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Mapping the Innovation DNA of Agribusiness Firms: A Multi-Method Analysis of Strategic Capabilities and Performance

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ABSTRACT

Innovation is essential for competitiveness in agribusiness facing dynamic environments. This study examines how market orientation, marketing, relational, and social capabilities influence innovation performance. Using data from 751 Spanish firms and a multi-method approach that integrates Structural Equation Modeling (PLS-SEM), Necessary Condition Analysis (NCA), and fuzzy-set Qualitative Comparative Analysis (fsQCA), the research explores linear, non-linear, and configurational relationships. Results show that market orientation, marketing, and social capabilities show significant linear relationships, while relational capabilities exhibit an inverted U-shaped relationship. NCA identifies marketing and relational capabilities as necessary conditions within the SEM framework; however, none meet the strict necessity thresholds under fsQCA. Configurational analysis reveals multiple successful capability combinations, supporting the concept of equifinality. These findings contribute to innovation theory by integrating variance- and set-theoretical approaches, offering a nuanced view of capability orchestration. Practical implications include guidance for managers on capability development and for policymakers aiming to strengthen innovation ecosystems in agribusiness.

JEL Classification: M21, O32, Q13

1 | Introduction

Innovation is widely recognized as a cornerstone of sustainable competitive advantage, particularly in sectors exposed to dynamic market forces, technological disruptions, and environmental and societal pressures (Huang 2021; Zhou et al. 2019). The agribusiness sector, in particular, faces growing challenges related to shifting consumer preferences, climate change, regulatory transformations, and the need for circular and resilient value chains (Agazu and Kero 2024; Bogetoft et al. 2024). In this context, the capacity to innovate is not simply a desirable attribute but a strategic imperative for firms striving to remain competitive and adaptive. In this article, we investigate whether and how market orientation, marketing, relational, and social capabilities influence innovation performance in agribusiness firms, and whether these effects are linear, non-linear, or configurational.

A significant body of literature emphasizes the role of organizational capabilities in shaping innovation outcomes. Existing research on innovation performance in agribusiness has largely focused on isolated capabilities and their direct effects (Fainshtein et al. 2024; Leo et al. 2022). Capabilities such as market orientation, marketing proficiency, relational networks, and internal social capital are regarded as central to a firm's innovation potential (Fitjar et al. 2013; Morgan et al. 2009;

Motamedimoghadam et al. 2024; Narver and Slater 1990). Specifically, market orientation facilitates the continuous generation of market intelligence (Narver and Slater 1990), while marketing capabilities enable the commercialization and value communication of new products (Morgan et al. 2009). Simultaneously, relational capabilities provide access to external knowledge through strategic partnerships (Dyer and Singh 1998), whereas social capabilities foster the internal collaboration and trust necessary for knowledge integration (Nahapiet and Ghoshal 1998).

Recent studies in agribusiness confirm that these capabilities, when effectively leveraged, enhance both incremental and radical innovation (Corchuelo et al. 2024). In particular, market orientation has been identified as a key antecedent of innovation ambidexterity (i.e., the simultaneous pursuit of exploitation and exploration strategies) in agrifood firms (Corchuelo et al. 2025a). While the present study draws on the same survey database as Corchuelo et al. (2025b), it addresses a fundamentally different research objective. Specifically, whereas the earlier study focused on identifying unobserved heterogeneity and latent segments in agribusiness firms' innovation dynamic capabilities, the current article examines the linear, non-linear, necessary, and configurational relationships between organizational capabilities and innovation performance through a multi-method analytical framework.

Despite this growing interest, consensus is still lacking regarding the nature of these relationships. Some studies advocate a linear, additive view, while others highlight the presence of threshold effects or the importance of capability configurations, arguing that the effects may be context-dependent, non-linear, and synergistic (Fiss 2011; Helfat and Peteraf 2003; Laursen and Salter 2006; Teece 2007). This ambiguity underscores the need for methodological approaches that allow researchers to identify both individual and combinatorial effects of capabilities on innovation performance. Conventional methods, such as Partial Least Squares Structural Equation Modeling (PLS-SEM), are effective for testing theoretical relationships and estimating average effects but are limited in their capacity to detect complex causality and necessary conditions. To address these limitations, complementary techniques such as Necessary Condition Analysis (NCA) and fuzzy-set Qualitative Comparative Analysis (fsQCA) have been introduced. NCA enables the identification of critical bottlenecks, conditions that must be present for an outcome to occur (Dul 2016), while fsQCA allows for the examination of multiple causal pathways, equifinality, and asymmetric relationships (Ragin 2008; Schneider and Wagemann 2012). Although this study uses PLS-SEM to test theoretically specified relationships among latent constructs, the results should not be interpreted as causally identified effects in the econometric sense (Henningsen et al. 2025). PLS-SEM relies on model specification grounded in theory and assumes the absence of major unobserved confounders rather than on an explicit identification strategy such as instruments or natural experiments. Accordingly, causality in SEM research is inferred from theoretical directionality and construct design rather than from econometric identification. Following established practice in the SEM and innovation management literature (e.g., Hair et al. 2017; Ringle et al. 2022), the findings are therefore interpreted primarily as structural relationships and associations consistent with the proposed theoretical framework rather than definitive causal effects.

In response to the theoretical and empirical gaps identified above, this study aims to comprehensively understand how organizational capabilities influence innovation performance in agribusiness firms. Specifically, the objectives of this study are to: (i) assess the linear and non-linear effects of market orientation, marketing, relational, and social capabilities on innovation performance; (ii) identify which of these capabilities act as necessary conditions for achieving high innovation performance; and (iii) explore the various configurational pathways through which these capabilities combine to produce high or low innovation performance. To achieve these objectives, the study addresses the following research questions: (i) Do market orientation, marketing, relational, and social capabilities have a significant impact on innovation performance? (ii) Which of these capabilities are necessary conditions for achieving high innovation performance? (iii) What are the different configurations of capabilities that result in high versus low innovation performance?

This study contributes to the literature on innovation performance in agribusiness in several keyways. The integration of PLS-SEM, NCA, and fsQCA provides a robust multi-method approach that captures both linear relationships and complex configurational effects, addressing limitations in prior research that relied solely on variance-based or set-theoretic methods. The study also provides actionable insights for agribusiness firms by identifying critical capabilities and optimal capability configurations that can drive innovation success, enabling managers to allocate resources more effectively.

2 | Literature Review

2.1 | Market Orientation Capabilities and Innovation Performance

The role of market orientation capabilities in driving innovation performance has been widely discussed in literature. On the one hand, a linear perspective (Hypothesis 1a) suggests that higher levels of market orientation capabilities consistently enhance innovation performance, as firms that continuously gather and respond to market intelligence are better equipped to develop and commercialize innovations (Narver and Slater 1990). This hypothesis is grounded in the Resource-Based View (RBV), which posits that firms with superior market orientation are better equipped to identify and respond to customer needs, thereby enhancing their innovation performance (Narver and Slater 1990; Song et al. 2015). Specifically, RBV treats market orientation as a valuable, rare, and inimitable intangible resource that allows firms to anticipate market trends better than competitors, thereby securing a sustainable competitive advantage (Narver and Slater 1990).

This view is also supported by more recent studies, such as Wei and Su (2023), who found that market orientation significantly enhances sustainable innovation performance, particularly when combined with dynamic managerial capabilities. Their findings reinforce the idea that a strong market orientation consistently drives innovation outcomes. Extending this perspective, Alkandi and Helmi (2024) emphasized that market orientation mediates the relationship between strategic agility and organizational performance, highlighting its pivotal role as a catalyst for innovation capabilities and long-term competitiveness.

While the linear perspective suggests that greater market orientation consistently enhances innovation outcomes, an alternative view proposes a non-linear relationship (Hypothesis 1b). According to this perspective, the benefits of market orientation may follow an inverted U-shaped curve: initially, increasing market orientation improves innovation performance by enabling firms to better understand and respond to customer needs. This possibility relies on the "too-much-of-a-good-thing" effect, suggesting that beyond a specific threshold, the costs of maintaining and deploying any strategic capability, such as information overload or resource diversion, may outweigh the marginal benefits (Zhou et al. 2005). A similar pattern has been observed in agribusiness diversification strategies. Su et al. (2023) found that while diversification initially enhances technological innovation efficiency, excessive diversification leads to diminishing returns. This reinforces the notion that strategic capabilities, including market orientation, may exhibit non-linear effects on innovation performance, requiring careful calibration.

This reasoning aligns with the ambidexterity literature, which emphasizes the need for organizations to balance exploitation (refining existing capabilities) and exploration (pursuing new knowledge and innovation). Overemphasis on market-driven strategies may constrain exploratory innovation, leading to incremental rather than radical innovation outcomes (Christensen and Bower 1996; Zhou et al. 2005). Recent empirical evidence supports this view. Wei and Su (2023) also observed a curvilinear effect of market orientation on sustainable innovation performance, suggesting that while market orientation is beneficial up to a point, excessive levels may hinder innovation. Their findings not only highlight the importance of strategic moderation in deploying market orientation capabilities but also align with earlier arguments by Christensen and Bower (1996) and Zhou et al. (2005), who recognized that firms overly focused on existing markets may miss disruptive opportunities. Thus, the competing hypotheses (Hypothesis 1a vs. Hypothesis 1b) reflect a debate between the consistent, positive role of market orientation in innovation and the potential drawbacks of excessive reliance on market insights.

Hypothesis 1a (H1a). *There is a linear relationship between market orientation capabilities and innovation performance.*

Hypothesis 1b (H1b). *There is an inverted U-shaped relationship between market orientation capabilities and innovation performance.*

2.2 | Marketing Capabilities and Innovation Performance

Marketing capabilities are critical for commercializing innovations and positioning them effectively in the market. From a linear perspective (Hypothesis 2a), firms with stronger marketing capabilities should experience a direct and continuous improvement in innovation performance, as they can better understand customer needs, communicate value propositions, and ensure successful market adoption (Morgan et al. 2009). This view is grounded in the dynamic capabilities' framework, which argues that superior marketing capabilities enable firms to rapidly adapt to changing competitive conditions and sustain innovation success. In this context, dynamic capabilities framework emphasizes the firm's ability to integrate, build, and reconfigure internal competencies to address rapidly changing environments, positioning marketing not merely as a function but as a higher-order dynamic capability that orchestrates resources for value creation (Teece 2007).

Recent studies reinforce this perspective. For instance, Duah et al. (2024) found that marketing capabilities significantly enhance firm performance, particularly when mediated by resource orchestration capabilities. Their findings suggest that marketing capabilities not only support innovation but also play a strategic role in aligning internal resources to market demands, thereby improving innovation outcomes. Similarly, Supriyanto et al. (2024), in a systematic review of dynamic marketing capabilities, concluded that these capabilities contribute to business sustainability and competitive advantage by integrating market knowledge and fostering cross-functional collaboration.

However, an alternative non-linear perspective (Hypothesis 2b) suggests that marketing capabilities may exhibit an inverted U-shaped relationship with innovation performance. While moderate levels of marketing expertise enhance innovation diffusion, excessive marketing focus may lead to over-commercialization at the expense of product novelty, reducing the firm's ability to introduce disruptive innovations (Zhou et al. 2005). Firms that invest too heavily in marketing might also become constrained by customer-driven feedback loops, leading to risk aversion in innovation strategy. The mutual exclusivity of these hypotheses lies in whether marketing capabilities continuously improve innovation outcomes (Hypothesis 2a) or whether their impact reaches a peak before diminishing (Hypothesis 2b).

Hypothesis 2a (H2a). *There is a linear relationship between marketing capabilities and innovation performance.*

Hypothesis 2b (H2b). *There is an inverted U-shaped relationship between marketing capabilities and innovation performance.*

2.3 | Relational Capabilities and Innovation Performance

Relational capabilities, defined as a firm's ability to build and leverage partnerships, are widely recognized as enablers of innovation. A linear hypothesis (Hypothesis 3a) suggests that relational capabilities directly and consistently enhance innovation performance by fostering knowledge sharing, collaboration, and resource exchange across networks (Dyer and Singh 1998). Strong relationships with suppliers, customers, and other stakeholders facilitate access to complementary knowledge, enhancing the firm's ability to develop innovative solutions. This perspective is rooted in the Relational View, which argues that critical resources may span firm boundaries and that competitive advantage is often generated through idiosyncratic interfirm linkages rather than solely through internal asset accumulation (Dyer and Singh 1998).

Recent research supports this view. For instance, Hu and Wu (2024) found that relational governance within innovation networks, particularly through joint planning and problem solving, positively influences innovation performance, with knowledge flows acting as a key mediating mechanism. Similarly, Yang et al. (2024) demonstrated that relational capabilities significantly contribute to value co-creation, which in turn enhances innovation outcomes. However, they also discovered that this positive effect is contingent on alignment with digital capabilities, reinforcing the strategic importance of balanced relational investments.

In contrast, a non-linear hypothesis (Hypothesis 3b) posits an inverted U-shaped relationship, where relational capabilities improve innovation up to a certain point but may become counterproductive at excessive levels. Over-reliance on external partnerships can lead to knowledge dependency, reduced internal absorptive capacity, and excessive coordination costs, which hinder rather than facilitate innovation (Laursen and Salter 2006). From a transaction cost perspective, managing a vast portfolio of partners increases monitoring and bargaining costs, potentially offsetting the value of accessed knowledge (Laursen and Salter 2006). Furthermore, as Uzzi (2018) notes, redundancy in network ties can lead to information overlap, reducing the novelty of incoming knowledge and resulting in diminishing returns for innovation performance.

Firms that engage in too many relationships may also face difficulties in managing conflicting interests and knowledge spillovers, ultimately leading to inefficiency. Yang et al. (2024) provide empirical support for this view, showing that incongruence between relational and digital capabilities, such as high relational but low digital capability, can result in diminishing returns, suggesting that excessive relational investment without complementary capabilities may reduce innovation effectiveness. The contrast between these hypotheses hinges on whether more relational capabilities always lead to better innovation performance (Hypothesis 3a) or whether too many relationships create diminishing returns (Hypothesis 3b).

Hypothesis 3a (H3a). *There is a linear relationship between relational capabilities and innovation performance.*

Hypothesis 3b (H3b). *There is an inverted U-shaped relationship between relational capabilities and innovation performance.*

2.4 | Social Capabilities and Innovation Performance

Social capabilities refer to a firm's ability to foster internal collaboration and build an organizational culture conducive to innovation. From a linear standpoint (Hypothesis 4a), stronger social capabilities should consistently enhance innovation performance, as firms that promote knowledge sharing, trust, and collaboration are better positioned to integrate diverse expertise and create breakthrough innovations (Nahapiet and Ghoshal 1998). Drawing on Social Capital Theory, this hypothesis assumes that the network of relationships within an organization constitutes a valuable resource for social action, facilitating the creation of new intellectual capital through the exchange and combination of diverse knowledge (Nahapiet and Ghoshal 1998).

Organizations with high social capital can leverage internal networks to accelerate innovation processes and reduce barriers to knowledge diffusion. More recently, Pundziene and Geryba (2023) found that collaborative innovation, driven by internal relational collaboration, significantly mediates the relationship between dynamic capabilities and firm performance in born-digital SMEs. Their findings highlight that internal collaboration, as a form of social capability, is a key enabler of innovation success, particularly when embedded in agile and digitally native organizational structures.

On the other hand, the non-linear hypothesis (Hypothesis 4b) suggests that social capabilities may have diminished or even negative effects beyond a certain threshold. Excessively strong internal ties can lead to groupthink, resistance to external ideas, and a lack of cognitive diversity, which stifles radical innovation (Uzzi 2018). When firms rely too much on internal collaboration, they may become inward-focused, failing to incorporate novel perspectives from external sources, thus limiting their ability to innovate. This view is confirmed in the study by Chen et al. (2024), who analyzed collaborative innovation in mega-projects and found that the relationship between internal collaboration and innovation performance is non-linear and iterative. Their system dynamics model revealed that while collaboration initially boosts innovation, its marginal benefits decline over time unless complemented by strategic and knowledge-based collaboration mechanisms. Thus, these hypotheses contrast a scenario in which social capabilities always enhance innovation (Hypothesis 4a) with one in which excessive internal cohesion leads to stagnation (Hypothesis 4b).

Hypothesis 4a (H4a). *There is a linear relationship between social capabilities and innovation performance.*

Hypothesis 4b (H4b). *There is an inverted U-shaped relationship between social capabilities and innovation performance.*

3 | Data and Methodology

3.1 | Data

This study investigates the proposed hypotheses using primary data collected from agribusiness firms in Spain. Due to the limited availability of secondary data, a primary data collection process was undertaken based on an independent database comprising 9125 agri-food companies located throughout Spain, excluding the regions Ceuta and Melilla, classified according to the 2009 CNAE (Spanish National Classification of Economic Activities) codes: 10 (Food Industry), 11 (Beverages), and 12 (Tobacco Industry). Data were gathered through an *ad hoc* questionnaire survey, which was refined through a pilot test (Corchuelo et al. 2025b), following the methodological approaches outlined by Corchuelo and Mesías (2017) and Corchuelo and Sama-Berrocal (2022). The survey included questions designed to measure the companies' market orientation, marketing, relational, and social capabilities, as well as their innovation performance.

The data collection was conducted between June and July 2022 through randomized interviews, resulting in a final sample of 751 companies. The sample is statistically representative of key study variables, including primary business activity, geographical location, and firm size, with a 95.5% confidence level and a sampling error of ± 3.60%. The questionnaire was completed by managers at various hierarchical levels within the participating agri-food firms, all of whom provided informed consent through their voluntary participation. The majority of respondents were male (55.4%), aged between 31 and 55 years (67.1%), and held a university degree (67.3%). Further details on respondent characteristics are provided in Table 1.

The companies were evenly spread across the various regions of Spain. Table 2 shows the distribution of companies among the Spanish Autonomous Communities.

The sample comprised 597 companies in the food industry (79.6%), 152 in beverage manufacturing (20.3%), and two in the tobacco industry. Table 3 outlines the distribution by size and legal structure: 66.4% were micro-enterprises with fewer than 10 employees, and 89.2% had fewer than 50 employees. Limited liability companies constituted 66.9% of the sample, while agri-food cooperatives accounted for 13.8%. Additionally, 47.3% of the companies were involved in export activities.

3.2 | Methodology

To examine the influence of market orientation, marketing, relational, and social capabilities on innovation performance in agribusiness firms, this study employs a multi-method approach integrating Partial Least Squares Structural Equation Modeling (PLS-SEM), Necessary Condition Analysis (NCA), and fuzzy-set Qualitative Comparative Analysis (fsQCA) with SmartPLS software (v4.0.9.6) (Ringle et al. 2022). The triangulation of PLS-SEM, NCA, and fsQCA provides a more comprehensive and nuanced understanding of the antecedents of innovation in agribusiness. While PLS-SEM tests linear and curvilinear relationships, NCA identifies minimum thresholds, and fsQCA reveals alternative and complex combinations of capabilities that may lead to innovation success.

PLS-SEM is used to assess the measurement and structural models and estimate the linear and non-linear effects of the capabilities under study. This variance-based technique is particularly suited to exploratory research and complex models with latent constructs and relatively large samples, such as the

TABLE 1 | Respondents' characteristics.

	Respondents	% of total
Gender		
Female	335	44.6
Male	416	55.4
Position		
Manager/General Manager/ Owner	315	41.9
Director/Department Head	342	45.5
Technicians/Middle Management	75	10
Other	19	2.5
Age		
Under 30 years old	80	10.6
Between 31–45 years old	266	35.4
Between 46–55 years old	238	31.7
More than 55 years old	167	22.3
Educational level		
Basic education	70	9.5
Intermediate studies	172	23.2
Higher education	498	67.3

TABLE 2 | Distribution of companies by Spanish Autonomous Communities.

Autonomous community	No. companies	% of total
Andalusia	141	18.8
Aragon	25	3.3
Asturias	17	2.3
Balearic Islands	14	1.9
Canary Islands	27	3.6
Cantabria	10	1.3
Castilla-León	74	9.9
Castilla-La Mancha	58	7.7
Catalonia	96	12.8
Valencian Community	63	8.4
Extremadura	35	4.7
Galicia	61	8.1
La Rioja	42	5.6
Community of Madrid	26	3.5
Region of Murcia	15	2
Navarra	32	4.3
Basque Country	15	2
Total	751	100

TABLE 3 | Sample distribution according to size and legal form.

	No. companies	% of total
Number of employees		
Less than 10 employees	499	66,4
10–49 employees	171	22,8
50–199 employees	60	8
More than 200 employees	21	2,8
Legal form		
Cooperative	104	13,8
Limited Company	503	66,9
Public Limited Company	137	18,2
Other	8	1,1

current dataset (Hair et al. 2017). To detect non-linear relationships, we employed the two-stage approach in PLS-SEM, which models a quadratic term (interaction term) for each exogenous construct. This allows for the simultaneous estimation of linear and curvilinear effects within the path model, a procedure explicitly recommended for investigating U-shaped or inverted U-shaped relationships (Hair et al. 2017).

Complementing PLS-SEM, NCA is applied to identify whether specific capabilities represent necessary, but not sufficient, conditions for achieving high levels of innovation performance. In contrast to traditional regression-based approaches, which primarily estimate average effects, NCA offers a methodological framework for identifying whether a minimum level of a given condition is indispensable for a particular outcome to occur (Dul 2016). Consistent with this approach, the measurement models were specified as reflective, as the indicators serve as manifestations of the underlying latent capabilities rather than forming them. This specification assumes that the indicators are highly correlated and interchangeable, meaning that a change in the latent construct leads to variation in all its indicators (Hair et al. 2017). This choice is further supported by the high internal consistency and average variance extracted values reported in the validity checks (Table A1).

Finally, fsQCA is employed to explore the configurational aspects of capability combinations. fsQCA uses set theory and Boolean algebra to identify multiple paths leading to high or low outcomes, thereby acknowledging equifinality, the idea that different combinations of conditions can lead to the same result (Ragin 2008; Schneider and Wagemann 2012). This method is especially relevant in organizational research where interdependencies among variables and relationship asymmetries are common (Fiss 2011). The fsQCA approach thus complements SEM and NCA by allowing for the identification of sufficient conditions and configurational pathways to performance. The sample size of 751 was above the minimum required for using these techniques.

4 | Results and Discussion

This section presents the empirical findings obtained through the triangulation of PLS-SEM, NCA, and fsQCA, followed by a discussion of their theoretical implications. We have chosen to integrate results and discussion to facilitate a cohesive interpretation of the complex, multi-layered evidence. By immediately contextualizing the statistical outputs of each method (linear effects, bottleneck conditions, and sufficient configurations) we aim to provide a more synthesized understanding of how capability orchestration is linked to innovation.

The analytical approach followed in this study was designed to comprehensively assess the antecedents of innovation performance in agribusiness firms, ensuring robustness and complementarity between different methodological techniques. The analysis began with PLS-SEM to evaluate the quality of the measurement and structural models, establishing linear and non-linear relationships between market orientation, marketing, relational, and social capabilities and innovation performance. Specifically, the measurement model assessment confirmed robust reliability and validity: all indicator loadings exceeded the recommended thresholds, Average Variance Extracted (AVE) values demonstrated satisfactory convergent validity (Table A1), and discriminant validity was established using the Heterotrait-Monotrait ratio (HTMT) criteria (Table A3), with all values below the critical threshold of 0.85 (Hair et al. 2017).

Following this, NCA was conducted within the SEM framework to determine whether specific capabilities were indispensable for achieving high innovation performance. To deepen this understanding, necessary conditions were also examined using fsQCA, allowing for a cross-methodological comparison. Finally, fsQCA was employed to identify specific configurations of capabilities that lead to both high and low innovation performance, acknowledging that different combinations of factors can yield similar outcomes.

4.1 | PLS-SEM Results: Linear and Non-Linear Effects

Prior to evaluating the structural relationships, the measurement model was assessed to ensure robustness. Internal consistency and convergent validity were established, as Cronbach's alpha, composite reliability (rho_c), and Average Variance Extracted (AVE) values for all constructs exceeded the recommended thresholds of 0.70 and 0.50, respectively (Table A1). Discriminant validity was confirmed using the Heterotrait-Monotrait (HTMT) ratio, with all values falling below the conservative cutoff of 0.85 (Table A3). Furthermore, the structural model was assessed for lateral collinearity; Variance Inflation Factor (VIF) values ranged from 1.764 to 2.262 (Table A2), well below the critical threshold of 3, indicating that multicollinearity was not a concern (Hair et al. 2017).

Table 4 shows the results of the hypothesis test. Regarding the relationship between market orientation capabilities (MO) and innovation performance (Innov_perf), the results support the linear relationship and reject the non-linear relationship, providing support for H1a. The model explains a substantial proportion of the variance in innovation performance ($R^2 = 0.536$), indicating strong predictive power. As detailed in Table 4, the path coefficients represent the strength of the linear relationships, while the quadratic effect coefficients (QE) indicate the significance of the non-linear terms.

These findings are consistent with prior research, including the studies of Narver and Slater (1990), Song et al. (2015), and Wei and Su (2023). Narver and Slater (1990) argued that firms exhibiting a strong market orientation are better positioned to collect and act upon market intelligence, thereby enhancing their innovation outcomes. In the context of agribusiness, Corchuelo et al. (2024) emphasized that market orientation plays a pivotal role in balancing both incremental and radical innovation efforts, offering critical insights for strategic decision-making. Similarly, Trott and Simms (2017) concluded that firms with a pronounced market orientation are more adept at responding to evolving consumer preferences and technological changes, resulting in superior innovation performance. Nevertheless, the study did not find empirical support for the non-linear hypothesis (H1b), indicating that a high degree of market orientation does not inherently impede innovation, a result that contrasts with the ambidexterity literature (Christensen and Bower 1996; Zhou et al. 2005), which

TABLE 4 | Hypotheses test.

	H	Beta	Standard deviation	T statistics	*p* values
Market orientation → Innovation performance	H1a	0.204	0.044	4.622	0.000
QE (Market orientation) → Innovation performance	H1b	0.023	0.026	0.863	0.388
Marketing capabilities → Innovation performance	H2a	0.484	0.038	12.641	0.000
QE (Marketing capabilities) → Innovation performance	H2b	0.005	0.028	0.176	0.861
Relational capabilities → Innovation performance	H3a	0.006	0.040	0.143	0.886
QE (Relational capabilities) → Innovation performance	H3b	−0.036	0.017	2.087	0.037
Social capabilities → Innovation performance	H4a	0.132	0.044	2.976	0.003
QE (Social capabilities) → Innovation performance	H4b	0.014	0.023	0.608	0.543

Abbreviation: QE, quadratic effect.

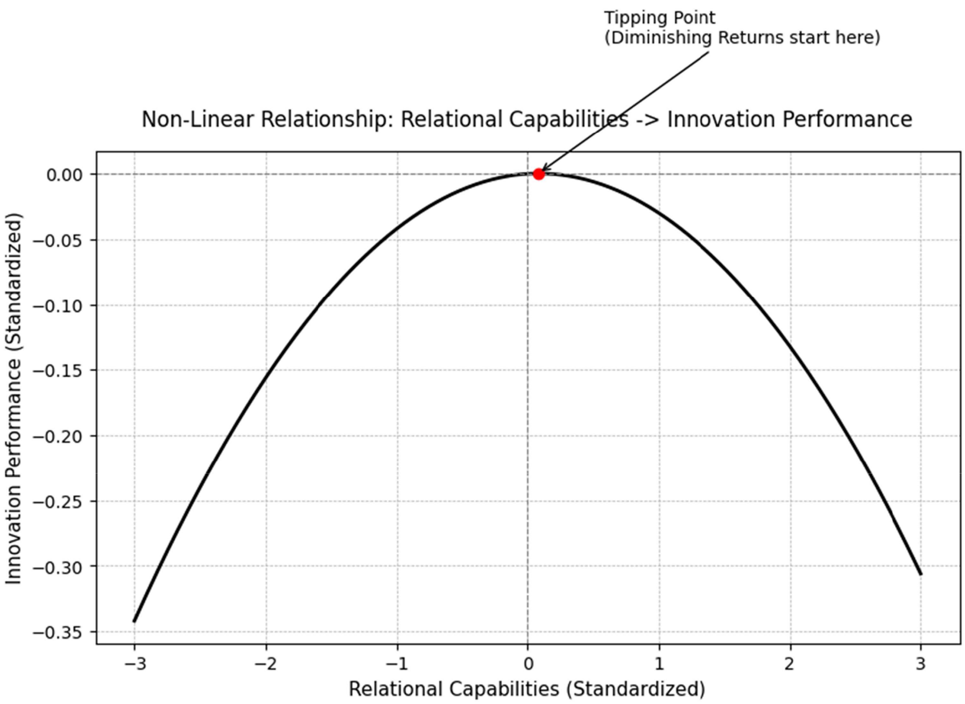

FIGURE 1 | Non-linear relationship between relational capabilities and innovation performance.

suggests that excessive market orientation may constrain exploratory innovation.

Similarly, the findings reveal a positive linear relationship between marketing capabilities (Mktg_cap) and innovation performance (H2a), consistent with the dynamic capabilities' framework articulated by Morgan et al. (2009). This result also corroborates the conclusions of Yuan et al. (2016), who demonstrated that marketing capabilities positively impact firm performance, as well as the conceptual insights of Vasumathi and Arun (2020) in the context of agribusiness. These findings suggest that firms possessing well-developed marketing capabilities are better equipped to understand customer needs and to effectively commercialize innovative products and services. However, the non-linear hypothesis (H2b) did not receive empirical support, indicating that elevated levels of marketing capabilities do not necessarily lead to over-commercialization or diminished product novelty. This outcome contrasts with the findings of Zang and Li (2017), who identified an inverted U-shaped relationship between marketing capabilities and innovation ambidexterity, implying that the effect of marketing capabilities may vary depending on contextual or industry-specific factors.

On the contrary, as shown in Figure 1, the relationship between relational capabilities (Rel_cap) and innovation performance was found to be non-linear, revealing an inverted U-shaped relationship between the two constructs. This brings support for H3b.

This finding is consistent with the study of Laursen and Salter (2006), who argued that although relational capabilities promote knowledge exchange and collaborative innovation, excessive reliance on external partnerships may result in knowledge dependency and increased coordination costs. These outcomes underscore the necessity of maintaining an optimal balance in the development and deployment of relational capabilities to prevent diminishing returns. Similarly, Fitjar et al. (2013) identified an inverted U-shaped relationship between relational capabilities and innovation performance, suggesting that while such capabilities initially contribute positively to innovation outcomes, their marginal benefits decline beyond a certain threshold. This decline in performance at high levels of relational capability can be attributed to several countervailing mechanisms. As noted by Laursen and Salter (2006), engaging in extensive search and collaboration imposes significant coordination costs and demands heavily on managerial attention, which can lead to information overload and divert resources from the actual commercialization of innovations. Furthermore, this finding aligns with the "paradox of embeddedness" described by Uzzi (2018), where excessive integration in networks may result in knowledge redundancy and reduced autonomy. In such scenarios, firms risk becoming "locked in" to existing partners who provide overlapping information, thereby stifling the access to novel perspectives required for breakthrough innovation.

The relationship between social capabilities (Soc_cap) and innovation performance was found to be linear, supporting H4a. These results suggest that enhanced social capabilities consistently contribute to improved innovation outcomes. This finding is in line with the theoretical perspective of Nahapiet and Ghoshal (1998), who highlighted the critical role of social capital in facilitating internal collaboration and the effective integration of knowledge within organizations. Furthermore, the non-linear hypothesis (H4b) was not supported, indicating that the presence of strong internal social ties does not inherently lead to groupthink or a reduced openness to external ideas.

4.2 | NCA Results: Necessary Conditions

To further investigate the necessity of each capability for achieving high innovation performance, we conducted NCA within the PLS-SEM framework (Table 5). The results indicate that marketing capabilities and relational capabilities met the necessary condition threshold, suggesting that firms require at least a minimal level of these capabilities to sustain high innovation performance. However, when applying necessary condition analysis in fsQCA, no capability strictly met the conventional necessity threshold (Consistency ≥ 0.9). Among them, Marketing Capabilities came closest to the threshold, with a consistency value of 0.814.

This discrepancy between SEM-based, NCA, and fsQCA-based NCA is expected, as fsQCA typically applies more stringent criteria for identifying necessary conditions. While SEM-NCA evaluates necessity in a linear framework, fsQCA considers set-theoretic relationships, where necessity is assessed in relation to different combinations of conditions rather than individual effects (Dul 2016). This methodological complementarity is echoed in Suder et al. (2025), who emphasize that under changing market conditions, the impact of strategic orientations such as entrepreneurial orientation varies depending on contextual moderators. Their use of PLS-SEM to capture these dynamics supports the relevance of flexible, multi-method approaches in innovation research, particularly when analyzing capability-performance relationships in volatile environments. As a result, identifying strict necessity in fsQCA is often more challenging, particularly in contexts where multiple configurations can lead to high innovation performance.

These findings reinforce the value of NCA as a complementary tool to traditional regression-based methods, as it allows researchers to identify conditions that must be present, even if they are not sufficient on their own to generate an outcome (Dul 2016). The importance of marketing capabilities as foundational drivers of innovation is supported in the literature, particularly in their role in translating market insights into commercially successful innovations (Morgan et al. 2009; Yuan et al. 2016).

Relational capabilities, likewise, have been shown to be critical for innovation, enabling firms to access and exchange knowledge through networks and partnerships (Fitjar et al. 2013). However, the non-linear relationship found in this study, where excessive relational investment leads to diminishing returns, is consistent with prior research by Laursen and Salter (2006), which cautions that over-reliance on external partners can result in dependency, reduced absorptive capacity, and coordination inefficiencies.

The discrepancy between SEM-based and fsQCA-based NCA outcomes is also methodologically consistent with the literature. Schneider and Wagemann (2012) and Goertz (2017) argued that fsQCA applies more stringent criteria for necessity, particularly because it evaluates necessity within a set-theoretic, configurational logic rather than isolating individual linear effects. In complex domains like innovation, where multiple paths may lead to success, these stricter thresholds often result in fewer variables qualifying as strictly necessary.

This divergence confirms that necessity is context-dependent. While NCA identifies global bottlenecks required to achieve a performance level, the fsQCA results suggest that firms can compensate for the lack of a specific capability by strongly leveraging others within specific configurations. Consequently, while Marketing and Relational capabilities appear necessary in the aggregate analysis, they do not meet the strict necessity test in fsQCA because equifinal pathways exist where these capabilities may be substituted, validating the complex architecture of innovation.

TABLE 5 | Necessary conditions tests.

	SEM	fsQCA	
	CR-FDH	Consistency	Coverage
Market orientation capabilities	0.011	0.812	0.791
Marketing capabilities	0.122***	0.814	0.823
Relational capabilities	0.265**	0.720	0.720
Social capabilities	0.092**	0.754	0.777

***$p < 0.01$; **$p < 0.001$.

Furthermore, the bottleneck analysis (see Appendix, Table A4) reveals that achieving high levels of innovation performance does not require firms to excel across all capabilities. This means that while these capabilities are important, firms can attain strong innovation outcomes without maximizing all of them simultaneously. Instead, specific minimum thresholds are sufficient. For instance, to reach 80% innovation performance, the data indicates that, on a 1–10 scale, firms need only a level of 3 (out of 10) in marketing capabilities, 5 in relational capabilities, and 2 in social capabilities to reach that level of innovation performance. This aligns with the dynamic capabilities' framework (Teece 2007; Helfat and Peteraf 2003), which emphasizes the strategic deployment and adaptation of capabilities rather than their sheer accumulation.

The NCA results contribute to a more nuanced understanding of capability-based innovation. Marketing and relational capabilities emerge as necessary, though not sufficient, conditions for innovation success. These insights complement the fsQCA findings, highlighting the value of integrating multiple analytical lenses to grasp the complexity of innovation processes in agribusiness firms.

4.3 | fsQCA Results: Configurational Pathways

Table 6 summarizes the configurations identified in the fsQCA estimations for high and low innovation performance. For high innovation performance, the frequency cutoff was 14 and the consistency cutoff was 0.855. For low innovation performance, the frequency cutoff was 14 and the consistency cutoff was 0.851.

Six configurations were obtained, three of which led to high innovation performance and another three to low innovation performance. Although this configurational analysis tool assumes that the results are not symmetrical, the data show that the configurations that lead to high innovation performance are exactly the opposite of the configurations that lead to low innovation performance, supporting the asymmetric nature of relationships in configurational theory (Fiss 2011). Thus, configuration C1 only considers the presence of marketing capabilities as a determinant of high innovation performance. Thus, it can be said that the first group relies exclusively on marketing capabilities to develop its approach to the market in terms of innovation. This configuration is symmetrical with configuration C4. This finding is consistent with the existing literature that emphasizes the role of marketing as a dynamic capability, which enables firms to effectively commercialize innovations and adapt to evolving market conditions (Morgan et al. 2009; Yuan et al. 2016). However, it stands in contrast to studies that argue marketing capabilities, in isolation, may be insufficient to fully realize their innovation potential and must therefore be complemented by other internal or external capabilities to maximize their impact (Zang and Li 2017).

The second configuration (C2) combines market orientation and relational capabilities as determinants of high innovation, showing that operationalization is dependent on an ability to understand the market and work together with relevant stakeholders. This configuration is symmetrical with C6. Firms that are market-oriented and maintain robust relational networks are better positioned to recognize and exploit innovation opportunities (Fitjar et al. 2013; Narver and Slater 1990). This configuration is consistent with open innovation theory, which emphasizes external collaboration as a mechanism for enhancing innovation outcomes (Chesbrough 2003).

The third configuration (C3) presupposes the combination of market orientation and social capabilities, suggesting that internal collaboration and external market responsiveness are jointly sufficient to foster innovation, and is symmetrical with configuration C5. This is in line with the ambidexterity perspective, which posits that balancing exploration and exploitation through internal and external capabilities enhances innovation performance (Tushman and O'Reilly 1996). Compared to C2, configuration C3 emphasizes the importance of the ability to develop collaborative networks in the market.

The presence of configurations (C4, C5, and C6) associated with low innovation performance, each being the inverse of a high-performing configuration, validates the robustness of the fsQCA

TABLE 6 | Configurations of high and low innovation performance.

	Configurations for high innovation performance			Configurations for low innovation performance		
	C1	C2	C3	C4	C5	C6
Market orientation capabilities		●	●		○	○
Marketing capabilities	●			○		
Relational capabilities		●				○
Social capabilities			●		○	
Raw coverage	0.814	0.629	0.664	0.820	0.673	0.623
Unique coverage	0.149	0.023	0.18	0.163	0.019	0.11
Consistency	0.823	0.866	0.864	0.811	0.869	0.862
Solution coverage		0.892			0.886	
Solution consistency		0.778			0.775	

Note: ● - presence of the condition; ○ - negation of the condition; raw coverage measures how much of the outcome is explained by a condition; unique coverage measures how much of the outcome is explained only by this specific recipe, excluding any cases that are also explained by other recipes in your solution; consistency is a measure of the reliability or accuracy of a relationship; solution coverage is the measure of the total explanatory power of your entire model; solution consistency measures the reliability of your entire set of results combined.

method and supports the concept of asymmetry. This shows that the absence of a specific capability or the presence of its opposite does not simply reduce innovation performance but may be part of an entirely distinct pathway to poor performance (Ragin 2008).

This triangulation of methods illuminates distinct dimensions of the capability-performance relationship that a single approach would miss. Specifically, PLS-SEM quantifies the average net effects and functional form (linear vs. non-linear) of each capability (Hair et al. 2017). Complementing this, NCA identifies the critical bottlenecks, the minimum necessary floors of Marketing and Relational capabilities that must be met regardless of other factors (Dul 2016). Finally, fsQCA reveals the sufficient configurations, confirming that there are multiple "winning recipes" for innovation success that rely on different capability permutations (Fiss 2011; Ragin 2008).

4.4 | Integrative Framework

To synthesize the complex set of findings emerging from this multi-method inquiry, we propose a visual integrative framework that reflects the multidimensional role of organizational capabilities in driving innovation performance in agribusiness firms. As depicted in Figure 2, the results indicate a differentiated pattern of influence across the four focal capabilities: market orientation, marketing, relational, and social, which manifest distinct effect types (linear or curvilinear), necessity thresholds, and configurational roles. This aligns with the theoretical tenets of the dynamic capabilities perspective (Helfat and Peteraf 2003; Teece 2007), which posits that performance differentials stem not merely from capability presence but from how capabilities are mobilized, recombined, and aligned with environmental contingencies. Market orientation and social capabilities exhibit robust linear relationships with innovation (Nahapiet and Ghoshal 1998; Narver and Slater 1990), echoing earlier findings that emphasize their enduring strategic value in cultivating responsiveness and internal cohesion (Pundziene and Geryba 2023; Song et al. 2015). Conversely, relational capabilities display an inverted U-shaped effect (Fitjar et al. 2013; Laursen and Salter 2006), suggesting the presence of diminishing returns beyond a relational intensity threshold, an insight that underscores the paradox of embeddedness (Uzzi 2018). These patterns, uncovered through PLS-SEM, are complemented by the NCA, which further identified marketing and relational capabilities as bottleneck conditions (Dul 2016), implying that without a minimal threshold in these domains, high innovation performance is unattainable.

Moreover, the configurational analysis conducted via fsQCA reveals the presence of equifinal pathways, distinct capability combinations that converge on high innovation performance outcomes. This configurational logic reinforces prior arguments on asymmetry and synergy among capabilities (Fiss 2011; Ragin 2008), demonstrating that no single capability is universally sufficient, but that strategic complementarities, such as the pairing of market orientation with relational or social capabilities, can generate innovation-enhancing synergies (Chesbrough 2003; Tushman and O'Reilly 1996). The fsQCA results also lend empirical support to open innovation paradigms, which stress the value of external relational embeddedness and internal collaborative capacity in navigating uncertain environments (Hu and Wu 2024; Yang et al. 2024).

However, it is crucial to contextualize these findings within the structural reality of the sample, which is heavily concentrated in micro-enterprises (66.4%) and small firms. Consequently, the specific linear effects and configurational pathways identified here, particularly the reliance on agile capability substitution,

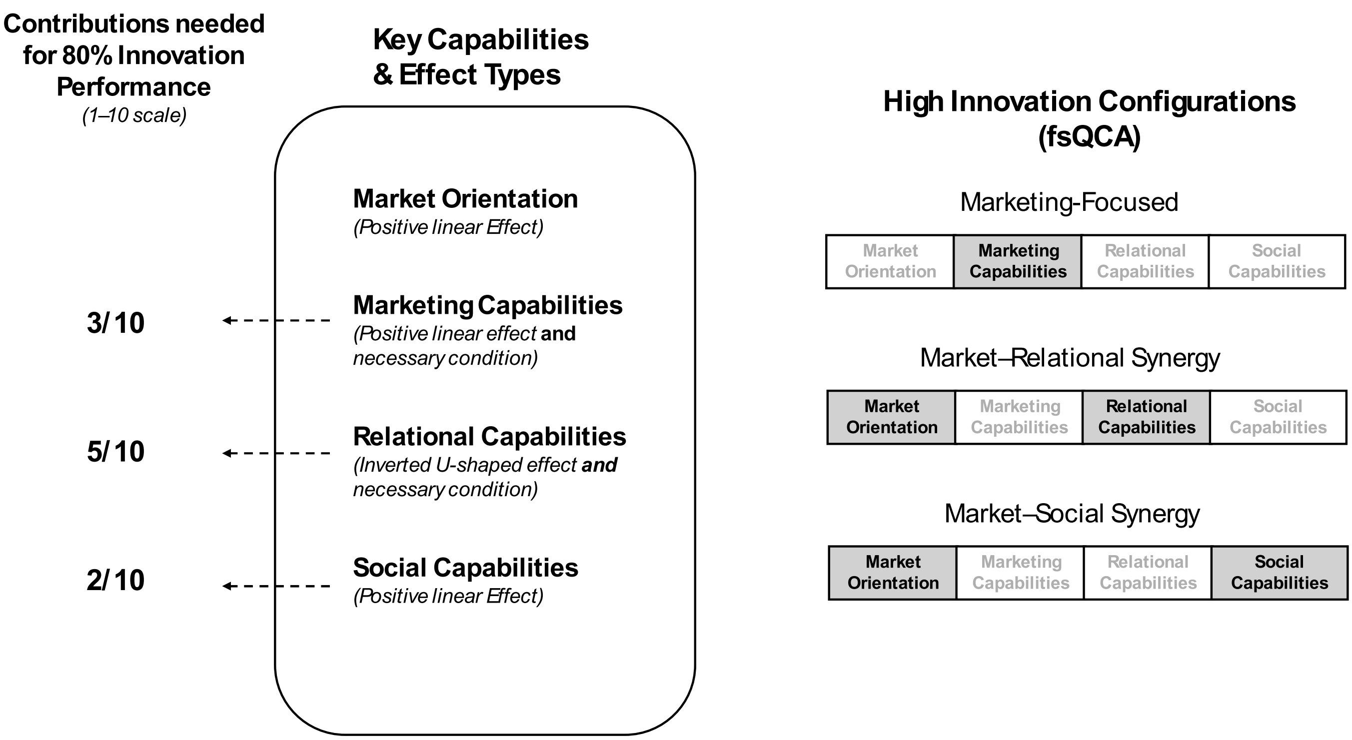

FIGURE 2 | Summary of results.

are most representative of SMEs within the Spanish agribusiness sector. Larger corporations may exhibit different capability dynamics due to their distinct resource endowments and hierarchical complexity.

5 | Conclusions

This study provides a comprehensive examination of the role that organizational capabilities play in driving innovation performance within agribusiness firms. By integrating PLS-SEM, NCA, and fsQCA, the research offers a multifaceted view that goes beyond traditional linear analyses to consider both necessary conditions and configurational pathways to innovation. The findings demonstrate that marketing and social capabilities show significant linear relationships with innovation performance, while relational capabilities exhibit a non-linear, inverted U-shaped relationship, suggesting diminishing returns beyond a certain threshold. Market orientation also proves to be a consistent enabler of innovation. Through NCA, marketing and relational capabilities were identified as necessary conditions, highlighting their foundational importance in achieving high innovation outcomes. However, fsQCA revealed that no single capability alone is sufficient; rather, it is the combination and configuration of capabilities that lead to success. The configurational analysis uncovered multiple, equifinal paths to high innovation performance, validating the idea that innovation in agribusiness is a complex and context-dependent process. This insight reinforces the value of a capabilities orchestration perspective, where firms must strategically combine their internal strengths to adapt to changing environments. Companies developing these capabilities can enhance their ability to innovate and, consequently, their overall performance.

5.1 | Theoretical Contributions

Building on the dynamic-capabilities framework, which stresses that competitive advantage hinges on the timely orchestration, recombination, and reconfiguration of firm resources in response to environmental dynamism (Helfat and Peteraf 2003; Teece 2007), this study demonstrates how different analytical lenses capture complementary yet previously unintegrated facets of capability deployment in agribusiness. Recent research by Held et al. (2025) reinforces this perspective by showing that dynamic capabilities play a pivotal role in enabling digital transformation in SMEs, particularly through the cultivation of digital leadership and culture. Their findings, based on PLS-SEM analysis, highlight how internal capability orchestration enhances organizational adaptability and innovation, supporting the broader relevance of dynamic capability theory across sectors.

Furthermore, these findings offer specific nuances to the foundational theories underpinning the studied capabilities. Regarding the Resource-Based View, we refine the understanding of market orientation (Narver and Slater 1990) by demonstrating that while it acts as a valuable linear driver, it is not a standalone bottleneck, suggesting its competitive value is maximized only when orchestrated with other resources. Similarly, our results extend Social Capital Theory (Nahapiet and Ghoshal 1998) by confirming that internal social capabilities consistently enhance innovation without the "dark side" effects often predicted. Conversely, the inverted U-shaped performance of relational capabilities contributes to the Relational View (Dyer and Singh 1998) by empirically validating that the benefits of interfirm linkages are bounded by transaction costs and coordination limits (Laursen and Salter 2006).

By triangulating variance-based PLS-SEM, threshold-oriented NCA, and set-theoretic fsQCA, we show that capabilities can be simultaneously performance-enhancing (linear), performance-limiting (necessary bottlenecks), and performance-enabling in specific configurations (equifinal paths). This multi-method fusion responds directly to recent calls for methodological pluralism capable of disentangling complex architectures in innovation research (Dul 2016). It refines the "isolated-capability" logic that dominates extant agribusiness studies by revealing when marketing and relational capabilities act as indispensable thresholds, how relational over-embeddedness produces diminishing returns an empirical instantiation of the paradox of embeddedness (Uzzi 2018) and why market orientation and social capital operate as amplifiers rather than prerequisites. In doing so, the article extends resource-orchestration arguments that emphasize the sequencing and prioritization of capability investments (Duah et al. 2024) and clarifies how firms can avoid capability misalignment traps that erode innovation potential.

Equally important, the configurational findings enrich open-innovation and relational-view theorizing by confirming that distinct capability bundles, not any single "best practice," can yield high innovation performance, thereby endorsing asymmetry and equifinality (Fiss 2011; Ragin 2008). The identification of a marketing-centric path, a market–relational synergy, and a market–social synergy illustrates how firms may substitute or complement internal and external knowledge mechanisms, offering empirical nuance to prescriptions that champion network promiscuity without qualification (Chesbrough 2003). Furthermore, by juxtaposing NCA and fsQCA necessity criteria, we expose methodological contingencies in what "necessary" means across analytical paradigms, echoing warnings from Schneider and Wagemann (2012) about divergent standards of evidence in configurational research. Overall, the study articulates a more granular capability-performance schema that reconciles linear, non-linear, and configurational logics, thereby advancing theory on dynamic capabilities, open innovation, and the strategic management of agrifood firms operating under conditions of technological turbulence and relational complexity.

5.2 | Managerial and Policy-Making Implications

This study offers agribusiness managers a practical roadmap for strengthening their firms' innovation performance through capability development and strategic orientation. First, marketing capabilities stand out as the single most critical lever for innovation. Firms with stronger marketing practices, those that understand customer needs, position products effectively, and respond to shifting demands, consistently outperform others in innovation. Importantly, even a moderate level of marketing capability appears to be essential: without it, high innovation outcomes are unlikely. Market orientation also plays a vital role, enabling firms to align their innovation strategies with external signals and customer expectations. Managers should therefore prioritize market intelligence processes and ensure that insights from the field actively shape product and service development. Internally, building a collaborative organizational culture, what this study refers to as social capabilities, also contributes to innovation by supporting trust, cross-functional learning, and knowledge sharing.

Beyond individual capabilities, managers must also be mindful of how capabilities interact. While relational capabilities (e.g., partnerships and external collaboration) support innovation, their influence follows an inverted U-shape. This means that forming too many partnerships or depending excessively on external networks may overwhelm internal coordination or dilute strategic focus. Managers should seek a balance: cultivate relationships that bring strategic value but avoid overextending the firm's relational bandwidth. Moreover, the analysis reveals that there is no single "formula" for innovation success.

Furthermore, while this study largely reflects the reality of SMEs, the implications for large agribusiness firms likely differ due to their distinct resource endowments. Unlike smaller entities that rely on agile capability substitution (as seen in the fsQCA results), large corporations with formalized R&D departments and governance structures may require a more robust "innovation DNA" where capabilities are not merely compensatory but are simultaneously maximized. In such contexts, the "bottleneck" effect of missing marketing or relational capabilities might be mitigated by internal redundancies, yet the risk of bureaucratic inertia makes the fostering of social capabilities (internal collaboration) even more critical to prevent silos (Nahapiet and Ghoshal 1998).

Different capability combinations, such as strong marketing alone, or a blend of market orientation and relational collaboration, can each lead to high performance. Therefore, firms should focus on developing a configuration of capabilities that fits their specific context and strategic intent. What matters is not having all capabilities at their maximum, but having the right mix in place, with at least the minimum required levels in marketing and relational domains.

The findings also provide clear guidance for innovation policy in the agrifood sector. Public support mechanisms should prioritize the development of marketing and market orientation capabilities among small and medium-sized agribusiness firms. This aligns with recent findings that emphasize the role of digital innovations in enhancing sustainability and resilience in agricultural systems, while also highlighting the need for supportive policy frameworks (Finger 2023). Many such firms lack formal marketing departments or structured market research processes, making them less equipped to identify and respond to innovation opportunities. Programs that build foundational marketing knowledge, through training, consultancy, or embedded advisory services, can yield significant returns in terms of sectoral innovation. This is consistent with evidence showing that targeted value chain interventions can significantly improve farmers' access to inputs, market information, and productivity, reinforcing the importance of integrated support mechanisms (Amare et al. 2024). Likewise, public initiatives that promote customer-centric thinking and improve firms' ability to interpret market signals can enhance the innovation capacity of the ecosystem.

At the same time, policymakers should recognize the importance of relational capabilities and the risk of over-embeddedness. While collaborative networks, clusters, and knowledge partnerships are often beneficial, an excessive emphasis on formal partnerships may impose coordination costs that small firms cannot afford to absorb. Policy design should therefore emphasize *quality over quantity* in collaborative initiatives, fostering targeted connections that add value rather than promoting widespread, unfocused networking. Finally, the configurational nature of innovation revealed in this study suggests that policy instruments should remain flexible and tailored. Rather than promoting a one-size-fits-all innovation model, public programs should support different capability paths to innovation, enabling firms to pursue strategies that match their resources, size, and stage of development. Adaptive program design, sensitive to firm diversity and the varying roles of internal and external capabilities, can increase the effectiveness of innovation policy in agribusiness contexts.

5.3 | Limitations and Future Research

This study has several limitations. First, the data were collected from agribusiness firms in Spain, which may limit the generalizability of the findings to other contexts. Second, the cross-sectional design of the study does not allow for causal inferences. Future research should consider longitudinal designs to explore how capability configurations evolve over time and influence innovation trajectories. Additionally, comparative studies across different countries and sectors could provide deeper insight into the generalizability and contextual nuances of the proposed framework. In particular, future research should aim to replicate this multi-method framework in contexts characterized by large-scale agribusinesses (e.g., North America) as well as in emerging markets. Such comparative analyses would verify whether the specific "innovation DNA" and capability configurations identified here remain valid or if they are contingent upon the prevalence of SMEs and specific regional economic structures.

Moreover, the sample is heavily skewed towards micro-enterprises (66.4%) and small firms (89.2% having fewer than 50 employees), reflecting the specific industrial structure of the Spanish agri-food sector. Consequently, the capability orchestration pathways identified here may not fully extend to large or multinational agribusiness corporations, which often operate with distinct resource endowments and more complex organizational hierarchies.

Finally, while the theoretical framework specifies directional relationships among capabilities and innovation performance, the cross-sectional design and the use of PLS-SEM do not allow for strict causal identification in the econometric sense. Consequently, the findings should be interpreted as theory-consistent associations rather than definitive causal effects. Future research using longitudinal data, experiments, or quasi-experimental designs could provide stronger causal inference.

Author Contributions

Beatriz Corchuelo Martínez-Azúa: conceptualization, investigation, methodology, validation, funding acquisition, writing – original draft,

writing – review and editing, visualization, formal analysis, project administration, data curation, supervision. **Alvaro Dias:** conceptualization, investigation, methodology, validation, writing – original draft, writing – review and editing, visualization, formal analysis, data curation, supervision.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Appendix A

TABLE A1 | Validity checks.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Innovation performance	0.725	0.737	0.829	0.549
Market orientation	0.770	0.790	0.867	0.685
Marketing capabilities	0.864	0.880	0.901	0.647
Relational capabilities	0.754	0.780	0.857	0.668
Social capabilities	0.769	0.802	0.895	0.810

Source: Own calculations.

TABLE A2 | Collinearity checks.

	VIF
Market orientation → Innovation performance	2.262
Marketing capabilities → Innovation performance	1.764
Relational capabilities → Innovation performance	1.770
Social capabilities → Innovation performance	2.005

Source: Own calculations.

TABLE A3 | HTMT indicators.

	Innov_perf	MO	Mktg_cap	Rel_cap
Innovation performance				
Market orientation	0.699			
Marketing capabilities	0.817	0.703		
Relational capabilities	0.459	0.544	0.446	
Social capabilities	0.590	0.595	0.554	0.465

Source: Own calculations.

TABLE A4 | Bottleneck table.

	Market orientation	Marketing capabilities	Relational capabilities	Social capabilities
0.000%	NN	NN	NN	NN
10.000%	NN	NN	NN	NN
20.000%	NN	NN	NN	NN
30.000%	NN	NN	0.963	NN
40.000%	NN	NN	1.835	NN
50.000%	NN	NN	2.707	NN
60.000%	NN	NN	3.579	NN
70.000%	NN	1.437	4.451	NN
80.000%	NN	3.051	5.323	1.578
90.000%	NN	4.665	6.194	4.354
100.000%	3.459	6.279	7.066	7.131