economic competitiveness while ensuring food sovereignty and social equity. Leveraging the paradox framework articulated by Lewis & Smith (2011), Carmine & De Marchi (2023) and Gerrifi *et al*. (2025) provides a unique and effective lens for co-designing agricultural policies that address these multifaceted tensions.

Paradox Framework for Agricultural Policy

Paradox Dimension	Lewis, Carmine & De Marchi Framework	Gerrifi Framework	Application in Agricultural Policy
Competitiveness vs. sustainability	Acknowledge inherent trade-offs	Promote simultaneous pursuits	Create policies that promote sustainable practices while maintaining export competitiveness. For example, implement eco-labeling and sustainability standards to differentiate agricultural exports and increase their value in global markets.
Global integration vs. local empowerment	Recognize systemic interdependencies	Facilitate local adaptation	Develop value chains that connect smallscale farmers to global markets while enhancing local capacities through cooperatives and territorial innovation systems that honor traditional knowledge.
Short-term gains vs. long-term resilience	Embrace structural contradictions	Encourage incremental transformation	Promote diverse cropping systems that enhance long-term food security while ensuring economic viability. Create monitoring systems that assess both immediate results and long-term resilience outcomes.
Technological innovation vs. resource efficiency	Leverage dynamic capabilities	Balance different types of innovation	Support research that combines advanced technologies with frugal or nature-based solutions (e.g. rainwater harvesting, drought-resistant crops, low-water irrigation systems). Promote farmer-led innovations focused on resource efficiency.
Equity vs. economic growth	Foster collaborative governance	Ensure inclusive development	Integrate marginalized farmers and rural communities into policy design and implementation. Develop tailored support mechanisms for smallholders, cooperatives, and agribusinesses to promote inclusive agricultural growth.

V. GENERAL CONCLUSION AND FINAL REMARKS

The paradoxical tensions in the Moroccan agricultural sector are not just temporary failures of the current model, or simple operational issues. Instead, they reveal a deep structural misalignment between available natural resources, public strategic decisions, and the main ways of creating and sharing economic value. These systemic contradictions are not just occasional, but reflect the system's ongoing inability to sustainably balance conflicting logics—such as productive versus social, environmental versus economic, and territorial versus inclusive—that are particularly intertwined and intense in a semi-arid region facing increasing water shortages. By using a systemic approach along with the organizational paradox theory of Smith and Lewis, this analysis moves beyond narrow sector-specific views that isolate agriculture into separate parts, individual programs, or limited indicators such as yields, productivity, and sustainability. Instead, it aims to restore a holistic perspective: viewing agriculture as a living, complex, and changing system, in which the need to produce more with less water, to join global markets while supporting local economies, to modernize practices without excluding small farmers, and to boost intensification while regenerating soils and groundwater, all coexist continuously.

The main empirical contribution of this paper is identifying water as a core element around which these tensions revolve. Beyond its traditional role as a simple input for production, water is a crucial factor shaping all Moroccan agricultural activities. It inextricably influences the competitiveness of high-value export sectors (such as fruits and vegetables, citrus), the resilience of rainfed food security (such as cereals), the socio-spatial disparities between irrigated areas in the Souss region and landlocked regions, the ecological health of fragile ecosystems, and rural social cohesion amid youth outmigration. Previous policies, which focused on technical efficiency measures (drip irrigation, dams, coastal desalination, inter-basin transfers), led to localized productivity improvements, but often caused rebound effects: increased yields per unit encouraged the expansion of cultivated land, worsening groundwater overexploitation, and exposing the limitations of relying solely on technological modernization. Therefore, a strategic rethink—representing a paradigm shift—is crucial: moving from producing more in a context of scarcity, to producing differently. This approach involves aligning economic output, minimizing water use, and generating socially rooted local value by explicitly prioritizing resource-efficient crops and agroecological practices suited to local biophysical conditions.

This systemic reinterpretation also encourages us to rethink agricultural innovation beyond just its technical aspects. Although widespread technology transfers, equipment subsidies, and modernization efforts have undeniably increased physical productivity, they have also maintained an unequal distribution of value, mainly benefiting downstream actors in GVCs and marginalizing rural communities and small producers. The new focus is on systemic value innovation, with the farmer is no longer a passive recipient but a key co-creator within localized ecosystems—such as agricultural knowledge and innovation systems, rural living labs, and participatory demonstration platforms—that blend local knowledge with external expertise to develop inclusive solutions. This change makes innovation a multifaceted process that is social (empowering women and young people), organizational (interprofessional cooperatives), and institutional (aligned incentive policies), serving as a critical foundation for a fair and resilient shift, especially in the face of recurring climate shocks.

From a theoretical and managerial standpoint, integrating paradox theory—defined as the ongoing coexistence of contradictory yet interconnected elements (Smith & Lewis, 2011)—promotes significant renewal in agricultural governance strategies. Rather than pursuing a false

compromise or a static balance between opposing forces, this analytical perspective suggests that contradictions (such as global competitiveness versus local sustainability, export success versus food sovereignty, innovative growth versus regenerative sobriety) are inherent and fundamental to the system. Managing these requires reflexive and adaptive governance: acknowledging these persistent dynamics, creatively blending opposing logics through ambidexterity routines (temporary separation followed by synergistic reconnection), and engaging multiple stakeholders who navigate various timeframes (short-term economics, long-term ecology) and scales (micro-practices, meso-sectors, macro-policies). Moroccan agricultural transformation calls for the illusion of a single solution to be let go in favor of listening, iterative territorial experiments, and ongoing collective learning—transforming tensions into drivers of innovation and resilience.

The contributions of this research are organized around three interconnected levels. Theoretically, it enhances analyses of agricultural value chains and sustainability by introducing a paradoxical systemic perspective that explicitly connects the micro level (farmers' perceptions and agronomic practices), the meso level (organizational dynamics of supply chains and interprofessional groups), and the macro level (national policies and global integration). Methodologically, it employs a comprehensive approach (systemic analysis of GVCs, mapping of tensions, and a compatibility matrix for initiatives inspired by Jeane Chiche, 2008) to convert contradictions into practical synergies. Lastly, operationally, it presents clear priorities: improving governance of water resources as a shared resource, encouraging rainfed and semi-arid agroecology, strategically adding value through processing and certification, and reforming public subsidies to promote social innovation and climate resilience, rather than focusing on overproduction.

The Moroccan experience illustrates how agricultural change is closely linked to global industrial, technological, and geopolitical trends. It highlights the importance of modern industrial policies that integrate smoothly with agricultural strategies. In the twenty-first century, agricultural policies must find a balance between maintaining sovereignty, integrating into global value chains, and promoting ecological progress. Morocco's major strengths, including its strategic position in agricultural inputs, a dynamic, export-focused agriculture, and a growing scientific community, set the stage for this transformation. Nonetheless, real improvements in agriculture require the agri-food sector be strengthened to better connect primary production with industrial processing. This needs a systemic approach that balances competitiveness, regional resilience, economic growth, and ecological renewal.

Ultimately, rethinking the Moroccan agricultural model does not mean making a radical break with its historical heritage or rejecting its established achievements, such as global leadership in phosphates through OCP, horticultural competitiveness, and large-scale hydraulic infrastructure. Instead, it aims to reach a new level of systemic maturity: shifting from a focus on unlimited expansion to a circular regeneration of ecosystems, from measuring success by tonnage, to shared and territorially internalized value, and from utilitarian resource management to a careful consideration of living organisms and their interdependencies. In a global context shaped by climate uncertainty and geo-economic restructuring, Morocco's paradoxical strengths, such as its unique phosphate resources combined with water scarcity, resilient family farms alongside high-performing export sectors, position it uniquely to create a hybrid model that is both intensive and regenerative, globally competitive, and locally sustainable. In this way, contradictions become the driving force behind renewed food sovereignty and shared prosperity.

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À PROPOS DE L'AUTEUR

ABDELMONIM AMACHRAA

AMACHRAA Abdelmonim is an expert in sustainability and global value chains. He is a doctoral researcher at IAV Hassan II, a laureate agricultural engineer from the Hassan II Agronomic and Veterinary Institute (Rabat) and holds a Master's degree in Geopolitics and Geo-economics of Emerging Africa (HEC Paris-UM6P). He is a collaborator at the OCP Foundation, with more than 20 years of experience in supporting public and private actors in the design and implementation of sustainable human development projects and programs.

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Policy Center for the New South

Rabat Campus of Mohammed VI Polytechnic University,
Rocade Rabat Salé - 11103
Email : contact@policycenter.ma
Phone : +212 (0) 537 54 04 04
Fax : +212 (0) 537 71 31 54

www.policycenter.ma

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