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Generativity is a Core Value of the ESJ: A Decade of Growth

Erik Erikson (1902-1994) was one of the great psychologists of the 20th century¹. He explored the nature of personal human identity. Originally named Erik Homberger after his adoptive father, Dr. Theodore Homberger, he re-imagined his identity and re-named himself Erik Erikson (literally Erik son of Erik). Ironically, he rejected his adoptive father's wish to become a physician, never obtained a college degree, pursued independent studies under Anna Freud, and then taught at Harvard Medical School after emigrating from Germany to the United States. Erickson visualized human psychosocial development as eight successive life-cycle challenges. Each challenge was framed as a struggle between two outcomes, one desirable and one undesirable. The first two early development challenges were 'trust' versus 'mistrust' followed by 'autonomy' versus 'shame.' Importantly, he held that we face the challenge of **generativity** versus **stagnation in middle life**. This challenge concerns the desire to give back to society and leave a mark on the world. It is about the transition from acquiring and accumulating to providing and mentoring.

Founded in 2010, the European Scientific Journal is just reaching young adulthood. Nonetheless, **generativity** is one of our core values. As a Journal, we reject stagnation and continue to evolve to meet the needs of our contributors, our reviewers, and the academic community. We seek to innovate to meet the challenges of open-access academic publishing. For us,

¹ Hopkins, J. R. (1995). Erik Homburger Erikson (1902–1994). *American Psychologist*, 50(9), 796-797. doi:<http://dx.doi.org/10.1037/0003-066X.50.9.796>

generativity has a special meaning. We acknowledge an obligation to give back to the academic community, which has supported us over the past decade and made our initial growth possible. As part of our commitment to generativity, we are re-doubling our efforts in several key areas. First, we are committed to keeping our article processing fees as low as possible to make the ESJ affordable to scholars from all countries. Second, we remain committed to fair and agile peer review and are making further changes to shorten the time between submission and publication of worthy contributions. Third, we are looking actively at ways to eliminate the article processing charges for scholars coming from low GDP countries through a system of subsidies. Fourth, we are examining ways to create and strengthen partnerships with various academic institutions that will mutually benefit those institutions and the ESJ. Finally, through our commitment to publishing excellence, we reaffirm our membership in an open-access academic publishing community that actively contributes to the vitality of scholarship worldwide.

Sincerely,

Daniel B. Hier, MD

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Multi-Level Governance and Industrial Engagement in Renewable Energy Communities: A Pre-Regulatory Study from Lombardy

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Abstract

This study investigates the early-stage development of renewable energy communities in Italy, focusing on how small and medium-sized industries in the Lombardy region perceived and responded to communication efforts before the full implementation of new regulatory frameworks and economic incentives. The research is based on data collected through a targeted survey conducted among industrial firms. The analysis explores the roles played by national and regional institutions, as well as local public authorities such as municipalities, in shaping awareness and interest in renewable energy participation. A non-parametric statistical test was used to assess the influence of different governance levels on industrial engagement. Results indicate that Local Public Authorities exert a significantly stronger influence on industrial perceptions and willingness to engage in Renewable Energy Communities (REC) than higher-level institutions. In the surveyed sample, 51% of Small and Medium-sized Industries (SMI) reported no or minimal awareness of REC, with 34% expressing no interest in participation, primarily due to limited communication and lack of familiarity. Conversely, the highest awareness levels (up to 26%) were recorded in areas where Local Public Authorities maintained proactive and trust-based communication, such as Lecco–Sondrio, suggesting that localized outreach is notably more effective than top-down regional campaigns. These findings highlight the need for coordinated, place-based governance strategies that reinforce the role of local

actors in energy transition initiatives. Municipalities and similar authorities may serve as crucial intermediaries, translating national strategies into meaningful local action. By capturing industry perceptions prior to the implementation of national Renewable Energy Communities incentives, this study offers a unique and unbiased perspective on how businesses naturally engage with different levels of governance. It contributes to the broader understanding of how trust and proximity influence participation in sustainable energy systems.

Keywords: Local Public Authorities (LPA); Small and Medium-Sized Industries (SMI); Energy Transition; Low-Carbon Economy; trust

Introduction

The escalating environmental crisis has intensified the urgency of transitioning toward sustainable development, with the energy sector emerging as a key focal point. Shifting away from fossil fuel dependency to cleaner, renewable sources is not only desirable but essential. This energy transformation - defined by the principles of decarbonization, scale-up of renewables, and smart energy systems - has gained traction globally, both in policy frameworks and academic discourse, also driving concerns about energy security, and the broader socio-economic potential of renewable energy, the transition has become central to international agendas (Cheng et al. 2019; Bazilian et al, 2020). According to the International Renewable Energy Agency (IRENA), energy transition entails a broad restructuring of how energy is produced and consumed, prioritizing low-carbon, sustainable alternatives over traditional fossil fuels (IRENA, 2020), along with a profound rethinking of energy geopolitics worldwide (Strielkowski et al, 2021; Zhang et al, 2023).

This imperative has been further amplified by the geopolitical instability triggered by the Russia–Ukraine conflict. The resulting energy crisis of 2022 caused major disruptions in natural gas, coal, and electricity markets, as well as significant volatility in oil supply. In response, governments worldwide implemented emergency interventions while accelerating structural reforms to decrease reliance on fossil fuels. Major policy initiatives such as the U.S. Inflation Reduction Act, the EU’s RePower EU and Fit for 55 packages, and Japan’s Green Transformation (GX) strategy are all designed to hasten the deployment of clean energy. Simultaneously, countries like China and India have announced ambitious renewable targets, while global energy markets adjust to the reconfiguration of Russia–Europe energy flows.

These developments align with the 2030 Agenda for Sustainable Development and the United Nations' Sustainable Development Goals

(SDGs), which emphasize collaborative approaches to achieving sustainability (www.un.org). In the energy domain, this vision has translated into increased emphasis on decentralized models. The European Union, in 2019, introduced legislation promoting Renewable Energy Communities (REC) - localized initiatives that integrate citizens and organizations into energy production, storage, and demand response. These communities aim to increase grid flexibility, stimulate local economic growth, and enhance long-term resilience (Strielkowski et al, 2021).

Italy presents a particularly relevant case. As one of the EU's most energy-import-dependent nations, relying on imports for over 77% of its energy consumption, especially in gas, oil, and coal, the Country has found itself under intense pressure to accelerate its energy independence (www.italyforclimate.org). Recent policy reforms have aimed to align national targets with EU directives, with REC positioned as a strategic component in achieving these objectives. However, several challenges persist, including administrative hurdles, limited access to financing, and low public awareness (Ahmed et al.2024; Esposito et al.2024).

While larger firms tend to manage the energy transition independently, thanks to their greater organizational capacity, small and medium-sized enterprises (SMEs), particularly in the industrial sector, often lag due to limited resources and knowledge. In Lombardy, a region known for economic vitality and industrial leadership, studies have shown that firms are increasingly sensitive to environmental issues and are investing in energy-related strategies (www.unioncamerelombardia.it). A positive correlation has been found between company size and sustainability investment behavior, underscoring the need for targeted support measures to engage SMI better. Enabling them to access renewable energy solutions and transition more effectively will be critical to meeting broader climate goals.

Although the legislation acknowledges the role of the private sector - not only as consumers of clean energy, but also as co-investors and co-managers in community-based systems - the spread of Renewable Energy Communities (REC) in Lombardy remained limited until the end of January 2024, largely awaiting the publication of the final regulatory framework: the Implementing Decree on Renewable Energy Communities (RECs), issued by the Italian Ministry of the Environment and Energy Security (MASE) at the end of January 2024, marks a fundamental step toward promoting the establishment and development of energy communities and widespread self-consumption in Italy. The decree establishes rules and incentives, financial support and technical requirements: before its issue, the landscape of REC was multifaceted and supported actively by a system of communication by Multi-Level Governance (MLG), having a different impact on SMI.

MLG refers to the interaction and coordination of decision-making processes across different layers of authority, typically involving supranational, national, regional, and local institutions. Within this framework, power and responsibilities are not concentrated in a single level of government but are instead distributed and shared among various actors operating at different scales. MLG is particularly relevant in the context of the energy transition, where policy design, regulatory enforcement, and operational implementation often involve multiple stakeholders with distinct but complementary roles. In the case of Renewable Energy Communities (REC), for instance, national and regional institutions tend to define strategic objectives and regulatory frameworks, while local authorities are crucial in translating those directives into practical initiatives by engaging directly with citizens, businesses, and civil society. This layered governance structure allows for both top-down alignment with policy goals and bottom-up responsiveness to local needs, making trust, communication, and institutional coordination key factors in the success of decentralized sustainability models.

Based on this context, this study investigates the role of Multi-level governance (MLG) in Lombardy's REC landscape, with a specific focus on the influence of Local Public Authorities (LPA, also Local Public Bodies - LPB) in fostering SMI participation.

The Lombardy region is located in the North of Italy and it is a leading industrial area, particularly rich in SMI. The regional Institution has actively pushed the development of REC. This includes offering financial incentives, technical support, and regulatory simplification (www.arpalombardia.it). The approach also involves partnerships with municipalities, local firms, and civil society actors; integrating REC planning with broader environmental and urban policy goals; and fostering knowledge sharing and community engagement (www.en.regione.lombardia.it). Awareness campaigns and educational programs are being implemented to encourage broader participation.

Building the conceptual framework for this study, we borrow and adapt the Multi-Level Governance (MLG) classification originally proposed by Hooghe and Marks (2003; 2010), which distinguishes between:

- Type I: Stable, general-purpose jurisdictions organized across nested territorial levels (for example, the EU, nation-state, region, municipality);
- Type II: Task-specific, flexible governance arrangements that often cut across levels and functions (for example, agencies, partnerships, or regulatory bodies).

We also match the Hooghe and Marks works with a complementary perspective, concerning the distribution of power across governance layers (Bache and Flinders, 2004). While they concentrate on Type I structures -

describing national authorities as agenda-setters and legal standard-bearers, and regional institutions as mediators adapting strategic directives to territorial contexts - they also emphasize the interdependence of actors operating at different territorial scales, including sub-national governments and local municipalities. These municipalities are explicitly recognized as key subnational actors within systems of shared authority, particularly in EU member states where local engagement is increasingly instrumental in policy implementation. The following table 1 summarizes the main Academic contributions on the topic.

Table 1. Literature review of the most recent contributions

Author(s), Year	Title	Main Contribution/focus	Multilevel Governance	Span of Control	CER
Hooghe & Marks (2003)	<i>Unraveling the central state, but how? Types of multi-level governance</i>	Typology of multi-level governance systems	Differentiates between Type I and Type II governance	Examines jurisdictional boundaries and coordination	Offers framework to analyze CER governance structures
Bache & Flinders (2004)	<i>Multi-level Governance</i>	Theoretical foundation for multi-level governance	Defines and conceptualizes the term	Explores challenges in coordination and control	Provides theoretical lens for CER governance
Krupa et al. (2015)	<i>Participatory and multi-level governance</i>	Applies MLG to Aboriginal renewable energy projects	Case-based participatory MLG		
Bauwens (2017)	<i>Polycentric governance approaches for a low-carbon transition</i>	Highlights community-based initiatives and resilience	Focus on polycentricity		Emphasizes role of renewable energy cooperatives
Jaramillo et al. (2019)	<i>Barriers to sustainability for SMEs in the framework of sustainable development</i>	Identifies barriers for SMEs in sustainability	Highlights lack of support from multiple governance levels	Limited influence of SMEs on broader sustainability agendas	Indirectly relevant; SMEs need inclusion in CER frameworks
Ciasullo et al. (2020)	<i>Multi-level governance for sustainable innovation in smart communities</i>	Proposes a harmonizing governance meta-level for communities	Recommends harmonizing governance tiers		
Swarnakar & Singh (2022)	<i>Local governance in just energy transition</i>	Proposes community-centric governance framework for energy justice	Links local governance with energy transitions		Focus on justice and inclusion
Trevisan et al. (2023)	<i>Renewable energy communities in</i>	Governance framework for	Aligns local actions with	Focus on managing inter-	Central to PED realization

	<i>positive energy districts</i>	Italian REC realization	national frameworks	organizational coordination	and energy transition
Anfinson et al. (2023)	<i>Does polycentrism deliver? A case study of energy community governance in Europe</i>	Evaluates effectiveness of polycentric governance in REC	Case study of governance effectiveness		Explores legal barriers for citizen energy companies
Ahmed et al. (2024a)	<i>A review of renewable energy communities: concepts, scope, progress, challenges, and recommendations</i>	Comprehensive review of REC progress and barriers	Highlights institutional challenges and policy gaps across governance levels	Limited analysis, implied need for coordinated management across entities	Addresses CER potential through community models
Ahmed & Măgurean (2024)	<i>Renewable Energy Communities: Towards a new sustainable model of energy production and sharing</i>	Proposes a sustainable model for RECs	Suggests integration of local/national levels	Advocates for decentralized energy management	Key mechanism in achieving climate and equity goals
Petrovics et al. (2024)	<i>Scaling mechanisms of energy communities</i>	Comparative study on scale-up mechanisms of REC			Discusses scalability of REC models
Teladia & van der Windt (2025)	<i>Lights, Policy, Action: A Multi-Level Perspective on Policy Instrument Mix Interactions for Community Energy Initiative</i>	Analyzes policy instrument interactions in multi-level settings	Identifies coordination gaps in MLG		Addresses support for federal CER targets

Figure 1 illustrates a conceptual model that bridges Multi-Level Governance (MLG) with the span of control and power, framing these dynamics within the context of communication efficacy in Renewable Energy Communities (RECs). Building on this concept and drawing on data collected through a structured survey, this study evaluates the readiness and willingness of small and medium-sized industries (SMIs) to participate in Renewable Energy Communities (RECs) prior to the formal establishment of the economic incentive framework (REC Decree 2024). Particular attention is given to the role of LPA.

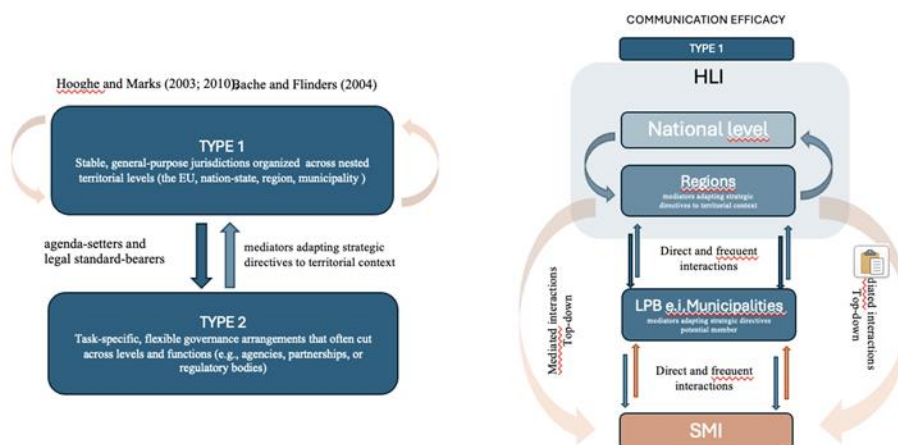


Figure 1: From MLG Models to the Communication Model to spread RECs interest among SMI

The primary objective is to provide an initial classification of the varying impacts that different Multi-Level Governance (MLG) levels have on communication efficacy with SMIs. The study posits that LPA plays a pivotal role in shaping SMI perceptions and in lowering informational and institutional barriers, primarily due to their trusted, locally embedded communication infrastructures. As noted by Vecchi et al (2024, the analysis of REC potential needs to integrate socio-economic, environmental, and spatial evaluations; these kinds of assessments are facilitated by spatial proximity and familiarity with LPA

Methods

Although the study employs a non-parametric design rather than a fully specified regression equation, the selection and operationalization of variables were guided by relevant theoretical and empirical literature. The two key dependent variables - awareness and attitude toward Renewable Energy Communities (REC) - were chosen as practical proxies for engagement, a construct frequently used in energy transition and policy adoption studies (Krupa et al., 2015; Swarnakar & Singh, 2022). These were assessed using ordinal scales to capture both levels of informational familiarity and the behavioral intention to participate in REC initiatives, aligning with frameworks drawn from the diffusion of innovation theory (Walker et al., 2010). The central independent variable - Local Public Authority (LPA) engagement - was derived from a comparative regional classification based on preliminary qualitative assessments of municipal communication efforts. This approach is supported by prior research that emphasizes the role of trust,

proximity, and frequency of interaction in fostering institutional credibility and sustainability adoption (Tillmar, 2009; Bauwens, 2017). LPA commitment was categorized across three territorial clusters to capture meaningful variation in communication strategy and intensity, consistent with place-based policy analysis methodologies used in energy transition research (Trevisan et al., 2023). The choice of the Mann–Whitney U test reflects the ordinal nature of the dependent variables and the non-normal distribution of awareness and attitude scores. This test has been widely adopted in comparative governance and energy policy studies where assumptions of parametric analysis cannot be satisfied (Zhou et al., 2019). Future research could build upon this foundation by adopting an ordinal regression framework to estimate the marginal effects of additional variables such as firm size, sectoral affiliation, and perceived energy cost impact.

Given the regular and often personal interactions between SMI and LPA, there is a tendency for SMI to exhibit greater levels of trust toward these institutions than toward regional or national counterparts (Tillmar, 2009). Trust, in this context, is cultivated through consistent, positive interactions that reinforce perceptions of credibility and integrity. For many SMI, ongoing engagement with LPA enables more tailored communication, fosters mutual understanding, and strengthens alignment on priorities. In numerous cases, local familiarity, such as direct acquaintance with municipal officials, removes communicative barriers and enhances the flow of information, especially regarding emerging initiatives like Renewable Energy Communities (REC).

Although trust dynamics can vary by context, this study posits that LPA enjoys a more favourable position in building trust among SMI. Local institutions are not only geographically closer but also embedded in the same social and economic environments, allowing them to respond more directly to the operational realities faced by local businesses. By contrast, regional entities may appear more bureaucratic and disconnected from local concerns, potentially reducing their perceived responsiveness and relevance. As a result, SMI are often more inclined to engage openly and constructively with local governments than with regional authorities.

This greater receptivity is shaped by a combination of proximity, shared community identity, and repeated contact. Local authorities are viewed as stakeholders with a vested interest in the immediate environment and development of the SMI ecosystem. Consequently, their communication efforts are perceived as more pertinent and action-oriented. The reputational capital built through such close, ongoing relationships positions LPA as trusted intermediaries, capable of mobilizing SMI around new sustainability initiatives such as REC.

Moreover, SMI often maintains a strong ethical commitment to its local communities, which informs its approach to business performance and

environmental responsibility (Longo et al. 2005). This embeddedness reinforces their sensitivity to sustainability-oriented programs, especially when these are framed and promoted by local actors. Local municipalities are thus increasingly seen as partners in advancing green transitions, while regional institutions may face challenges in generating similar levels of engagement due to less frequent interaction and limited personalization of outreach.

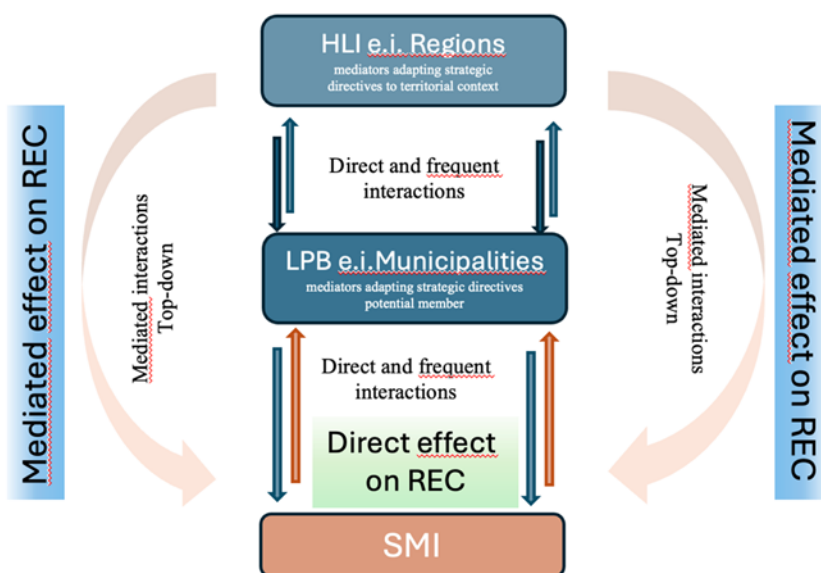


Figure 2. Hypothesis Framework: The Role of LPA and Trust in SMI Participation in REC

This study proposes the hypothesis that SMI exhibit a higher degree of trust in LPA compared to regional institutions, particularly when faced with novel or previously unexplored initiatives, such as the establishment of Renewable Energy Communities (REC) (see Figure 2). The hypothesis suggests that the familiarity and direct interactions typical of local governance environments can render local-level initiatives more compelling and actionable for SMI than those initiated at more distant administrative levels.

To examine this hypothesis, the research focuses on SMI operating in the Lombardy region, which stands as Italy's most industrialized area and one of the foremost economic engines within the European Union. With the highest density of manufacturing and artisanal enterprises in the country, Lombardy provides a strategically significant context for investigating the dynamics of institutional trust and engagement with sustainability initiatives. We consider the extensive legislation on REC issued between 2020 and 2022 - including at the EU level (Clean Energy Package), nationally (Decreto

Milleproroghe), and regionally (Regional Law 2/2022) (we define those Institutions as High Level Institutions (HLI) in the introduction section) - and the substantial communication and financial efforts to promote REC development through information campaigns and support mechanisms. Also, we consider as given the shared regional engagement in Lombardy to raising awareness and stimulating interest in REC, but we acknowledge the variability in engagement levels among LPA in the region.

Within this framework, the study is guided by two central research questions:

- RQ1: To what extent is the concept of Renewable Energy Communities (RECs) understood by Small and Medium-sized Industries (SMIs) in Lombardy?
- RQ2: Is there a measurable relationship between SMI awareness of RECs and the degree of commitment demonstrated by Local Public Authorities (LPA)? RQ2 also leads to a sub-question:
- RSQ1: Can we consider that SMI interest in RECs is directly and positively correlated with LPA commitment?

To generate original empirical data, this research was conducted in collaboration with Confapi Lombardia (hereafter, Confapi) a regional association representing small and medium-sized industrial enterprises. The decision to focus specifically on SMI was based on several considerations. Since the onset of the energy crisis in 2021, energy-related expenditures have emerged as a critical driver of the transition toward cleaner, more efficient energy systems. While larger firms often possess internal capabilities to autonomously manage their energy transitions, SMI face more pronounced informational and structural limitations - making them an especially relevant group for investigating the diffusion and reception of REC initiatives.

Preliminary qualitative discussions with communication officers from local Confapi branches highlighted marked differences in LPA engagement strategies across the region. These insights informed the selection of three target areas within Lombardy for the empirical study: the provinces of Varese, Brescia, and Lecco plus Sondrio. The provinces of Varese and Brescia were identified as having received minimal REC-related communication from their respective LPA. In contrast, Lecco and Sondrio - although administratively distinct - were treated as a unified area by Confapi and were noted for their proactive institutional engagement, including robust efforts to inform and involve SMI in REC development. This contrast offered a meaningful basis for exploring the influence of LPA activity on SMI awareness and responsiveness to energy community initiatives.

In January 2023, a structured survey was administered to small and medium-sized enterprises (SMI) affiliated with Confapi. The purpose was to assess, in the evolving local and regional policy contexts, their awareness, attitudes, and responses to Renewable Energy Communities (REC). The

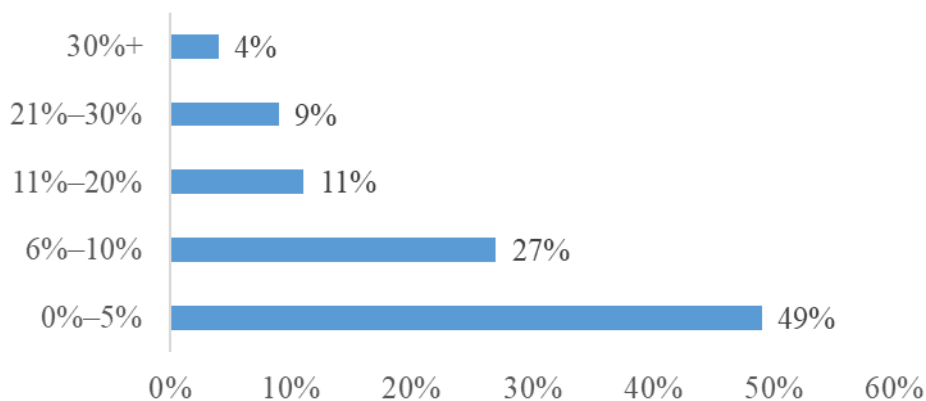
survey was conducted over a two-week period and yielded 450 responses. After eliminating incomplete and inconsistent submissions, a final dataset of 212 valid responses was retained for analysis.

The demographic profile of the sample revealed 48% operating in the metalworking sector, followed by 11% in rubber and plastics, and the remaining categories - including chemicals, food production, and textiles (accounting for less than 2% each). This distribution reflects the high industrial density of Lombardy, particularly in manufacturing and craft sectors.

Through an introductory question, respondents were asked to quantify the impact of energy costs on their revenue using a five-point scale. Results (Table 2) indicate that half of the respondents reported minimal energy cost impact (0–5%), while only 4% indicated energy costs had a critical impact (over 30%). This helps understand the cost-sensitivity of the respondents in a period of rising energy costs.

Respondents' answers are distributed mainly in the low category means that the sample under exam is touched by the topic, but it is not an emergency; thus answers concerning REC are not influenced by any personal urgency.

Table 2. Distribution of the impact of energy costs on sales



To answer RQ1, we generate two different questions, exploring awareness and attitudes towards REC. Awareness was assessed using a five-point semantic differential scale, from 1 (no awareness) to 5 (strong knowledge). Attitudinal responses were initially unstructured but were reorganized into five ordinal categories:

- 1 → "Not interested" or no response
- 2 → "Currently searching for basic information"
- 3 → "Currently searching for in-depth information"
- 4 → "Intending to participate in a REC"
- 5 → "Already involved in a REC"

This transformation allowed for consistent analysis of how awareness levels correlate with active engagement. Only 14% showed high or complete awareness (levels 4 and 5); over half of the respondents (51%) indicated minimal or no knowledge of REC, while. The mean awareness score was 2.02, with a median of 1.0, reinforcing the conclusion that REC awareness remains low across the region.

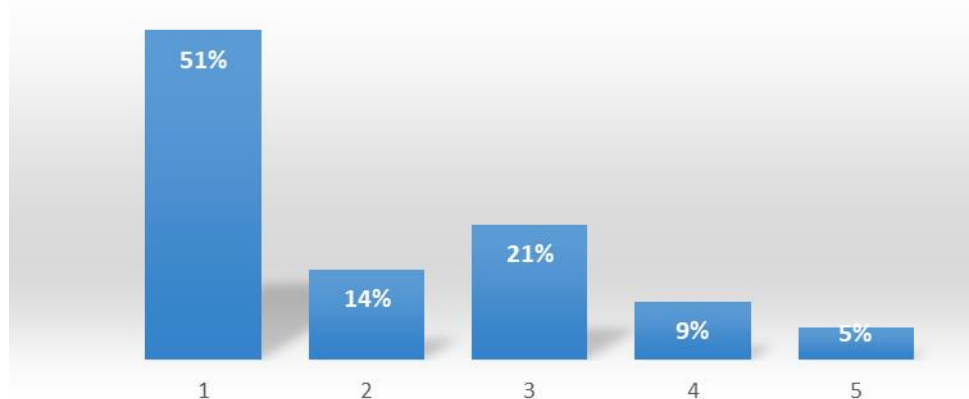


Figure 3. REC awareness at a regional level

The visual analysis of the frequency distribution revealed a sharp decline in respondent numbers as awareness increased (Figure 3). This skewed distribution highlights a clear knowledge gap among SMI, underscoring the need for more effective communication and training on REC-related opportunities.

To deepen the analysis, awareness scores were correlated with attitudinal categories (Table 3).

Table 3. Attitude towards REC

Awareness level	%	1	2	3	4	5
Attitude towards REC						
Not interested	34%	42%	13%	28%	33%	29%
Searching for basic information	50%	54%	81%	48%	11%	14%
Searching for in-depth information	8%	2%	6%	16%	33%	0%
Try to build/join an REC	4%	2%	0%	4%	11%	29%
Actively involved	4%	0%	0%	3%	7%	25%
Total	100%	51%	14%	21%	9%	5%

A correlation coefficient of 0.34 between awareness levels and attitude was found, indicating a moderate positive correlation: SMI with higher

awareness of REC are more likely to express interest or participate in such initiatives.

In addition, the relationship between awareness and the economic impact of energy costs was tested by recoding the cost impact variable to a five-point ordinal scale. The resulting correlation ($r \approx 0.023$) is considered statistically weak, suggesting that awareness and attitudes toward REC are not strongly influenced by rising energy costs alone.

Table 4. REC awareness levels by province/area

AREA	Lecco-Sondrio	Varese	Brescia
Scale			
1	31%	57%	60%
2	21%	9%	16%
3	26%	22%	16%
4	17%	7%	4%
5	5%	5%	5%
TOT	100%	100%	100%

To address RQ2, responses from the Lecco-Sondrio area (high LPA engagement) were compared to those from Varese and Brescia (limited LPA engagement) using a Mann–Whitney U test. This non-parametric test is appropriate for comparing ordinal data that may not follow a normal distribution. Statistical analysis produced a p-value < 0.05 for both awareness and attitude comparisons, suggesting a significant difference between the Lecco-Sondrio cluster and the other two provinces.

This supports the hypothesis that more intensive and trust-based communication from LPA can positively influence SMI awareness and engagement with REC-related initiatives.

Results

The analysis performed using the Mann–Whitney U test to compare REC knowledge levels between the Lecco–Sondrio area and the other provinces reveals a statistically significant difference in awareness. The mean awareness score in the Lecco–Sondrio area stands at 2.40, surpassing the mean scores of 1.93 for Varese and 1.85 for Brescia (see Figure 2-3).

The p-value of 0.0045 (Table 5), which falls below the conventional 0.05 threshold, indicates that the observed variance is unlikely due to random chance. These outcomes provide empirical support for the hypothesis that active local engagement by LPA correlates with higher awareness of REC initiatives. In areas where LPA have assumed a prominent role in disseminating information and supporting REC-related actions, such as Lecco–Sondrio - SMI demonstrate a greater understanding of the topic than those in areas primarily influenced by regional-level communication efforts.

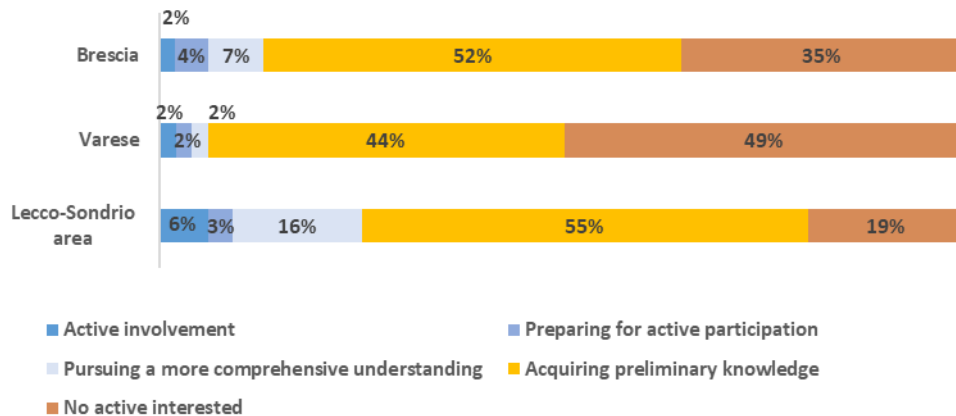


Figure 4. Comparative Analysis of SMI Engagement with REC by Area

In contrast, when comparing *attitudinal* differences toward REC across the same regions using the same statistical test, the p-value of 0.0836 does not indicate statistical significance (table 5).

Table 5. P-value

P-value	Knowledge level	Attitude level
Lecco-Sondrio area vs. the other provinces	0.0045	0.0836

Although the mean attitude score (shown in Figure 5) is slightly higher for Lecco–Sondrio (1.67) than in Varese (1.42) and Brescia (1.55), this variation is not sufficient to confirm a definitive impact of local engagement on attitude formation. While a positive trend is observable, giving insightful suggestions to be investigated, it probably lacks the statistical strength required for generalization.

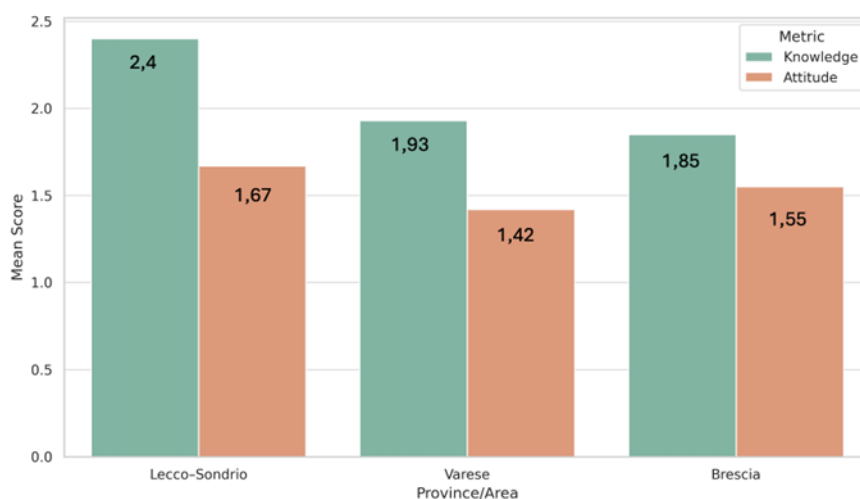


Figure 5. Mean Knowledge and Attitude Levels Toward REC by Area

The results clearly indicate that the involvement of local institutions has a statistically significant positive effect on REC awareness among SMI. However, the same cannot be concluded for SMI attitudes, which appear less directly influenced by LPA activity.

The findings of the analysis point to a general knowledge deficit among Lombard SMI regarding REC. A considerable portion of respondents assessed their understanding as either minimal or non-existent, aligning with earlier survey insights that emphasized widespread informational gaps. If a weak correlation has been found between awareness and the economic impact of energy costs ($r \approx 0.023$), a moderate positive correlation (≈ 0.34) between awareness and attitude levels suggests a meaningful relationship: as SMI knowledge of REC improves, so does their openness and willingness to engage. This association underscores the importance of targeted educational and outreach initiatives designed to enhance SMI familiarity with the benefits and functioning of REC. To leverage this potential, it may be necessary to reassess current communication strategies, particularly those implemented at the regional level. Findings from the Lecco–Sondrio area provide a compelling case for the strategic role of LPA, such as municipalities. Their proximity to SMI, combined with more frequent and personalized interaction, appears to generate higher levels of trust, an essential factor in overcoming scepticism and inertia, especially when introducing novel sustainability models like REC. While the Lecco–Sondrio area demonstrates a clear advantage in terms of SMI knowledge, this did not translate into a statistically significant difference in attitudes compared to Varese and Brescia. This may suggest that awareness alone is not always sufficient to shift perceptions or behaviours, particularly when structural, economic, or organizational barriers remain unaddressed.

Those results, as in Figure 6, reinforce the idea that local commitment from LPA contributes meaningfully to awareness building but that further support mechanisms, such as training, incentives, or collaborative platforms, may be necessary to transform awareness into proactive participation in energy communities.

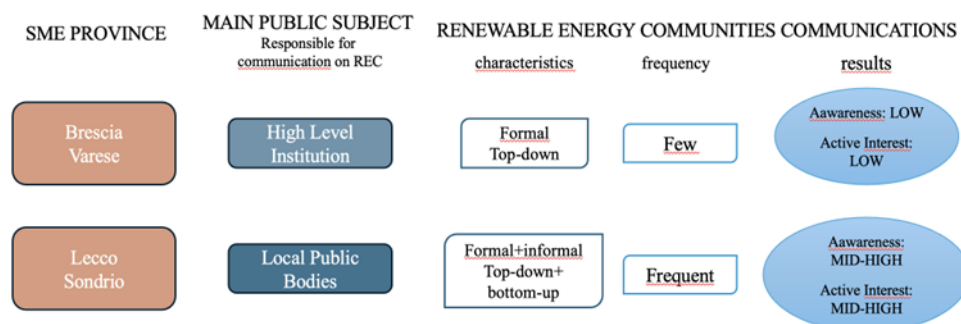


Figure 6. Research findings

Conclusions

This study has addressed the growing relevance of Renewable Energy Communities (REC) within the broader framework of Italy's commitment to sustainable, low-carbon energy transitions. Grounded in empirical evidence from a regional survey, the analysis focused on three economically and industrially comparable areas of Lombardy - Lecco–Sondrio, Brescia, and Varese - chosen for their differing levels of engagement with REC-related initiatives.

The findings confirm that LPA plays a crucial role in shaping awareness and perceptions of REC among SMI. Statistical analysis underlined several interesting issues that can be summarised as follows:

- i. The highest awareness at a regional level is 51%, not interested due to low familiarity with the REC concept, minimal exposure to targeted communication, and the absence of perceived urgency. Among the respondents, 51% indicated minimal or no knowledge of REC, and 34% openly stated they were not interested in participating, reflecting a significant informational and motivational gap.
- ii. The impact of energy on cthe ost of sales appears limited for most SMI in Lombardy. 50% of firms reported that energy expenses accounted for less than 5% of their sales revenue, and only 4% faced a critical impact (above 30%). This suggests that economic pressure from energy prices alone does not currently serve as a strong incentive for REC participation.
- iii. Comparative analysis across provinces shows a statistically significant difference in awareness levels. Lecco–Sondrio, where Local Public Authorities (LPA) demonstrated proactive and trust-based communication strategies, reported a mean awareness score of 2.40, compared to 1.93 in Varese and 1.85 in Brescia. The difference was statistically significant ($p = 0.0045$), highlighting the importance of localized engagement.

- iv. The attitude levels toward REC were generally low across all areas. Only 5% of respondents were actively engaged or trying to join an REC. Although Lecco–Sondrio also recorded the highest attitude score (mean 1.67), the comparative results across territories did not yield statistical significance ($p = 0.0836$). This suggests that awareness does not automatically lead to proactive participation.
- v. A moderate correlation ($r = 0.34$) was observed between awareness and attitude, indicating that higher awareness is associated with greater interest in REC initiatives. However, this correlation alone is insufficient to explain engagement behavior, implying that additional enabling factors, such as institutional support, incentives, or clearer implementation pathways, are necessary.
- vi. Trust in LPA emerged as a key driver of awareness and information accessibility. SMI demonstrated higher receptiveness to communications from local institutions than from regional authorities. This can be attributed to closer geographic and relational proximity, shared community identity, and ongoing interaction between firms and municipal actors.

The findings of this study suggest that the success of REC in industrial regions like Lombardy depends heavily on the active engagement of Local Public Authorities (LPA). Given their unique capacity to build trust and facilitate communication with Small and Medium-sized Industries (SMI), municipalities should be formally empowered and resourced to act as institutional bridges in energy transitions. Regional and national policy frameworks would benefit from a subsidiarity-based approach, wherein LPA are not only implementation agents but strategic actors in awareness campaigns, training programs, and local investment facilitation. Moreover, the moderate correlation between REC awareness and engagement underscores the need for multilayered interventions: incentives and legislative reforms must be complemented by grassroots communication and tailored support at the local level to convert awareness into participation.

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Conflict of Interest: The authors reported no conflict of interest.

Data Availability: Data available on request due to privacy restrictions. The data presented in this study are available on request from the corresponding author.

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Family Entrepreneurship in the Local Economic Structure: A Study in Ecuador

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Abstract

This research paper analyzes the impact of family entrepreneurship on the economic structure of Ecuador, Guano Canton. It adopts a qualitative and quantitative approach. The sample represents the total entrepreneurial population, which includes 72 entrepreneurs. Using analytical methods such as multinomial logistic regression and multiple linear regression, it examines how family entrepreneurship, measured through income generated, entrepreneur training, and participation in fairs, relates to the canton's economic structure. It highlights the role of entrepreneurship in job creation, economic diversification, and social progress in the canton. It also emphasizes the dynamic interaction between entrepreneurs and the community, as well as the importance of training mechanisms and participation in fairs in promoting innovation and entrepreneurial development.

Keywords: Family entrepreneurship, income, fairs, training, economic structure

Introduction

Family entrepreneurship arises from different motivations and circumstances. At its inception, it is based on a family's ability to notice an opportunity in the market, which may be related to the identification of unmet needs, a shared enthusiasm for a specific field, or the inheritance of particular knowledge and skills (Rahman et al., 2022; Harahap et al., 2023; Gimmon & Felzensztein, 2023; Brogan & Dooley, 2024). As this opportunity takes shape, the family creates a business plan that addresses key aspects such as strategy, financing, and management. It also involves a willingness to face certain risks, given that every new business entails uncertainty and challenges (Hadri et al., 2023; Blanco-Gonzalez-Tejero & Cano-Marin, 2023; Uzuegbunam et al., 2024). The ability to address these challenges with ingenuity and determination is essential to transform the idea into a successful and sustainable long-term venture. Family businesses may have risks, but their development opportunities are broad and are based on local resources, their social and human capital (Hadri et al. 2023; Uzuegbunam et al., 2024).

Family entrepreneurship plays an important role in the household economy and has the capacity to transcend generations by transmitting knowledge, values, experiences, and traditions, thus enriching the local economy with a long-term vision and a special commitment to sustainable development at the community level (Chirapanda, 2020; Gomez-Mejia et al., 2020; Lin & Wen, 2021; Clauß et al., 2022). These businesses are not only economic drivers but also play a fundamental role as agents of change, driving progress at the individual and community levels (Astrachan et al., 2020; Hair et al., 2021; Tien, 2021; Le Breton-Miller & Miller, 2022; Bargoni et al., 2023). Family businesses are immersed in a challenging scenario that threatens their continuity and the development of these business units due, in some cases, to a lack of performance policies and strategies at the production and market levels (Camilleri & Valeri, 2021; Ferreira et al., 2021; Lumpkin & Bacq, 2022; Gashi Nulleshi, 2024). Competition with other medium and large companies is also a factor to which they are exposed (Sorenson & Milbrandt, 2023); however, experience, family unity, and cultural aspects of family businesses have been present over time, and their prospects are sustainable over time due to their micro and family structure (Haynes et al., 2021; Obermayer et al., 2022; Alkaabi et al., 2023).

Access to financing and resources, restricted markets in the face of the constant threat of globalization can also be mentioned as obstacles. These aspects represent some of the most significant barriers for these businesses in rural areas (Manelli et al., 2023; Harahap et al., 2023; Floris & Dettori, 2024), as well as logistical resources for transportation and others related to marketing processes (Vázquez-Parra et al., 2022; Lind & Calapuja, 2022). Furthermore, the need to adapt to current technological demands and the lack

of access to specialized training programs become additional challenges to increase their productive capacity and competitiveness in a changing economic environment (Wu et al., 2022; Randerson, 2024; Arregle et al., 2024; Uzuegbunam et al., 2024).

In Latin America, microenterprises represent 88% of formal businesses and contribute 27% of employment, although their contribution to production is only 3.2% (Cacay et al., 2023). Last year, this sector received 2.2% of global financing, a decrease from 3% the previous year (Mika et al., 2024). This reduction is significant considering the importance of the entrepreneurial sector for economies (Ventín-Sánchez et al., 2023). In the region, 42% of entrepreneurs proactively identify business opportunities, while 28% start ventures out of necessity (Gomez-Mejia et al., 2024). Therefore, it is crucial to promote and strengthen the development of entrepreneurship, given its fundamental role in economic growth and job creation (Khoo et al., 2024; Pischetola & Martins, 2024).

In Ecuador, an entrepreneurial activity rate of 34% is observed, reflecting people's willingness to undertake despite the fear of failure (Anzules-Falcones, 2023). Regarding aspirations to become entrepreneurs, the country records 10% of people interested in this prospect (Buitron & Deshoullière, 2023). Furthermore, 19% of the population shows a long-term intention to undertake a business (Desfrancois & Gilles, 2023). These data indicate the presence of an entrepreneurial spirit in Ecuadorian society, although there are challenges and opportunities to promote entrepreneurship and support those who wish to become long-term entrepreneurs (Ayaviri-Nina et al., 2023).

The Guano canton is located in the province of Chimborazo in Ecuador. It has a total population of 42,851 inhabitants, distributed between 7,758 inhabitants in the urban area and 35,093 inhabitants in the rural area. These data come from the population and housing census conducted on November 28, 2010. Furthermore, the poverty rate due to unmet basic needs reaches 83.44% of the total population of the canton, while extreme poverty affects 49.6% of its inhabitants. Within this context, 42.3% of the population identifies as part of the economically active population (EAP). Additionally, a total of 72 entrepreneurial ventures have been registered in the two urban parishes. Against this background, this research aims to determine the impact of family entrepreneurship on the productive economic structure of the Guano canton.

Literature Review

Numerous studies, both theoretical and empirical, have raised great expectations on the subject to be investigated, since, in recent years, family entrepreneurship has been recognized as an essential element to promote the

economic growth and development of a country (Yilmaz et al., 2024). Family entrepreneurship arises with the purpose of achieving business independence, freeing itself from dependence on external organizations. Entrepreneurships together with small and medium-sized companies constitute 86% of the total establishments' nationwide (Toloza et al., 2023). This sector generates 75%. Therefore, the contribution to the economic structure is relevant and they are agents of economic change and contribute to the sustainability and long-term growth of family businesses (Zehra & Usmani, 2023; Marín-Palacios, 2023; Cruz et al., 2024). In the specific case of Guano, recognized as the artisanal capital of Ecuador, a unique entrepreneurial network has been fostered, where the creation of products and services goes beyond simple commercial transactions. In this context, businesses not only focus on artisanal production but have also become carriers of skills and knowledge that are passed down from parents to children, thus preserving ancestral techniques and fostering a sense of cultural continuity (Cabrera et al., 2021).

The dynamic interaction between entrepreneurs and the community not only strengthens social ties but also generates an enabling environment for innovation and creativity (Bislími, 2022; Ayaviri-Nina et al., 2024). Education is presented as an integral component that facilitates the effective transmission of knowledge, values, and skills, significantly influencing the modification of behaviors and attitudes (Ferreira et al., 2021), where knowledge and entrepreneurship are intrinsically intertwined, providing an enlightening answer to the recurring question of whether entrepreneurs have an innate predisposition or whether they develop from a good entrepreneurial education (Shaturaev, 2022). The education of entrepreneurs would be a factor strongly related to the development of entrepreneurship and in this way, the contribution to the local economy is important in the same terms (Bichler et al., 2022).

Others, however, highlight the progress of local development in rural communities through the formation of groups of people interested in establishing business units with common objectives, based on trust and community culture (Lee, 2023), which are intrinsically linked to the active participation of various local actors (Kraus et al., 2021); these actors include local organizations, leaders and representatives of organizations, unions, educational institutions, health centers, Non-Governmental Organizations, producers, associations and the population (Hussin & Aziz, 2021), where the contribution to the family and local economy is important and allows it to project the local development of the communities (Mars, 2022). The key to promoting such progress lies in the implementation of inclusion mechanisms, association of producers and effective joint participation in initiatives aimed at strengthening local development, considering the economic contribution coming from productive units (Roslan et al., 2022; Paunović et al., 2024).

Methods

The research includes the hypothetical-deductive method on family entrepreneurship in the productive economic structure of the Guano Canton, which is descriptive correlational because it looks to determine the degree of relationship between the study variables. According to data provided by the Guano Canton Learning and Entrepreneurship Unit, a total of 72 family businesses were registered, such as carpet, shoe, leather goods, textile, bakery, and gastronomy. This constituted the population and study sample in the urban area that was surveyed. The questionnaire included 32 dichotomous questions, Likert scales, structured and semi-structured questions, and open-ended questions. Secondary information was used, such as documents and reports from the Guano GAD (National Autonomous Government of Guano), and specialized literature on the subject. SPSS software was used for data processing and hypothesis testing, and hypothesis testing was performed through multinomial logistic regression and multiple linear regression.

Results

The surveyed population was 45.8% male and 54.2% female. Regarding their educational background, 55.6% had a secondary education, followed by 33.3% who reported having completed elementary school, and 11.1% had a university education. 76% indicated that they decided to start a business out of necessity, while 24% chose it out of opportunity. Most family businesses have been operating for more than six years, representing 47% of the sample; they are followed by those that have been operating for four to five years, at 32%. A smaller percentage, at 15%, has between one and three years of market experience.

Family businesses are the primary source of income for 81% of respondents, while the remaining 19% indicate they also have other income from productive economic activities. This suggests that most rely primarily on their family businesses for their economic support, highlighting the importance of these businesses in generating income for families in Guano. Regarding the financing of business units, 53% financed their ventures through bank loans, followed by 28% who used personal savings and 19% who resorted to family loans. None of the respondents indicated having financed their ventures with government subsidies. This indicates that most entrepreneurs rely on external resources, primarily bank loans.

Hypothesis verification

To test the hypothesis, two models are used: multinomial logistic regression and multiple linear regression. Both allowed us to examine the relationship between the economic structure and factors such as income, participation in fairs, and training within the context of family

entrepreneurship in the Guano canton. Based on Bichler et al. (2022) and Mars (2022), the economic structure is classified into three distinct categories: a) High: contribution; b) Medium: contribution; c) Low: low contribution.

Dependent variable

Yi=Economic structure (K=3 was set: 1=high, 2=medium, 3=low).

Independent variable

Xi1=Monthly income=It represents the amount of income generated monthly by the family business in the Guano canton.

Xi2=Participation in fairs=The frequency with which the family business participates in trade fairs and events in the Guano canton.

Xi3=Training=Reflects whether family business employees have received specific training related to family entrepreneurship over the past 12 months.

The multinomial logistic regression formula is presented as follows:

$$\pi_{in} = \frac{e^{z_{in}}}{1 + e^{z_{i1}} + e^{z_{i2}} + e^{z_{i3}} + \dots + e^{z_{ik}} - 1}$$

$$Z_{in} = \beta_{n0} + \beta_{n1}X_{i1} + \beta_{n2}X_{i2} + \dots + \beta_{nj}X_{ij}$$

Where:

π_{in} represents the probability that case i belongs to class n.
 Z_{in} is the value of the dependent variable Z for case i in class n.
 β_{nj} is the coefficient of the independent variable j for class n.
 X_{ij} is the value of the independent variable j for case i.

The following hypothesis is proposed: **H1**= Family entrepreneurship impacts the productive economic structure of the Guano canton through employees or family members.

Descriptive analysis

The qualitative variables were numerically coded with 0 and 1 (see table 1), which was subsequently used in the multinomial logistic regression model.

Table 1: Description of the dependent variable

Variable	Variable name	Values	Descriptive	
Economic structure	Thunderstorm	High = 0	31	43.1%
		Average=1	22	30.6%
		Low= 2	19	26.4%
Total			72	100%

Source: Own elaboration

According to the data presented in Table 1, it is observed that 43.1% of respondents have a high economic contribution, followed by 30.6% who have a medium rate, and finally, 26.4% have a low rate. Once the data was entered into the SPSS statistical software and the multinomial logistic regression analysis was applied, the following results were obtained, see Table 2.

Table 2: Case Processing Summary

		N	Marginal percentage
Withholding of employees or family members	High	31	43.1%
	Average	22	30.6%
	Low	19	26.4%
Valid		72	100.0%
Lost		0	
Total		72	

Source: Own elaboration

This table presents the number of cases entered into the model, those selected for analysis, and those excluded due to missing values, which are considered lost cases. The total number of cases entered was 72.

Table 3: Model Fit Information

Model	Model fit criteria	Likelihood ratio tests		
	Log likelihood -2	Chi-square	Gl	Sig.
Intersection only	137.17			
End	6.39	130.78	6	.000

Fountain: Own elaboration

The Pearson statistical tests showed a statistically significant result for the model, and the sigma value was 0.000 ($p < 0.05$). The Pseudo R-squared is also presented in Table 4.

Table 4: Pseudo R squared

Cox and Snell	.837
Nagelkerke	.947
McFadden	.844

Source: Own elaboration

The Cox and Snell (0.837), Nagelkerke (0.947) and McFadden (0.844) values indicate that the model explains between 83.7% and 94.7% of the variance in the data, indicating a robust and significant fit of the model to predict the categories of the dependent variable.

Table 5. Likelihood ratio tests

Effect	Model fit criteria	Likelihood ratio tests		
	Reduced model -2 log likelihood	Chi-square	Gl	Sig.
Intersection	25.55	19.158	2	.000
Generain	14.16	7.773	2	.021
Feriaspt	13.52	7.135	2	.028
Capaemp	14.90	8.512	2	.014

Source: Own elaboration

The chi-square values and their corresponding significance levels indicate whether the inclusion of each effect significantly improves the model's predictive power. In this case, the effects (monthly revenue generated, venture participation in fairs, and employee training in the last 12 months) show significant chi-square values ($p < 0.05$), indicating that these factors have a significant impact on the dependent variable (employee or family retention). The parameter estimates are shown in Table 6.

Table 6. Parameter estimates

Tsemplea		B
Average	Intersection	-0.12
	Geneing	3.41
	Fairs	-1.77
	Capacity	0.24
Low	Intersection	-5.36
	Geneing	4.86
	Fairs	-2.66
	Capacity	2.07
a. The reference category is high		

Source: Own elaboration

The parameter estimates in the table show how each variable, such as revenue, trade show attendance, and employee training, influences the probability of retaining employees in the company compared to the business-as-usual situation, represented by the High category, indicating that when revenue decreases or trade show attendance increases, the probability of retaining employees decreases, while higher employee training increases this probability.

$$Z_{in} = \beta_{n0} + \beta_{n1}X_{i1} + \beta_{n2}X_{i2} + \dots + \beta_{nj}X_{ij}$$

Probability for mean:

$$Z_{in} = -0,12 + 3,41X_{i1} - 1,77X_{i2} + 0,24X_{i3}$$

$$Z_{in} = 1,76$$

Probability for decline:

$$Z_{in} = -5,36 + 4,86X_{i1} - 2,66X_{i2} + 2,07X_{i3}$$

$$Z_{in} = -1,09$$

Once the Z values for each category (Employee Retention) were obtained, the probability of belonging to each category was calculated using the equation expressed.

$$\pi_{in} = \frac{e^{Z_{in}}}{1 + e^{Z_{i1}} + e^{Z_{i2}} + e^{Z_{i3}} + \dots + e^{Z_{ik}-1}}$$

$$\pi_{in} = \frac{e^{Z_{1,76}}}{1 + e^{Z_{1,76}} + e^{Z_{-1,09}}} = 0,81$$

$$\pi_{in} = \frac{e^{Z_{-1,09}}}{1 + e^{Z_{-1,09}} + e^{Z_{1,76}}} = 0,04$$

It is observed that the probability of belonging to the medium employee retention category is 81%, while the probability of belonging to the low employee retention category is 0.4%.

Multiple linear regression is formulated as follows:

$$Y(\text{Estruenco}) = \beta_0 + \beta_1(\text{Geneing}) + \beta_2(\text{Ferias}) + \beta_3(\text{Capacit}) + \varepsilon$$

Where:

Yt: Dependent variable. (Economic structure).

$\beta_0, \beta_1, \beta_2, \dots$: Attribution between variables

$X_1, X_2, X_3, \dots$: Independent variables (Income generation, fairs, training)

β_0 : Constant term or intercession

The results for the alternative hypothesis: **H1**= Family business impacts the economic structure of the Guano canton, through the income generated monthly, participation in the local market and the participation of the business in fairs, is the following (see table 7).

Table 7. Model summary

Model	R	R squared	Adjusted R-squared	Standard error of the estimate
1	.908a	.824	.816	.387

a. Predictors: (Constant), Participation of the venture in fairs, Training, Income generated monthly

Source: Own elaboration

In table 6, it is shown that R represents 0.908 which indicates that there is a strong positive correlation between the dependent variable (years operating your business) and the independent variable (income generated monthly, participation in the local market and participation of the business in fairs) of 90.8%, because this result is close to 100%, it is also shown that R² has a value of (0.824), which means that the independent variable explains 82.4% of the variance of the dependent variable.

Table 8. Anova

Model	Sum of squares	Gl	Mean square	F	Sig.
1 Regression	47.69	3	15.89	106.23	.000b
Residue	10.17	68	.150		
Total	57.87	71			

a. Dependent variable: Years operating your business

b. Predictors: (Constant), Participation of the venture in fairs, Participation in the local market, Income generated monthly

Source: Own elaboration

Table 8 shows a significance level of .000 less than 0.05, which indicates that the null hypothesis is rejected and the alternative hypothesis is accepted, that is, family entrepreneurship affects the economic structure of the Guano canton, manifested through the income generated monthly, participation in the local market and the participation of the enterprise in fairs.

Table 9. Coefficients

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.	95.0% confidence interval for B	
	B	Dev. Error	Beta			Lower limit	Upper limit
1 (Constant)	.973	.330		2.945	.004	.314	1.632
Income generated monthly	-.190	.079	-.196	-2.407	.019	-.347	-.032
Participation in the local market	.776	.106	.641	7.305	.000	.564	.988
Participation of entrepreneurship in fairs	.177	.081	.190	2.174	.033	.015	.340

a. Dependent variable: Years operating your business

Source: Own elaboration

In Table 9, the three independent variables show statistically significant coefficients, as they are less than 0.05, and are therefore associated with the number of years the business has been operating. After analyzing the results of the different hypothesis testing methods, it is concluded that the alternative hypothesis is valid in all cases. In the multinomial logistic regression test, a result of 0.000 was observed, which is lower than the standard significance level of 0.05. This leads to the rejection of the null hypothesis and the acceptance of the alternative hypothesis. In the multiple linear regression, a significance level of 0.000 is identified, which is also below the standard of 0.05. As a result, the proposed alternative hypothesis is accepted: Family entrepreneurship impacts the productive economic structure of the Guano canton.

Discussion

Based on the findings identified through the testing methods employed, they consistently support the alternative hypothesis. First, the multinomial logistic regression test, with a result of 0.000, below the standard significance level of 0.05, confirms the hypothesis H_i that family entrepreneurship impacts the productive economic structure of Guano canton through the retention of employees or family members. Likewise, the multiple linear regression revealed a significance level of 0.000, also confirming the alternative hypothesis, through the monthly income generated, the training of entrepreneurs, and the presence of the enterprise at fairs.

Research such as Bislimi (2022), Shaturaev (2022), and Cruz et al. (2024) highlights the crucial role of entrepreneurship in generating employment and economic income, diversifying and contributing to the economic structure in rural contexts. Furthermore, contributions from authors such as Cevallos and Zaldumbide (2021) and Vásquez et al. (2023) highlight the dynamic interaction between entrepreneurs and the community, which not only strengthens social ties but also promotes an enabling environment for innovation and creativity in markets or fairs (Bargoni et al., 2023; Mika et al., 2024; Randerson, 2024). In this context, training mechanisms and participation in fairs play a fundamental role by providing entrepreneurs with the necessary tools and spaces to develop their skills, adapt to market changes and take advantage of new growth opportunities (Quispe Fernandez et al., 2017; Gomez-Mejía et al., 2020; Uzuegbunam et al., 2024).

Conclusions

The results obtained from the analysis conclusively support the assertion that family entrepreneurship has a significant impact on the productive economic structure of Guano Canton. When identifying the challenges and opportunities for family entrepreneurship in Guano Canton, a

number of factors were observed that influence its success and development. Among the challenges are lack of access to financing, competition with larger companies, and a lack of specialized training. However, various opportunities were also identified, such as the growth of the local market, government support through specific policies and programs, and access to new technologies. Overcoming these challenges and taking advantage of these opportunities is critical to strengthening and sustaining family entrepreneurship in Guano Canton.

Finally, as a recommendation, strategies should be implemented to create a favorable environment for family entrepreneurship, promoting innovation, competitiveness, and sustainable growth in the Guano Canton. To achieve this, it is important to have all local stakeholders participate in a continuous and coordinated manner in implementing a set of support and mentoring actions, such as financing, local fairs, and the opening of new markets. This will strengthen and diversify the canton's economic base and improve the quality of life of its residents.

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Advancing Cloud Adoption in the Saudi Public Sector: Challenges, Global Insights, and Strategic Policy Recommendations

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Abstract

Cloud computing has become a cornerstone of digital transformation strategies in the public sector, offering government entities scalable infrastructure, cost efficiency, and enhanced service delivery. In Saudi Arabia, adopting cloud technologies is a national priority aligned with Vision 2030, aiming to modernize government operations and increase digital agility. However, the transition to cloud environments within government institutions faces several challenges. This paper explores the key barriers to cloud computing adoption in Saudi Arabia's governmental sector. These include data governance concerns, cybersecurity requirements, organizational readiness gaps, and rigid procurement models. Through a comprehensive analysis of national frameworks and sector-specific studies, the paper uncovers the root causes of slow adoption and identifies opportunities for improvement. The study also draws comparative insights from global practices, offering lessons that can inform local strategies. Based on the findings, it proposes practical recommendations to support more effective cloud adoption in the Kingdom's public sector. These focus on governance enhancement, capacity building, policy alignment, and fostering a cloud-positive culture within institutions.

Keywords: Cloud Computing, Government Sector, Public Sector Transformation, Saudi Arabia, Cloud First Policy, Data Sovereignty, Digital Government, Cloud Adoption Challenges, Cloud Cybersecurity, Vision 2030

Introduction

Cloud computing is transforming how governments operate and deliver services. It provides public institutions with scalable, on-demand infrastructure, offering the potential to reduce costs, enhance flexibility, and modernize service delivery. Globally, cloud technologies have become essential components of government digital strategies as agencies move away from traditional systems in favor of more secure and efficient environments.

In Saudi Arabia, cloud adoption supports the goals of Vision 2030, which seeks to expand the digital economy, improve government efficiency, and foster innovation. The Cloud First Policy advances this agenda by urging ministries and agencies to prioritize cloud-based solutions in all new technology initiatives. Supporting this policy is a regulatory ecosystem that includes data governance rules, cybersecurity standards, and standardized service models.

Despite this strategic direction, implementation remains uneven across government entities. Many organizations face structural and operational challenges that slow progress. These issues include legacy procurement systems, internal resistance, limited technical capacity, and complex compliance requirements. As noted in one national report, "government agencies face challenges in cloud adoption due to fragmented internal processes and varying digital capabilities" (NCA, 2022). These gaps show the importance of focused actions to turn national policy into practical steps at the institutional level.

This paper explores the current landscape of cloud computing adoption in Saudi Arabia's government sector. It analyzes institutional, regulatory, and technical barriers, reviews relevant literature and policy frameworks, and offers strategic recommendations tailored to the national context.

Methodology

This study takes a qualitative, policy-focused approach appropriate for examining complex institutional and regulatory contexts where statistical data may be limited or non-generalizable. It draws primarily on secondary data and published materials to explore how cloud adoption progresses within Saudi Arabia's public sector. The methodology consists of three key components, each contributing to the analysis distinctly:

- **Document Analysis:** Key national frameworks were systematically reviewed to understand the strategic and regulatory landscape. These included the KSA Cloud First Policy (2020), DGA guidelines (2023), SDAIA's NORA framework (2024), and other official publications issued by relevant authorities. These documents were selected based on their regulatory significance and direct relevance to public sector cloud adoption.

- **Literature Review:** A thematic analysis of peer-reviewed academic studies and sector-specific reports was conducted. Sources were identified through targeted keyword searches in academic databases and grey literature repositories. The review aimed to surface commonly cited challenges, risks, and enablers of cloud adoption, especially in the Saudi context.
- **Comparative Case Study Analysis:** International practices from the United Kingdom, United Arab Emirates, and Singapore were examined to identify relevant lessons. These cases were chosen using purposive sampling based on similarity in government structure, policy maturity, and alignment with Vision 2030 priorities. The case studies were analyzed using a comparative lens to extract transferable strategies.

This multi-source analytical approach provides a robust basis for identifying patterns, challenges, and actionable insights. It allows the study to synthesize evidence from national policy frameworks, academic findings, and international experiences to form a grounded set of recommendations.

Literature Review

Cloud computing is regarded as a foundational element in modernizing government services worldwide. Its ability to streamline infrastructure, improve agility, and reduce costs makes it an attractive option for public sector transformation. Nevertheless, adoption is frequently hindered by various internal and external factors. The literature identifies issues related to data security, regulatory uncertainty, technical complexity, and organizational readiness.

Among the most persistent concerns are data privacy and security. Government institutions often handle sensitive citizen information, making them particularly cautious about migrating services to the cloud. One study found that "security, privacy, and loss of governance are still the main obstacles for adopting cloud computing technology" (Majid Al-Ruithe, 2018). These concerns are especially prominent in environments with strict national data regulations, such as Saudi Arabia.

Institutional capacity also plays a critical role. A government report noted that "adoption efforts remain uneven due to varying levels of maturity, leadership support, and internal technical readiness" (CITC, 2023). This inconsistency suggests that policy mandates alone are insufficient to ensure widespread adoption; organizations must possess the skills, tools, and change-readiness to act on those policies.

Other studies echo the challenge of limited internal expertise. For instance, a lack of cloud awareness and IT proficiency in higher education institutions has hindered implementation. A sector-specific review reported

that a "lack of awareness and technical knowledge" significantly delayed cloud projects in Saudi universities (Fatani, 2021).

A recent review by Al Khatib and colleagues (2025) emphasized that while cloud computing holds great promise for public e-services, its successful implementation requires addressing institutional capacity gaps, data security risks, and appropriate service model selection, especially in contexts governed by strict data regulations. This reinforces the need for tailored strategies in policy-driven environments like Saudi Arabia.

Several countries have addressed these barriers internationally through coordinated national strategies. The United Kingdom, for example, launched a G-Cloud framework to simplify procurement and ensure secure access to pre-approved vendors. Singapore's GovTech model and the UAE's cloud zones similarly prioritize standardization and security compliance.

Additionally, the OECD highlights that cloud computing services represent essential infrastructure in the digital economy but are marked by high market concentration, with a few global providers dominating many jurisdictions (OECD, 2025). This concentration has implications for regulatory frameworks and procurement decisions, especially in smaller or developing markets.

Furthermore, technological infrastructure is a determining factor in effective cloud deployment. According to a strategic outlook report, "the increasing enterprise adoption of cloud-based solutions necessitates high-performance, secure, and scalable connectivity" (Khan, 2025). These requirements pressure national networks and data centers to evolve alongside digital government initiatives.

Empirical research conducted in Greek municipalities has shown that cloud adoption remains exploratory, with limited use of virtual machines and higher reliance on SaaS and private cloud models. The study emphasized the influence of IT staff readiness, infrastructure quality, and perceived control on cloud decisions (Nanos & Stafyla, 2024). Such findings highlight the need for localized assessments when planning cloud rollouts in government contexts.

Overall, the literature suggests that cloud adoption in the public sector depends on regulatory guidance and institutional capacity, trust frameworks, and technological readiness. In Saudi Arabia, these findings highlight the need to match policy goals with the ability to carry them out effectively on the ground.

Saudi Arabia Context

Saudi Arabia's public sector is undergoing a strategic digital transformation as part of its Vision 2030 agenda. A key element of this transformation is the broad use of cloud computing technologies to enhance government efficiency, improve service delivery, and support data-driven

decision-making. The government introduced the Cloud First Policy in 2020, which serves as the primary directive for cloud adoption among government entities to support this shift.

The policy requires that public institutions adopt a tiered approach to cloud service deployment. Specifically, "government entities must always prioritize Cloud solutions in the following sequence: first Software as a Service (SaaS), then Platform as a Service (PaaS), and lastly Infrastructure as a Service (IaaS)" (KSA Cloud First Policy, 2020). This structure is intended to reduce complexity, optimize performance, and minimize the cost and time of implementation.

Regulatory and operational oversight of the Cloud First Policy is distributed among several national bodies. The Digital Government Authority (DGA) is responsible for policy guidance and digital maturity assessment. The National Cybersecurity Authority (NCA) enforces cybersecurity compliance through instruments such as Cloud Cybersecurity Controls (CCC). The National Data Management Office (NDMO) ensures proper data classification and information governance, while the Communications, Space & Technology Commission (CST) regulates cloud service providers and enforces licensing and operational standards.

Another barrier is the variation in digital readiness among different agencies. Some ministries have successfully initiated migration strategies, while others rely on legacy infrastructure. This inconsistency was acknowledged in a national digital guideline, which emphasized that "agencies must evaluate cloud readiness across technical, security, and data classification dimensions before initiating migration" (DGA, 2023). In practice, many agencies lack the internal capacity and effective governance models to perform such evaluations.

A study on national digital architecture further explained that "digital transformation programs must address differences in institutional capacity and establish a common governance baseline to ensure consistent outcomes" (SDAIA, 2024). Without this consistency, cloud migration efforts risk being fragmented, delayed, or mismatched with national strategies.

While Saudi Arabia has made significant progress in developing policy frameworks and infrastructure, the operationalization of cloud adoption remains uneven. Bridging this gap will require more substantial alignment between national strategy and agency-level execution, supported by tailored governance models, shared platforms, and capacity-building initiatives.

According to a World Bank assessment, Saudi Arabia's digital ambitions are advancing steadily. The country has improved its standing in global digital governance rankings and is actively positioning itself among the top digital performers worldwide (World Bank, 2024). This upward

momentum underscores the urgency of resolving internal barriers to cloud adoption.

Key Challenges in Saudi Government Cloud Adoption

In Saudi Arabia's public sector, cloud computing adoption faces several interrelated challenges that limit national cloud strategies' widespread and consistent implementation. These barriers are technical but also institutional, regulatory, and cultural. This section outlines six primary challenges identified through policy reviews and empirical studies.

Data Sovereignty and Loss of Governance

Data sovereignty is one of the most cited concerns in Saudi government cloud adoption. Agencies are restricted in where and how they store sensitive data, especially those categorized under high-security classifications. As mandated by policy, "data classified in level 1 (top secure) or level 2 (secure) must be hosted in the Government cloud (NIC)" (KSA Cloud First Policy, 2020). This requirement supports national security but restricts broader cloud ecosystems' flexibility and scalability. Inter-agency coordination and clarity in governance responsibilities also remain inconsistent. For example, one report notes that "government agencies are required to coordinate with multiple stakeholders to ensure proper data governance, but the fragmentation between cloud providers and institutional policies creates risk" (Yesser, 2023).

Security and Privacy Concerns

Government agencies are particularly cautious about data security due to the sensitivity of the information they manage. Concerns about unauthorized access, breaches, and insufficient control over external environments persist. A foundational study found that "privacy issues," "security issues," and "loss of governance" were the most significant concerns expressed by public sector employees regarding cloud computing (Majid Al-Ruithe, 2018). These worries are exacerbated by limited awareness of existing cybersecurity frameworks. Another review confirmed that "security and privacy challenges continue to discourage organizations from moving sensitive workloads to public cloud environments" (Amin, 2021).

Organizational Readiness and Skills Gap

While policy frameworks exist, many government agencies lack the skilled personnel to execute cloud migration plans. A national review in the education sector found that a "lack of awareness and lack of technical knowledge" delayed or derailed cloud initiatives (Fatani, 2021). Similarly, a gap in practical skills has been identified as a key barrier in government

settings. One study concluded that "the shortage of experienced IT personnel is a major concern for government institutions planning to migrate to cloud platforms" (Khanfar, 2020).

Resistance to Change and Digital Culture

Adopting cloud solutions often requires structural changes in workflows and governance. These shifts can meet internal resistance, particularly in risk-averse and hierarchical organizational cultures. According to one research paper, "resistance to organizational change remains a challenge in digital transformation, especially where roles, control, and data access are restructured by cloud platforms" (Alshehri, 2021). Effective change management and leadership engagement are essential to mitigate this challenge.

Procurement Limitations and Vendor Lock-In

The cloud services procurement process often conflicts with the traditional procurement models used in the public sector. These legacy systems were designed for hardware and long-term software contracts, not for the pay-as-you-go, service-based model typical of cloud computing. One study revealed that "vendor lock-in" remains a pressing concern, particularly when agencies lack exit strategies or contract flexibility (Majid Al-Ruithe, 2018). Another report explained that "the rigidity of current procurement models in the public sector reduces the ability to engage flexibly with cloud service providers or to diversify across vendors" (Mansour, 2020).

Technical Infrastructure and Connectivity Barriers

Despite national investments in ICT, disparities in infrastructure remain across Saudi government agencies. Some entities lack access to the high-performance connectivity required for secure, uninterrupted cloud services. This can deter or delay migration efforts. A recent analysis observed that "the growing complexity of cloud infrastructure necessitates more advanced connectivity solutions, particularly for mission-critical applications" (Alotaibi, 2022). Without such infrastructure, cloud transformation will continue to face operational bottlenecks.

Comparative Insights from Global Practices

Governments worldwide have developed various strategies to overcome the challenges of cloud computing adoption. The approaches taken by the United Kingdom, the United Arab Emirates (UAE), and Singapore are noteworthy. Their models offer valuable insights that Saudi Arabia can adapt to strengthen its cloud transformation journey.

United Kingdom: G-Cloud and Centralized Procurement

The United Kingdom has implemented a highly structured and centralized approach to cloud adoption through its G-Cloud framework. This digital marketplace enables public agencies to procure cloud services from pre-approved vendors quickly and efficiently. The framework also reduces the administrative burden of procurement while ensuring compliance with national cybersecurity and data protection standards. As observed in one comparative study, "countries like the UK and Singapore established national cloud platforms that served to standardize procurement, enhance cybersecurity, and centralize compliance" (El-Haddadeh, 2020).

United Arab Emirates: Executive-Driven Transformation and Data Localization

The UAE's government has promoted cloud computing through strong top-down leadership and public-private partnerships with major global cloud providers. Executive sponsorship has played a pivotal role in accelerating cloud adoption, supported by national cloud zones that align with local data residency and security requirements. These zones have helped address concerns about data sovereignty while providing scalable and compliant cloud infrastructure. This approach illustrates the effectiveness of aligning political will with technological deployment.

Singapore: Trust Frameworks and Technical Enablement

Singapore has advanced cloud adoption through a balanced model that combines governance, technology, and workforce development. Its Government on Commercial Cloud (GCC) program provides agencies with secure cloud access supported by centralized compliance controls, pre-certified service providers, and technical templates. One analyst noted that "the integration of centralized compliance frameworks and technical enablement tools increases institutional trust in cloud platforms and encourages adoption" (Mujtaba, 2021).

Relevance to the Saudi Context

The experiences of the UK, UAE, and Singapore provide Saudi Arabia with actionable models for institutional alignment and technical acceleration. Standardizing procurement, investing in executive-level advocacy, and establishing technical toolkits for government agencies are all proven enablers of cloud success. These international examples suggest that centralized governance, regulatory clarity, and digital skill-building are essential to translating policy intent into operational impact.

Strategic Recommendations

To advance cloud adoption in Saudi Arabia's public sector, a set of integrated strategic measures is required. These recommendations are derived from the challenges explored earlier and shaped by global practices that have yielded positive outcomes. Each recommendation reinforces alignment between national policy and organizational action while promoting trust, capability, and performance across institutions.

Establish Cloud Governance Units in Each Government Entity

While national frameworks exist, institutional-level governance is inconsistent. Government entities should create dedicated cloud governance teams to oversee adoption strategies, ensure regulatory compliance, and align with national digital priorities. One guideline emphasizes that "agencies must evaluate cloud readiness across technical, security, and data classification dimensions before initiating migration" (DGA, 2023). These internal structures are essential for translating strategic intent into operational results.

Build a National Public Sector Cloud Skills Program

A structured training program should be introduced to address skill gaps to enhance cloud literacy, cybersecurity awareness, and vendor management capabilities across ministries. This initiative could include tiered certification, on-the-job learning, and career advancement incentives. A national study confirms that "the shortage of experienced IT personnel is a major concern for government institutions planning to migrate to cloud platforms" (Khanfar, 2020).

Modernize Public Sector Procurement for Cloud Services

Procurement reform is needed to enable flexible engagement with cloud service providers. This includes implementing pre-approved vendor lists, standardized contract templates, and consumption-based billing options. As highlighted in comparative research, "standardized procurement frameworks can enhance cybersecurity and reduce institutional delays" (El-Haddadeh, 2020). These models can significantly reduce onboarding time and support multi-vendor ecosystems.

Introducing a Cloud Acceleration Fund for Priority Agencies

Targeted financial support should be directed toward under-resourced government entities that demonstrate high cloud impact potential. A cloud acceleration fund can finance pilots, shared services, and fast-track cloud transformation in ministries with cross-cutting public service functions. This can stimulate sector-wide adoption and generate proven templates for replication.

Implement National Change Management Frameworks

Adoption success depends on stakeholder buy-in and cultural alignment. Ministries should be supported with national toolkits that guide leadership alignment, staff engagement, and workflow redesign. As one study affirms, "resistance to organizational change remains a challenge in digital transformation, especially where roles, control, and data access are restructured by cloud platforms" (Alshehri, 2021). A national change management framework will help mitigate these internal barriers and normalize adoption practices across the public sector.

Conclusion

Cloud computing has become a vital enabler of digital transformation in the Saudi public sector. The government has taken commendable steps through the Cloud First Policy and regulatory frameworks, but implementation remains inconsistent across ministries. This paper identified key adoption challenges, including data residency requirements, cybersecurity concerns, procurement inflexibility, and skills shortages.

The study analyzed local barriers and examined global benchmarks from the United Kingdom, United Arab Emirates, and Singapore. It emphasized the importance of an integrated, whole-of-government approach to ensure consistent and scalable outcomes. Saudi Arabia can benefit from international practices prioritizing centralized procurement, capacity building, and institutional alignment.

The recommendations proposed in this paper range from governance structures and procurement reforms to skills development and change management, offering a path forward. As highlighted in the literature, "resistance to organizational change remains a challenge in digital transformation" (Alshehri, 2021), highlighting the critical role of leadership, communication, and organizational preparedness.

With continued investment in policy execution and organizational capability, Saudi Arabia is well-positioned to lead in developing secure, scalable, and citizen-centric government cloud services.

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Environmental Accounting in Albania: Current Public Disclosure and the Reality Behind Closed Doors

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Abstract

Environmental accounting (EA) has become an essential tool for incorporating environmental costs and performance into corporate reporting and decision-making. This paper analyzes the status of EA in Albania, a developing economy and EU candidate, by evaluating the public disclosure of environmental information and the internal practices of EA within enterprises. A content analysis was performed on the websites and financial reports of 100 big Albanian enterprises, in conjunction with a structured survey of 71 managers. Results indicate a substantial disparity between outward reporting and internal practices. Public environmental disclosures are scant; only a limited number of companies release quantitative or financial environmental data, and almost none produce independent sustainability reports, indicating a "gray" reporting environment. Survey results reveal that approximately one-third of organizations have initiated internal environmental accounting practices or sustainability initiatives, albeit without external communication. Significant obstacles hindering the wider implementation of Environmental Accounting encompass constrained financial resources, the absence of regulatory mandates, inadequate stakeholder pressure, and minimal awareness or expertise in sustainable accounting, as noted by prior literature in developing countries. Analyzing the results via stakeholder, legitimacy, and institutional theories indicates that the lack of external pressures and obligatory frameworks has resulted in complacency in disclosure, notwithstanding increasing internal awareness. The research underscores an

immediate necessity for enhanced regulatory frameworks, capacity development, and stakeholder involvement in Albania. In aligning with the EU's CSRD (2022) and global reporting requirements, it is imperative to bridge the divide between public reporting and private practice to enhance corporate transparency and accountability.

Keywords: Environmental Accounting; Sustainability Reporting; Developing Countries; EU Corporate Sustainability Reporting Directive (CSRD); implementation barriers

Introduction

Sustainable development has emerged as a global necessity due to the escalating threat of environmental degradation to economic and social welfare. Business entities are recognized as significant contributors to environmental degradation and essential participants in implementing solutions. The discipline of environmental accounting has developed to enhance conventional accounting by integrating environmental costs, obligations, and performance indicators into financial reporting and managerial decision-making. Essentially, EA offers a framework for firms to assess and disclose their environmental impacts in both monetary and non-monetary terms, thereby improving transparency and stewardship.

The necessity for environmental accounting, both theoretically and practically, is well-established. Notwithstanding its acknowledged significance, the practice and disclosure of environmental accounting exhibit considerable variation globally. A substantial body of literature has examined why certain firms adopt EA while others fall behind. Several theoretical frameworks have been employed to understand these practices. Stakeholder theory asserts that companies respond to the expectations and pressures of their stakeholders, such as investors, regulators, consumers, employees, and communities, by disclosing pertinent environmental information and improving performance.

Developing countries typically experience weaker external influences on EA, and Albania is no exception. The corporate sector in Albania is in the nascent stages of its sustainability journey, and anecdotal evidence indicates that environmental disclosure by Albanian entities is limited (ICG Research Team, 2020). Until the late 2010s, there was almost no issuance of independent sustainability reports by Albanian companies. A notable exception was a cement manufacturer, part of an international conglomerate, which published an audited sustainability report in accordance with Global Reporting Initiative (GRI) standards.

The financial reporting framework in Albania has not officially incorporated environmental reporting, and previous studies indicate that

Albania's accounting standards lack specific mandates or structure for environmental disclosure (Jupe et al., 2014; Biracaj et al., 2014). The regulatory deficiency, coupled with insufficient stakeholder awareness, indicates that numerous companies may see environmental information as confidential or immaterial, resulting in diminished openness. Nonetheless, activities conducted behind closed doors, such as whether companies monitor environmental costs internally or implement sustainable practices without public disclosure, remain mostly ambiguous due to insufficient prior research.

Given Albania's bid for European Union (EU) membership, the matter of environmental accounting and reporting has acquired heightened significance. Compliance with EU requirements, including the recently enacted Business Sustainability Reporting Directive (CSRD, 2022), would necessitate significant enhancements in business transparency regarding environmental, social, and governance (ESG) issues. This establishes both an expectation and an opportunity for Albanian organizations to enhance environmental accounting procedures (European Commission, 2025). However, a deficiency persists in both the research and practice: to what degree are Albanian enterprises presently involved in environmental accounting, whether publicly or privately? What variables are impacting their behavior?

This study seeks to address the gap by exploring “Environmental accounting in Albania: actual public reporting and the reality behind closed doors.” While prior research acknowledges that environmental accounting practices in developing countries are typically hindered by weak institutional pressures, limited stakeholder engagement, and regulatory deficiencies (Belal & Owen, 2007; Hahn & Kühnen, 2013), little attention has been devoted to explicitly quantifying or comparatively analyzing these conditions in the Albanian context. Although literature identifies broad patterns in developing economies (e.g., limited disclosure due to resource constraints and inadequate regulatory frameworks) (Ali, Wilson, & Husnain, 2022; Belal, 2015), a direct comparative analysis highlighting Albania's unique situation remains absent. By examining both external disclosures and internal practices within Albanian firms and juxtaposing these findings against data and established literature from comparable developing nations, this research aims to clearly quantify and illustrate the distinct nature of Albania's environmental accounting landscape, thus providing a richer, empirically grounded understanding of this critical research gap.

The subsequent research questions (RQs) guiding the investigation:

- RQ1: What environmental information, if any, do Albanian enterprises disclose in their official communications (e.g., financial statements, annual reports, websites)?

- RQ2: What is the internal status of environmental accounting within Albanian enterprises in terms of implemented practices, managerial awareness, and perceived barriers or enablers?

Our report offers a thorough examination of the status of environmental accounting in Albania by answering these inquiries. The results are analyzed using stakeholder, legitimacy, and institutional theories to comprehend how external forces and internal factors intersect to influence EA outcomes. The study not only records the existing disparity between public reporting and internal procedures but also examines its implications concerning Albania's sustainable development commitments and alignment with the EU. In the following sections, we initially examine pertinent literature regarding the global demand for EA and the recognized challenges in developing nations (Section 2). Subsequently, we delineate our methodology, encompassing content analysis and survey methodology (Section 3). Section 4 presents the results, followed by a discussion that connects the findings to theory and expectations in Section 5. Section 6 outlines the study's limitations, Section 7 provides recommendations for policy and practice in Albania, and Section 8 concludes the paper.

Review of Literature

Global Significance of Environmental Accounting and Theoretical Frameworks

Environmental accounting has gained international significance as stakeholders increasingly demand corporate responsibility for ecological effects. Climate change and environmental threats are widely acknowledged as financial challenges, rather than merely ethical concerns, impacting company performance and long-term economic stability. Environmental Accounting is seen as an essential instrument for firms to recognize and address environmental costs (such as waste, pollution, and resource use) that conventional accounting may overlook. By quantifying environmental consequences in monetary terms (such as expenses associated with pollution or the benefits of eco-efficient investments), environmental accounting facilitates improved internal decision-making and conveys sustainability performance to external stakeholders. Research indicates that incorporating environmental factors can stimulate innovation and enhance efficiency; for example, thorough examination of environmental expenses frequently uncovers opportunities for waste reduction, resulting in decreased operational costs and increased long-term profitability (Henri & Journeault, 2010; Burritt & Christ, 2016). Moreover, thorough environmental reporting can bolster a company's reputation and brand equity, as investors and customers increasingly prefer enterprises with robust sustainability credentials. A seminal study by Eccles et al. (2014) identified a positive association between

the quality of sustainability reporting and a firm's financial performance, indicating that "doing good" can coincide with "doing well" financially.

Three theoretical frameworks are frequently employed to elucidate corporate involvement, or the absence thereof, in environmental reporting: stakeholder theory, legitimacy theory, and institutional theory. Stakeholder theory posits that businesses are responsible to a diverse array of stakeholders who can influence or are influenced by the company's actions (Freeman, 1984). In the context of environmental disclosure, stakeholder theory posits that companies will provide more environmental information when subjected to heightened demands or expectations from significant stakeholders, including regulators, investors, customers, local communities, and non-governmental organizations. For instance, when investors seek climate risk information or when significant customers mandate that suppliers adhere to environmental norms, organizations are strongly motivated to implement EA practices and provide relevant information (Fasua & Osifo, 2020; David, 2022). Conversely, in the absence of stakeholder interest or pressure, firms may deprioritize environmental projects.

Legitimacy theory emphasizes the societal “license to operate.” It asserts that firms strive to ensure their operations are perceived as legitimate by society, aligning with social values and expectations. Achieving environmental legitimacy involves demonstrating that the firm’s environmental performance is acceptable to the public. If a company’s activities threaten the environment or draw public scrutiny (after a pollution incident), legitimacy theory predicts the firm will respond by improving environmental disclosures or practices to restore its reputation and align with societal norms (Suchman, 1995; Deegan, 2002). Notably, legitimacy theory can sometimes lead to a different prediction than stakeholder theory: it often suggests that organizations with compromised environmental legitimacy (due to poor performance) might disclose more information to manage perceptions. However, if external scrutiny is minimal (as in a setting where regulators and society show limited interest in corporate environmental performance), even poor performers may feel no need to disclose, resulting in consistently low reporting levels.

Institutional theory provides a broad perspective on how regulatory, normative, and industry forces shape corporate behavior. In developed markets, environmental reporting is increasingly formalized and mandated (through stock exchange rules, sustainability standards, etc.), creating coercive and normative pressures for companies to comply. In such contexts, not reporting can have legitimacy costs or signal non-compliance. In contrast, in many developing countries environmental reporting began as voluntary and

fragmented, with companies selectively adopting frameworks (GRI¹, SASB², TCFD³, etc.) or disclosing only favorable information. The absence of standardized requirements led to inconsistencies and non-comparable reports. Companies may selectively disclose favorable metrics, treating sustainability reports more as public relations tools than accountability instruments. Institutional theory posits that in the absence of coercive pressures (binding laws) and strong normative pressures (professional norms, industry best practices valuing EA), corporate behavior will vary widely. Many firms may simply not engage in environmental reporting, especially if they see no immediate benefit or if competitors are also not reporting (lack of mimetic pressure).

Global developments are now strengthening institutional pressures for EA. The EU's CSRD (2022) extends mandatory sustainability reporting to a broader range of companies and requires the use of uniform standards, while the new ISSB standards (IFRS S1 and S2, 2023) aim to globalize sustainability disclosure. These represent emerging coercive pressures that will likely influence Albanian companies via EU accession obligations and through multinational business networks. IFAC (2024) warns that without embracing international standards, developing markets could become a "gray zone" characterized by unreliable sustainability information and reduced investor trust. In summary, all three theories suggest that where external pressure is weak - a typical scenario in developing economies - corporate environmental transparency will remain low. Our study will later use these frameworks to interpret Albania's specific situation.

Environmental Accounting Challenges in Developing Countries

The difficulties of implementing environmental accounting are exacerbated in underdeveloped nations, where economic and institutional limitations sometimes obstruct the adoption of EA techniques and the scope of public reporting. A previous study delineates many principal obstacles and contributing elements in these contexts:

¹ Global Reporting Initiative is an international independent standards organization that provides guidelines and standards for sustainability reporting, enabling businesses and organizations to communicate their environmental, social, and governance (ESG) impacts transparently

² The Sustainability Accounting Standards Board (SASB) is an independent nonprofit organization that develops industry-specific sustainability standards, enabling companies to disclose financially material environmental, social, and governance (ESG) information to investors.

³ The Task Force on Climate-related Financial Disclosures (TCFD) is an initiative established by the Financial Stability Board (FSB) that develops voluntary, consistent disclosure recommendations to help companies inform investors and stakeholders about climate-related financial risks and opportunities.

Restricted Financial Resources: Enterprises in emerging nations often function under stringent capital limitations and may perceive investments in environmental management systems or certifications as nonessential. The expenses associated with implementing new pollution control technology, acquiring certifications such as ISO 14001, or employing environmental professionals can be exorbitant, particularly for small and medium firms. In the absence of external incentives or subsidies, environmental activities are often deprioritized relative to essential company expenses. According to the resource-based view of the company, organizations with ample resources are more capable of implementing EA, while resource-constrained firms prioritize survival and short-term financial gains. A 2012 global survey conducted by ACCA also identified the notion of elevated costs as a significant factor contributing to reluctance in voluntary environmental reporting. In underdeveloped nations, this obstacle is particularly pronounced: for instance, obtaining inexpensive finance for green initiatives is challenging, and governments infrequently provide financial incentives (such as tax cuts or grants) to mitigate initial expenses.

Expertise and Data Challenges: The implementation of environmental accounting necessitates specialized knowledge to quantify and assign monetary value to environmental impacts. Numerous companies have methodological challenges in evaluating environmental performance, such as assigning a monetary value to a ton of CO₂ emissions or estimating the costs associated with water pollution. Environmental impacts often involve externalities and scientific uncertainty, making quantification complex (Deegan, 2013). In fact, companies may resort to reporting select non-monetary indicators (such as trash or emissions in tons) without including them into financial records, owing to the absence of recognized valuation methodologies. Furthermore, the quality and availability of data are critical concerns. Companies may operate across various locations or suppliers, making the collection of consistent environmental data difficult.

Developing nations frequently lack comprehensive environmental monitoring infrastructure (laboratories, sensors, databases) and depend on manual data collection, resulting in increased variability and inaccuracies. Boiral et al. (2022) observe that discrepancies in data gathering among various sites and suppliers cause managers to doubt the veracity of sustainability metrics in comparison to established financial figures. Moreover, only a fraction of sustainability data, often comprising critical indicators such as carbon emissions, is subject to independent audit or assurance, if it is examined at all, even inside large companies. In 2021, around 69% of large multinational companies received some level of assurance for their sustainability reports, indicating that 31% lacked any assurance, and even those with assurance frequently addressed only a restricted range of criteria.

In poor nations, external verification is exceedingly uncommon, attributable to the scarcity of qualified auditors and experience. These factors erode confidence in environmental data and may deter organizations from comprehensive reporting, as managers might fear that the data will not withstand inspection or find the process overly cumbersome from a technical perspective.

Inadequate Regulatory Frameworks: A recurring observation in emerging economies is the lack or ineffective enforcement of environmental reporting rules. In contrast to financial reporting, which is often obligatory and governed by stringent rules, environmental disclosure in numerous developing nations has predominantly been optional. Governments may implement fundamental environmental regulations (e.g., necessitating an Environmental Impact Assessment for certain projects or pollution discharge licenses), although they frequently do not require firms to disclose environmental performance in annual reports or financial statements. As a result, numerous companies, particularly those concentrating on local markets, opt not to disclose any sustainability statistics publicly. This regulatory void results in a situation where firms possess significantly more knowledge about their environmental impacts than they disclose publicly, hence producing information asymmetry. Belal and Owen (2007) serve as a seminal reference, illustrating that in Bangladesh, the lack of statutory regulations resulted in limited and selective corporate social disclosures, with companies frequently neglecting environmental considerations.

The latest EU CSRD (2022) significantly alters the landscape in applicable jurisdictions by expanding mandatory sustainability reporting to encompass a wider array of organizations, including major unlisted firms, and mandates the use of standardized criteria. Nonetheless, those outside the EU or not adhering to these norms may lag behind. IFAC (2024) cautions that without the integration of international standards, developing markets may transform into a "gray zone" for capital markets, characterized by untrustworthy sustainability information, leading responsible investors to refrain from investment. In conclusion, in the absence of a compelling impetus from regulators, many enterprises in developing countries display inactivity or inconsistency in the adoption of EA.

Insufficient Stakeholder Pressure and Awareness: Stakeholder activity and public consciousness on environmental issues are typically diminished in emerging contexts, hence lessening the informal accountability pressure on companies. Concerns such as poverty alleviation and economic progress frequently overshadow discussions regarding environmental protection. Belal et al. (2015) noted a trend of "prioritizing industrialization over sustainability" in numerous developing nations. Local communities may not request environmental information from companies, and oversight by civil

society or the media is frequently inadequate. In Albania, public and NGO influence on business environmental performance has traditionally been feeble, due to more pressing economic issues. According to stakeholder theory, a significant absent impetus is evident: if customers, investors, and communities do not inquire, companies will not disclose information.

Our analysis indicates that numerous Albanian managers regard the absence of customer or client need for certifications or reports as a primary factor for not participating in EA. A survey of managers (Wilson & Husnain, 2022) in various developing nations identified "low stakeholder interest" as a major impediment to sustainability reporting. Likewise, concerns regarding legitimacy are diminished; companies do not apprehend public reprisal for non-disclosure if society is not attuned to these matters. The outcome is a low-pressure equilibrium in which neither the market nor society significantly urges companies to alter their environmental accounting practices.

Organizational Culture and Management Perspectives: Internal variables are pivotal. Numerous enterprises in emerging economies have a short-term, profit-oriented management strategy, which may foster opposition to innovative methods such as environmental accounting, viewed as costly with unknown advantages. If senior executives lack personal conviction on the strategic importance of sustainability, they may perceive Environmental Assessment as a bureaucratic encumbrance or a transient phenomenon (Gray, 2010; Qian et al., 2018). Organizational culture prioritizing quick financial results sometimes disregards non-financial measures. Stakeholder theory posits that managerial response is contingent upon leaders' perceptions of stakeholders' concern with the issue. If not, people are prone to disregard it. According to legitimacy theory, if a company's leadership perceives no legitimacy threat (due to insufficient external inspection), it lacks motivation to modify internal values or promote environmental openness. In contrast, the uncommon instance of an ecologically aware owner or leader can markedly alter the scenario: research has indicated that the personal values of senior management can propel proactive sustainability implementation (Chang & Deegan, 2008).

In underdeveloped nations, certain small enterprises spearheaded by "green" entrepreneurs may voluntarily exceed compliance due to authentic dedication, even in the absence of external forces. Our findings indicate that several micro-enterprises in Albania adopted sustainability methods solely based on the owner's values, contrary to the prevailing tendency (as elaborated later). Nonetheless, a prevalent assertion is that insufficient managerial support and limited internal awareness regarding EA are obstructive elements (Jamil et al., 2014). Numerous organizations lack training or exposure to environmental accounting ideas, which intensifies leadership's indifference or mistrust. In our survey, 70% of Albanian respondents indicated that they had

never received information or training on environmental accounting, underscoring an educational and cultural deficiency inside firms.

In conclusion, literature and contextual evidence suggest that Albanian firms likely exhibit minimal public environmental reporting, largely due to the hurdles outlined above (regulatory gaps, weak pressures, resource and knowledge constraints). However, it is plausible that some companies have undertaken internal environmental initiatives (like adopting ISO 14001 or tracking certain metrics) without publicizing them. This discrepancy between private action and public disclosure is precisely what our research investigates. We aim to determine whether Albania's "gray" reporting environment signifies an actual lack of environmental management activity or simply a lack of transparency about activities occurring behind closed doors.

Table 1 delineates the relationship between these principal barriers and determinants and the theoretical viewpoints outlined.

Barrier/Factor	Theoretical Link
<i>Financial resource constraints</i>	Resource-Based View / Stakeholder Theory: Firms with limited resources avoid costly EA initiatives. Unless stakeholders (e.g. investors) provide financial support or demand it, cost is a deterrent (Elhossade, et al., 2022; Abubakr, et al., 2024; Hossain, 2019; IFAC, 2024; Zatini, et al., 2025).
<i>Difficulty in measurement & data</i>	Institutional Theory (Normative/Cognitive): Lack of standardized methods and expertise makes EA technically challenging. In weak institutional environments, no normative pressure ensures capability-building, so firms struggle to quantify impacts reliably (Deegan, 2013; Arendt, et al., 2020; Biral, et al., 2022; IFAC, 2021; UNCTAD, 2023)
<i>Weak regulatory requirements</i>	Institutional Theory (Coercive): In absence of coercive laws or standards, firms face no legal mandate to report. Under legitimacy theory, abiding by minimum legal requirements means if none exist for EA, non-disclosure is not seen as illegitimate (Gray & Bebbington, 2001; Oyedokun, 2021; Eljido-Ten, 2004; Hahn & Kühnen, 2013; Latif, et al., 2020; Benvenuto, et al., 2023).
<i>Lack of stakeholder pressure</i>	Stakeholder Theory: If key stakeholders (customers, investors, public) do not demand environmental accountability, firms have little incentive to engage in EA. Legitimacy Theory: Low public awareness means companies do not fear legitimacy loss for ignoring EA (Wilson & Husnain, 2022; Qian, et al, 2021; Ikram & Khalid, 2019; Sarkis, et al., 2010; Alnaim & Metwally, 2024).
<i>Management attitude & culture</i>	Stakeholder/Legitimacy Theories: Management's stance depends on perceived stakeholder expectations. In a profit-focused culture, seen through legitimacy theory, unless external norms shift, internal values resist change. Champions with personal "green" values (agency of leaders) can override these trends (Chang & Deegan, 2008; Nazari, et al., 2015; Benvenuto, et al., 2023; Hahn & Kühnen, 2013; Ali, et al., 2024; Adnan, et al., 2010; Amran, et al., 2013).
<i>Knowledge and training gap</i>	Institutional Theory (Normative): Weak educational and professional infrastructure on sustainability leads to low awareness (no normative pressure to conform to EA best practices). This undercuts adoption, as identified in many developing contexts. Stakeholder theory also implies that if managers don't understand EA, they won't recognize potential stakeholder benefits, perpetuating low engagement (Elhossade, et al., 2022; Zatini, et al., 2025; Ikram & Khalid, 2022; IFAC, 2024).

Table 1. Principal Obstacles/Elements in EA Execution and Their Theoretical Associations
Impediment/Element Theoretical Connection, Sources: Assembled by the author from diverse publications (Belal & Owen, 2007; Hahn & Kühnen, 2013; Dissanayake et al., 2020; Nazari et al., 2015; etc.) and the referenced theoretical frameworks.

The Albanian Context and Research Deficiency

Albania, as an evolving economy in Southeast Europe, illustrates the issues. The nation's accounting and corporate governance systems have been reformed to align with international norms, such as the adoption of IFRS for financial reporting; however, obligations for environmental and sustainability reporting are nearly nonexistent. A 2014 study on environmental liabilities in Albania determined that accounting procedures and regulations failed to establish an adequate framework for reporting environmental concerns. Since that time, there have been gradual enhancements (e.g., heightened discourse on environmental issues in specific companies' annual reports), however, no overarching mandate has been established. Environmental disclosures by Albanian companies are predominantly voluntary and limited.

Before this study, information regarding the involvement of Albanian enterprises in environmental accounting was exceedingly scarce. No academic research has systematically quantified the number of enterprises disclosing environmental information or the extent to which Albanian firms internally implement environmental accounting. Nonetheless, expert assessments and geographical analyses reveal a substantial disparity. For instance, adjacent nations that are EU members or aspirants have commenced the implementation of EU non-financial reporting regulations, but Albania remains behind. The singular significant instance of advanced sustainability reporting in Albania was ANTEA Cement (a subsidiary of the TITAN group), which, until about 2015–2020, was allegedly the only company in the country to produce a GRI-standard sustainability report. The company stated in its integrated report that, to its knowledge, it was the only entity in Albania with such a standardized sustainability report. This underscores the remarkable nature of detailed reporting within the Albanian environment.

Concurrently, Albania has environmental challenges, including urban air pollution, industrial waste management difficulties, and the necessity for sustainable natural resource utilization. In pursuit of EU entry, adherence to European environmental norms is crucial. The EU's CSRD (2022) is expected to be implemented by transposition into national legislation, necessitating that several Albanian enterprises, particularly large and publicly listed entities, will soon be obliged to report on their environmental and social performance in accordance with EU regulations. This forthcoming transition necessitates an evaluation of the current status of Albanian enterprises and the challenges they encounter in adopting environmental accounting.

In conclusion, the literature and contextual analysis indicate that Albanian enterprises likely exhibit minimal public environmental disclosure, possibly attributable to the stated hurdles (regulatory deficiencies, insufficient pressure, etc.). Nonetheless, it is conceivable that certain companies have initiated internal initiatives, such as implementing ISO 14001 environmental

management systems or monitoring certain environmental indicators for internal use, which are not disclosed in public reports. This study investigates both outward reporting and internal procedures and awareness. This approach offers a foundational evaluation for Albania and enhances the discourse on environmental accounting in developing nations, utilizing Albania as a case study to demonstrate the disparity between real practices and public responsibility.

Methods

To address the research questions, we employed a dual-method approach: content analysis of public disclosures and a structured survey of corporate managers. This mixed methodology allowed us to juxtapose companies' external environmental claims with their internal actions (or, at minimum, managers' perceptions of practices and obstacles). By triangulating these methods, we can discern whether a lack of public reporting reflects a genuine absence of internal EA activity or merely a lack of disclosure. All data were collected in line with ethical guidelines. The survey was anonymous, and participants were assured that only aggregated results would be reported. Given the sensitive nature of potentially admitting limited environmental action, ensuring confidentiality was essential to obtaining candid responses.

Content examination of Public Environmental Reporting:

We conducted a qualitative content analysis of environmental information disclosed by a sample of 100 Albanian enterprises. The sample focused on medium and large firms across key industries, primarily drawn from the national registry of major taxpayers (which lists top companies by revenue). The industry composition included approximately 33 manufacturing firms, 25 in trade, 16 in construction, 8 in energy and mining, and the remainder in services (such as transport and telecommunications). For each company, we gathered all publicly available materials related to environmental issues: annual financial statements and notes, annual reports or standalone sustainability reports (if any), press releases, and relevant website content (sections on corporate responsibility, environment, health & safety, etc.). We searched these sources for references to environmental policies, initiatives, performance, or expenditures. Our analysis focused on the period 2020–2023 to capture the current state of reporting.

We performed a manual content review, scanning documents for specific keywords (e.g., “environment,” “sustainability,” “emissions,” “ISO 14001”) and noting the presence or absence of various types of environmental disclosure. The key categories we tracked for each company were:

- **Environmental policy/commitment:** Does the company mention having an environmental or sustainability policy or mission?

- **Environmental management systems:** Any reference to certifications like ISO 14001 or internal environmental management frameworks.
- **Environmental initiatives:** Descriptions of projects or measures aimed at improving environmental performance (energy efficiency, waste reduction, etc.).
- **Quantitative environmental data:** Reporting of metrics such as emissions levels, energy or water usage, waste generation, etc.
- **Environmental expenditures or liabilities:** Disclosure of environmental capital investments, provisioning for environmental remediation, fines or penalties for non-compliance, etc.
- **Risk and governance disclosures:** Mention of environmental or climate-related risks in risk management sections, and any indication of governance structures for environmental oversight (e.g., sustainability committees or dedicated managers).

For each category and each company, we recorded whether such information was disclosed. We then aggregated the results to determine what percentage of companies disclosed each type of information (e.g., the percentage that have an environmental policy statement publicly, the percentage that reported any emissions data, etc.). This content analysis provides a broad overview of public environmental reporting practices (or lack thereof) among Albania's largest enterprises.

Survey of Managers on Internal Practices and Perceptions

To investigate the 'reality behind closed doors', we developed a structured questionnaire aimed at individuals responsible for finance or management within Albanian enterprises. These individuals were often chief financial officers (CFOs), accounting managers, or sustainability managers, when applicable. The survey was disseminated to the identical cohort of organizations utilized in the content analysis (when feasible) and to supplementary enterprises using professional networks and an online survey link. We obtained 71 legitimate responses, encompassing a varied array of sectors akin to the content analysis sample. The sector distribution of the responding companies closely reflected the sample frame: manufacturing (~25% of respondents), trade (~24%), services (~18%), construction (~10%), with additional sectors including energy and transport. This suggests that our study included a broad cross-section of the corporate environment.

The survey instrument was organized into sections aligned with our research topic and informed by the relevant literature on EA:

1. **Company and respondent background:** Questions about the firm's industry, size, and ownership, and the respondent's position (to contextualize responses).

2. **Knowledge and awareness:** Questions evaluating the respondent's familiarity with environmental accounting and sustainability reporting concepts. We asked if they were aware of frameworks like GRI, or if they had any training related to environmental accounting. We also asked about their awareness of national or international sustainability reporting regulations.
3. **Current practices:** Questions on whether the company has implemented any environmental accounting or sustainability practices internally. This included yes/no items on tracking environmental costs, setting environmental performance targets, having an environmental management system (e.g., ISO 14001 certification), measuring carbon footprint or other metrics, producing any sort of sustainability report (even if not public), or sharing environmental information with stakeholders (like investors or a parent company).
4. **Barriers to implementation:** Using a Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), we presented a list of potential barriers identified from the literature (see Section 2.2) and asked respondents to rate their agreement that each was a significant barrier for their company. The listed obstacles included: "Insufficient financial resources for environmental initiatives," "Absence of legal requirements for reporting," "Lack of pressure from customers or investors," "Management does not see environmental accounting as important," "Inadequate expertise or guidance on environmental accounting," and "Belief that environmental reporting is just marketing and not valuable." This section helped identify which barriers were considered most severe by managers.
5. **Perceived benefits and support needs:** Also using Likert scales, we asked about potential benefits of EA and what external support might encourage adoption. For example, we asked respondents to respond to statements like "Adopting environmental accounting could reduce our costs or improve our reputation," and whether they agreed that certain incentives or assistance would help (options included government-provided training or guidelines, subsidies or tax incentives for sustainability initiatives, availability of expert consulting support, opportunities to partner with universities on projects, etc.). This aimed to gauge managers' views on the advantages of EA and what would motivate their companies to engage more in it.
6. **Open comments:** A final open-ended question invited any additional observations or experiences regarding environmental accounting in the company, allowing respondents to elaborate in their own words or provide examples.

The survey questions were developed based on prior research to ensure we covered relevant topics. The list of barriers in section 4, for instance, was directly informed by common challenges found in developing country contexts (as summarized in our literature review). We conducted a pilot test of the questionnaire with a small number of experts and managers to check for clarity and relevance, making minor adjustments prior to full deployment.

Data Analysis

We used descriptive analytical techniques for both the content analysis and the survey data. For the content analysis, we calculated simple frequencies and percentages of companies disclosing each category of information. For example, we determined what fraction of the 100 companies had an environmental policy statement publicly, or how many provided quantitative environmental metrics. These results were primarily descriptive (e.g., “X% of companies report having an environmental policy”).

For the survey, we similarly relied on descriptive statistics. We computed the percentage of respondents who answered “yes” to implementation of various practices, the proportion who agreed (rated 4 or 5) that certain barriers apply, and average Likert-scale ratings for barrier and benefit statements. We also looked at differences between subgroups (e.g., comparing the responses of companies that have adopted EA practices vs. those that have not) in a qualitative manner - such as noting if one group tended to agree more with a statement than another (as we did for the cost barrier, comparing adopters’ and non-adopters’ average ratings). Given the exploratory nature of our study, we did not conduct advanced inferential statistical tests; instead, our analysis focuses on identifying key patterns and themes from the data.

By integrating the content analysis and survey findings, we can triangulate the results. For instance, if many managers claim their firms have implemented a certain internal practice, we can check whether evidence of that practice appears in their public disclosures. Conversely, if the content analysis shows very limited public reporting, the survey responses help us determine whether that reflects a genuine lack of activity or simply reticence to disclose.

This combined approach strengthens our interpretations: a convergence between the two data sources provides confidence in a finding, while a divergence (e.g., internal action present but external reporting absent) points to an interesting gap that warrants explanation.

All data were analyzed at an aggregate level to preserve the confidentiality of individual companies. In the next section, we present the results of the content analysis (public disclosures), followed by the survey results (internal practices and perceptions).

Results

Public Environmental Reporting: Findings from Content Analysis

The content analysis indicates that environmental disclosure among Albanian enterprises is remarkably weak. A significant majority of the 100 companies examined do not disclose any meaningful environmental information in their annual reports or on their websites. Table 2 presents the frequency and types of environmental disclosures among 100 Albanian companies analyzed in this study. Results indicate limited transparency, with 80% of companies providing no environmental disclosures.

Table 2: Frequency and Type of Environmental Disclosures (Content Analysis of 100 Companies)

Type of Environmental Disclosure	Frequency (n=100)	Percentage (%)
No Environmental Disclosure	80	80%
General Environmental Policy Statement	15	15%
ISO 14001 Certification or Environmental Management System (EMS)	12	12%
General Environmental Initiatives (Qualitative)	10	10%
Quantitative Environmental Performance Data (e.g., emissions, waste)	2	2%
Environmental Expenditures or Liabilities	2	2%
Governance Structures (Dedicated roles or committees for EA)	2	2%
Standalone Sustainability Report (GRI or equivalent)	1	1%

Key findings include:

Overall prevalence of environmental information: Merely 20% of companies disseminated any environmental information in their public communications, and this was frequently minimal. Approximately 80 out of 100 companies made no reference to environmental effect, strategies, or performance at all. The variation was sector-specific: around one-third of manufacturing firms referenced environmental issues, whereas only roughly 13% of trading companies disclosed such information. Industries such as services and energy were intermediate, with approximately one in four companies referencing environmental concerns. These references, however, were typically superficial.

Policy statements: Merely 15% of companies expressly indicated the existence of an environmental policy or commitment. Often, this was encapsulated in a solitary sentence inside the corporate profile or CEO statement (e.g., “We are dedicated to environmental protection and regulatory compliance”). Only a few organizations (approximately 2-3) provided additional details, such as specification of policy objectives or environmental

management systems. The majority of companies lacked a clearly articulated environmental policy.

Environmental management systems (EMS): Approximately 12% of the sampled organizations reported the implementation of an environmental management system certified to ISO 14001. These primarily comprised larger manufacturing or construction companies whose activities had considerable environmental influence. The disclosure usually appeared as a statement in the annual report or on the website indicating ISO 14001 certification. Although 12% is a small proportion, it is significant that several companies hold international standard certificates. It indicates that certain companies, particularly those engaging with foreign partners or markets, are willingly implementing these systems to enhance performance or comply with supply chain mandates. Nevertheless, the statistic indicating that over 90% lack such certification underscores the restricted dissemination of environmental management methods within the Albanian corporate sector.

Sustainability reporting and standards: Almost no Albanian enterprises provide independent sustainability or environmental reports that adhere to global standards (e.g., GRI). Historically, one company in the cement industry was the sole example of a comprehensive sustainability report that was both audited and compatible with GRI standards. Excluding that instance, our investigation did not identify any company issuing a GRI report or its equivalent. Certain companies incorporate a segment on environmental and social matters in their annual reports, particularly if they are subsidiaries of overseas multinationals that mandate ESG reporting. However, these parts are generally concise. The absence of uniform reporting results in a deficiency of comparability and depth, aligning with prior observations that GRI-based reporting has been "virtually non-existent" in Albania until recently.

Environmental hazards and compliance: Merely 2 out of 100 organizations were identified as recognizing environmental issues in their public documentation. This suggests that the disclosure of environmental risks, including potential liabilities, regulatory changes, and climate-related threats to the firm, is exceedingly uncommon. Likewise, discourse regarding adherence to environmental regulations was predominantly lacking; companies appear to assume legal compliance as a given and do not expound upon it in their reports. This low occurrence indicates that companies either do not formally evaluate these hazards or, if they do, opt not to disclose them. This also indicates the absence of regulatory mandates to incorporate such information in financial disclosures.

Governance and accountability: We saw a significant lack of transparency about environmental governance frameworks. Only one corporation specifically said that a board committee or a senior executive was accountable for environmental issues. Another corporation reported

possessing a structure, such as a Health, Safety, and Environment (HSE) department, for addressing environmental concerns. No other firm indicated any internal accountability for environmental performance beyond those mentioned. This indicates that environmental concerns have mostly not been incorporated into corporate governance for most companies (e.g., absence of sustainability committees, lack of referenced environmental managers).

Quantitative data about environmental performance: The most notable discovery is the significant lack of empirical data. Merely 2 companies (2%) revealed any quantifiable environmental performance metrics (e.g., emission levels, resource use). In such instances, the disclosures were restricted: for instance, a beverage firm revealed its annual water conservation and CO₂ emission reductions attained through efficiency initiatives. Another company supplied several statistics pertaining to recycling and trash minimization. These are exceptional instances; often, firms refrain from disclosing data such as total greenhouse gas emissions, energy consumption, water usage, or garbage production. Our data indicates that even companies in heavy industry did not publicly disclose such figures. Consequently, stakeholders possess few quantitative criteria to assess the environmental performance of Albanian enterprises.

Environmental expenditures and accounting entries: In alignment with the previously mentioned, financial disclosures about environmental expenditures or liabilities are nearly nonexistent. Merely 2% of companies, specifically two entities, disclosed any financial data pertaining to the environment. One corporation indicated the establishment of an environmental provision, presumably for prospective remedial expenses. None of the companies revealed environmental capital expenditures or fines incurred for environmental violations. This indicates that environmental expenditures are predominantly unrecognized in financial statements - they are either not incurred, unacknowledged, or not delineated from general expenses in reporting. This indicates a near-total absence of environmental accounting integration in external financial reporting: environmental expenses are not specified nor emphasized, and environmental liabilities, if there, are rarely acknowledged or quantified in public disclosures.

Table 3: Sectoral Differences in Environmental Disclosure

Sector	No. of Companies	% with Environmental Disclosure	Average "Environmental Score"
Energy & Hydrocarbons	9	~22% (2 of 9)	0.33 points (very low)
Pharmaceuticals	10	30% (3 of 10)	0.40 points
Construction/Infrastructure	16	~19% (3 of 16)	0.69 points
Manufacturing/Processing	33	33% (11 of 33)	1.12 points
Trade/Services	24	~13% (3 of 24)	0.21 points
Other (Telecom, Media, etc.)	8	25% (2 of 8)	0.75 points
Total/Average	100	~24% (24 of 100)	0.58 points (low)

Table 4 presents a summary of sectoral differences in environmental disclosure among 100 Albanian companies. The data show generally low disclosure rates across all sectors, with the highest rate observed in the Manufacturing/Processing sector (33%, averaging 1.12 points). Conversely, the Trade/Services sector demonstrated the lowest level of disclosure (around 13%, averaging just 0.21 points). Overall, environmental transparency remains limited, reflected by the low average score of 0.58 points across all sectors, highlighting the significant gap in public environmental accountability within Albanian companies.

In conclusion, the public disclosure of environmental issues by Albanian enterprises is largely minimal or non-existent. A limited number of comparatively advanced companies offer minimal disclosures (policy statements, ISO certification, a few performance indicators), although they are the exception. The general assessment is characterized by "gray" reporting, a term used by Gray (1993), who noted that numerous countries' business reports largely lack environmental (green) information. Our findings support the hypothesis derived from legitimacy theory that, in an environment characterized by minimal external demand, companies will not willingly disclose significant information regarding their environmental impact. The subsequent section's findings indicate whether this absence of reporting correlates with a deficiency in action or if certain companies are internally involved in EA without public disclosure.

Internal Practices and Perceptions: Survey Results

The managers' survey offers insight into the developments occurring behind closed doors concerning environmental accounting. The findings indicate that, although public disclosure is limited, there is somewhat increased internal activity, albeit still in the nascent stages for most organizations. Table 3 highlights sectoral differences in the adoption of internal environmental accounting (EA) practices based on survey responses

from 71 Albanian enterprises. The manufacturing sector showed the highest rate of internal EA practice implementation (77.8%), followed closely by construction (71.4%). Service-based sectors and energy/utilities also exhibited notable adoption rates (61.5% and 60%, respectively). In contrast, sectors such as trade/wholesale/retail (47.1%) and transportation/logistics (33.3%) demonstrated lower levels of EA engagement. Overall, approximately 59.2% of surveyed companies reported initiating some form of internal environmental accounting practices, underscoring considerable variability among industry sectors.

Table 4: Sectoral Differences in Internal Environmental Accounting (EA) Practices (Survey Results, n=71)

Sector	Number of Respondents	Companies Implementing EA Practices	Implementation Rate (%)
Manufacturing	18	14	77.8%
Construction	7	5	71.4%
Energy and Utilities	5	3	60.0%
Services	13	8	61.5%
Trade/Wholesale/Retail	17	8	47.1%
Transportation and Logistics	6	2	33.3%
Other	5	2	40.0%
Total/Average	71	42	59.2%

We present the principal findings:

Awareness and training: Respondents possess a limited understanding of environmental accounting. Merely 30% of managers reported having had any training or education in environmental accounting or sustainability reporting in recent years. In contrast, almost 70% reported lacking instruction on these subjects. Indeed, 40% of respondents acknowledged that they had not obtained any information regarding this topic from any source, including training, professional organizations, or media. This underscores a considerable awareness deficiency - numerous financial professionals in Albania remain unacquainted with EA concepts, indicative of the absence of such material in university curricula or ongoing professional development, a notion supported by IFAC (2024), which advocates for the modernization of accounting education to incorporate sustainability. Several respondents indicated in their comments that they became aware of certain terminology, such as “environmental management accounting,” solely through participation in the survey, highlighting the novelty of the notion in this context.

Current implementation of environmental accounting practices: We inquired if companies have initiated the implementation of any environmental accounting or sustainability practices. Approximately 32% of firms (23 out of 71 respondents) reported having initiated some form of internal EA practices.

This may encompass basic activities such as quantifying power consumption to more formal initiatives like implementing an environmental policy or acquiring ISO 14001 certification. Simultaneously, 44% (31 companies) reported that they have not yet adopted any such practices. The remaining 24% ("16 don't know" responses) indicates that those respondents were uncertain about their company's position, possibly due to the absence of a formal practice and their lack of personal engagement with it. The data indicates that almost one-third of companies are initiating sustainability efforts, despite a minimal percentage publicly disclosing any information. It verifies a disparity between internal practices and external disclosures: numerous companies that engage in internal actions fail to communicate them transparently.

Characteristics of practices among adopters: Among the respondents indicating that their company has initiated Environmental Assessment practices, prevalent examples included: monitoring energy or water usage to enhance efficiency, establishing waste segregation or recycling initiatives, adherence to ISO 14001 (notably, several of the 12% with ISO certification provided responses), and incorporating environmental criteria into investment decisions (such as evaluating environmental impact for new projects). Several individuals indicated that they have started the internal calculation of their carbon footprint or environmental KPIs, frequently motivated by mandates from international partners or parent companies. It is essential to acknowledge that these efforts are predominantly operational or managerial and have not yet been reflected in public reports.

The inclination to initiate Environmental Accounting practices was greater in specific sectors, consistent with anticipated environmental impact. Manufacturing and construction companies exhibited the highest adoption rates, with almost 80% of manufacturing firms and 71% of construction firms implementing at least one sustainable strategy. Sectors such as services and trading experienced a decline, with approximately 60-65% reporting some impact. This tendency is rational, as companies with more substantial environmental footprints (such as factories and building sites) are likely to experience a heightened necessity or external pressure (e.g., from overseas clientele) to mitigate those impacts. Notably, certain micro and small firms were included among the adopters. Our survey encompassed several diminutive firms (fewer than 10 employees), and unexpectedly, several reported participation in environmental initiatives. For example, one small design agency claimed to be "100% green" in its operations by utilizing solar power and offsetting emissions, motivated by the founder's principles. This corroborates our previous observation that firm size is not an unequivocal indicator; driven small firms might defy the trend. Statistically, size did not demonstrate a substantial impact on adoption rates in our sample, maybe due to sample biases or the pronounced effects of individual cases.

Identified obstacles: The survey illuminated the barriers that managers perceive most acutely. The obstacle identified as most significant by respondents was the **lack of pressure from customers/clients**. Approximately 41% of respondents gave this barrier a high rating (4 or 5 on the 5-point agreement scale), making it the most widely acknowledged hurdle. One respondent stated, "Our local clients do not request any environmental certifications or reports, so it is not a priority for us." This supports the prior theoretical assumption that in the absence of stakeholder demand, companies feel little incentive to act (Elhossade et al., 2022; Hossain, 2019). The next most frequently cited obstacles were:

1. **Financial cost concerns:** Numerous managers, particularly from firms that have not embraced Environmental Accounting, regard the supplementary expenses associated with environmental projects or reporting as considerable. Non-adopters assigned a high average rating of approximately 4.2/5 to the statement "Environmental accounting would incur significant financial costs for us," in contrast to adopters, who ranked it lower at 3.0/5. This suggests that cost represents a significant obstacle for enterprises that have yet to commence operations – a quintessential hindrance. **Absence of regulatory mandates:** A significant majority concurred that "If there were more stringent laws or obligatory requirements, we would comply, but in their absence, we do little." This indicates that companies mostly acknowledge the ineffectiveness of the voluntary method, yet they would adhere to regulations. A manager remarked, "We adhere to all Albanian environmental laws; however, as reporting is not mandated, we do not engage in it." If it is necessary tomorrow, we will certainly comply.
2. **Adequate knowledge/expertise deficiency:** Approximately 50% of respondents concurred that they "lack sufficient know-how or guidance" to execute environmental accounting. This correlates with the training deficiency. Companies lack confidence in initiating processes and determining metrics, resulting in their reluctance.
3. **Management and cultural disposition:** The responses were rather divided; approximately one-third explicitly concurred that their senior management "does not regard environmental accounting as significant" or that the corporate culture prioritizes short-term financial objectives over sustainability. Some individuals remained indifferent or expressed disagreement, frequently indicating that their own participation may elicit greater interest. Nonetheless, the absence of intrinsic motivation was recognized as a concern by numerous individuals.

4. ***Perception of low value (PR⁴ concern):*** A significant minority of respondents perceived that "sustainability reporting is primarily a public relations/marketing endeavor rather than a source of genuine value." Those who concurred with this viewpoint were predominantly from companies that do not engage in Environmental Accounting, suggesting a level of cynicism or skepticism regarding the efficacy of reporting. This mentality can serve as an impediment, as it diminishes possible advantages.
- ***Perceived advantages and motivations:*** Conversely, participants who have adopted EA methods or exhibit a favorable disposition generally believe in specific benefits. A significant proportion of adopters concurred that "enhancing environmental practices can diminish operational expenses (via efficiency)" and "it enhances our company's reputation and stakeholder confidence." Adopters also exhibited greater consensus with assertions such as "Our company would derive long-term advantages from incorporating environmental considerations." This disparity in perception between adopters and non-adopters indicates that once a company initiates engagement with environmental accountability, they begin to recognize its value, whereas those who have not remain skeptical or uninformed – a quintessential knowledge/experience gap.
- ***Required support:*** There was widespread agreement among both adopters and non-adopters that additional external assistance would be beneficial. Approximately 85% of participants concurred that the government ought to furnish more explicit recommendations or training on environmental accounting and reporting, and that various incentives (such as recognition, subsidies for sustainable initiatives, or streamlined reporting frameworks for small and medium-sized enterprises) would motivate them. A considerable percentage (about 60%) expressed a willingness to collaborate with institutions or experts to establish EA systems, and many desire workshops or pilot projects for experiential learning. A mere 18% expressed a willingness to incur substantial sums for external consultants to execute EA, suggesting a preference for public or subsidized support. One reply expressed a preference for assistance from universities or the state through projects or training, rather than using costly consultants, indicating a sensitivity to expenses.
- ***Internal versus external disparity:*** A significant revelation from integrating the previously mentioned results with the content analysis is the substantial divergence between internal actions and outward

⁴ Public Relations

disclosures. Of the 23 companies that reported implementing sustainability strategies, only a few publicly acknowledged such efforts. Numerous organizations engaged in internal initiatives, such as those adhering to ISO 14001 or implementing energy conservation programs, are not publicly disclosing these efforts, potentially overlooking an opportunity to highlight their achievements. In response to inquiries regarding their limited publicity, some managers indicated that either (a) they believed the public or investors would lack interest, (b) they were awaiting formal requirements or guidelines for reporting, or (c) they were apprehensive that partial or voluntary reporting could invite unwarranted scrutiny or necessitate additional effort to uphold. This suggests a prudent strategy; companies opt for silence over voluntary disclosure, potentially until it becomes customary.

The survey results illustrate a complex reality: a minority of Albanian enterprises are beginning to adopt environmental accounting or management techniques, primarily motivated by pragmatic considerations such as efficiency, fulfilling partner expectations, and individual initiative. Nevertheless, the majority are still in preliminary phases or have yet to commence, citing various obstacles. Knowledge deficiencies and the absence of external stimuli are widely evident. External action is poised to occur, either via regulation or capacity-building, to alter these views and behaviors.

Discussion

The results of our analysis indicate a significant disparity between the environmental claims made by Albanian enterprises and their actual practices. In analyzing these data, we utilize the previously established theoretical frameworks to elucidate the factors contributing to this disparity and juxtapose the literature's assumptions with the actual observations.

From a stakeholder theory perspective, the limited presence of environmental information in Albanian corporate reporting results logically from insufficient stakeholder pressure. Stakeholder theory predicts that if important stakeholders (investors, customers, regulators, community) do not require environmental accountability, companies will not provide it voluntarily. Our findings robustly corroborate this concept. Managers expressly said that insufficient pressure from customers or investors is a primary reason for not pursuing EA, with "no one requests it" being the foremost obstacle. Furthermore, Albania's capital market is limited and mostly influenced by short-term financial factors; environmental performance has not yet become a requirement for bank loans or investments, and there is a negligible presence of activist investors. Moreover, public understanding and civil society engagement regarding corporate environmental matters are

constrained. This backdrop corresponds with previous findings in underdeveloped nations (Belal & Owen, 2007; Belal et al., 2015), indicating that stakeholders frequently refrain from applying pressure, leading to limited corporate openness. The empirical observation that around 80% of companies provide no environmental disclosures, and merely 2% present quantitative data, can be attributed to the lack of incentives driven by stakeholders. Companies do not recognize a detriment from non-disclosure or an advantage from disclosure in the present environment.

Legitimacy theory provides an additional perspective. One may inquire: considering that Albania continues to confront substantial environmental issues (such as pollution), would firms not pursue legitimacy by demonstrating environmental responsibility? Legitimacy theory posits that they will, but solely if their legitimacy is jeopardized or if societal norms shift to anticipate such disclosures. In Albania, the social contract concerning corporate environmental responsibilities seems to be weak. Our findings indicate that firms do not perceive a legitimacy threat from their environmental impact, presumably due to insufficient challenges from society and regulators. For instance, even industries recognized for their pollution, such as oil extraction or mining in Albania, have not encountered significant public crises or pressure campaigns that compel them to engage in defensive transparency.

Legitimacy theory suggests that underperformers may release more information to manage perceptions; however, in this case, underperformers (assuming most are indeed underperforming or failing to handle impacts effectively) refrain from disclosures, indicating that the external pressure mechanism is inactive. Albanian enterprises arguably sustain legitimacy by adhering to minimal legal standards; specifically, if they comply with fundamental environmental requirements and face no protests, they perceive their legitimacy as secure without further reporting obligations. This aligns with the quotation from our literature: in a low-pressure climate such as Albania, we did not anticipate numerous companies to disclose environmental statistics, and this assumption was fulfilled.

Legitimacy theory can elucidate one facet: why do certain organizations implement internal processes notwithstanding the absence of external pressure? This may represent proactive legitimacy management in expectation of forthcoming norms. Companies with overseas partners or ambitions for worldwide markets may foresee the necessity of demonstrating environmental credentials in the future. By obtaining ISO 14001 or initiating emissions measurement at this time, they develop internal capabilities to ensure preparedness for any legitimacy demands that may emerge, such as EU rules or customer requirements. This is an endeavor to attain pragmatic legitimacy with certain stakeholders (Suchman, 1995) - for instance, companies mandating certification for suppliers. Some survey replies

indicated that organizations sought environmental certification due to expectations from a foreign client or parent company. In terms of legitimacy, Albanian enterprises are conforming to the standards of international stakeholders to preserve legitimacy in that relationship, despite the absence of local normative requirements.

Institutional theory elucidates the structural and normative context influencing these results. The absence of a coercive regulatory system in Albania is a critical element. In the absence of obligatory sustainability reporting regulations, companies incur no legal repercussions for failing to provide information. Our findings indicate that firms acknowledge they would increase their efforts if mandated by legislation, exemplifying a scenario where coercive pressure is now lacking but may be impactful if implemented. The institutional void encompasses normative pressures: Albania's professional accounting organizations, educational establishments, and business groups have just lately initiated discussions on sustainability, if they have done so at all. A robust professional standard asserting that "effective accounting encompasses environmental accounting" has yet to be established. This is evidenced by the limited training and understanding among managers, indicating an immature normative institutional framework. Mimetic pressures are minimal; if no peers are releasing sustainability reports, a company lacks an industry benchmark to imitate and may hesitate to differentiate itself or reveal sensitive information unnecessarily.

Institutional theory also encapsulates the emerging dynamic: the global movement towards standardization, exemplified by CSRD and ISSB standards, may ultimately impose coercive pressure on Albania through EU accession prerequisites and normative pressure as global companies and investors disseminate expectations. Initial indications suggest that the few enterprises exhibiting increased activity are frequently subsidiaries of multinational companies (subject to coercive pressure from their parent company) or those engaged with EU markets (experiencing mimetic pressure to conform to international standards). It is anticipated that as these companies lead by example, others will emulate them; however, this mimetic impact has not yet shown significantly, presumably due to the scarcity of examples and their limited publicity. Albania is now in the nascent phase of developing the institutional mechanisms for EA.

Comparing expectations with actual outcomes: Prior to the study, it could have been anticipated, considering Albania's EU candidacy and global trends, that a moderate proportion of bigger Albanian enterprises would have initiated sustainability reporting in some capacity. It would be logical to anticipate that banks or telecommunications businesses, typically early adopters in other sectors, may release CSR reports. Our data, however, indicate that essentially none of the large companies engage in such practices.

The extent of the public reporting gap is more significant than expected. Regarding internal procedures, we anticipated minimal adoption; yet the survey indicated a higher engagement level (32% adoption) than a skeptic might presume (it is not 0%; some organizations are implementing measures). This signifies latent progress under the surface. The relationship between knowledge and action is noteworthy: our findings corroborate other empirical research indicating that more awareness is associated with greater adoption. Organizations with managers possessing greater awareness of EA were markedly more inclined to use it, underscoring the significance of education and information dissemination as a catalyst.

One expectation of stakeholder and legitimacy theories is that companies in environmentally sensitive industries will disclose information or act more frequently due to increased legitimacy risk or stakeholder interest. In Albania, we observed that those sectors, specifically manufacturing and construction, exhibited greater rates of internal adoption. Nevertheless, they continued to withhold external disclosures. This indicates that although they acknowledge the necessity of managing the environment operationally (perhaps for reasons of efficiency or regulatory compliance), they do not perceive a requirement to disclose this publicly. They may be apprehensive that revealing environmental data could invite scrutiny, as some companies fear adverse reactions if the data is unfavorable, leading them to choose for silence - a tendency noted by certain legitimacy theory experts.

A significant topic of discussion is the disparity between public perception and private reality. The term "Reality Behind Closed Doors" is fitting; internally, organizations may be engaging in activities beyond public awareness. This disparity may provide challenges. From a stakeholder perspective, stakeholders cannot incentivize or promote companies for sustainability initiatives if they are uninformed about them. From a company's standpoint, any goodwill derived from environmental responsibility is relinquished if it remains concealed. Why would firms choose not to capitalize on reputational advantages from positive actions? The perceived dangers of disclosure, such as accountability, continual reporting, and providing information to regulators or NGOs that could be detrimental, likely outweigh the minimal reputational benefits in a society that has not yet fully recognized the value of such initiatives. In other words, firms may deliberately remain silent about their benevolent actions to prevent establishing a precedent or attracting scrutiny. This indicates a trust issue; they may lack confidence that disclosures will be addressed favorably or equitably.

By correlating data with theory, it is evident that all three viewpoints possess explanatory efficacy.

The stakeholder hypothesis is substantiated by the association between low pressure and minimal reporting. Legitimacy theory is demonstrated by

the generally low need for legitimacy restoration, except for enterprises exposed internationally.

Institutional theory is demonstrated by the absence of regulation and the explicit indication that the introduction of regulation would alter behavior, since respondents expressed a readiness to comply if required. Our research aligns with findings from earlier studies conducted in poor countries. Hahn & Kühnen (2013) observed that firm size and international orientation are prevalent drivers of sustainability reporting; in Albania, larger firms and those with overseas affiliations were marginally more engaged, while still not publicly reporting. Belal and Cooper (2011) identified a disparity between the external statements of companies in Bangladesh and their internal practices, frequently resulting in minimal disclosures; likewise, Albanian organizations exhibit slightly greater internal actions while maintaining limited external communication. One distinction is that in certain nations, external CSR reporting increased despite its low quality, occasionally serving merely as a superficial embellishment.

In Albania, firms have mostly refrained from reporting altogether, instead producing potentially shallow sustainability reports. This may be perceived as either a significantly delayed condition or a more candid approach (no reporting is preferable to deceptive reporting).

The discourse would be deficient without considering the forthcoming EU directive (CSRD). The significance cannot be exaggerated: once Albanian organizations, especially in the banking sector or large enterprises, are required to comply, we anticipate a profound transformation. Where legitimacy and stakeholder pressures have not incited action, a legal mandate is likely to do so. The inquiry, however, is: Are they prepared? Our data indicate a negative conclusion currently. If companies were required to prepare ESG reports tomorrow, many would have difficulties with data and expertise. This highlights the necessity for capacity improvement (as discussed in the recommendations).

In conclusion, the disparity between Albania's present condition and the anticipated criteria for EU alignment is substantial. The theoretical frameworks anticipated minimal interaction considering Albania's setting, and our empirical research corroborates these predictions. Theory also proposes avenues for enhancement: augment stakeholder pressures (via awareness and activism), elevate legitimacy concerns (by educating the public on corporate environmental accountability), and implement stringent institutional pressures (such as rules, standards, and education). Our proposals in the subsequent section derive directly from these consequences.

Limitations

This study provides important insights into environmental accounting in Albania; however, it has several limitations that should be acknowledged:

- **Sample coverage:** We examined 100 enterprises and obtained 71 survey responses, which included many of Albania's larger companies. Even so, the sample may not fully represent all businesses in the country. Small and micro-sized enterprises (which constitute most businesses in Albania) were underrepresented. Therefore, our findings are most applicable to medium and large firms. Caution is warranted in generalizing results to very small enterprises or the informal sector.
- **Self-reporting bias:** The survey data rely on managers' self-reported behaviors and perceptions. There is a risk of response bias; for example, managers who choose to respond might have a greater interest in sustainability and thus could overstate the extent of internal EA adoption. Conversely, some respondents might underreport certain practices or attitudes due to social desirability bias (e.g., reluctance to admit doing nothing at all). We tried to mitigate this by assuring anonymity, but the potential for bias remains.
- **Depth of content analysis:** Our content analysis was primarily qualitative, focusing on the presence or absence of information rather than quantifying disclosure quality in detail. It is possible we missed some subtle disclosures, or that some companies include environmental information in fragmented ways (for instance, a brief note in financial statements about an environmental provision) that we did not fully capture or quantify. However, given the generally minimal disclosure, it's unlikely that any small omissions would change the overall conclusion. Another related constraint is that we only reviewed publicly accessible documents; if a company communicates environmental information privately to certain stakeholders (but not via its website or reports), our study would not have captured that.
- **Time frame (snapshot):** The study offers a snapshot of practices in the early-to-mid 2020s. This is a period of rapid change in global sustainability reporting. It is possible that Albanian companies will alter their behavior soon in response to external factors, such as gearing up for CSRD compliance in 2024–2025. Our findings could quickly become outdated if there is a surge in the adoption of EA in the next few years. Conversely, we did not perform a historical analysis to see how things have trended over time; we cannot conclusively say whether the situation is improving or stagnating, only that current levels of disclosure and practice are low.

- Scope of internal practices assessed: Environmental accounting encompasses a wide range of concepts. We necessarily narrowed our focus to specific practices and perceptions (as captured in our survey). We did not measure actual improvements in environmental performance or financial outcomes resulting from EA practices. Nor did we delve deeply into related domains such as corporate social responsibility or governance practices that might interact with environmental efforts. By design, our scope was focused on environmental accounting, and thus, we do not provide a comprehensive view of overall corporate sustainability performance in Albania.
- Lack of comparative benchmark: We did not include a direct comparison group (such as a parallel survey in another country) in this study. Thus, while we refer to other developing nations in our discussion based on the literature, we cannot empirically compare Albania's situation to its peers within our data. Including a comparative international perspective could enhance understanding of how Albania differs or aligns with regional or global patterns, but that was beyond our reach in this project. These limitations point to opportunities for future research. For instance, longitudinal studies could track the evolution of Albanian firms' EA engagement over time, especially post-CSR implementation. Comparative studies could examine similar economies to put Albania's progress in context. Additionally, qualitative approaches (e.g., interviews with executives, regulators, or stakeholders) could provide deeper insights into attitudes and motivations that quantitative surveys might not fully capture.

Suggestions

Drawing on our findings, we propose the following actions for policymakers, professional bodies, and business leaders in Albania to enhance environmental accounting and bridge the gap between private practices and public reporting:

Strengthen regulatory requirements for environmental reporting:

A decisive regulatory push is crucial to overcome the current inertia. Policymakers should **integrate EU-aligned sustainability reporting mandates into Albanian law** to prepare companies for the CSRD. This could start with phased requirements: for example, initially mandating that large companies and publicly listed companies include environmental and broader ESG information in their annual reports. Relevant authorities (such as financial regulators or the stock exchange) should establish clear guidelines on the structure and content of these disclosures, possibly by adopting the upcoming European Sustainability Reporting Standards as a template. Equally

important is to set up enforcement mechanisms: companies must understand that non-compliance will carry penalties. In short, explicit and mandatory reporting rules would create a level playing field and force companies to allocate resources to EA, addressing the shortcomings of the current voluntary approach.

Build capacity through education and training: To tackle the evident knowledge gap, targeted initiatives are needed to improve expertise in environmental accounting. **University accounting curricula should be updated** to include modules on sustainability accounting and reporting (as recommended by De Silva & Nilipour, 2024) so that new graduates enter the workforce with basic awareness. Professional organizations, such as the Institute of Authorized Chartered Auditors of Albania, ought to offer continuing professional development courses focusing on environmental accounting practices, standards, and tools. Government agencies and international donors could sponsor workshops and certification programs for corporate accountants and managers on implementing EA (covering skills like conducting materiality assessments, calculating carbon footprints, or preparing GRI-based reports). Our survey revealed significant interest from companies in receiving training and workshops; fulfilling this need will empower firms to act. Fostering partnerships between businesses and local universities or consultants for pilot projects can also provide hands-on experience. A “train-the-trainer” model could be effective: developing a core group of local experts who can then mentor multiple companies.

Increase stakeholder awareness and engagement: Over time, stakeholder pressure will grow if stakeholders themselves recognize and demand environmental accountability. Efforts should be made to raise public consciousness about corporate environmental impacts and the importance of sustainability reporting. For example, **NGOs and media in Albania could start benchmarking and publicizing such information as is available**, perhaps via an annual “sustainability transparency” scorecard or awards for companies, to spark competition and awareness. Government and civil society might also facilitate stakeholder dialogues or forums in which companies are required to respond to community or investor questions about their environmental performance. Educating investors is key: the financial sector (banks, pension funds) should be encouraged or required to consider ESG criteria in lending and investment decisions. If banks begin asking borrowers about environmental risk management, companies will take note. Additionally, international buyers of Albanian products (in industries like textiles or minerals) should be engaged to impose environmental standards in their supply chains, leveraging foreign stakeholder influence. The goal is to shift societal norms so that a company failing to report or manage environmental issues is seen as an outlier. In doing so, even absent immediate

laws, the “soft power” of stakeholders and legitimacy concerns can start to drive improvements ahead of or in parallel with formal regulations.

Encourage early adopters and showcase best practices: To motivate companies to exceed mere compliance, Albanian authorities and business associations should implement incentive programs for exemplary environmental accounting and performance. This could include **recognition awards or public honors** for firms that publish sustainability reports or achieve notable certifications (like ISO 14001 or other ESG benchmarks), thereby providing positive publicity and reputational benefits. The government might consider fiscal incentives (tax breaks, grants) for companies investing in green technologies or obtaining environmental certifications, to offset some of the upfront costs. Establishing a national sustainability reporting award or index could create competition and prestige around transparency. These measures signal that doing the right thing will be noticed and rewarded, helping shift management mindsets from viewing EA as just an expense to seeing it as an opportunity for positive visibility and innovation. Over time, as a few organizations gain recognition for their sustainability efforts, they can serve as leaders to inspire their peers, gradually transforming business culture to value sustainability.

Prepare for EU and international standards compliance: Given Albania’s trajectory toward EU integration, it is imperative that companies begin aligning with European and global sustainability frameworks now. Regulators and industry groups should actively disseminate information about the CSRD requirements and timelines so that companies are not caught unprepared. **Pilot programs** could be launched where a select group of volunteer companies attempt to produce “mock” sustainability reports in line with GRI or the European Sustainability Reporting Standards (ESRS), receiving expert feedback to learn from the exercise. Albanian regulators might also consider early adoption of international standards such as the ISSB’s IFRS S1 and S2 for sustainability disclosure, once they are available and suitably translated, to ensure global consistency in reporting. Additionally, efforts can be made to harmonize any local environmental reporting indicators (for instance, metrics companies must report to environmental regulators for permits) with the metrics that will be required for ESG disclosures, improving efficiency. The overarching aim is proactive preparation: companies that start aligning with these standards now will find the transition smoother when such reporting becomes mandatory, and they may even gain a competitive edge (as well as avoid a last-minute scramble as deadlines approach).

Improve data infrastructure and assurance: To support credible environmental accounting, collaboration between government and industry is needed to improve data collection and verification mechanisms. This might involve investing in environmental monitoring infrastructure, such as national

databases for emissions and pollution data and better laboratory facilities for environmental measurements, which companies can utilize. The environmental ministry and statistical agencies could develop sector-specific guidelines for measuring and calculating environmental indicators (like carbon emissions), providing companies with a standardized methodology. Furthermore, encouraging the development of a local sustainability assurance/audit market will enhance trust in reported data. This could mean training financial auditors in reviewing non-financial information or cultivating a niche of environmental audit professionals. In the long run, having third-party assurance for sustainability information (like financial audits) would increase its reliability and stakeholder confidence. Support from professional bodies or international partners might be leveraged to build this verification capacity.

Integrate environmental accountability into corporate governance: Companies should embed environmental accountability into their governance structures as part of modern risk management and strategy. Boards of directors ought to consider establishing sustainability committees or assigning explicit oversight responsibility for ESG issues to an existing committee or board member. We recommend that organizations designate a lead executive (e.g., a Sustainability Manager or an HSE Manager) if they haven't already, to drive internal EA initiatives and liaise with stakeholders. Including environmental performance on board agendas sends a signal of leadership commitment. Corporate executives in Albania are urged to view environmental accounting not as a mere compliance burden, but as a strategic component of contemporary management - one that can foster efficiency, innovation, and market access (particularly in EU markets). Companies that move early and adopt such governance measures can act as role models, demonstrating the business value of sustainability and encouraging others by their example.

By pursuing these recommendations, Albania can accelerate its progress in environmental accounting, transforming the current dichotomy of "public reporting versus hidden reality" into a system of transparent, trustworthy, and responsible business practice. Achieving this will require coordinated efforts by government bodies, educational institutions, civil society, and the corporate sector. The benefits - from improved environmental outcomes to enhanced international reputation and investor trust - will outweigh the effort. As global trends continue to favor corporate transparency and accountability, Albania's timely adaptation in this domain will support its sustainable development and EU integration goals.

Conclusion

This study examined the state of environmental accounting and reporting in Albania, highlighting a significant disconnect between what companies disclose publicly and what they practice internally. Albanian companies generally refrain from addressing environmental issues in public communications; only a handful provide any environmental data, and virtually none offer comprehensive sustainability disclosures. Internally, however, a notable minority of organizations have begun implementing environmental accounting practices or sustainability programs, even though these efforts remain mostly invisible externally. Our findings indicate that the absence of external pressure and regulatory mandates has led to complacency in transparency, a result consistent with stakeholder and legitimacy theory expectations. At the same time, some forward-thinking firms are taking voluntary steps, often driven by efficiency motives or international stakeholder demands, signaling an emerging recognition of sustainability's importance behind closed doors.

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Appendix A: Data coding Process (Content Analysis)

Studies analyzing environmental elements published in the financial or non-financial reports of the surveyed economic entities have generally utilized coding or indexing as an analytical tool. Wiseman (1982) relied on this method aiming firstly to measure information objectively, and secondly to establish a numerical basis for comparing disclosures among entities. Published environmental information does not have a mandatory format or content requirement, but economic units are encouraged to refer to one of the generally accepted frameworks or standards such as GRI, CSRD, etc.

The environmental reporting indicators were divided into three main categories for analysis purposes:

1. General (contextual) indicators – showing the company's general environmental policy and approach. This includes elements such as:

- **Environmental policy:** the existence of an environmental policy declared by the company (a formal commitment to the environment in the annual report).
- **Environmental certifications:** whether the company is certified with ISO 14001 for environmental management, or similar standards.
- **Organizational structure for the environment:** defining responsibilities, mentioning a manager or committee responsible for environmental issues, or the company's capability to respond to environmental problems.
- **Environmental risk assessment:** identification of environmental risks associated with operations (risks of pollution, environmental accidents, etc.).
- **Compliance with legislation:** references to environmental laws and measures to comply with them (statements that the company adheres to environmental permits, domestic standards, or EU regulations).
- **Environmental legal issues:** mentioning any lawsuits, fines, or legal issues related to environmental breaches.

2. Financial-specific indicators (environmental information of a financial nature), reflecting the financial impact of the environment on the company. This category aims to uncover whether companies monetize environmental effects in their reports, including:

- **Environmental costs and provisions:** expenditures made for environmental protection or provisions created for environmental liabilities (funds for environmental rehabilitation after pollution).
- **Environmental capital investments:** capital expenditures for environmental projects or clean technology (investments in filtering equipment, renewable energy, etc.).
- **Environmental fines:** the financial value of any publicly disclosed environmental fines or penalties. (It is noteworthy that in practice, as will be seen, companies often hesitate to report fines or negative costs, which relates to a tendency to avoid "negative reporting".)

3. Environmental performance indicators, measured in physical units, showing concrete environmental results for the company. These included:

- **Greenhouse gas emissions:** tons of CO₂ emitted or mentions of emission reductions.
- **Water pollution:** wastewater discharges, water quality indicators, or treatment methods.
- **Use of natural resources:** consumption of energy, raw materials, water, etc., and any mention of efficiency measures.
- **Recycling and waste management:** quantity of recycled waste, recycling programs, treatment of hazardous waste, etc.

Each company was evaluated for each of the above indicators based on the intensity and quality of disclosed information. To ensure consistent measurement, a Likert scale from 0 to

4 points was used. This coding system refers to similar literature practices for converting qualitative data into quantitative (use of Likert scales in social accounting studies; see also Kirchner-Krath et al., 2024). Below are the criteria for each value on this scale:

- **0 points – Not mentioned at all:** The indicator is completely missing from the company's disclosures (the company nowhere mentions the issue of environmental policy).
- **1 point – Mentioned superficially:** The indicator is mentioned only very briefly or superficially, without details (a single sentence implying the existence of an environmental policy, without further clarification).
- **2 points – Discussed qualitatively:** A general qualitative description is provided about the indicator, without concrete numerical data (the company declares an environmental policy explaining its principles or mentions qualitative measures like "energy saving" without specific figures).
- **3 points – Quantitative information provided (non-financial):** Numerical data or quantitative indicators related to the indicator are provided, though not necessarily expressed in monetary values (annual CO₂ emissions are reported as X tons, or Y m³ water savings due to efficiency measures).
- **4 points – Detailed/monetary information provided:** The indicator is fully reported and/or expressed in financial or comparative terms, showing a high level of transparency (the company not only states the quantity of emissions but also the monetary cost of emission reduction schemes; or reports specific expenditures made for environmental purposes during the year).

This evaluation scale was consistent for all indicators, although in practice, not every indicator reached level 4 for the companies studied. For instance, the presence of an environmental policy could receive 0 points if completely missing, 1 point if only briefly cited, 2 points if qualitatively described, etc. Whereas an indicator like environmental fines would receive 4 points only if the company disclosed the monetary value of the fine in the report (which practically did not happen for any entity). By thus coding all collected information, an "environmental profile" was calculated for each company. This profile includes the points obtained in each category (general, financial, performance) as well as an overall total. The theoretical maximum rating for a company (if it received 4 points for all indicators) is approximately 60 points in total; whereas the actual scores of Albanian companies were far from this maximum, as will be explained subsequently.

Appendix B: Survey Instrument

Overview: The following questionnaire was used to survey managers of Albanian enterprises about their internal environmental accounting practices, awareness, obstacles, and attitudes toward environmental reporting. The survey is divided into five sections. Questions include multiple-choice, Likert-scale, and open-ended items, as detailed below.

Section I: General Company Information

1. Industry Sector: Which of the following best describes your company's primary industry?
 - Manufacturing (production/industrial)
 - Trade/Wholesale/Retail
 - Services (e.g., finance, IT, tourism)
 - Construction/Real Estate
 - Energy/Utilities
 - Transportation/Logistics
 - Other: please specify _____

2. Company Size (Number of Employees): Approximately how many employees does your company have?

- 1–50 (Small)
- 51–250 (Medium)
- >250 (Large)

3. Ownership Type: What is the ownership structure of your company?

- Privately owned (domestic)
- State-owned or public sector enterprise
- Foreign-owned or subsidiary of an international company
- Joint venture (mixed domestic and foreign ownership)
- Other: please specify _____

4. Respondent's Position: What is your position in the company?

(Open-ended – e.g., CEO, Financial Manager, Environmental/Sustainability Officer, etc.)

Section II: Environmental Accounting Awareness and Practices

5. Familiarity with Environmental Accounting: How familiar are you with the concept of “environmental accounting” and corporate sustainability reporting?

- Not at all familiar
- Have heard of the concept but have limited understanding
- Somewhat familiar (basic understanding of what it involves)
- Very familiar (knowledgeable or have direct experience with it)

6. Awareness of Frameworks/Standards: Which of the following sustainability accounting/reporting frameworks or standards are you aware of? (Check all that apply)

- Global Reporting Initiative (GRI) sustainability reporting guidelines
- ISO 14001 environmental management system standard
- EU Corporate Sustainability Reporting Directive (CSRD) requirements
- Integrated Reporting (< Framework)
- None of the above (not aware of specific frameworks/standards)
- Other: please specify _____

7. Training or Education: Have you ever received any training or education specifically on environmental accounting or sustainability reporting?

- Yes
- No

8. Regulatory Awareness: Are you aware of any laws or regulations (national or international) that require or encourage companies to report environmental or sustainability information?

- No, not aware of any such regulations
- Yes (please name or describe the regulation(s) if possible): _____

9. Current Internal Practices: Which of the following internal environmental accounting or sustainability practices are currently implemented in your company? (Check all that apply)

- We track environmental costs separately (e.g., costs of waste management, energy usage, environmental fees) as part of our accounting system.
- We set environmental performance targets or KPIs (e.g., goals for energy reduction, emissions, or waste minimization).
- We have an environmental management system or certification (e.g., ISO 14001 certification for environmental management).
- We measure environmental impacts (such as calculating our carbon footprint, water usage, or other sustainability metrics on a regular basis).
- We prepare internal environmental/sustainability reports for management or specific stakeholders (reports on our environmental performance that are not publicly released).

- We share environmental performance information with select external stakeholders (e.g., a parent company or major investors), even if it is not publicly disclosed.
- None of the above (we have not yet implemented any specific environmental accounting or sustainability practices internally).

Section III: Reporting and Disclosure Behavior

10. Public Environmental Disclosure: Which of the following best describes your company's public reporting of environmental or sustainability information? (Select all that apply)

- No public disclosure: We do not currently publish any environmental or sustainability information publicly.
- Policy/qualitative disclosure: We publicly communicate some general environmental information (e.g., an environmental policy statement or qualitative description of environmental efforts in our annual report or on our website).
- Quantitative data disclosure: We publish quantitative environmental performance data (e.g., metrics on emissions, energy or water use) as part of our annual financial report or other public reports.
- Standalone report: We have issued a dedicated sustainability or environmental report (a standalone report separates from the regular annual report).
- Other forms: We disclose environmental information in other ways (e.g., through press releases, newsletters, or as part of a parent company's sustainability report). (If other, please specify): _____

Section IV: Obstacles and Barriers to Environmental Accounting

11. Perceived Barriers: For each of the following potential obstacles, please indicate your level of agreement that it is a significant barrier to implementing environmental accounting or sustainability initiatives in your company. (Use a 5-point scale where 1 = Strongly Disagree and 5 = Strongly Agree.)

- Insufficient financial resources (budget constraints limit our environmental initiatives).
- Absence of legal requirements (no laws or regulations mandating environmental reporting or accounting for our type of company).
- Lack of stakeholder pressure (customers, investors, or the public are not pressuring us to improve environmental reporting or performance).
- Low management priority (top management does not see environmental accounting as important to our business goals).
- Inadequate expertise or guidance (lack of in-house expertise or external guidance on how to implement environmental accounting).
- Perception issue ("Green reporting" is viewed as just a PR/marketing exercise and not genuinely valuable for the company).

Section V: Managerial Attitudes and Future Plans

12. Perceived Benefits: Please indicate your agreement with the following statements about potential benefits of adopting environmental accounting in your company. (1 = Strongly Disagree, 5 = Strongly Agree)

- Cost reduction: Implementing environmental accounting practices could help reduce operational costs (e.g., via energy efficiency, waste reduction).
- Reputational gains: Adopting environmental accounting and reporting could improve our company's reputation or brand value among customers and partners.
- Long-term compliance/preparedness: Proactively engaging in environmental accounting will help our company be prepared for future regulations or market demands (it will likely become necessary for compliance or competitiveness).

13. Support and Incentives: Indicate your agreement with the following statements regarding factors that could help or encourage your company to adopt/enhance environmental accounting. (1 = Strongly Disagree, 5 = Strongly Agree)

- a. Guidelines/Training: Government or industry-provided training and clear guidelines on environmental accounting would make it easier for us to implement these practices.
- b. Financial incentives: Subsidies, tax incentives, or financial support for sustainability initiatives would motivate our company to invest more in environmental accounting.
- c. Expert support: Access to external expert advice or consulting on environmental accounting would help us adopt these practices.
- d. Partnership opportunities: Opportunities to partner with universities or external organizations on environmental projects would facilitate our implementation of environmental accounting.

14. Plans: Does your company have plans to improve or expand its environmental accounting practices or to begin publishing environmental/sustainability information soon?

- Yes, short term: We plan to initiate/improve these practices within the next 1–2 years.
- Yes, medium term: We plan to work on this in the next 3–5 years.
- Considering: We are considering or discussing such initiatives, but no definite plan yet.
- No concrete plans: We do not have any specific plans currently.

15. Additional Comments: Please provide any additional comments or observations regarding your company's environmental accounting practices or reporting (optional).

(Open-ended response: respondents could elaborate on any aspect of environmental accounting, challenges, or suggestions.)

Integrated Marketing Communication Mix Elements and Adoption of a Sports Culture: The Case of Academic Staff Members of Chartered Public Universities in Nairobi City County, Kenya

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Abstract

Adoption of a sports culture occurs when people make sports to be part of their lives. This study investigated the mediating role of lifestyle habits and the moderating role of socio-ecological factors in the relationship between the integrated marketing communication mix elements and adoption of a sports culture among academic staff members of chartered public universities in Nairobi City County, Kenya. The inquiry was based on the theory of planned behaviour (TPB), communication theory, Attention-Interest-Desire-Action (AIDA) model, and the diffusion of innovation theory. The realism paradigm and a descriptive survey research design were used for the study. The researchers sampled 372 academic staff members from five chartered public universities based in Nairobi City County using stratified random sampling. Binomial logistic regression was used in the data analysis since the dependent variable was categorical in nature. The study established that integrated marketing communication mix elements predicted the adoption of a sports

culture, with lifestyle habits mediating and socio-ecological factors moderating the relationship between integrated marketing communication mix elements and adoption of a sports culture by the academic staff members of the identified institutions. The study recommends that managers of health-promoting sports clubs should consider the integrated marketing communication mix elements, lifestyle habits, and socio-ecological factors when designing their communication programs.

Keywords: Integrated Marketing Communication Mix Elements, Socio-ecological Factors, Lifestyle Habits, Adoption, Culture

Introduction

Participation in physical activities like sports is associated with numerous benefits that include less expenditure on healthcare, lower chances of contracting cardiovascular diseases like stroke and hypertension, better mental health, and longevity of life (World Health Organization, 2022). Sports also enable people to socialize with others, avoid crime and drugs, reduce obesity, and unify people from different backgrounds. While these benefits are widely acknowledged worldwide, nearly 27% of the global population lives a sedentary lifestyle (Guthold *et al.*, 2018). Among the reasons advanced to justify sedentary behavior are lack of energy, motivation, and time to do exercises, automation of many activities, increased urbanization, and changing lifestyles of people (Roychowdhury, 2020). Health-promoting sports clubs should motivate people to lead physically active lifestyles in order to avoid the dangers associated with sedentary behavior, which could lead to premature deaths.

Due to the complexity of the contemporary business environment, firms must communicate with their stakeholders, who include their current and potential customers. Communication is a multifaceted concept, given that everything communicates. From a marketing perspective, communication is the process of transmitting information from a sender to a receiver through a certain channel. The main tools used by marketers to communicate are classified under direct marketing, advertising, sales promotions, public relations, and personal selling; these have to be coordinated with the marketing mix elements of product, price, place, people, processes, and physical evidence for them to achieve the best results. For instance, the shapes of products as well as where they are sold communicate something. The coordination of different elements of communication forms the integrated marketing communication mix.

The challenge of low participation in sports has attracted the attention of numerous scholars and practitioners who seek to find out how it can be solved (Park *et al.*, 2024). Specifically, some attention has been focused on

finding out the factors that make more people to participate in sports activities, thereby reducing sedentary behavior. While no consensus has been reached, the socio-ecological model proposed by McLeroy *et al.* (1988) identifies a set of five factors that greatly influence participation in sports. The model has gained wide acceptance among researchers of health-related behaviors (Sallis, Owen, & Fisher, 2024).

According to McLeroy *et al.* (1988), one determinant of the level of participation in sports is personal factors, which include gender, attitude towards sports, and age. A person with a positive attitude towards sports is more likely to engage in sports activities compared to another whose attitude is a negative. The second determinant is interpersonal factors like the support received from teammates, family members, and friends. Support from these groups of people can motivate someone to increase their level of participation in sports activities.

Organizational factors are the third determinant, and these include the playing schedules used by different clubs. Participation in sports can be increased by clubs having schedules that accommodate the needs of different people. The fourth determinant is community factors like the availability of sports facilities and equipment, and the attitude of a community towards sports. A community with a positive attitude towards sports is likely to have more physically active people, especially when sports facilities and equipment are available. The fifth determinant is public policy factors, like the influence of marketing activities and the presence of government laws that support participation in sports. Where a government or government department actively supports participation in sports, the level of participation is likely to be higher. Similarly, marketing efforts can increase the level of participation. Lifestyle is one variable in the psychographic base of classifying consumers. It refers to the uniqueness of personal and social behaviors that make one person or group different from other persons or groups (Nassè, 2023). The differences can be in terms of how people live, the activities they engage in, the motivations for engaging in those activities, patterns of spending money, interests, opinions, and the implications of their activities on others (Dacay, Rañon, & Culajara, 2024). Negative lifestyle habits like unhealthy eating and excessive consumption of alcohol and tobacco products can affect an individual's health negatively, while positive lifestyle habits like participating in sports and taking meals on a regular basis partially contribute to longevity of life. According to WHO (2004), the main lifestyle habits that lead to non-communicable diseases are alcohol consumption, physical inactivity, unhealthy diets, and tobacco use.

The academic staff of chartered public universities in Kenya play a critical role in teaching and examining large numbers of students. They also supervise projects, theses, and dissertations at various levels besides

conducting research. Some academic staff members also perform administrative work, like heading different functions, departments, and colleges, among many others. In order for them to perform their work effectively and efficiently, they need to be physically, socially, and mentally healthy. One way of enhancing their health is by having them participate in physical activities like sports.

Mwangi and Rintaugu (2017) found that nearly 59.98% of academic staff in chartered public universities in Kenya led sedentary lifestyles, with just 28.27% of them being members of health-promoting sports clubs. At the same time, Matilda *et al.* (2020) found 75% of employees in Kenyan universities were physically inactive, implying a high level of sedentary behavior in Kenyan public universities. There is a need to reverse this negative trend in order to enable academic staff members to effectively perform their roles of teaching, examining, and supervising students, and conducting research. This study, therefore, sought to investigate the direct effects of the integrated marketing communication mix elements of public relations, advertising, sales promotion, direct marketing, and personal selling on the adoption of a sports culture by the identified group of respondents. It also sought to determine the mediating role of lifestyle habits and the moderating role of socio-ecological factors on this relationship.

Literature Review

This research reviewed both theoretical and empirical literature related to integrated marketing communication mix elements, lifestyle habits, socio-cultural factors, and adoption of a sports culture.

Theoretical Review

Several theories guided this study. The communication theory, originally proposed by Shannon and Weaver (1949), has been revised many times over the years. It holds that communication is an important aspect of all living things, and that it facilitates the survival and prosperity of all types of organizations, including health-promoting sports clubs. Without communication, many activities would greatly reduce, hence the need for organizations to actively manage their communication programs as opposed to leaving them to chance. Similarly, the attention-interest-desire-action (AIDA) model developed by Strong (1925) advocates that any communication should capture attention, gain interest, arouse desire to purchase the product, and lead people into purchasing the product. The two theories informed the integrated marketing communication mix elements aspect of the research.

The diffusion of innovation theory is attributed to Rogers (1962) and it explains how innovations spread through a social system. An innovation refers to a new idea, while diffusion is the process through which the new idea

spreads and gets accepted by a group of people. The theory further classifies people into different adopter categories based on the speed with which they adopt innovations. The categories are innovators, early adopters, early majority, late majority, and laggards. The hierarchy-of-effects model proposed by Lavidge and Steiner (1961) holds that consumers follow some steps when adopting innovations. These two theories informed the dependent variable of the study, which was adoption of a sports culture.

The theory of planned behavior (TPB) is attributed to Ajzen (1991) and it acknowledges that some behaviors are beyond the control of an individual, which partially explains why impulse buying occurs. The theory informed the mediating variable of the study, which was the lifestyle habits. In addition, the socio-ecological model proposed by McLeroy *et al.* (1988) informed the moderating variable of the study, which was the socio-ecological factors. The model argues that the level of participation in sports activities depends on personal, interpersonal, organizational, community, and public policy factors.

Empirical Review

Several studies have linked integrated marketing communication mix elements, socio-ecological factors, and adoption of a sports culture. For example, Kim and Kim (2018) found that attitudes towards advertisements influenced the rate at which people frequented the advertised premises, while Bae *et al.* (2020) found that attitude was a strong predictor of participation in sports. Hu, Zhou, Crowley-McHattan, and Liu (2021) established that gender, age, self-concept, ethnicity, safety of neighborhoods, access to sports facilities, and support from friends influenced the extent to which people participated in sports activities.

Rasmussen, Dufur, Cope, and Pierce (2021) found that 65% of Nike's advertisements were directed at males, creating the impression that sports were mainly for men. Bae *et al.* (2020) established that perceived behavioral control, subjective norm, attitude, and prior knowledge positively influenced the intention to participate in sports. Thormann and Wicker (2021) found that people who were environmentally conscious behaved in more environmentally friendly ways, which was in line with the theory of planned behavior. Many of these studies originated from the Western world, where conditions differ significantly from those in Kenya. Few studies are related to the Kenyan context. For instance, Simiyu (2019) identified the problems faced by Kenyan sports clubs, which included corruption, limited finances, financial mismanagement, political interference, and poor governance and leadership. Inadequate studies covering the area of sports, integrated marketing communication mix elements, the mediating role of lifestyle habits, and the

moderating role played by socio-ecological factors led the researchers to conduct this research so as to fill that gap.

Research Methodology

This study was based on the realism paradigm, which ontologically assumes that human weaknesses and the complexity of the world limit the ability to obtain the whole truth of any phenomenon (Saunders, Lewis, & Thornhill, 2023). This philosophy acknowledges the values held by researchers and respondents, although the researchers in this study were as objective as possible. The paradigm is suitable for undertaking research of a qualitative or quantitative nature.

The researchers used the descriptive survey research design to achieve the objectives of the study, since surveys enable the collection of quantitative data in situations where the researcher does not have control over the respondents and the research issues are contemporary in nature, as was the case for this study. The study targeted academic staff members of five chartered public universities that had their headquarters in Nairobi City County. These were Multimedia University, Technical University of Kenya, Kenyatta University, Cooperative University of Kenya, and the University of Nairobi. Out of a population of 5,331 academic staff members, the researchers used stratified random sampling to select 372 respondents, following the sampling recommendations of Yamane (1967).

Data was collected using a structured questionnaire that was personally administered by the researchers and the research assistants. Prior to the actual data collection, the questionnaire was pilot-tested using ten percent of the respondents, which was 37 respondents. Cronbach's alpha was used to establish the reliability of the questionnaire, while Confirmatory Factor Analysis (CFA) was used to determine its validity. Results from both tests confirmed that the questionnaire was reliable and valid for data collection. Binomial logistic regression was used to test the variables of interest, namely integrated marketing communication mix elements, lifestyle habits, socio-ecological factors, and adoption of a sports culture. The mediating effects of lifestyle habits and the moderating effects of socio-ecological factors on the relationship between the integrated marketing communication mix elements and adoption of a sports culture were tested at 5% significance level.

Research Findings and Discussion

The first objective of the study was to establish the direct relationships between integrated marketing communication mix elements and the adoption of a sports culture. The findings indicated that integrated marketing communication mix elements significantly predicted adoption of a sports culture, with $\beta = .043$, $SE = 0.126$, $p = 0.003 < 0.05$ level of significance. An

Exp (B) value of 2.044 indicated that the probability of an academic staff member adopting a sports culture was equal to 1, and it was 2.044 times likely to occur if the sports club increased its integrated marketing communication mix elements by one unit. Therefore, the researchers established that integrated marketing communication mix elements influenced the adoption of a sports culture by the identified group of respondents.

Secondly, the researchers sought to determine the moderating effects of socio-ecological factors on the relationship between integrated marketing communication mix elements and adoption of a sports culture. The results obtained after conducting the moderation test confirmed that socio-ecological factors significantly moderated the adoption of a sports culture, with $\beta = .247$, $SE = 0.192$, $p = 0.002 < 0.05$ significance level. The Exp (B) value of 1.781 implied that an academic staff member's probability of adopting a sports culture was equal to 1 and it was 1.781 times likely to occur if the health-promoting sports club improved its socio-ecological factors by one unit. The researchers concluded that socio-ecological factors had significant moderating effects on the relationship between integrated marketing communication mix elements and adoption of a sports culture by the respondents.

The third objective of the study was to find out the mediating role of lifestyle habits on the relationship between integrated marketing communication mix elements and adoption of a sports culture. This was tested through a series of four steps in line with the recommendations of Baron and Kenny (1986). After testing for direct relationships, the second step involved establishing the relationship between integrated marketing communication mix elements and lifestyle habits. The results of this step indicated an adjusted R^2 of 0.444 and a corresponding p-value of 0.000. This implied that integrated marketing communication mix elements explained 44.4% of the changes in lifestyle habits, and the relationship was significant ($p\text{-value } 0.000 < 0.05$). The beta value for integrated marketing communication mix elements of 0.668 implied that, holding all things constant, a unit change in integrated marketing communication mix elements would result in a 66.8% change in lifestyle habits. The findings of this study agree with those of Rakic and Rakic (2015), whose study in the Republic of Serbia established that integrated marketing communication mix elements affected the development of healthy lifestyle habits.

The third step investigated the relationship between lifestyle habits and the adoption of a sports culture. The study found that lifestyle habits ($\beta = .029$, $SE = 0.105$, $p = 0.016 < 0.05$) significantly predicted the adoption of a sports culture, with an Exp (B) value of 1.030 implying that an academic staff member's probability of adopting a sports culture was equal to 1 and it had 1.030 chances of occurring when a sports club increased its lifestyle habits by one unit. These findings corroborate those of Hernández-Beltrán *et al.* (2023),

which positively associated lifestyle habits with the adoption of a sports culture.

The fourth step introduced lifestyle habits as an explanatory variable and regressed it with integrated marketing communication mix elements on adoption of a sports culture to determine whether it had a partial, complete, or no influence on the relationship between integrated marketing communication mix elements and adoption of a sports culture. The study established that the combined effects of lifestyle habits and integrated marketing communication mix elements had a partial but significant effect on the adoption of a sports culture. The results indicated an Exp (B) value of 1.036, implying that the relationship between integrated marketing communication mix elements and adoption of a sports culture in the presence of lifestyle habits was significant. These findings agree with those of Manika *et al.* (2019), who established the positive role played by lifestyle habits in the adoption of a sports culture.

Conclusion

This study established that integrated marketing communication mix elements were important predictors of the adoption of a sports culture among academic staff members of chartered public universities in Nairobi City County, Kenya. In addition, the researchers found lifestyle habits to play a mediating role and socio-ecological factors to play a moderating role in the relationship between integrated marketing communication mix elements and adoption of a sports culture among the identified group of respondents.

This investigation concluded that managers of health-promoting sports clubs should consider the personal, interpersonal, organizational, community, and public policy factors when developing their communication strategies. The combined effects of the five socio-ecological factors influence the level at which people participate in sports activities. In addition, managers of health-promoting sports clubs should use the integrated marketing communication mix elements of advertising, personal selling, sales promotions, public relations, and direct marketing to communicate with their current and potential customers, integrating these elements with the marketing mix elements of product, price, place, people, processes, and physical evidence in order to achieve the best results. Managers of such clubs should also consider the lifestyle habits of their current and potential clients so as to incorporate them into their activities.

Recommendations for Further Research

The researchers recommend that similar investigations involving both the public and private chartered universities in Kenya could be conducted, given that the current study was limited to the public sector. In addition, the scope of the study could be expanded to cover other universities in the country

or even in more developed countries, as opposed to concentrating on Nairobi City County. Alternatively, other sectors could be researched using qualitative, quantitative, or mixed methods research approaches.

Fourthly, the researchers recommend that similar research could be conducted focusing on a single integrated marketing communication mix element and its effects on the adoption of a sports culture, considering that each element is broad enough to be studied on its own. A separate study could also be conducted emphasizing the services aspects of sports clubs, with emphasis being laid on service inseparability, intangibility, perishability, and heterogeneity in terms of how they affect the adoption of a sports culture. Alternatively, a study examining the role played by the marketing mix elements of place, physical evidence, price, processes, product, people, and promotion in relation to the adoption of a sports culture could also be conducted.

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Impact of Social Media on Senior Secondary School Students' Involvement in Cybercrime in Udi Local Government Area of Enugu State, Nigeria

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Abstract

This study investigated the impact of social media on senior secondary school students' involvement in Cybercrime in Udi Local Government Area of Enugu State, Nigeria. The study specifically explored the level of addictiveness to social media by students in senior secondary schools, and the influence of social media on students' involvement in Cybercrime in senior secondary schools. Two research questions guided the study, and two null

hypotheses were formulated for the study and tested at a 0.05 level of significance. The study employed a descriptive survey research design. The respondents used for the study consisted of 173 SS 2 students (73 males and 100 females) from the four schools sampled for the study using a simple random sampling technique (balloting). Data was collected using the Social Media and Cybercrime Questionnaire (SMCQ), which was validated by experts. An estimate of the stability of the instrument yielded a reliability coefficient of 0.85 using Cronbach's Alpha statistic. Mean and standard deviation were used as descriptive statistics to answer the research questions, while the independent samples t-test was adopted as an inferential statistic. The findings indicated that male students have a higher level of addiction to social media than their female counterparts, and male students are more involved in Cybercrime as a result of social media influence than their female counterparts. The results also revealed that there is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in Cybercrime in secondary school. It was recommended that the school authorities should monitor both the male and female students on the usage of social media in schools, as its usage has a positive relationship with their involvement in Cybercrime.

Keywords: Cybercrime, Cybersecurity, Gender, Impact, Secondary Schools, Social Media, Social Networking

Introduction

Criminal activities in society date back to time immemorial, and no known society, at whatever level of development, is free from them. Societies of primitive, ancient, and medieval times, as well as those of modern industrial, scientific and digital eras, have their fair share of experiences of criminal activities perpetrated by their citizens or strangers, with their attendant consequences on individuals, families, communities, corporate bodies, and governments. Agara et al. (2021) observed that the level of criminal activities that take place in society differs from place to place and is influenced or shaped by several factors, which include the extent of technological development, the degree of compliance and adherence to religious principles and doctrines, the level of poverty of individuals, the value systems of the place, the seriousness or otherwise of sanctions and sanctioning institutions/law enforcement agencies, etc.

In traditional societies, most crimes were planned and committed in crude and mechanical forms and involved the exertion of force by the criminals with the aid of certain physical or mechanical devices. In modern societies, crimes and the ways they are planned and executed have changed with the levels of technological advancement and sophistication, especially

following the advent of Information and Communications Technology (ICT) in general and social media in particular (Angioha, Enuokoha, Agba, & Ikhizamah, 2020; Ukwaiyi, Akintola, & Angioha, 2019; Ukwaiyi, Obafaye, & Akintola, 2019). The coming of these new technologies has given birth to a new wave of criminality referred to as cybercrime, that is, crimes committed with the aid of the Internet and its associated social media networks, such as Facebook, Twitter, Instagram, WhatsApp, Snapchat, etc.

The rapid growth of the Internet in the 21st century across the globe has brought tremendous changes in virtually every institution within different societies. These changes can, however, be described in both positive and negative dimensions. Although the positive dimensions of the Internet revolution are fascinating, the negative dimensions are, however, overwhelming and often produce maladies that threaten the social order of society (Ibikunle & Eweniyi, 2013; Odumesi, 2014; Okeshola & Adeta, 2013). One of the negative outcomes of the Internet revolution across nations, especially in developing nations like Nigeria, is the growing prevalence of Cybercrimes. In the view of Odumesi (2014), the rise in technology and online communications has not only produced a dramatic increase in the incidence of Cybercrimes but has also resulted in the emergence of what appears to be a new variety of criminal activities.

Cybercrime is not a old sort of crime to the world. Cybercrime, according to Das and Nayak (2013), is a crime committed mostly by individuals or organised groups in which computers or computer networks are a tool, a target, or a place of criminal activity and include everything from electronic cracking to denial of service attacks. Tonkolu (2019) defined Cybercrime as a horrible crime committed against a group of individuals or an individual by the help of new technology, such as chat rooms, e-mail, and the Internet, with the intention of producing emotional, physical, and mental harm. Muraina and Muraina (2015) refer to Cybercrimes as offences that are committed against individuals or groups of individuals with a criminal motive to intentionally harm the reputation of the victim or cause physical or mental harm to the victim directly or indirectly, using modern telecommunication networks, such as the Internet (chat rooms, emails, etc.) and mobile phones. Cybercrime is an uncontrollable evil having its base in the misuse of growing dependence on computers in modern life. Usage of computers and other allied technology in daily life is growing rapidly and has become an urge that facilitates user convenience. It is a medium that is infinite and immeasurable. Whatever the good Internet does to us, it has its dark sides too (Chaubey, 2012).

The implementation of numerous online applications and the abundance of threats to the use of social media nowadays have put users at higher risk of online-related threats. Different kinds of Cybercrimes occur,

such as identity theft, Cyber-extortion, online scams, cyber-bullying, copyright infringement, and online fraud (Oluga, Agana & Inyama, 2014). Some of the newly emerged Cybercrimes are Cyber-stalking, cyber-terrorism, e-mail spoofing, e-mail bombing, Cyber pornography, Cyber-defamation, etc. A number of crimes happen, like Cyberbullying, online fraud, addiction towards gaming and gambling, and pornography, which are among the risks that online users may be exposed to in their daily lives (Khalid, Daud, Rahman, & Nasir, 2018). Some conventional crimes may also come under the category of Cybercrimes if they are committed through the medium of a computer or the Internet. The major contributor to Cybercrime is the Internet. In the adoption and usage of the Internet, Cybercriminals often use images, programs, or digital communication in order to run malicious attacks (Chauhan, 2012).

Protecting the integrity, confidentiality, availability and access control of the data in the social network systems is very significant and challenging. It is noted that the majority of the people who are connected to social networks are students. Curiosity and revenge are noted to be the main reasons for students to get involved in Cybercrimes. Most of the time, students are not aware of the implications of Cybercrime. Many reports from colleges and universities show that Cyber-attack rates have increased significantly over the recent years, with many hacking attempts into the information systems (Senthilkumar & Easwaramoorthy, 2017).

Cybercrimes can be categorized into two, namely the crimes where a computer network attacks other computer networks, for instance, a program code or a virus used to disable a system, and the second category, namely crimes where a computer network attacks a target population, for example, identity theft, fraud, and intrusions (Svensson, 2011). In the digital era, most organizations over-depend on the usage of the Internet; hence, this promotes Cyberattacks. Most academic institutions have adopted the use of e-learning. The Internet creates unlimited opportunities for commercial, social and other human activities. But with Cybercrime, the Internet introduces its own critical risks. The usage of the Internet and other digital technologies has enhanced the risk of attack by Cybercriminals across the globe. Cybercrime varies from computer fraud, theft and forgery to infringements of privacy, the propagation of harmful content, the falsification of prostitution, and organized crime. Financial Cybercrime includes the sale of illegal articles, pornography, online gambling, intellectual property crime, e-mail spoofing, forgery, Cyber defamation, and Cyberstalking (Asma, cited in Masese, Masoud, Charo & Mvurya, 2021).

Cybercrime is also carried out among organizations on an interpersonal level. Illner, cited in Agara et al. (2021), has observed that cybercrime on interpersonal organizations can be stalled into three classifications: the customary broad-sweep scams, an attempt luring web users

to click on “ads” or sites that could trap malware on their computers; an attempt to sneak into an exposed account registered online (personal or corporate account) for sensitive information; and utilizing web-based media as a stage to associate, trade thoughts and exchange stolen information. However, generally, crimes committed in the cyber world include reconnaissance, phishing, Catfishing, fake profiles, social engineering, hacking, identity theft, scamming, Cyberstalking, child pornography, Cyberbullying, etc. (Hernandez, 2018; Perlmutter, 2019). These crimes take place every day and make social media a world with both good and bad sides. Perlmutter (2019) maintained that social media has become deep-rooted in many people’s lives and is often referenced in news reports. For instance, a research report by Smith and Anderson (2018) on social media use shows that 74% of Facebook users in the US say they visit the site daily, with 51% visiting several times a day. This frequency in its use makes social media a very convenient environment for the criminally minded users and a potentially dangerous environment for other users with no criminal intent. Corroborating this stance also, researchers from CISCO have maintained that Facebook has become a host to a good number of busy marketplaces and interactions used by Cybercriminals to buy and sell stolen commodities.

Social media networking is a platform that enables users to participate and share multimedia content, for example, text, audio, video, images, graphs and animations, through the medium of a website or an application. These contents are cloud-based big data contents and can be viewed in the form of volume, variety, velocity, veracity, volatility, quality, discovery and dogmatism (Thabet & Soomro, 2015). Kapor et al. (2017) defined social media as an internet-dependent application formed to promote social intercommunication and for diffusing, using and developing information through society. Social media use not only provides Cyber-thieves with a fertile ground for their nefarious activities but also makes other users become exposed or vulnerable to Cybercrime. This happens especially when they place vital personal or corporate information on social media sites, interact with some other social media users who may be known or unknown to them, and click on certain links that are placed on social media sites by some other users who operate under various guises. In GoMedia, it is noted that social media networks like Facebook may seem harmless, but by making data about oneself public, people end up putting themselves and those around them in danger.

The aggressive adoption of social media among the younger generation, according to Vorderer (2016), could be attributed to their up-to-date knowledge of and comfort with the latest technology and the convenient accessibility of the social networking tools. For instance, they can access social media from their cell phones at any time and in any place. This

encourages them to use social media not only for receiving and retrieving information but also for being online and connecting with others, and from being consumers and participants to “prosumers”, which means that they consume and produce media on the social media platform (Obar & Wildman, 2015). The advantage of social media is to allow a group of people or persons to exchange information with people through the use of the social network. Addiction to social media by students could exert a negative influence on their academic performance.

Statement of the Problem

The contribution of the Internet to the academic development of Nigerian students has been marred by the conscious evolution of new waves of crime. The Internet has also become an environment where the most productive and safest offence thrives. Cybercrime has come as a surprise and a strange appearance that, for now, lives with us in Nigeria. With each passing day, more and more alarming cases of cybercrime are observed and perpetrated by youths in Nigeria, with each new case more shocking than the one before. It has become a stubborn mouth sore which causes a lot of pain and shame because criminally minded students in secondary schools in Udi LGA of Enugu State are stealing and committing all sorts of academic and economic atrocities through the aid of social media contacts and transactions.

Although there are many positive sides to social media, there are also its negative sides, especially as it concerns students' involvement in cybercrimes. The worrisome situation among secondary school students in Udi Local Government Area is that the use of social media has caused more harm than good in the students' involvement in Cybercrimes. In most cases, various forms of crimes are being witnessed, ranging from exam malpractices, pornography, Cyber-bullying, rape, robbery and stealing, sexual molestation, onslaught, and cultism, among others. Many students get addicted to the use of social media sites as they continue to engage in one activity or another on the social media sites very often. With this ugly scenario, the students have suffered a lot of setbacks in their academic pursuit. It is in this regard that this study will investigate the impact of social media on involvement in cybercrime among senior secondary school students. Gender was also investigated as an intervening variable that could influence the students' involvement in cybercrime.

Objectives of the Study

The general purpose of this study is to determine the impact of social media and gender on senior secondary school students' involvement in Cybercrime in Udi LGA of Enugu State, Nigeria. Specifically, the study intends to determine the:

1. Level of addictiveness to social media by students in senior secondary schools.
2. Influence of social media on students' involvement in Cybercrime in senior secondary schools.

Research Questions

The following research questions guided the study:

1. What are the mean responses of male and female students on their level of addictiveness to social media?
2. What are the mean responses of male and female students on the influence of social media on their involvement in Cybercrime?

Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance:

HO₁: There is no significant difference in the mean responses of male and female students on their level of addictiveness to social media.

HO₂: There is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in Cybercrime.

Literature Review

Modern technology in communication no doubt has turned the entire world into a “global village”. But as it is, technology, like two sides of a coin, brings with it both negative and positive sides. It helps people to be better informed and enlightened and to keep abreast of world developments. Technology exposes mankind to a better way of doing things. Social networking sites include Twitter (now X), Yahoo Messenger, Facebook Messenger, Blackberry Messenger (BBM), WhatsApp Messenger, 2go Messenger, Skype, Google Talk, Google Messenger, iPhones and Androids. These networking sites are used by most people to interact with old and new friends, physical or internet friends (Asemah & Edegoh, 2012). The world has been changed rapidly by the evolution of technology; this has resulted in the use of technology as the best medium to explore the wide area of knowledge. The millions of social networking sites have transformed the thought of a global village into a reality, whereby billions of people communicate through social networking sites. Numerous benefits have been obtained through distant communication through the use of social networking sites.

Social media is affecting the cultural, economic and social lives of people, and it has become an essential part of everyone's life. Social media networking is a platform that enables users to participate and share multimedia content, for example, text, audio, video, images, graphs and animations,

through the medium of a website or an application. These contents are cloud-based big data contents and can be viewed in the form of volume, variety, velocity, veracity, volatility, quality, discovery and dogmatism (Thabet & Soomro, 2015).

The term Cybercrime was coined by Peter Cassidy, Secretary General of the Anti-Phishing Working Group, to distinguish computer programmes (and coordinated, interlocking sets of programmes) that are designed specifically to animate financial crime from other kinds of malevolent packages (Shehu, 2014). Cybercrime involves the use of computers and the internet to defraud unsuspecting victims, ranging from identity theft and credit card theft (in which victims' credit cards or bank account numbers are stolen by computer scanners and used to pay for goods and services) to money laundering by terrorists and organized crime syndicates. Kamini (2011) defines Cybercrime as crimes committed on the internet or unlawful acts using the computer as either a tool (e.g., fraud, forgery, identity theft, phishing scams, spam, junk e-mails, pornography, online gambling, intellectual property crime, cyber defamation, Cyberstalking, etc.) or a targeted victim (e.g., unauthorized access to computer networks, electronic information theft, denial of service attacks, malware, malicious codes, e-mail bombing, data diddling, salami attacks, logic bombs, web jacking, internet time theft, Trojan attacks, etc.). This implies that all Cybercrimes involve both the computer and the individuals as victims; it depends on which of the two is the main target.

According to Maitanmi, Ogunlere, Ayinde & Adekunle (2013), Cybercrime is a type of crime committed by criminals who make use of a computer as a tool and the internet as a connection in order to reach a variety of objectives such as illegal downloading of music files and films, piracy, spam mailing and the likes. Similarly, Okeshola (2013) opined that the term Cybercrime can be used to describe any criminal activity which involves the use of a computer or the internet network, including such crimes as fraud, theft, blackmail, forgery, and embezzlement. These two definitions are very narrow in the sense that they do not give a holistic view of what Cybercrime is all about. In the same vein, Cybercrime as criminal ventures, involving information technology infrastructure, includes unauthorized access to computer data from or within a computer (Adeleke, 2017). With the above descriptions of Cybercrime, in this study, Cybercrime could be defined as crimes committed with the aid of ICT-enabled tools and channels.

Social media has a profound impact on people's lives, whether for good or bad. One cannot imagine life without social media; therefore, it is not a surprise that criminal activity involving social media has also become a norm (Thukral & Kainya, 2022). As a result of the rise of social media, crime has been able to thrive online. One of the most powerful and successful tools, social media, has suddenly become a haven for criminals. In the last decade, as the

number of internet users has grown, so has the number of Cybercrimes (Soomro & Hussain, 2019). One may also construct a bogus social media persona to spread false information about someone or to obtain someone's credit card information, which is readily available on e-commerce sites. Gender-based violence and assaults on minors are two further types of violence. Since the perpetrator's identity is obscured, women and small children are the primary victims of internet child pornography (Gupta, 2020).

Some scholars carried out research on social media addictiveness among students. Osharive (2015) examined the influence of social media on the academic performance of students at the University of Lagos. The author showed that a great number of students at the University of Lagos are addicted to social media. Similarly, Wordu, Dan-Jumbo and Dick-Mina (2021) investigated the effects of social media addiction on the academic performance of students in public senior secondary schools in Rivers State, Nigeria. It was revealed that students who spent more time on social media were more likely to have higher Internet addiction.

Some research was also done by scholars on social media and Cybercrime. Umeozulu (2012) carried out a study to examine the perception of cybercrime among Nigerian youths using Caritas University, Amorji-Nike, Enugu, as a case study. The author revealed that the Internet is used as a channel for the perpetration of criminal spamming activities, which was the finding drawn. In the same vein, Asogwa (2019) examined public perception of the influence of digital media on Cybersecurity. It was found that digital media are significantly and negatively affecting Cybersecurity breaches and promoting Cybercrimes. Finally, Agara et al. (2021) conducted a study to examine the phenomenon of social media use and students' exposure to Cybercrimes in Nigeria and revealed that Facebook, Instagram and Twitter (now X) use significantly expose students to Cybercrimes. These studies were carried out in various locations.

Methods

The study employed a descriptive research survey design. The population of this study consists of 1,156 senior secondary two (SS 2) students in the 25 public secondary schools in Udi Local Government Area of Enugu State (Enugu State PPSMB Statistics, 2023). A multistage sampling procedure was used to first of all select four secondary schools from the 25 secondary schools, using a simple random sampling technique (balloting). There are three hundred and five (305) SS 2 students from the four schools sampled. The researcher further used the Taro Yamane formula to determine a sample size of one hundred and seventy-three (173) SS 2 students (73 male and 100 female) to be used for the study. To distribute the sample size among the four sampled schools, the researcher used the proportionate simple random

sampling technique. Data was collected using the social media and cybercrime questionnaire (SMCQ) designed by the researchers and validated by experts. The internal consistency reliability estimate yielded an overall reliability estimate of 0.85 using the Cronbach Alpha statistic.

Results

Research Question 1: What are the mean responses of male and female students on their level of addictiveness to social media?

Table 1: Mean and standard deviation of the respondents on their level of addictiveness to social media

S/N	Item Statement	Gender	N	X	SD	Decision
1.	I am addicted to social media, and it is a problem that affects me in mathematics.	Male	73	2.78	.99	HE
		Female	100	2.73	1.01	HE
2.	Social media networks distract me from my studies.	Male	73	2.89	1.03	HE
		Female	100	2.83	.92	HE
3.	I spend time chatting on Facebook and WhatsApp.	Male	73	2.79	.91	HE
		Female	100	2.67	.88	HE
4.	My mathematics results have been negatively affected since I became engaged with these social media.	Male	73	2.45	1.00	LE
		Female	100	2.30	.88	LE
5.	Overuse of social media platforms makes me lazy in doing my mathematics take-home assignments.	Male	73	2.66	1.00	HE
		Female	100	2.57	.96	HE
6.	I leave school for Internet Café to do ‘Yahoo Yahoo’.	Male	73	2.67	.97	HE
		Female	100	2.51	1.01	HE
7.	I watch pornographic images and videos.	Male	73	2.82	.82	HE
		Female	100	2.89	.86	HE
8.	I have sleepless nights engaging myself on social media.	Male	73	2.74	.96	HE
		Female	100	2.70	.94	HE
9.	I chat on social media even when I am eating.	Male	73	2.41	.94	LE
		Female	100	2.45	.99	LE
10.	I come to school with my phone in order to chat on social media.	Male	73	2.64	.89	HE
		Female	100	2.58	.93	HE
Overall Mean		Male	73	2.69	.51	HE
		Female	100	2.62	.49	HE

Key: 3.50 – 4.00 = Very High Extent (VHE); 2.50 – 3.49 = High Extent (HE); 1.50 – 2.49 = Low Extent (LE); 0.50 – 1.49 = Very Low Extent (VLE)

Table 1 shows the mean responses of both male and female SS 2 mathematics students on their level of addictiveness to social media in Udi LGA, Enugu State. It indicates that the mean responses of the male and female students to items 1-3 and 5-8 and 10 are within the real limit decision point of 2.50-3.49. This implies that both the male and female SS 2 students in the secondary schools engage in the statements in items 1-3 and 5-8 to a high extent. Also, the mean responses of both male and female students to items 3 and 9 are within the real limit decision point of 1.50-2.49. This implies that

the male and female students engage in the statements in items 3 and 9 to a low extent. The overall means of 2.69 (SD = .51) and 2.62 (SD = .49) for the male and female students, respectively, imply that the male and female students are equally addicted to social media, though the male students obtained a higher mean rating, which indicates a higher level of addiction than their female counterparts.

Hypothesis 1: There is no significant difference in the mean responses of male and female students on their level of addictiveness to social media.

Table 2: t-test score on the level of students' addictiveness to social media by gender

Gender	N	X	SD	df	t-cal	Sig. (2-tailed)	Decision
Male	73	2.69	.51	171	.83	.410	HO ₁ Accepted
Female	100	2.62	.49				

Data in table 2 shows the t-test score on the level of mathematics students' addictiveness to social media by gender, $t(171) = .83, p = .410 > .05$. Since the p -value of .410 is greater than the 0.05 probability level set for the study, the null hypothesis, which states that there is no significant difference in the mean responses of male and female students on their level of addictiveness to social media, is accepted. This implies that there is no significant difference in the mean responses of male and female students on their level of addictiveness to social media in secondary schools.

Research Question 2: What are the mean responses of male and female students on the influence of social media on their involvement in cybercrime?

Table 3: Mean and standard deviation of the respondents on the influence of social media on their involvement in cybercrime

S/N	Item Statement	Gender	n	X	SD	Decision
11.	I use the Internet to dupe people.	Male	73	3.18	.77	A
		Female	100	3.01	.88	A
12.	I constantly place unwanted calls to people.	Male	73	2.86	.85	A
		Female	100	3.01	.73	A
13.	I send unwanted text messages and email to people.	Male	73	3.05	.74	A
		Female	100	2.85	.81	A
14.	I upload female pictures on social media without their consent.	Male	73	3.00	.78	A
		Female	100	3.07	.84	A
15.	I use the Internet to do illegal business.	Male	73	2.52	.94	A
		Female	100	2.46	.96	D
16.	I always access cyber pornographic images and videos.	Male	73	3.29	.70	A
		Female	100	3.20	.82	A
17.	I hack into people's personal and sensitive information on the Internet.	Male	73	2.66	.97	A
		Female	100	2.69	.94	A
18.	I use social networking sites and technology to track people.	Male	73	2.05	.88	D
		Female	100	2.07	.95	D
19.	I use social networking sites to blackmail people.	Male	73	2.42	.90	D
		Female	100	2.29	.84	D
20.		Male	73	2.88	.90	A

	I use a cell phone to bridge into people's privacy.	Female	100	2.83	.87	A
21.	I use social media for examination malpractice.	Male	73	3.05	.81	A
		Female	100	2.75	.91	A
	Overall Mean	Male	73	2.82	.36	A
		Female	100	2.75	.38	A

Key: 3.50 – 4.00 = Strongly Agree (SA); 2.50 – 3.49 = Agree (A); 1.50 – 2.49 = Disagree (D); 0.50 – 1.49 = Strongly Disagree (SD)

Table 3 shows the mean responses of both male and female SS 2 students in Udi LGA, Enugu State, on the influence of social media on their involvement in cybercrime. It indicates that the mean responses of the male and female students to items 11-14, 16, 17, 20 and 21 are within the real decision point limit of 2.50 – 3.49. This implies that both the male and female SS 2 students in the secondary schools agree with the statements in items 11-14, 16, 17, 20 and 21. Secondly, the mean response of male students to item 15 is within the real limit decision point of 2.50-3.49, while that of their female counterparts is in the real limit decision point of 1.50-2.49. This implies that the male students agree with the item statement while their female counterparts disagree. Again, the mean responses of both male and female students to items 18 and 19 are in the real limit decision point of 1.50-2.49. This indicates that the male and female students disagree with the statements in items 18 and 19. The overall means 2.82 (SD = .36) and 2.75 (SD = .38) for the male and female students, respectively, implying that the male and female students in the secondary schools agree with the statements in the items. It also implies that the male and female students' involvement in cybercrime is influenced by social media, though the male students obtained a higher mean rating, an indication that male students are more involved in cybercrime as a result of social media influence.

Hypothesis 2: There is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in cybercrime.

Table 4: t-test score on the influence of social media on mathematics students' involvement in cybercrime by gender

Gender	n	X	SD	df	t-cal	Sig. (2-tailed)	Decision
Male	73	2.82	.36	171	1.19	.237	HO ₂
Female	100	2.75	.38				Accepted

Data in table 6 shows the t-test score on the influence of social media on mathematics students' involvement in cybercrime by gender, $t(171) = 1.19$, $p = .237 > .05$. Since the p -value of .237 is greater than the 0.05 probability

level set for the study, the null hypothesis, which states that there is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in cybercrime, is accepted. This implies that there is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in cybercrime in secondary schools.

Discussion

The findings of this study revealed that male students have a higher level of addiction to social media than their female counterparts in the secondary schools in Udi Local Government Area of Enugu State. The study also found that there is no significant difference in the mean responses of the male and female students on their level of addictiveness to social media in secondary schools. This finding is in agreement with the findings of Osharive (2015) that a great number of students at the University of Lagos are addicted to social media. This is corroborated by Ayatalumo and Ukegbu (2018), who revealed that most of the Nigerian students spend 3-5 hours of their study time on social media. The findings of this study are also in line with Azizi et al. (2019), who found that male students had a higher level of addiction to social media than female students. Bhandarkar et al. (2021) revealed a strong positive correlation between social media usage and the social media addiction score. Supporting this finding, Wordu et al. (2021) revealed that students who spent more time on social media were more likely to have higher Internet addiction.

Evidence from the study reveals that the male students are more involved in Cybercrime as a result of social media influence than their female counterparts. It also reveals that there is no significant difference in the mean responses of male and female students on the influence of social media on their involvement in Cybercrime in secondary schools in Udi Local Government Area of Enugu State. This agrees with the finding of Umeozulu (2012) that the Internet is used by Nigerian youths for the perpetuation of criminal spamming activities. It is also in line with Asogwa (2019), who revealed a significant association between digital media and cybercrime, and Agara et al. (2021), who found that Facebook, Instagram and Twitter (now X) significantly expose students to cybercrimes.

Conclusion

From the findings of this study, the following conclusions are drawn: Evidence from the findings of this study on the level of addictiveness to social media showed that the male students had a higher level of addiction to social media than their female counterparts in the secondary schools in Udi Local Government Area. This calls for proper orientation of the students, especially

in the senior classes, on the adverse effects of addiction to social media usage. The results of the findings on students' involvement in Cybercrime as a result of social media revealed that male students are more involved in Cybercrime as a result of social media influence than their female counterparts. The school authorities should do their best to discourage students from using phones in school. The students should also be made to understand the law of the land against Cybercriminals.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. School administrators should give students proper orientation, especially those in the senior classes, on the adverse effects of addiction to social media.
2. Teachers should teach students to understand the law of the land against Cybercrime.
3. The school authorities should monitor both the male and female students on the usage of social media in schools, as its usage relates to their involvement in Cybercrime.

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Data Availability: All data are included in the content of the paper.

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Upscaling Corporate Governance Principles for Performance of National Sports Federations in Kenya and Beyond

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Abstract

The sports industry in Kenya continues to grow swiftly and emerge as a vibrant and crowd-pulling phenomenon. However, few studies have been conducted on the critical topic of corporate governance principles and the performance of national sports federations. Thus, the research focused on determining the effect of corporate governance principles on National Sports Federations' performance in Nairobi City County, Kenya. The objectives included evaluating the effects of transparency, accountability, sustainability, and integrity on National Sports Federations' performance in Nairobi City County, Kenya. The study variables were anchored in the Stewardship theory, Balanced Scorecard theory, and Stakeholder theory. The research utilized both secondary and primary data. The research utilized a descriptive research design to collect data from a sample of 145 federation members: Head of National Team Coaches, Assistant National Team Coaches, and Technical Directors. Semi-structured questionnaires were utilized for data collection. Self-administered Questionnaires were utilized, employing the drop-off and later pick-up approach. Data was analyzed using the Statistical Package for Social Sciences (SPSS). Quantitative data collected was analyzed using multiple regression, descriptive analysis, and Correlation analysis. The study found that accountability, transparency, integrity, and sustainability have a significant positive relationship with the performance of national sports federations in Nairobi City County. Further findings reveal that increased

service delivery, customer feedback, employee satisfaction, and financial performance of national sports federations indicate performance. This study recommends the formation of clear corporate governance policies that raise sustainable development in the Kenya sporting sector, federation members to adopt continuous training on best practices of corporate governance, utilize digital platforms for governance practices, national and county government to establish measurable performance indicators to be adopted by national sports federations, consistent monitoring, and evaluation of these performance indicators. These recommendations will help both the national sports federations and the government to increase transparency, accountability, sustainability, and integrity in the sports industry in Kenya.

Keywords: Corporate Governance, Performance, National Sports Federations, Accountability, Transparency, Sustainability, Integrity

1. Introduction

The concept of effective governance has risen in different regions of the world, influenced by diverse cultures and various theoretical frameworks. One prevalent theoretical influence is the corporate governance concept. At the outset of the 21st century, corporate governance appeared to be making positive strides on a global scale, with its importance widely acknowledged. However, a major setback occurred when Enron, one of the United States' largest companies, crumbled due to undisclosed debt and questionable corporate governance practices among its executive leaders. Similarly, companies like Waste Management, Tyco, and WorldCom also experienced collapses, and their auditing firm, Arthur Andersen, one of the world's five leading accounting firms, faced challenges as clients changed auditors and partners shifted to other firms (Tricker, 2020).

The sports sector has changed since the turn of the twenty-first century, shifting from its previous volunteer-based culture to one that aims to provide sports services more professionally. It is increasingly crucial to formally establish the principles of sound governance to guarantee the efficient provision of these sports services. In response to the increasing instances of controversies within global bodies like the International Olympic Committee (IOC), structural and governance changes were put into effect (Verschuuren, 2021). Corporate governance is starting to receive attention in Kenya, even though minimal efforts have been made in this field, including within well-regulated institutions and sectors. State-owned corporations are grappling with significant governance issues, and a few of them have partially closed due to these challenges (Miringu and Muoria, 2019).

Incorporating the topic of effective governance into the bylaws of national sports federations has become essential, given the increase in

instances where sports organizations have been involved in numerous fraudulent schemes, spanning from misconduct to match manipulation. As recently as 2015, a variety of sports entities ranging from the Kenya Rugby Union (KRU), the Kenya National Olympic Committee (NOCK), Athletics Kenya (AK), and Football Kenya Federation (FKF) have been implicated in several misappropriation and corruption scandals, necessitating the incorporation of principles of governance for the protection and well-being of shareholders' interests (Edmund, 2021).

The distinction in evaluating performance sets apart sports federations from commercial counterparts (Nowy, Wicker, Feiler, & Breuer, 2015). While corporate governance primarily revolves around the financial prosperity and viability of organizations within the formal business segment, including the sports industry in this segment has elevated the necessity for sports organizations to comprehend and adhere to the tenets of effective governance. Corporate governance principles were employed to gauge the operational success of national sports federations in Nairobi City County, Kenya. Consequently, the objective of this research was to present an outline of the guiding principles of corporate governance, such as transparency, integrity, accountability, and sustainability, influencing the efficiency and effectiveness of sports federations in achieving their goals, ensuring long-term sustainability, and maintaining public trust.

1.1 Statement of the problem

Although sports are a substantial contributor to individuals' income and the Gross Domestic Product in Kenya, sports federations have, over the years, undergone strained financial performance (Musonye, 2017). This alone has slowed down the rate of development in the sports industry by a great deal and inhibited the realization of the sector's economic potential. Upon realization of the funding challenges, the government came up with corporate governance policies in the hope that, once adhered to, these policies would lead to increased organizational performance (Kenya Sports Act, 2013). Despite the introduction of corporate governance policy, the performance of national sports federations in Kenya has not improved as expected. The degree of commitment by National Sports Federations (NSFs) management to corporate governance remains uncertain, and it's not evident how this may correlate with the current constrained performance levels.

Lasisi (2017) study found a positive correlation between financial performance and corporate governance practices in non-profit organizations listed on the Nigerian Securities Exchange. However, the relationship was not found to be statistically significant. This study will be conducted in Kenya among National Sports Federations in Nairobi City County, Kenya, which operate in distinct settings compared to the non-financial firms in Nigeria.

Ullah et al., (2016) examined one aspect of corporate governance, corporate accountability, while studying the effect of transparency and corporate accountability on manufacturing firms' performance in Pakistan. The study was confined to transparency and accountability within industrialized firms in Pakistan, while this study expounds on four key variables: transparency, sustainability, accountability, and integrity.

Okoko (2017) study on the correlation between firm performance in Kenya and corporate governance was limited to board structure and was conducted among 40 insurance companies, while this study explores four corporate governance principles on the performance of national sports federations in Nairobi City County, Kenya.

1.2. Objective of the Study

To determine the influence of corporate governance principles (accountability, transparency, sustainability, and integrity) on the performance of National Sports Federations in Nairobi City County, Kenya.

2.0 Review of Literature

The study utilized both empirical and theoretical reviews, focusing on what has already been discussed and the supporting variables of the study.

2.1 Theoretical Review

This study was based on different theories that support the study variables. The covered theories include: Stakeholder Theory, Stewardship Theory, and Balanced Scorecard Theory.

2.1.1 Stakeholder Theory

Freeman (1984) introduced the concept of Stakeholder Theory, which argues that shareholders are only one of several stakeholders in an organization. This theory also suggests that the stakeholder system consists of all individuals and entities with an interest in, or influence over, the organization, including vendors, governmental agencies, employees, and environmental advocates residing near the company's facilities and suppliers. Stakeholders Theory suggests that the success of an organization lies in the satisfaction of stakeholders rather than those who may gain from its stock performance.

The Anglo-American corporate governance measures grant significant power to managers, which they could potentially exploit for their gain, at the expense of both the wider community and shareholders. Advocates of this perspective argue that the existing institutional checks on managerial conduct, including the auditing process, the risk of taking over, and non-executive directors, are insufficient in preventing the misuse of corporate authority by

directors. The stakeholder theory stipulates that organizations work to expand and balance numerous stakeholders' interests, ensuring each stakeholder is compensated. It is suggested that an organization has a broader obligation, extending beyond its sole responsibility, to also consider the welfare of the wider society (Freeman, Harrison, & Zyglidopoulos, 2018).

The stakeholder theory enables organizations to generate greater profits through practical approaches. Organizations should prioritize the concerns of stakeholders since they have multifaceted impacts on firms' performance. Stakeholders assume certain risks due to their direct or indirect investments in a specific organization. According to Charles Blattberg, this theory exhibits certain shortcomings, and it tends to yield ideal outcomes when consistently applied within an organization. Furthermore, the evaluation of this theory's analysis can occasionally be subjective, and it may be challenging to fulfill all stakeholder interests simultaneously (Sternberg, 2019). Often, companies prioritize stakeholders such as shareholders over employees and consumers. This theory was employed in this research since it provides practical methods mainly focused on boosting efficiency, enhancing organizational performance, and ultimately increasing profits.

2.1.2 Stewardship Theory

Davis and Donaldson (1989) introduced Stewardship theory as a significant concept in corporate governance. This theory suggests that managers ought to function as stewards, prioritizing the best interests of shareholders. Stewardship theory is rooted in psychology and sociology and assumes that managers will protect and generate profits for shareholders. The firm's success is closely tied to management commitment, benefiting both shareholders and managers through remunerations (Davis & Donaldson 2018).

What makes stewardship theory unique is its emphasis on building trust in managers, with the belief that directors and managers are prone to act in favor of shareholders (Schillemans & Bjurström, 2020). Shareholders grant managers (stewards) more power and trust, expecting wealth maximization in return. This theory nurtures a favorable relationship between management and shareholders, constituting a crucial aspect of effective corporate governance. Chrisman (2019) examined that Stewardship theory mainly focuses on motivating managers to contribute to business goals, therefore, aligning the interests of managers (agents) and shareholders (principals). This theory summarizes the views and objectives of a steward, which speak to the principles of transparency, integrity, sustainability, and accountability under this study.

2.1.3 Balanced Scorecard Theory

The concept of a Balanced Scorecard was established by Norton and Kaplan (1992) as a mechanism for transforming an organization's mission statement and broad business strategy into specific, verifiable goals and monitoring the organization's success in accomplishing these goals. (Kefe, 2019). Originally, the Balanced Scorecard was meant for for-profit organizations but was later adapted by government agencies and non-profit organizations. According to Kefe (2019), the fair scorecard approach was expected to give an unmistakable remedy concerning what organizations ought to quantify to "balance" the financial viewpoint in the execution and control of strategic plans. The balanced scorecard provides a comprehensive assessment of the general performance of an organization across four domains: financial analysis, the most regularly utilized presentation marker that permits directors to follow monetary achievement and investor esteem; customer analysis which focuses on retention and customer feedback; growth and learning analysis which explores management effectiveness in terms of the approach to measuring employee satisfaction, retention, and information system performance. Lastly, Internal analysis, whose focus is on production and innovation.

The Balanced Scorecard uses standardized measurements. These standardized or fundamental outcome measurements sum up the shared objectives of various methodologies. Examples of general measurements include customer retention, profitability, customer satisfaction, market share, and employee expertise. Performance drivers are specific to each business unit. They mirror the uniqueness of the business unit's strategy, encompassing factors such as the factors that affect profitability, markets that will compete, the value propositions provided to consumers in those segments, as well as the specific internal procedures, learning and growth capabilities, which support the achievement of both financial and consumer goals (Sartor, 2019).

In the current, often-changing and complex business environments, it is essential for organizations to thoroughly understand their objectives and the methods to swiftly achieve them. The Balanced Scorecard stands as an innovative instrument that inspires employees to achieve the organization's objectives. It goes beyond mere performance monitoring, serving as a managerial strategy that directs employees' endeavors throughout the entire enterprise, steering them toward the attainment of strategic goals. The Balanced Scorecard addresses the dependent variable, the performance of National Sports Federations in Nairobi City County, Kenya, about accountability, transparency, integrity, and sustainability.

2.2 Empirical Review

2.2.1 Accountability and performance of National Sports Federations

Masoumi et al. (2022) studied the implications of managerial accountability within sports organizations. This study adopted the foundational framework of data theory. The research methodology followed a structured approach as outlined by Strauss and Corbin. Respondents consisted of experts in sports, both from scientific and executive domains, spanning across the nation. Employing a snowball sampling technique based on theoretical saturation, 12 individuals were interviewed. The collected data was analyzed through three interwoven stages: selective coding, open coding, and axial coding. The findings of the study were then studied within the context of interventionist, contextual, and causal accountability aspects, considering viewpoints from managerial as well as non-administrative standpoints. This research explored both macro- and micro-level strategies, leading to advancements in transparency and consistency, elevated performance standards, fortified trust, effective persuasion, prevention of resource mismanagement, heightened empathy, empowerment of managers, and enhanced efficacy of actions.

Moses and Turyasingura (2022) carried out research in Kabale Municipality, Uganda, to examine how accountability impacts the performance of selected commercial banks. The research used a cross-sectional design with a descriptive, quantitative approach, involving 118 participants chosen randomly and purposively. The study adopted SPSS to analyze the collected data. The research established a positive association between financial performance and accountability in certain commercial banks in Kabale Municipality. The authors established that effective accountability practices foster a positive business environment, encouraging local investment and enhancing public trust in commercial banks.

Kavila, Mwalwa, and Karanja (2023) did a study on organizational performance and financial accountability at Ndolo DCC Church. The study utilized a mixed methodology, collecting data from both qualitative and quantitative sources from 42 respondents. 33 respondents were involved in the quantitative data collection, while 9 were involved in the qualitative aspect. Data was collected using questionnaires and interviews. Statistical Package for the Social Sciences (SPSS) version 23 and QDA Miner were utilized for data analysis. The findings of the study revealed there was a substantial and positive correlation between financial transparency and organizational performance ($p=0.026$, $\beta=0.228$). Additionally, the research revealed that financial attitude and financial management knowledge also had positive and momentous relationships with organizational performance ($\beta=0.450$, $p=0.005$ and $\beta=0.304$, $p=0.035$ respectively).

Chemakai, Alala, and Charles (2018) studied how board accountability impacts the performance of the Savings and Credit Cooperative Societies in Kakamega County. The research utilized an explanatory survey research design, focusing on 5 selected SACCOs with a total membership of 50,000 in Kakamega town. The researcher selected 890 participants using a stratified random sampling method. The participants comprised 40 top managers, 5 financial managers, 45 board members, and 800 shareholders. The researcher collected data using questionnaires, and the analysis utilized both inferential and descriptive statistics. Study findings showed a significant and positive correlation between board accountability and SACCO performance, with a correlation coefficient (r) of 0.416 and a p -value of 0.00 at a 99% confidence level.

2.2.2 Transparency and performance of National Sports Federations

Gani, Rahbi, and Ahmed (2021) conducted an Empirical Analysis of Corporate Transparency, Competitive Advantage, and Performance for the Muscat Securities Market. 60 participants were sampled from the industrial, service, and financial sectors within the Muscat Securities Market. The data collected was analyzed with Smart PLS 3.0. The secondary data gathered indicated that a high level of transparency led to enhanced corporate performance. Consequently, improved transparency has a positive impact on performance. Findings showed there is a correlation between corporate transparency and competitive advantage, which also improves management accounting metrics. Therefore, transparency stands as a vital tool for attaining a competitive edge and improving the financial performance of businesses.

Zehir, Çınar, and Şengül (2016) studied the significance of stakeholder participation in hospital management regarding transparency and qualitative and quantitative performance. The study demonstrated that transparency and stakeholder participation have a positive correlation, serving as crucial elements of good governance in enhancing corporate performance. The study employed a survey approach, encompassing 351 managers at upper and mid-level positions across 74 hospitals registered under provincial health directorates in Istanbul during the period 2013-2014. The gathered data underwent analysis using SPSS 16.00, with techniques like regression analysis, factor analysis, reliability analysis, and correlation analysis applied for testing. The outcomes revealed that adhering to transparency principles has a favorable effect on both qualitative and quantitative performance, achieved through stakeholder involvement.

Akhigbe and Akhigbe (2021) explored the correlation between organizational effectiveness and organizational transparency among money deposit banks in Rivers State, Nigeria. The research employed a cross-sectional study design, with a target population of 15 banks with 159

employees. Primary data was collected from a sample size of 114 employees using a meticulously developed questionnaire. The data analysis utilized the Pearson product-moment correlation. The results of the study showed a strong relationship between the various features of organizational transparency (participatory and informational transparency) and the indicators of organizational efficiency (namely, goal consensus and job satisfaction). Therefore, the study established that an increase in transparency influences the enhancement of organizational effectiveness.

2.2.3 Sustainability and performance of National Sports Federations

Hugaerts et al. (2022) explored the function of sports federations and their linked ecological endeavors and tactics in Belgium. The researchers conducted a scrutiny of the websites of 141 sports federations using content analysis. Their analysis revealed that sports federations have not established a sustainable ecological approach and exhibit minimal dedication to initiatives and comprehensive strategies to address climate change. Nevertheless, in reaction to the increasing societal demands for sports institutions to interact with their surroundings, the writers propose and finalize progressive approaches and deliberate on how governmental, communal, and utilitarian coercion can additionally be utilized to propel ecological durability in athletic alliances.

Erdei-Gally, Fekete-Farkas, and Muchiri (2022) conducted a study focusing on the financial performance of Kenyan financial institutions and Corporate Social Responsibility (CSR). The study specifically examined the effects of philanthropic, gender-inclusive, and ethical sustainable business practices on banking establishments' financial performance in Kirinyaga County. The study involved 300 personnel from financial organizations in Kirinyaga County and sampled 171 participants through stratified and systematic sampling methods. Data analysis was carried out using SPSS software, using a causal research methodology. In-person questionnaires were the primary method used for data collection. Study findings disclosed a notable positive link between the economic success of financial institutions and CSR practices. As a result, the study recommends that companies increase their involvement in CSR initiatives that prioritize ethics, philanthropy, and gender inclusivity, as these efforts have the potential to enhance financial performance.

Weerasinghe et al. (2023) researched to examined how multifaceted corporate sustainability practices affect the performance of organizations in Sri Lanka's textile and apparel sector, particularly during the COVID-19 pandemic. The research utilized Smart PLS 4.0 software for analysis and tested its hypotheses using the partial least squares structural equation modelling (PLS-SEM) method. Data collection involved the use of

questionnaires distributed to 300 apparel businesses that were registered with Sri Lanka's Board of Investment. The findings of the study showed that social equity, ethical practices, and economic vigor significantly influence organizational performance, while the impact of corporate governance on environmental performance was deemed insignificant.

2.2.4 Integrity and performance of National Sports Federations

Abdullah and Atshan (2019) researched to examine how organizational integrity and leadership conduct influence performance in the banking sector. They explored the arbitrating impact of work engagement in this relationship. The researcher collected data using a questionnaire distributed to 285 employees in the Southern and Central regions of Iraq's banking sector. The findings revealed that work engagement partially mediated the correlation between organizational integrity and organizational excellence, while it fully influenced the link between leadership behavior and organizational success.

Hartanto (2019) carried out a study to examine the influence of integrity and knowledge management on organizational performance through the lens of managerial commitment at PT Bhinneka Mentari Dimensi. The research involved a sample of 128 employees across all organizational sectors and data collected from primary sources using a questionnaire. The study employed path analysis to analyze data. The results from the analysis indicated that integrity and knowledge management concurrently influence organizational performance. Specifically, both knowledge management and integrity variables have partial effects on organizational performance. The study also highlighted that organizational commitment variables contribute partially to organizational performance. Notably, a stronger commitment to the organization enhances the combined impact of integrity and knowledge management on organizational performance.

Kazem et al. (2021) studied how psychological capital may be used to improve organizational performance while maintaining organizational integrity. Data was collected from 155 employees in the general firm oil business in the governorate of Maysan using a questionnaire. A statistical program (SPSS v.23) was utilized for data analysis in the study. Research findings demonstrated the importance of organizational integrity as a management philosophy and concept in organizational behavior for accomplishing organizational objectives.

3.0 Research Methodology

This research adopted a descriptive research design to examine how national sports federations' performance in Nairobi City County, Kenya, relates to corporate governance principles. The study incorporated quantitative

and qualitative elements for collecting data and analysis. The research focused on 76 registered National Sports Federations in Nairobi City County, Kenya. The units of observation were the technical directors, the head of national team coaches, and assistant national team coaches from the 76 national sports federations. The target population, therefore, comprised 228 National Sports Federation members, which includes 76 technical directors, 76 head of national team coaches, and 76 assistant national team coaches. The researcher used these categories of national sports federation members because each of these members works directly with the national sports federations' office. The study adopted Yamane's (2021) formula to determine the sample size of the population. The researcher selected a 5% significance level to minimize sampling errors.

$$n = N / (1 + Ne^2)$$

In the formula above, N = population, n = sample size and e = error margin (0.05).

$$n=2281+228 (0.05)^2=145$$

Therefore, the study sample size consisted of 145 National Sports Federation employees selected using simple random and purposive sampling. The researcher selected respondents from each national sport federation in Nairobi City County, Kenya, using simple random and purposive sampling. The study adopted a semi-structured questionnaire to obtain data. The questionnaire helped provide significant information required to accomplish the study objectives. The questionnaire had six sections. General questions about the respondents and national sports federations were asked in the first section, while the other five sections contained questions on each of the four research questions.

This study's measurement scales were predominantly interval scales, in this case, Likert scales. The questionnaire had closed questions, including 5-point Likert scale questions, since more strong statistical measures can be utilized with interval scales (Kumar, 2018). These questionnaires were written with clarity and conciseness in mind. Willis (2020) noticed that for a high response rate, it is advisable to keep the number of questions limited and design them in a way that demands minimal effort from respondents during completion. Nevertheless, the questions maintained a sufficient level of accuracy to gather essential data, all the while ensuring a prompt and comprehensive response from participants.

A pilot study was done on four national sports associations that have similar systems to national sports federations in Nairobi City County, Kenya. Respondents were asked to give feedback on their understanding of the items and the effort required to fill out the questionnaires during pilot testing.

Recommendations provided by pilot testing respondents were used in making amendments to the final questionnaire. The questionnaire underwent assessment for content and face validity to assess whether the questionnaire was accurate and applicable to its intended purpose. The study used the internal consistency method to check whether the instrument was reliable, where Cronbach's Alpha for each variable was examined. Cronbach's Alpha values were greater than the threshold of 0.7, making the questionnaire reliable, and hence no amendments were needed before data collection.

Descriptive statistical methods, including figures, percentages, frequency distributions, standard deviation, and mean, were employed for quantitative data analysis, utilizing the Statistical Package for Social Sciences (SPSS) version 23. Additionally, the study used corporate content analysis for open-ended questions, presenting the findings in narrative form. The results were then summarized and presented in tables. Correlation and Multiple Regression techniques were utilized to establish the statistical relationship among variables. The four independent variables were subjected to regression against the dependent variable, unveiling the quantitative impact exerted on the dependent variable. The Regression and Correlation data analysis methods were conducted at a 95% confidence level ($\alpha = 0.05$).

4.0 Research Findings and Discussion

The research respondents were 145 employees from the selected 76 National Sports Federations in Nairobi City County. However, only 75 respondents responded and returned their questionnaires, contributing to a 52% response rate, which is satisfactory for reporting and analysis (Mugenda & Mugenda, 2013).

4.1 Accountability and performance of National Sports Federations

An examination of the influence of accountability on the performance of National Sports Federations was conducted through a point Likert scale. Table 4.1 shows a summarized rating of respondents. Respondents agreed that through accountability, NSFs can get a sustainable competitive advantage (mean=3.51, std. dev = 1.359). The statements that were neutral to respondents include; NSFs have clear roles and responsibilities of each of their members (mean= 3.4, std. dev = 1.263), have an audit committee (mean= 3.21, std. dev = 1.298), Address risk management within the federation (mean = 3.07. std. dev = 1.189) and that an external auditor is appointed annually for each federation (mean = 2.84, std. dev = 1.175).

Table 4. 1 Accountability and Performance of National Sports Federations

	N	Minimum	Maximum	Mean	Std. Deviation
The NSF has clear roles and responsibilities of each member.	75	1	5	3.40	1.263
The NSF has an audit committee.	75	1	5	3.21	1.298
The NSSF addresses risk management within the federation.	75	1	5	3.07	1.189
The NSF appoints an external auditor annually.	75	1	5	2.84	1.175
Through accountability the NSF is able to gain sustainable competitive advantages.	75	1	5	3.51	1.359
Valid N	75				

Source: research data, 2024

4.2 Transparency and Performance of National Sports Federations

The study sought to establish the influence of transparency on the Performance of the National Sports Federation using a five-point Likert scale. Respondents summarized ratings as shown in Table 4.2. Respondents were neutral about having transparency in National Sports Federations. Respondents were neutral that transparency is the base of the performance of the National Sports Federation (mean = 3.32, std. dev = 1.453). They neither agreed nor disagreed that National Sports Federations provide accurate information to stakeholders and shareholders (mean = 3.00, std dev = 1.127). Respondents were also neutral about federation members adhering to the code of conduct and ethics (mean = 3.19, std. dev = 1.123). In addition, respondents were neutral about National Sports Federations sharing their financial reports to stakeholders and shareholders (mean = 3.11, std. dev = 1.290) and that the NFSs communicate all their activities to the national government (mean = 3.16, std. dev = 1.263).

Table 4. 2 Transparency and Performance of National Sports Federations

	N	Minimum	Maximum	Mean	Std. Deviation
Transparency is the base of performance of NSF.	75	1	5	3.32	1.453
The NSF provides accurate information to Stakeholders and Shareholders.	75	1	5	3.00	1.127
Federation members adhere to code of conduct and ethics.	75	1	5	3.19	1.123
The NSF shares financial reports annually to the shareholders and stakeholders.	75	1	5	3.11	1.290
The NSF communicates all their activities to the National Government.	75	1	5	3.16	1.263
Valid N	75				

Source: research data, 2024

4.3 Sustainability and Performance of National Sports Federations

An analysis of the influence of sustainability on the performance of National Sports Federations was evaluated through the five-point Likert scale. According to Table 4.3, the majority of the respondents agreed that training and personal development are needed for sustainable growth (mean = 4.24, std. dev = 1.113). In addition, respondents agreed that the sustainability of National Sports Federations influences performance and Corporate Social Responsibility influences NSF's performance as shown by (mean= 3.79, std. dev = 1.233) and (mean = 3.65, std. dev = 1.059) respectively. Moreover, respondents were neutral that NSF's have sustainability programs (mean = 3.09, std. dev = 1.210) and that the NSF's actively participate in sustainability programs (mean = 3.16, std. dev = 1.053).

Table 4.3 Sustainability and Performance of National Sports Federations

	N	Minimum	Maximum	Mean	Std. Deviation
Sustainability of NSF influences performance.	75	1	5	3.79	1.233
Corporate Social Responsibility influence NSF's performance.	75	1	5	3.65	1.059
The NSF you are working in has a sustainability program.	75	1	5	3.09	1.210
The NSF actively participates in the sustainability program.	75	1	5	3.16	1.053
Training and personal development is needed for personal growth.	75	1	5	4.24	1.113
Valid N	75				

Source: research data, 2024

4.4 Integrity and Performance of National Sports Federations

The influence of integrity on the performance of National Sports Federations was examined using a five-point Likert scale, as shown in Table 4.4. Findings revealed that majority of respondents agreed with the following statements: Federation members believe integrity plays a big role in the performance of NSF's (mean = 4.29, std. dev = 1.124), The nature of NSF's require official with integrity behavior to be successful (mean = 4.23, std. dev = 1.060), Federation members are assigned clear roles and responsibilities (mean = 3.65, std. dev = 1,059) and that National Sports Federations encourage the culture of integrity among members (mean = 3.53, std. dev = 1.178). However, respondents were neutral about National Sports Federations officials working faithfully with loyalty and devotion (mean = 2.93, std. dev. = 1.095).

Table 4. 4 Integrity and performance of National Sports Federations

	N	Minimum	Maximum	Mean	Std. Deviation
As a federation member, I believe integrity plays a big role on performance of NSFs.	75	1	5	4.29	1.124
NSF officials work faithfully with loyalty and devotion.	75	1	5	2.93	1.095
The nature of NSF requires officials with integrity behavior to be successful.	75	1	5	4.23	1.060
Federation members are assigned clear responsibility and accountability.	75	1	5	3.65	1.059
The NSF encourages the culture of integrity among members.	75	1	5	3.53	1.178
Valid N	75				

Source: research data, 2024

4.5 Performance of National Sports Federations

The study sought to examine the rate of performance of national sports federations in Nairobi City County. Respondents used the five-point Likert scale to indicate the extent to which the mentioned statements indicated the performance of NSFs. Respondents agreed that there are different methods of measuring performance. Despite respondents having agreed on the following statements moderately indicating performance, Increased service delivery was highly thought to indicate performance (mean = 3.08, std. dev. = 0.969, followed by increased customer feedback (mean = 2.93, std. dev. = 1.095), increased employee satisfaction (mean = 2.80, std. dev. = 0.986), and the least seen as performance was increased financial performance (mean = 2.71, std. dev = 1.050). A balance of all these will improve the strategic performance of National Sports Federations.

Table 4. 5 Performance of National Sports Federations

	N	Minimum	Maximum	Mean	Std. Deviation
Increased service delivery.	75	1	5	3.08	.969
Increased employee satisfaction.	75	1	5	2.08	.986
Increased customers' feedback.	75	1	5	2.93	1.095
Increased financial performance.	75	1	5	2.71	1.050
Valid N	75				

Source: research data, 2024

4.6 Correlation Analysis

The study conducted Pearson correlation analysis at a 95% level of confidence to establish the relationship between corporate governance principles and performance of the National Sports Federations in Nairobi City County, Kenya. The findings are illustrated in Table 4.6.

Table 4. 6 Pearson Correlation Analysis Output

		Accountability	Transparency	Sustainability	Integrity	Performance
Accountability	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	75				
Transparency	Pearson Correlation	.813**	1			
	Sig. (2-tailed)	.000				
	N	75	75			
Sustainability	Pearson Correlation	.837**	.847**	1		
	Sig. (2-tailed)	.000	.000			
	N	75	75	75		
Integrity	Pearson Correlation	.865**	.848**	.935**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	75	75	75	75	
Performance of NSF	Pearson Correlation	.856**	.773**	.805**	.782**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	75	75	75	75	75

** . Correlation is significant at the 0.05 level (2-tailed).

Source: research data, 2024

As per the findings in Table 4.6, the study established that there is a strong and positive relationship between accountability and performance of the National Sports Federations in Nairobi City County, Kenya, as shown by a correlation coefficient of 0.856. Since the p-value (0.000) was less than 0.05, the study concluded that there is a significant relationship between accountability and performance of the National Sports Federations in Nairobi City County.

Further, the results showed that there is a strong and positive relationship between transparency and performance of the National Sports Federations in Nairobi City County, Kenya, as shown by a correlation coefficient of 0.773. Since the p-value (0.000) was less than 0.05, the study concluded that transparency is significantly associated with the performance of the National Sports Federations in Nairobi City County.

In addition, the findings found that there is a strong and positive relationship between sustainability and performance of the National Sports Federations in Nairobi City County, Kenya ($r = 0.805$). Since the p-value (0.000) was less than 0.05, the study concluded that there is a significant

relationship between sustainability and performance of the National Sports Federations in Nairobi City County.

Finally, the findings revealed that there is a strong and positive relationship between integrity and performance of the National Sports Federations in Nairobi City County, Kenya, as shown by a correlation coefficient of 0.782. Since the p-value (0.000) was less than 0.05, the study concluded that there is a significant relationship between integrity and performance of the National Sports Federations in Nairobi City County.

4.7 Multiple Regression Analysis

The study conducted multiple regression analysis at a 95% level of confidence to establish the influence of accountability, transparency, sustainability and integrity on the performance of the National Sports Federations in Nairobi City County. The findings are shown in Tables 4.1, 4.2 and 4.3.

Table 4. 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error
1	.876 ^a	.768	.755	.418

a. Predictors: (Constant), Integrity, Transparency, Accountability, Sustainability

Source: research data, 2024

From the outcomes in Table 4.7, the R-squared was 0.768, which implies that 76.8% of the variations in the performance of the National Sports Federations in Nairobi City County could be attributed to corporate governance principles such as accountability, transparency, sustainability, and integrity. This implies that the remaining 33.2% of the changes in performance of the National Sports Federations could be attributed to other factors, such as government support, which forms the basis for further studies.

Table 4. 8 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.549	4	10.137	57.946	.000 ^b
	Residual	12.246	70	.175		
	Total	52.795	74			

a. Dependent Variable: Performance

b. Predictors: (Constant), Integrity, Transparency, Accountability, Sustainability

Source: research data, 2024

As per the findings in Table 4.8, the F-computed was 57.946 and the p-value was 0.000. Since the F-computed was greater than F-critical (2.5027) and the p-value was less than 0.05, the study concluded that the regression was significant. This implies that the performance of the National Sports Federations in Nairobi City County could be predicted using corporate governance principles such as accountability, transparency, sustainability, and integrity.

Table 4. 9 Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.440	.180		2.450	.017
Accountability	.761	.054	.856	14.162	.000
Transparency	.671	.064	.773	10.402	.000
Sustainability	.402	.177	.388	2.278	.026
Integrity	.791	.074	.782	10.718	.000

a. Dependent Variable: Performance

Source: research data, 2024

From the regression coefficients in Table 4.9, the regression model equation was:

$$Y = 0.440 + 0.761 X_1 + 0.671 X_2 + 0.402 X_3 + 0.791 X_4$$

Where:

Y = Performance of the National Sports Federations

X₁ = Accountability

X₂ = Transparency

X₃ = Sustainability

X₄ = Integrity

The first objective aimed to establish the influence of accountability on National Sports Federations' performance in Nairobi City County, Kenya. From the findings in Table 4.10, the study revealed that a unit change in accountability would lead to a 0.761 change in the performance of the National Sports Federations in Nairobi City County. Since the p-value (0.000) was less than 0.05, the study concluded that accountability had a significant influence on the performance of National Sports Federations in Nairobi City County, Kenya. This highlights the critical role of holding all stakeholders responsible for their actions towards organizational success.

Kavila, Mwalwa, and Karanja (2023) found evidence to support the influence of accountability on performance. The study concluded there was a substantial and positive correlation between financial accountability and organizational performance. These results also coincide with the study of Masoumi et al. (2022) and Moses and Turyasingura (2022), who studied the implications of managerial accountability on organizational performance. These alignments assert that adopting accountability within National Sports Federations in Nairobi City County is important for proper operational efficiency and overall performance.

The second objective aimed at establishing the influence of transparency on the performance of National Sports Federations in Nairobi City County, Kenya. Findings showed that a unit change in transparency

would lead to 0.671 changes in the performance of National Sports Federations in Nairobi City County. Since the p-value (0.000) was less than 0.05, the study concluded that transparency significantly influenced the performance of National Sports Federations in Nairobi City County, Kenya. These study findings are in agreement with Akhigbe and Akhigbe (2021) study that established a positive and significant relationship between the facets of organizational transparency and the indicators of organizational effectiveness in Rivers State, Nigeria. This comparison emphasizes the general significance of transparent practices in a variety of circumstances, reinforcing their importance in enhancing the performance of national sports federations in Nairobi City County.

The third objective sought to examine the influence of sustainability on the performance of National Sports Federations in Nairobi City County, Kenya. The results revealed that a unit change in sustainability would lead to 0.402 changes in the performance of the National Sports Federations in Nairobi City County. Since the p-value (0.000) was below 0.05, the study concluded that sustainability significantly influenced the performance of National Sports Federations in Nairobi City County, Kenya. These findings, hence, agree with Weerasinghe et al. (2023) study, which established that corporate sustainability practices significantly impacted organizational performance. This emphasizes the need to integrate sustainable practices within the strategic frameworks of sports federations to promote long-term growth and competitiveness.

The fourth objective was to examine the influence of integrity on the performance of National Sports Federations in Nairobi City County, Kenya. The findings showed that a unit change in integrity would lead to 0.791 changes in the performance of the National Sports Federations in Nairobi City County. Since the p-value (0.000) was below 0.05, the study established that there was a significant influence of integrity on the performance of National Sports Federations in Nairobi City County, Kenya. These study findings concur with the study by Hartanto (2019) that indicated knowledge management and integrity variables concurrently influence organizational performance at PT Bhinneka Mentari Dimensi. These findings are also similar to Abdullah and Atshan (2019), who established that work engagement partially mediated the correlation between organizational integrity and organizational excellence, while it fully influenced the link between leadership behavior and organizational success. Nevertheless, there is also an emphasis on the importance of integrity in promoting good governance standards and building confidence among stakeholders.

Conclusion

Corporate governance principles are key to the success and overall performance of organizations. The study examined the influence of

accountability, transparency, sustainability, and integrity on national sports federations' performance in Nairobi City County, Kenya. The researcher concluded that accountability, transparency, sustainability and integrity statistically can predict the performance of national sports federations in Nairobi City County, Kenya. The researcher also concludes that there is a significant relationship between corporate governance principles and performance of national sports federations in Nairobi City County, Kenya. However, the effects of transparency, accountability, sustainability and integrity on performance are not immediate. It is a step-by-step, ongoing process with progressive results in the form of continuous improvement.

Policy Recommendations

This study highlights the importance of corporate governance principles on the performance of national sports federations in Nairobi City County, Kenya. Nairobi City County, Kenya, and the national government could take into account these concerns to improve corporate governance policies in the sports sector. This will enhance efficiency in their operations, promote ethical conduct, and ensure better financial management in national sports federations.

The study recommends an approach to good governance through the formation of clear corporate governance policies, which not only develop stakeholder confidence but also raise sustainable development in the Kenyan sporting sector. This will also curb challenges such as corruption and inadequate resources to enhance the attainment of the long-term goals of national sports federations. It is key to prioritize corporate governance to enhance the performance and credibility of national sports federations in Nairobi City County, Kenya.

Results indicate that the majority of federations' employees understand corporate governance as practices or rules that an organization is guided by. Therefore, these employees are likely to adopt continuous training on best practices of corporate governance and development for board members and sports federations' employees in general. These trainings should be designed to educate sports federations' employees on the best corporate governance practices in the sports sector, since corporate governance principles were found to positively influence the performance of national sports federations. Uptake of these trainings will help improve the implementation of corporate governance policies and effectively manage operations. National Sports Federations' management should utilize digital platforms for governance practices such as voting online, digital financial reporting, and embracing virtual board meetings. This will enhance integrity, transparency, and accountability and also reduce costs associated with governance practices.

Performance was found to be in various measures in different national sports federations. Therefore, the national and county governments should establish measurable performance indicators to be adopted by national sports federations for both sports outcomes and good governance. There should also be consistent monitoring and evaluation of these performance indicators to assist federations in tracking progress, making necessary adjustments, and increasing accountability.

Limitations and Future Research Direction

The researcher encountered certain constraints during the study. Some of the respondents were not accessible, and others were unwilling to participate in the questionnaire. To address this, respondents were informed that findings would only be utilized for academic purposes. Additionally, respondents were assured that the researcher would keep their identity confidential. The researcher provided respondents with an introductory letter from the university and a permit letter from the National Commission for Science, Technology and Innovation (NACOSTI), assuring them that this study was solely for academic purposes. Conducting data collection using questionnaires also had its limitations, as responses may be biased due to the common method employed for collecting all data. To mitigate this, the researcher ensured that the questionnaires were well-designed and conducted a pilot study to improve the questions. Nevertheless, criticism of the survey method cannot be completely disregarded and should be considered.

The research was also limited to four corporate governance principles (accountability, integrity, transparency and sustainability) due to time constraints of the study. There are other governance principles that may influence national sports federations' performance and factors other than corporate governance. However, this limitation did not invalidate the study's findings but instead offers opportunities for future and related research in this area.

The study focused on corporate governance principles and the performance of national sports federations in Nairobi City County, Kenya. Further research is therefore needed to determine the profitability impact of adopted corporate governance principles on national sports federations. The results may possibly help identify the best corporate governance principles and other governance practices that would generate high income for national sports federations, hence improve performance.

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De la logistique militaire au Supply Chain Management : évolution historique, transformations industrielles et innovations technologiques

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Résumé

Cet article retrace de manière chronologique et analytique l'évolution du concept de logistique, depuis ses origines militaires jusqu'à son intégration dans les modèles de gestion contemporaine, marqués par la digitalisation et la globalisation. D'abord fonction tactique destinée à soutenir les armées, la logistique s'est progressivement étendue au domaine économique, devenant un pilier organisationnel des entreprises durant l'ère industrielle. À partir des années 1970, sous l'effet des mutations de la demande, des chocs pétroliers et de la mondialisation, elle se transforme en un système intégré : la chaîne logistique (Supply Chain), puis en gouvernance stratégique via le Supply Chain Management. L'étude met en lumière trois grandes phases d'évolution logistique (séparée, intégrée, coopérée) et souligne l'impact majeur des révolutions industrielles - notamment la 4.0 et 5.0 - sur la refonte des processus logistiques. Enfin, l'analyse présente les catalyseurs technologiques (IA, IoT, Big Data, Blockchain, Cloud, exosquelettes) qui redéfinissent aujourd'hui les paradigmes de performance, de résilience et de durabilité logistique.

Mots-clés : Logistique, Supply Chain, technologies numériques, industrie 4.0, management stratégique

From military Logistics to Supply Chain Management: Historical Evolution, Industrial Transformations and Technological Innovations

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Abstract

This article chronologically and analytically traces the evolution of the concept of logistics, from its military origins to its integration into contemporary management models, marked by digitalization and globalization. Initially, a tactical function intended to support armies, logistics gradually expanded into the economic sphere, becoming an organizational pillar of companies during the industrial era. Beginning in the 1970s, driven by shifts in demand, oil shocks, and globalization, it transformed into an integrated system: the supply chain, and then into strategic governance via Supply Chain Management. The study highlights three major phases of logistics evolution (separate, integrated, cooperative) and highlights the major impact of industrial revolutions, particularly 4.0 and 5.0, on the redesign of logistics processes. Finally, the analysis presents the technological catalysts (AI, IoT, Big Data, Blockchain, Cloud, exoskeletons) that are today redefining the paradigms of performance, resilience, and logistics sustainability.

Keywords: Logistics, Supply Chain, digital transformation, industry 4.0, strategic management

Introduction

La logistique constitue une composante essentielle des opérations militaires et commerciales depuis l'Antiquité, témoignant de son rôle déterminant dans l'organisation et la réussite des entreprises humaines. Ses origines remontent à l'armée romaine, qui mit en place les premiers systèmes structurés de gestion des ressources, destinés à assurer l'approvisionnement en vivres, en équipements et en munitions. Ce besoin stratégique de ravitaillement a fondé la logistique en tant que discipline autonome, centrale dans l'expansion de l'Empire romain.

Historiquement centrée sur les enjeux militaires, la logistique s'est progressivement émancipée de ce cadre initial pour investir le champ économique et managérial. À partir du XXe siècle, elle opère un tournant

décisif, devenant une fonction structurante de la gestion d'entreprise. Cette transition marque l'émergence d'une segmentation fonctionnelle intégrant le transport, la gestion des stocks, la distribution physique et plus largement, la coordination de la chaîne d'approvisionnement ou Supply Chain (Ahmed Yahia, 2023 ; Benkhedda et al., 2023).

Parallèlement, l'évolution technologique joue un rôle déterminant dans cette transformation. L'introduction des systèmes d'information et des outils de gestion intégrée a considérablement optimisé les flux logistiques. Des concepts tels que la gestion juste-à-temps (Just-In-Time) ou la planification avancée des ressources ont redéfini les modalités de gestion des flux, contribuant à une efficacité accrue et à une meilleure adaptation à la demande. À cela s'ajoutent les effets de la mondialisation, qui ont favorisé l'extension des réseaux de transport et le développement du commerce international.

Aujourd'hui, la logistique se situe au cœur des dynamiques de l'économie globale. Elle s'appuie sur des technologies de pointe telles que l'intelligence artificielle, la robotique, l'Internet des objets et la blockchain, qui façonnent une nouvelle ère logistique marquée par l'automatisation, la traçabilité et la résilience des chaînes de valeur (El Gadroui, 2020 ; Rhazzi et al., 2022 ; Benzidia et al., 2023 ; Chaib et al., 2024).

Dans ce contexte, la logistique contemporaine ne cesse d'évoluer, explorant des voies orientées vers l'optimisation de la valeur perçue par le client, par la qualité, la rapidité, la flexibilité et l'efficacité des services (El Bahi, 2021). Le présent travail s'inscrit dans une démarche d'analyse diachronique, visant à retracer les principales transformations de la logistique, depuis ses racines militaires jusqu'à sa structuration actuelle en tant que système intelligent et intégré.

La problématique centrale que nous abordons est la suivante : **Quelles sont les mutations majeures qui ont marqué l'évolution historique de la logistique, depuis ses origines militaires jusqu'à l'ère numérique ?** Afin d'y répondre, nous avons structuré notre analyse en trois sections principales : La première section est consacrée à l'étude de l'évolution historique de la logistique, en mettant en lumière son enracinement dans les stratégies militaires et son intégration progressive dans les structures économiques et industrielles. La deuxième section s'attache à examiner l'émergence et la consolidation du concept de Supply Chain Management, perçu comme une transformation stratégique de la fonction logistique dans un environnement globalisé et compétitif. Enfin, la troisième section explore les mutations contemporaines impulsées par les révolutions industrielles successives, avec un accent particulier sur les apports technologiques récents (logistique 4.0 et 5.0) et les enjeux futurs de la discipline.

L'évolution historique de la logistique

Évolution de la logistique dans les systèmes militaires

La logistique puise ses origines dans les stratégies militaires de l'Antiquité, où la gestion rigoureuse des ressources conditionnait le succès ou l'échec des campagnes. Les plus grands stratèges de l'histoire — Sun Tzu, Alexandre le Grand, Jules César, Napoléon Bonaparte — ont rapidement compris que la supériorité tactique ne pouvait être atteinte sans une organisation logistique efficace.

Dès le IV^e siècle avant J.-C., Sun Tzu, dans *L'Art de la guerre*, souligne que « ...une armée sans chariots d'approvisionnement, ni céréales, ni provisions, est perdue », insistant ainsi sur la centralité des moyens de subsistance pour la survie et l'efficacité militaire (Noël, 2019 ; Ortholan, 2022). Alexandre le Grand, quant à lui, adoptait une approche radicale en ordonnant à ses troupes de brûler les chariots superflus pour accroître leur mobilité et leur agilité tactique, anticipant ainsi des principes modernes d'optimisation logistique (Oubaouzine, 2023). De son côté, Jules César a structuré un système logistique avancé basé sur la construction de routes, de camps fortifiés (*castra*) et sur l'instauration du rôle de *logista*, chargé de la planification des marchés, des campements et du ravitaillement (Aboussaad, 2009).

L'ère napoléonienne illustre les risques d'une logistique défaillante : la campagne de Russie en 1812 s'est soldée par un désastre en raison d'un ravitaillement mal planifié et de l'isolement progressif des troupes, soulignant l'importance d'une planification logistique robuste dans les environnements hostiles (Colin, 1996; Le Moigne, 2017 ; Rouquet, 2018 ; Bruyère-Ostells, 2024).

Un tournant décisif dans l'histoire logistique militaire s'opère au cours de la Première Guerre mondiale, avec l'extension des zones de combat et l'éloignement croissant des bases d'approvisionnement. L'introduction du chemin de fer, véritable colonne vertébrale logistique de l'époque, a profondément restructuré les opérations de ravitaillement (Desplantes, 1995). Dès 1917, le développement du transport routier par poids lourds et automobiles diversifie les moyens logistiques, offrant une flexibilité accrue mais entraînant une dépendance nouvelle vis-à-vis des carburants. Cette nécessité donne naissance au « service des Essences », entité spécialisée dans la gestion des carburants (Aboussaad, 2009).

La Seconde Guerre mondiale (1939–1945) constitue une étape d'extension sans précédent du périmètre logistique. Les armées doivent alors maîtriser simultanément les transports terrestre, maritime et aérien, tout en assurant un approvisionnement continu sur plusieurs fronts. Cette complexité stimule l'essor de la recherche opérationnelle appliquée à la logistique

militaire, visant à optimiser la gestion des ressources, des stocks et des flux en contexte de guerre.

L'opération Overlord plus connue sous le nom de débarquement de Normandie constitue une démonstration magistrale d'une planification logistique intégrée. Le général Eisenhower orchestre une mobilisation logistique inédite pour contrer la supériorité aéronavale allemande. Préalablement au débarquement, les lignes de ravitaillement ennemies sont ciblées par des frappes aériennes stratégiques. Ensuite, 7400 navires, appuyés par 3000 bâtiments supplémentaires, permettent le déploiement de 150 000 soldats sur les côtes normandes, en coordination avec 14 000 parachutistes et troupes aéroportées (Didast, 2023). Comme le souligna le général de Gaulle : « *c'est en respectant la logistique que le général Eisenhower mena jusqu'à la victoire la machinerie des armées du monde libre* » (Colin, 2013).

C'est ainsi qu'émerge le concept de stratégie logistique militaire, désormais reconnu comme levier décisif de la supériorité opérationnelle.

L'infiltration de la logistique dans l'entreprise : l'éveil post-guerre

À la suite de la Seconde Guerre mondiale, l'économie mondiale entre dans une phase de transformation structurelle profonde, marquée par la reconstruction industrielle et une forte croissance économique. Durant les trois décennies suivantes, connues sous l'appellation des « Trente Glorieuses », les entreprises, souvent en situation de quasi-monopole dans les secteurs clés, bénéficient d'un pouvoir de marché considérable. Cette situation leur permet de fixer les prix, de déterminer unilatéralement les délais de livraison et de définir les modalités de distribution, indépendamment des attentes différenciées des consommateurs.

Cependant, les crises pétrolières des années 1970 et l'essor de la mondialisation viennent bouleverser ce paradigme. Les entreprises sont désormais confrontées à une nouvelle configuration de marché où la demande devient plus volatile, plus personnalisée et concurrentielle. Dans ce contexte, les décideurs se tournent vers les méthodes logistiques éprouvées par les armées alliées durant le conflit mondial, perçues comme des leviers potentiels d'efficacité et d'agilité (Nouschi, 2014 ; El Bahi et al., 2021).

Le premier domaine à intégrer les principes logistiques dans les pratiques managériales est celui du marketing. Avec le développement du *Marketing Mix* ou *Plan de Marchéage* articulé autour des « 4P » (Produit, Prix, Promotion, Place), la question de la distribution physique devient centrale. En effet, l'absence de disponibilité physique du produit sur le lieu de consommation rend caduques les autres efforts marketing (Lièvre, 2007). Dans cette optique, les professionnels du marketing adoptent les principes militaires de gestion des stocks et du transport afin de renforcer leur réactivité face aux fluctuations du marché. Le marketing a donc servi de pont entre les

exigences du marché et l'héritage logistique militaire (Fadel, 2019 ; El Bahi et al., 2021).

Cette première approche logistique, qualifiée de *logistique aval* ou *logistique de distribution*, se concentre essentiellement sur les flux sortants (entreposage, transport, livraison). Toutefois, la complexité croissante des chaînes de production conduit progressivement à intégrer les flux entrants, ou *logistique amont*. C'est dans ce cadre que le National Council of Physical Distribution Management (NCPDM), créé en 1962, élargit la définition de la logistique pour inclure l'ensemble des activités nécessaires au déplacement efficace des produits finis, tout en reconnaissant bien que marginalement le rôle des matières premières. Il y associe des fonctions telles que le transport, l'entreposage, la manutention, le traitement des commandes, les prévisions de marché et le service client (Lièvre, 2007 ; Médan et al., 2007 ; Akbari Jokar et al., 2002 ; Noureddine et al., 2023).

L'approche classique évolue radicalement avec les travaux de Magee (1968), qui propose une vision élargie intégrant les flux d'approvisionnement, la production, et la consommation finale. Selon lui, la logistique est une « *technique de contrôle et de gestion des flux des matières et des produits depuis leur source d'approvisionnement jusqu'à leur point de consommation* ». Cette conception est reprise et approfondie par le NCPDM en 1972, qui introduit pour la première fois une dimension intégrée et systémique de la logistique. La nouvelle définition intègre des fonctions complémentaires : gestion des retours, gestion des pièces détachées, coordination des transports, recyclage des matériaux, et traitement des produits non conformes (Paché, 2000).

À partir de 1973, James Heskett isole la logistique comme une discipline autonome au sein des sciences de gestion, en soulignant ses implications stratégiques et organisationnelles (Heskett, 1973 ; 1978). Cette reconnaissance académique stimule une dynamique de recherche et de publication aux États-Unis, contribuant à la diffusion des théories logistiques dans la sphère managériale (Benrezzouq, 2008).

Dans les années 1980, les apports de Michael Porter consolident cette évolution. Par le biais de son modèle de la chaîne de valeur, Porter positionne la logistique comme une activité stratégique, directement liée à la création de valeur pour le client et à l'avantage concurrentiel. En parallèle, l'intégration des systèmes d'information transforme la gestion des flux, amorçant une véritable révolution informationnelle dans le domaine logistique (Lièvre, 2007 ; Aboussaad, 2009).

En 1986, le NCPDM devient le *Council of Logistics Management* (CLM) et redéfinit la logistique comme une fonction intégrée à la chaîne logistique (*Supply Chain*). Cette redéfinition insiste sur la planification, l'exécution et le contrôle des flux physiques et informationnels, du point

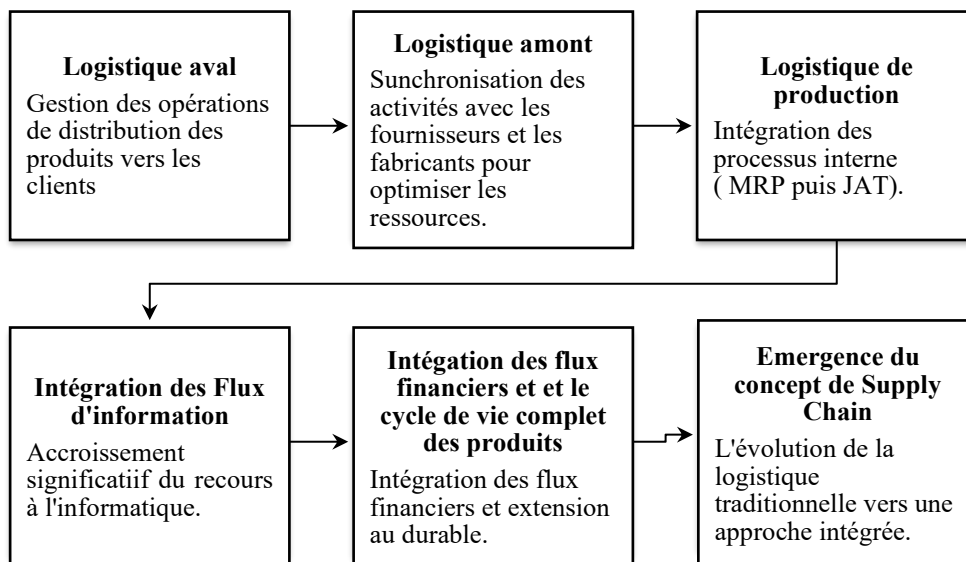
d'origine au point de consommation, dans le but de satisfaire les exigences des clients. L'introduction du concept d'« information » comme ressource stratégique marque une rupture avec les approches antérieures centrées uniquement sur les flux physiques.

La décennie suivante marque une nouvelle étape avec la création de l'*Institute of Logistics* en 1993, qui propose une vision managériale et stratégique de la logistique. Celle-ci est désormais définie comme « *le management stratégique d'une chaîne logistique* », englobant à la fois les flux matériels, informationnels, et la coordination inter-organisationnelle.

En 1996, les travaux de Tixier, Mathe et Colin institutionnalisent cette évolution en définissant la logistique comme « *le processus stratégique par lequel l'entreprise organise et soutient son activité* », intégrant les flux internes et externes, en amont comme en aval. En 1998, *The Logistics Institute* pousse plus loin cette conceptualisation en y intégrant les flux financiers ainsi que le cycle de vie complet du produit, du sourcing initial jusqu'au recyclage final (Lièvre, 2007).

Ces redéfinitions successives traduisent une montée en complexité et une extension fonctionnelle de la logistique, qui ne se limite plus aux aspects opérationnels. Elles annoncent également l'émergence d'un nouveau paradigme organisationnel : celui de la Supply Chain, ou chaîne logistique, envisagée comme un système global, interconnecté et piloté de manière stratégique. Cette évolution peut être modélisée à travers le schéma suivant :

Figure 1 : Evolution de la logistique vers la Supply Chain



Source : Élaboré par les auteurs

Le schéma met en évidence la transition d'une logistique traditionnellement orientée vers l'optimisation des flux physiques notamment le stockage, le transport, l'entreposage et la distribution vers une logique systémique, plus large et interconnectée : celle de la chaîne logistique, ou *Supply Chain*. Cette évolution témoigne d'un changement de paradigme, où la logistique ne se limite plus à une fonction opérationnelle, mais s'intègre à un réseau collaboratif d'acteurs internes et externes.

Ce nouveau modèle prend en compte des impératifs multidimensionnels (économiques, technologiques, sociaux et environnementaux) et encourage une coordination renforcée entre les partenaires de la chaîne de valeur : fournisseurs, prestataires logistiques, distributeurs, détaillants et clients finaux. Il s'agit d'un passage d'une logique de flux à une logique de réseau.

De la Logistique d'entreprise au Supply Chain Management Analyse de l'évolution de la Supply Chain vers le SCM

Depuis la Seconde Guerre mondiale, le domaine de la logistique a connu une transformation progressive mais profonde, marquée par une série d'évolutions qui ont redéfini ses contours conceptuels, ses fonctions et ses objectifs. D'abord perçue comme une fonction essentiellement opérationnelle, la logistique s'est progressivement élargie pour embrasser une vision systémique, donnant naissance au concept de *Supply Chain*, puis à celui de *Supply Chain Management* (SCM), qui en constitue l'expression stratégique la plus aboutie (Benrrezzouq, 2008).

Pour comprendre cette mutation, il est fondamental d'examiner l'évolution du marché, moteur principal de ces transformations logistiques. Akbari Jokar, Frein et Dupont (2002) ont proposé une typologie reposant sur trois phases clés, chacune correspondant à un contexte historique particulier et traduisant une approche logistique spécifique : la logistique séparée, la logistique intégrée, et la logistique coopérée.

La logistique séparée (avant 1975) : Cette phase s'inscrit dans le contexte des Trente Glorieuses (1950–1975), une période caractérisée par une forte croissance économique et une demande largement supérieure à l'offre. Les entreprises évoluent alors dans un environnement peu concurrentiel, dominé par la production de masse et la standardisation des biens. La priorité est accordée aux volumes, au détriment de la qualité et de la personnalisation des produits. Sur le plan organisationnel, les fonctions logistiques sont compartimentées selon une logique taylorienne. Les départements d'approvisionnement, de production et de distribution opèrent en silos, sans coordination ni échanges transversaux. Chaque service cherche à optimiser ses propres performances, souvent au détriment de la performance globale. Cette fragmentation engendre des conflits internes, des délais de livraison

imprévisibles, une accumulation de stocks excédentaires, et une inefficience structurelle (Mouhsine et al., 2023).

La logistique intégrée (1975-1990) : La saturation progressive des marchés, la montée en puissance du pouvoir du consommateur et l'émergence des technologies de l'information induisent une transformation majeure. Les entreprises doivent désormais répondre à une demande plus exigeante, variée et informée. La logique d'indépendance fonctionnelle cède la place à une approche collaborative entre les différentes fonctions logistiques internes : approvisionnement, production, stockage, distribution. Cette dynamique donne naissance à des philosophies organisationnelles innovantes telles que le *Just-in-Time* (JAT), les systèmes flexibles de production (FMS), le *Total Quality Management* (TQM), ou encore les outils de planification comme le MRP I et MRP II. Ce passage d'un modèle conflictuel vers un modèle coopératif que Colin (1996) désigne par le terme de *choc logistique* marque le début de l'intégration des flux internes et du partage d'informations. Parallèlement, sous l'effet d'une concurrence mondiale croissante, les entreprises sont amenées à élargir cette logique collaborative à l'ensemble de leur écosystème. Cette ouverture débouche sur l'émergence du concept de *chaîne logistique*, qui dépasse les frontières organisationnelles pour intégrer fournisseurs, sous-traitants, distributeurs et clients finaux (Chabel, 2016).

La logistique Coopérée (à partir des 1990) : Depuis les années 1990, les environnements économiques sont marqués par une instabilité croissante, une forte intensité concurrentielle, une accélération des cycles de vie des produits et une offre devenue supérieure à la demande. Dans ce contexte, les entreprises adoptent des partenariats stratégiques avec les différents acteurs de leur chaîne de valeur : fournisseurs, distributeurs, voire concurrents. Ces alliances logistiques favorisent l'émergence de systèmes d'information logistiques (SIL), essentiels pour coordonner les activités inter-organisationnelles. La concurrence ne s'exerce plus entre entreprises isolées, mais entre chaînes logistiques entières. Cette nouvelle réalité repose sur des principes-clés tels que la transparence, la synchronisation, la confiance et la mutualisation de l'information (prévisions, niveaux de stocks, données client). Elle engendre une nouvelle forme de gouvernance logistique, souvent désignée sous plusieurs appellations équivalentes : *logistique coopérée*, *logistique intégrée*, *gestion de la chaîne logistique*, ou encore *Supply Chain Management* (SCM). Ce modèle implique une coordination étroite et continue entre les partenaires, un alignement stratégique des objectifs (qualité, coûts, délais) et l'usage d'outils technologiques communs tels que les progiciels ERP, les étiquettes RFID, ou les plateformes collaboratives (Akbari et al., 2002 ; El Bakkouri, 2021 ; Chabel, 2016).

En somme, les mutations successives des marchés impulsées par la mondialisation, l'essor des technologies de l'information et les exigences

accrues des consommateurs ont profondément redéfini la fonction logistique. D'un rôle opérationnel cloisonné, elle a évolué vers une logique intégrative, transversale et stratégique.

Le passage de la logistique traditionnelle au Supply Chain Management représente bien plus qu'une simple évolution terminologique : il symbolise une transformation du mode de gouvernance des flux, reposant sur la coopération, la co-construction de valeur et la gestion globale des réseaux d'acteurs. La section suivante s'attachera à clarifier les distinctions conceptuelles entre les notions de logistique, de chaîne logistique, et de Supply Chain Management.

Clarification des distinction : Logistique, Supply Chain et Supply Chain Management

La littérature spécialisée met en évidence des distinctions conceptuelles nettes entre les notions de logistique, de chaîne logistique (*Supply Chain*) et de gestion de la chaîne logistique (*Supply Chain Management* ou SCM). Bien qu'interconnectées, ces notions correspondent à des niveaux d'analyse, de responsabilités et de finalités distincts.

La logistique renvoie principalement à la gestion opérationnelle des flux physiques et d'informations associés, depuis l'approvisionnement jusqu'à la livraison du produit fini au client. Elle comprend notamment le choix des modes de transport, la gestion des stocks, l'entreposage, le conditionnement et le traitement des commandes. Elle s'inscrit dans une logique d'exécution visant à assurer l'efficacité, la ponctualité et la fiabilité des flux à l'intérieur de l'organisation.

La chaîne logistique (*Supply Chain*) désigne, quant à elle, un système élargi, constitué de l'ensemble des acteurs impliqués dans le processus de transformation et de distribution d'un produit, depuis la source initiale des matières premières jusqu'au consommateur final. Elle intègre les fournisseurs, les sous-traitants, les fabricants, les prestataires logistiques, les distributeurs et les clients. Contrairement à la logistique, elle adopte une approche structurelle, intégrant les relations inter-organisationnelles, les flux d'information, les flux financiers et les contraintes environnementales (Saikouk & Spalanzani, 2018).

Le Supply Chain Management représente l'étape la plus aboutie de cette évolution. Il ne se limite pas à la simple coordination fonctionnelle des opérations logistiques, mais repose sur une gouvernance stratégique de l'ensemble de la chaîne logistique. Le SCM vise à synchroniser les processus inter-organisationnels, à optimiser les coûts de manière collaborative, à gérer les risques de manière concertée et à créer de la valeur partagée entre les différents maillons du réseau (Barykin et al., 2020). Dans cette perspective, les partenaires ne sont plus de simples fournisseurs ou clients, mais des co-acteurs stratégiques réunis autour d'objectifs communs (qualité, performance,

durabilité, innovation) (Mounaim, 2021). Le tableau ci-dessous synthétise les distinctions entre ces trois concepts:

Tableau 2 : Tableau comparatif des concepts de logistique,
Chaîne logistique et Supply Chain Management

Facteur	Logistique	Chaîne logistique	Supply Chain Management
Portée	Gestion des flux physiques (transport, entreposage, distribution)	Intégration des flux physiques, informationnels, financiers, et relationnels	Gouvernance stratégique de l'ensemble des flux et relations
Approche	Opérationnelle	Structurelle	Stratégique et collaborative
Objectif	Exécution efficace des opérations logistiques	Coordination des acteurs et optimisation des flux	Création de valeur partagée, résilience, performance globale
Horizon temporel	Court terme (tâches quotidiennes)	Moyen terme (optimisation des processus)	Long terme (vision stratégique, transformation)

Source : Réalisé par nos soins à partir de la littérature spécialisée
(Saikouk & Spalanzani, 2018 ; Mounaim, 2021 ; Barykin et al., 2020)

Évolution de la logistique traditionnelle vers la logistique 5.0

Logistique et révolution industrielle

Cette section retrace l'évolution historique de la logistique à travers le prisme des révolutions industrielles, depuis l'essor de la mécanisation au XVIII^e siècle jusqu'aux dynamiques actuelles de digitalisation et d'automatisation intelligente. Chaque phase de mutation industrielle a constitué un vecteur de transformation majeur pour les pratiques logistiques, redéfinissant à la fois les structures productives et les modalités de gestion des flux (Sharma et al, 2020).

Première révolution industrielle (1760–1840)

La première révolution industrielle, amorcée à la fin du XVIII^e siècle en Grande-Bretagne, repose sur des innovations fondamentales : la mécanisation de la production, l'exploitation massive du charbon, l'invention de la machine à vapeur, ainsi que le développement du chemin de fer et des bateaux à vapeur. Ces avancées techniques ont profondément modifié les systèmes de transport, permettant une circulation plus rapide, fiable et étendue des marchandises. Cette transition marque le passage d'une économie agraire à un modèle de production industrielle mécanisée, posant les premiers jalons de la logistique moderne (Szmrecsányi, 1996 ; Brasseul, 1998 ; Abdoulaye, 2024).

Deuxième révolution industrielle (1870–1914)

La deuxième révolution industrielle se caractérise par l'exploitation du pétrole, l'avènement du moteur à combustion, l'électrification des usines et les progrès de l'industrie chimique. Elle inaugure l'ère de la production de masse, rendue célèbre par la mise en œuvre, en 1913, de la chaîne de montage par Henry Ford. Cette phase transforme profondément les systèmes productifs et logistiques, en standardisant les flux de production, en structurant la distribution à grande échelle et en augmentant les exigences en matière de coordination, de stockage et de transport.

Troisième révolution industrielle (années 1960–1990)

Également qualifiée de révolution numérique ou informatique, cette phase est impulsée par l'apparition des semi-conducteurs, des ordinateurs (années 1960), des micro-ordinateurs (années 1970-1980) et de l'Internet dans les années 1990. Elle marque une rupture majeure dans la gestion logistique grâce à l'introduction des systèmes de gestion d'entrepôt (*Warehouse Management Systems*), des technologies de traçabilité (codes-barres, RFID), et des logiciels de planification (ERP, MRP). Ces innovations permettent une automatisation croissante des opérations, une meilleure prévision de la demande, ainsi qu'un suivi en temps réel des flux logistiques (Fontanel, 2020).

Quatrième révolution industrielle (depuis les années 2010) – Industrie 4.0

La quatrième révolution industrielle, désignée sous le nom d'**Industrie 4.0**, repose sur la convergence des technologies numériques, physiques et biologiques. Elle intègre l'Internet des objets (IoT), la fabrication intelligente (*smart manufacturing*), l'intelligence artificielle, l'apprentissage automatique, le *Big Data* et les systèmes cyber-physiques. Dans le domaine de la logistique, cette révolution permet une gestion connectée, prédictive et adaptative des chaînes d'approvisionnement, offrant une visibilité en temps réel sur l'ensemble du réseau logistique (Mounaim, 2021).

La logistique 4.0 se distingue par une automatisation intelligente, une interopérabilité des systèmes et une collaboration étroite entre les machines et les opérateurs humains. Chaque entreprise, quelle que soit sa taille ou son secteur, est confrontée à la nécessité de garantir la connectivité, la rapidité d'accès aux données, et la capacité à réagir en temps réel à des aléas complexes et fluctuants (Guennoun et al, 2023 ; Derrouiche et al., 2024).

Cinquième révolution industrielle (depuis les années 2020) – Industrie 5.0

L'Industrie 5.0, en émergence depuis les années 2020, introduit une nouvelle dimension à la transformation industrielle. Contrairement à Industrie 4.0, axée sur la technologie et l'automatisation, l'Industrie 5.0 remet l'humain au centre du système productif. Elle s'inscrit dans une logique de durabilité,

de résilience et d'inclusion sociale, répondant aux préoccupations croissantes liées aux impacts sociaux et environnementaux des technologies avancées (Maddikunta et al., 2022 ; Müller, 2020; Wolniak, 2023).

La Commission européenne identifie trois piliers fondamentaux de cette nouvelle approche (European Commission, 2021) :

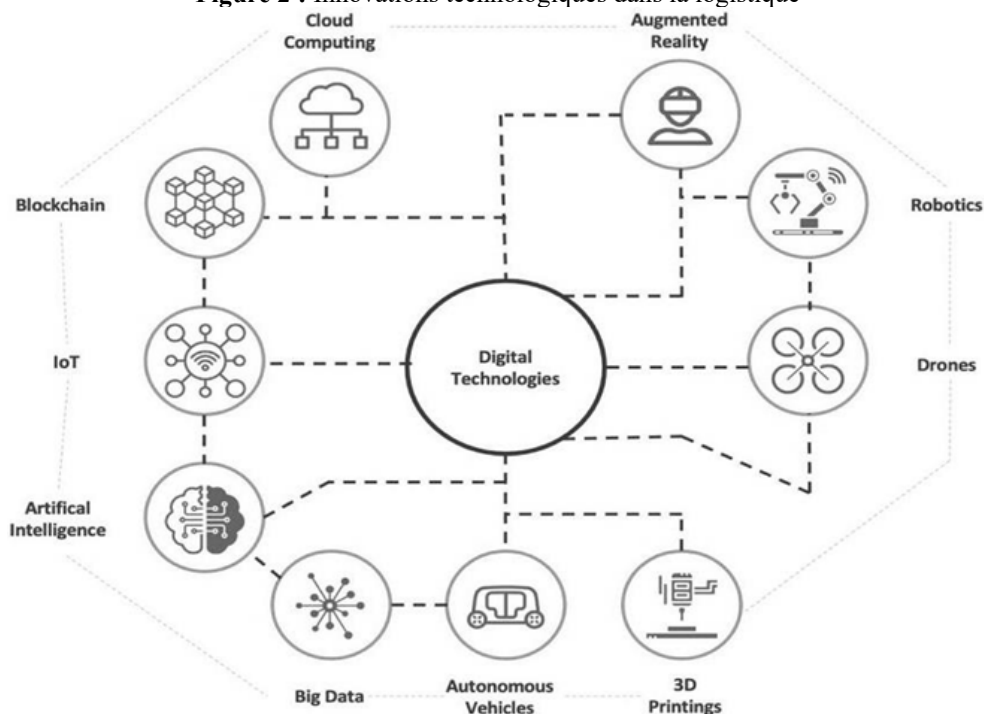
- La diversité et l'inclusion des besoins humains ;
- La durabilité environnementale ;
- La résilience face aux perturbations globales.

Comme le soulignent Goujon et al. (2023), l'Industrie 5.0 n'est pas une rupture technologique, mais une extension éthique et sociétale de l'Industrie 4.0. Elle vise à intégrer les nouvelles technologies dans une perspective holistique, orientée vers le bien-être des individus, des organisations et de la planète.

Les catalyseurs technologiques de la logistique

Avant l'ère numérique, la logistique reposait essentiellement sur le savoir-faire humain, des procédures manuelles et des outils rudimentaires. Toutefois, ces dernières décennies, le secteur a connu un essor technologique sans précédent, catalysé par l'émergence d'innovations majeures telles que l'intelligence artificielle, la robotique, les systèmes autonomes, les objets connectés, ou encore la blockchain (Boulitama et al., 2025).

Figure 2 : Innovations technologiques dans la logistique



Source : Boulitama et al., 2025

La maîtrise de ces technologies représente aujourd'hui un enjeu stratégique majeur pour les entreprises, car elles redéfinissent en profondeur les paradigmes de fonctionnement de la chaîne logistique (Guenfoudi et al., 2020). Parmi les innovations les plus impactantes, on peut citer :

- **L'Internet des objets (IoT) :** L'Internet des objets (*Internet of Things* – IoT) désigne un réseau d'objets physiques dotés de capteurs, d'actuateurs, de logiciels et de connectivité leur permettant de collecter et d'échanger des données via Internet. Le terme fut introduit en 1999 par le technologue britannique Kevin Ashton, dans le contexte d'une application RFID pour la chaîne d'approvisionnement de Procter & Gamble. Depuis, le concept a largement évolué pour englober un écosystème complet d'acteurs : fabricants de capteurs, intégrateurs de solutions, fournisseurs de plateformes logicielles et opérateurs de réseaux (Gubbi et al., 2013 ; Wang et al., 2018).

Dans le domaine logistique, l'IoT représente un levier stratégique d'optimisation des chaînes d'approvisionnement. Il permet de suivre en temps réel les expéditions de marchandises, grâce à la géolocalisation GPS, à la RFID et à des réseaux à faible consommation d'énergie (LoRa, NB-IoT). L'IoT facilite également la surveillance des conditions environnementales (température, humidité, vibrations) tout au long du transport et de l'entreposage. Cette capacité de contrôle continu contribue à prévenir les dégradations, à maintenir la qualité des produits sensibles, et à automatiser les alertes logistiques en cas d'anomalie (Mounaim, 2021 ; Mansouri et al., 2025).

À titre d'exemple, Wang et al. (2018) ont démontré que l'usage de capteurs IoT embarqués dans les véhicules de transport permet la détection en temps réel de variations inappropriées de température ou d'humidité. Ces écarts déclenchent automatiquement des alertes à destination des responsables logistiques, permettant ainsi une réaction immédiate et une réduction significative des pertes ou détériorations.

- **La chaîne de blocs (Blockchain) :** La blockchain, ou chaîne de blocs, est une technologie de stockage et de transmission de données décentralisée, transparente et sécurisée. Son fonctionnement repose sur un registre distribué dans lequel chaque transaction est enregistrée de manière chronologique, vérifiée par un réseau de nœuds, puis chiffrée sous forme de blocs liés entre eux. Sa particularité réside dans l'absence d'une autorité centrale de contrôle, ce qui confère au système une résilience, une immutabilité et une confiance accrues (Leloup, 2017 ; Bajolle et al., 2021 ; Lesueur-Cazé et al., 2023 ; Benbachir et al., 2023).

Historiquement liée à l'émergence des crypto-monnaies telles que le Bitcoin, cette technologie est désormais utilisée dans de nombreux

secteurs, dont la logistique. Elle permet d'enregistrer des informations de manière infalsifiable, rendant extrêmement difficile toute tentative de modification, de fraude ou de falsification (Mounaim, 2021).

Dans le cadre de la chaîne logistique, la blockchain offre des fonctionnalités clés en matière de traçabilité, transparence et sécurisation des échanges. Chaque acteur de la chaîne (fournisseur, transporteur, distributeur, client) détient une copie synchronisée et horodatée des données, garantissant une vision partagée et fiable des flux, de l'origine du produit jusqu'à sa destination finale (Saber et al., 2019).

Un exemple emblématique est celui de l'entreprise De Beers, qui a intégré la blockchain dans son processus de certification afin de garantir aux consommateurs la provenance éthique et authentique des diamants, assurant ainsi une transparence totale sur l'ensemble du cycle d'approvisionnement (Fosso Wamba et al., 2020).

- **Le Big Data (ou méga données) et analyse :** Le concept de Big Data, ou méga-données, a été popularisé dans les années 1990 par John Mashey, informaticien chez Silicon Graphics (Diebold, 2019 ; Nesvijejskaia, 2020). Il désigne l'ensemble des données massives, complexes et hétérogènes générées à une vitesse exponentielle à partir de sources variées telles que les réseaux sociaux, les plateformes de commerce électronique, les capteurs connectés, les moteurs de recherche ou encore les dispositifs mobiles.

Ces données peuvent être :

- Structurées (ex. : bases relationnelles),
- Semi-structurées (ex. : formats XML, JSON),
- Non structurées (ex. : textes, images, vidéos, sons, logos).

Les systèmes de gestion traditionnels comme les SGBDR ou les requêtes SQL sont rapidement dépassés par ces volumes, d'où le recours à des technologies avancées de traitement et d'analyse (Zouhri, 2016 ; Bourany, 2018).

Laney (2001) a identifié trois caractéristiques fondamentales du Big Data, connues sous l'acronyme des 3V :

- **Volume** : la quantité massive de données générées quotidiennement ;
- **Vélocité** : la rapidité avec laquelle ces données sont produites, collectées et traitées ;
- **Variété** : la diversité des formats et des sources (Ghanouane et al., 2020).

Ces dimensions ont ensuite été étendues à 5V, en intégrant : **véracité** (la fiabilité, la précision et la qualité des données) et **valeur** (les retombées concrètes que les entreprises peuvent tirer de l'analyse de ces données).

Dans le secteur logistique, l'exploitation du Big Data permet d'extraire des modèles comportementaux, de détecter des tendances émergentes, d'anticiper les perturbations et d'optimiser la prise de décision. Il constitue ainsi un levier stratégique de compétitivité, en renforçant la réactivité, la personnalisation et la qualité de service (Mounaim, 2021 ; Abdoulaye et al., 2024).

À titre illustratif, Tan et al. (2015) soulignent que le Big Data permet de :

- Renforcer la traçabilité des produits dans la chaîne logistique,
- Réduire les délais de livraison,
- Optimiser les coûts opérationnels,
- Améliorer la satisfaction client.

Ainsi, l'analyse des méga-données transforme profondément la logistique, en lui conférant une dimension prédictive et adaptative, essentielle dans un environnement incertain et globalisé (El Gadrouri, 2020).

- **Le Cloud Computing (ou Cloud) :** Le Cloud Computing, ou informatique en nuage, désigne un modèle technologique permettant d'accéder à la demande à des ressources informatiques (serveurs, bases de données, logiciels, outils de stockage) via Internet. La première conceptualisation de cette approche remonte aux années 1960, lorsque John McCarthy, pionnier de l'intelligence artificielle, proposa l'idée d'une « informatique utilitaire », une vision selon laquelle la puissance informatique serait distribuée comme l'électricité, accessible à tous sous forme de service public. Il anticipait ainsi le paradigme du cloud moderne, affirmant que « *dans le futur, l'informatique deviendra un service organisé, accessible au public* » (Rivard, 2012 ; Zouhri et al., 2016; Taleb, 2022).

Ce concept a connu plusieurs phases d'évolution jusqu'à atteindre aujourd'hui un niveau de maturité technologique élevé, reposant sur des infrastructures virtualisées, facturées à l'usage (modèle à la demande), évolutives, et accessibles en tout lieu grâce à la connectivité Internet (Hafnaoui, 2022 ; Sabouk et al., 2022).

Dans le domaine de la logistique, le Cloud Computing constitue un levier d'agilité opérationnelle et de flexibilité stratégique. Il permet aux entreprises de se recentrer sur leur cœur d'activité en externalisant les fonctions de traitement et de gestion des données logistiques. L'adoption du cloud facilite la mise en service rapide d'applications collaboratives, améliore la coordination inter-entreprises, et réduit les charges de maintenance liées aux systèmes d'information internes (Mounaim, 2021).

Plus encore, le cloud permet de répondre efficacement aux nouvelles exigences des chaînes logistiques contemporaines, telles que :

- La visibilité de bout en bout des processus.
- La volatilité des marchés.
- La croissance exponentielle des volumes de données.
- L'interopérabilité entre les partenaires.

Selon Mounaim (2021), « *le Cloud Computing permet aux entreprises d'externaliser de manière flexible leurs logiciels logistiques, de réduire les délais de déploiement applicatif, et de s'adapter aux mutations digitales qui redéfinissent les réseaux d'approvisionnement traditionnels* ».

- **L'intelligence artificielle (IA) :** L'histoire de l'intelligence artificielle (IA) remonte aux travaux fondateurs de Warren McCulloch et Walter Pitts, qui en 1943 publièrent l'article *A Logical Calculus of the Ideas Immanent in Nervous Activity*. Ils y proposaient le premier modèle mathématique de réseau de neurones artificiels, ouvrant ainsi la voie à une modélisation computationnelle des processus cognitifs (Alsaïdi, 2023).

En 1951, Marvin Minsky et Dean Edmonds développèrent le SNARC, considéré comme le premier réseau de neurones artificiels fonctionnel. En parallèle, Alan Turing posait les bases philosophiques de l'IA dans son célèbre article *Computing Machinery and Intelligence*, introduisant le test de Turing, critère visant à évaluer la capacité d'une machine à simuler l'intelligence humaine (Véry et al., 2019).

Le concept d'« intelligence artificielle » fut officiellement formalisé en 1956 par John McCarthy lors de la conférence de Dartmouth, événement considéré comme l'acte de naissance académique de la discipline (Leveau-Vallier, 2023). McCarthy y proposa une définition structurante : « *L'intelligence artificielle est la science et l'ingénierie de la fabrication de machines intelligentes, en particulier de programmes informatiques intelligents* » (Marcus, 2018).

Dans le domaine de la logistique, l'IA constitue une révolution fonctionnelle et stratégique. Elle permet l'automatisation des processus décisionnels, l'optimisation dynamique des flux, l'anticipation des perturbations, ainsi que la planification prédictive. Ses applications vont de la maintenance prévisionnelle à la gestion intelligente des stocks, en passant par la simulation de scénarios de crise.

Selon une étude de McKinsey & Company, l'intégration de l'IA dans le secteur logistique pourrait générer entre 1,3 et 2 milliards de dollars de valeur économique par an, en réduisant les coûts, en fluidifiant les opérations et en améliorant la performance globale des réseaux d'approvisionnement (Mounaim, 2021). En effet, grâce à sa capacité à

traiter des volumes massifs de données en temps réel, l'IA permet une prise de décision plus rapide, plus fiable et mieux adaptée aux environnements complexes et instables (Ghoubach et al., 2024).

- **Les exosquelettes :** Les exosquelettes sont des dispositifs mécatroniques portés par l'utilisateur, conçus pour soutenir ou renforcer ses capacités physiques lors de l'exécution de tâches répétitives ou pénibles. L'une des définitions techniques les plus couramment admises les décrit comme un « système d'assistance porté et contrôlé par l'humain, destiné à compenser son poids, une charge ou à amplifier un effort, en intégrant uniquement des contrôles bas niveau » (Lee et al., 2012, cité par Voilqué, 2020). Une autre définition les qualifie de « structures externes revêtues par l'opérateur pour lui apporter une aide physique dans l'exécution de ses tâches et l'accompagner dans ses mouvements » (Gallet, 2023).

Dans le secteur industriel et logistique, ces équipements s'imposent comme des solutions prometteuses pour réduire la pénibilité du travail, prévenir les troubles musculo-squelettiques (TMS) et prolonger l'employabilité des travailleurs. Selon Mounaim (2021), les TMS représentent un coût économique considérable pour les entreprises, à travers les arrêts de travail, les dépenses médicales et le renouvellement du personnel. L'usage d'exosquelettes contribue à diminuer significativement les douleurs lombaires, cervicales et articulaires, notamment chez les opérateurs sollicités physiquement.

Par ailleurs, ces dispositifs représentent une réponse aux contraintes liées au vieillissement de la population active. Ils permettent aux travailleurs âgés ou fragilisés de maintenir leur productivité sans compromettre leur santé, tout en répondant à l'intensification des rythmes de traitement des commandes, dans un contexte de croissance exponentielle du e-commerce.

Sur le plan logistique, les exosquelettes sont de plus en plus intégrés dans les entrepôts automatisés, notamment pour des tâches de manutention, de prélèvement ou de conditionnement. Ils permettent de limiter la fatigue musculaire liée aux efforts prolongés, d'améliorer l'ergonomie des postes de travail, et de réduire les risques d'accidents professionnels (Schröder Jakobsen et al., 2024).

Ainsi, les exosquelettes s'inscrivent dans une démarche globale de logistique augmentée, conjuguant innovation technologique, sécurité au travail et performance humaine.

Conclusion

Au terme de cette étude théorique consacrée à l'évolution historique du concept de logistique, plusieurs constats fondamentaux peuvent être

dégagés. D'une fonction tactique d'origine militaire centrée sur le ravitaillement des troupes, la logistique s'est progressivement transformée en un levier stratégique de performance globale pour les entreprises modernes. Cette transition s'est opérée à la faveur des grandes mutations économiques, technologiques et sociales ayant marqué les révolutions industrielles successives.

La logistique contemporaine dépasse désormais la simple gestion des flux physiques pour embrasser des dimensions informationnelles, technologiques, relationnelles et environnementales. Elle assure la planification, la coordination et le pilotage des flux de matières, de produits et d'informations à travers l'ensemble de la chaîne de valeur, depuis le fournisseur initial jusqu'au client final. Ce système intégré s'illustre notamment par le développement du Supply Chain Management, qui formalise une gouvernance collaborative, agile et orientée vers la création de valeur partagée.

Les innovations technologiques récentes telles que l'intelligence artificielle, l'Internet des objets, le Big Data, le cloud computing ou encore les exosquelettes ont joué un rôle catalyseur dans cette transformation, en automatisant, en optimisant et en sécurisant les opérations logistiques. Elles ont permis à la logistique de répondre aux nouveaux impératifs du XXI^e siècle : personnalisation de la demande, durabilité, réactivité et résilience face aux perturbations.

Ainsi, la logistique s'impose aujourd'hui comme un pilier transversal et stratégique, au croisement des enjeux économiques, sociaux et écologiques. Sa maîtrise constitue un facteur clé de différenciation pour les organisations évoluant dans un environnement globalisé, volatile et interconnecté. Loin d'être une simple fonction de soutien, elle est désormais un moteur de compétitivité, d'innovation et de durabilité.

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Fluctuations des Prix du Pétrole, Subventions et Croissance Économique au Maroc (1998–2022)

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Résumé

Cet article analyse l'impact des fluctuations des prix du pétrole et du régime de subventions sur la croissance économique du Maroc entre le premier trimestre 1998 et le quatrième trimestre 2022. En mobilisant une modélisation dynamique appliquée aux données trimestrielles, l'étude distingue les effets linéaires et asymétriques des variations des prix du pétrole, tout en intégrant l'effet d'un régime de subventions à travers une variable dichotomique construite selon les principales phases de réforme. Les résultats montrent que les hausses des prix du pétrole ont un effet significatif sur la croissance du PIB, tandis que les baisses n'ont pas d'impact direct mesurable. Par ailleurs, le régime de subventions joue un rôle stabilisateur en atténuant l'impact des chocs pétroliers à la hausse, bien que cet effet dépende du contexte institutionnel et budgétaire, notamment avant et après la réforme de 2014. Cette dernière, marquée par la libéralisation progressive des prix, a profondément modifié les mécanismes d'ajustement économique. Cette étude souligne ainsi l'importance des politiques de subventions dans la préservation de la stabilité économique face à la volatilité des marchés pétroliers. Toutefois, la période post-2014, marquée par la réforme de la compensation et la libéralisation progressive des prix, mérite une attention spécifique dans l'analyse des dynamiques récentes. Enfin, des perspectives de recherche pourraient consister à intégrer d'autres variables macroéconomiques telles que l'inflation, le taux de change ou encore l'ouverture commerciale, afin

d'approfondir la compréhension des déterminants de la croissance économique marocaine dans un contexte de chocs externes.

Mots-clés : Fluctuations des prix du pétrole, modèles dynamiques, régime de subventions, PIB, Maroc

Oil Price Fluctuations, Subsidies, and Economic Growth in Morocco (1998–2022)

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Abstract

This article examines the impact of oil price fluctuations and the subsidy regime on Morocco's economic growth between the first quarter of 1998 and the fourth quarter of 2022. By employing a dynamic modeling approach on quarterly data, the study distinguishes between the linear and asymmetric effects of oil price variations, while accounting for the influence of the subsidy system through a dichotomous variable reflecting key reform phases. The results reveal that increases in oil prices have a significant effect on GDP growth, whereas price decreases do not exhibit a measurable direct impact. Moreover, the subsidy regime plays a stabilizing role by mitigating the effects of upward oil price shocks, although this impact depends on the institutional and fiscal context, particularly before and after the 2014 reform. The latter, characterized by the gradual liberalization of fuel prices, has substantially altered the economic adjustment mechanisms. This study thus highlights the crucial role of subsidy policies in preserving economic stability in the face of oil market volatility. However, the post-2014 period, marked by compensation reforms and price liberalization, warrants specific attention when analyzing recent dynamics. Future research avenues could involve incorporating additional macroeconomic variables such as inflation, exchange rates, and trade openness to further deepen the understanding of the determinants of Morocco's economic growth in a context of external shocks.

Keywords: Oil price fluctuations, dynamic models, subsidy system, GDP, Morocco

Introduction

L'énergie joue un rôle crucial dans l'économie mondiale. Malgré le débat croissant sur le rôle des sources d'énergie renouvelables alternatives telles que l'eau, le solaire, l'éolien et le nucléaire, le pétrole demeure une

source énergétique dominante pour une grande partie des pays du monde. Par conséquent, les chocs pétroliers peuvent avoir des conséquences macroéconomiques considérables pour les pays importateurs. En outre, les fluctuations des prix du pétrole affectent les coûts de production, les factures de chauffage et les coûts de transport. Cela génère de l'incertitude quant à l'avenir de l'économie mondiale et peut inciter les investisseurs à différer leurs décisions d'investissement, entraînant une réallocation des ressources vers des secteurs moins dépendants du pétrole (Sill, 2007).

En effet, le marché pétrolier, l'un des marchés de matières premières les plus dynamiques et influents, demeure au cœur des enjeux économiques et géopolitiques. Depuis les années 1970, il a traversé des périodes de chocs et de fluctuations, suscitant des préoccupations croissantes quant aux répercussions de ses variations sur la stabilité économique mondiale. Plus récemment, des événements comme la pandémie de COVID-19 et les tensions géopolitiques, en particulier en Europe de l'Est, ont exacerbé ces incertitudes. Ces perturbations ont poussé les économistes à analyser la structure de ce marché, où le prix du pétrole est façonné par des interactions complexes entre producteurs, consommateurs et acteurs financiers, souvent influencées par des facteurs spéculatifs autant que par les fondamentaux de l'offre et de la demande. En 2022, par exemple, les prix du baril de pétrole ont atteint des niveaux records, frôlant les 120 dollars, en raison des incertitudes pesant sur les chaînes d'approvisionnement, accentuant ainsi la volatilité du marché.

Des études empiriques majeures, initiées par les travaux de Hamilton (1983) et approfondies par Mork (1989), ont cherché à comprendre les effets des chocs pétroliers sur la croissance économique. Ces travaux ont démontré un lien étroit entre les variations du prix du pétrole et les cycles économiques, en particulier dans les pays importateurs. Avec l'ajout de données plus récentes et de modèles économétriques asymétriques, les chercheurs Mory (1993), Ferderer (1996) et Hooker (1996) ont constaté que les hausses des prix du pétrole ont des impacts plus significatifs et plus durables que les baisses. Cela a conduit à une intégration de nouvelles variables et méthodes, telles que les modèles dynamiques, les modèles VAR (Vector AutoRegression) et SVAR (Structural Vector AutoRegression), pour capter les effets dynamiques des fluctuations pétrolières sur la croissance économique. Ces modèles permettent d'analyser les interactions complexes entre le prix du pétrole, l'inflation, la consommation, et d'autres indicateurs macroéconomiques (Brini et al., 2016). Ces travaux ont été enrichis récemment par des contributions intégrant la dimension sectorielle (Ratti & Vespignani, 2016), les régimes de volatilité (Joëts, Mignon & Razafindrabe, 2018) et les canaux financiers (Kilian & Zhou, 2020).

Pour le Maroc, importateur net de pétrole, les fluctuations des prix internationaux ont des répercussions majeures sur les équilibres

macroéconomiques. En 2021, les importations énergétiques représentaient environ 10 % du PIB, mettant en évidence la dépendance du pays aux importations pétrolières (Office des Changes, 2022). Face à cette situation, les finances publiques marocaines ont été mises sous pression, notamment lors de la flambée des prix de 2022, qui a engendré une hausse des coûts de production et une pression inflationniste sur les prix des biens de consommation.

La réforme du système de subvention, amorcée en 2013 et conclue par une libéralisation totale des prix en 2015, visait à alléger le poids de la compensation sur le budget de l'État, tout en permettant aux prix d'évoluer selon les conditions du marché (Cour des Comptes, 2014). En effet, avant cette réforme, le coût des subventions aux carburants pesait lourdement sur les finances publiques, atteignant 56 milliards de dirhams (soit environ 5,6 milliards de dollars américains) en 2012. En libéralisant le marché, l'objectif était de réduire ce fardeau tout en encourageant l'efficacité énergétique et la compétitivité des entreprises marocaines. Cependant, après la libéralisation des prix des produits pétroliers, le Maroc a été confronté à la fermeture de la Société Anonyme Marocaine de l'Industrie du Raffinage (SAMIR) en 2016, la seule raffinerie du pays. Cette fermeture a eu des implications significatives sur la sécurité énergétique en matière de stockage et accru la dépendance du Maroc aux importations de produits raffinés. Sans une production nationale de produits pétroliers, le pays est désormais entièrement dépendant des importations pour répondre à sa demande énergétique, ce qui le rend particulièrement plus vulnérable aux fluctuations des prix internationaux du pétrole.

Malgré l'importance de ces enjeux, les études empiriques sur l'économie marocaine restent rares et souvent limitées aux approches statiques ou aux modèles VAR et SVAR (El Khider, A., & Hajhouj, H. (2024) ; Lamy AOZAL, L. (2018)). Peu de recherches ont mobilisé des modélisations dynamiques de séries temporelles permettant d'analyser les effets linéaires et asymétriques des fluctuations pétrolières sur la croissance marocaine, tout en tenant compte des changements de régime de subvention instaurés au cours des deux dernières décennies.

C'est dans ce contexte que s'inscrit cet article, dont l'objectif est double :

- Analyser empiriquement les effets dynamiques des fluctuations des prix internationaux du pétrole sur la croissance économique marocaine, à l'aide de modèles dynamiques de séries temporelles tenant compte des éventuelles asymétries.
- Évaluer l'impact différencié du régime de subvention et de la politique de décompensation progressive sur cette relation, à travers l'introduction d'une variable binaire distinguant trois phases : une première période sans subvention (1998T1-2002T3), une période avec subvention (2002T4-2013T4), et enfin une période de décompensation

progressive et d'indexation des prix intérieurs sur les cours internationaux (2014T1-2022T4).

A cet égard, cet article propose ainsi un cadre d'analyse empirique basé sur des données récentes pour étudier les effets des variations des prix du pétrole sur la croissance économique marocaine. À travers des modèles économétriques dynamiques de séries temporelles, nous analysons les relations entre le PIB et les fluctuations des prix du pétrole, en tenant compte des effets des réformes de subvention et de l'indexation progressive. Nous intégrons une variable binaire pour isoler les périodes de réforme (2013-2015) et saisir les changements dans la réaction de l'économie marocaine aux variations du prix du pétrole.

Cet article est structuré en plusieurs parties : une revue de la littérature qui présente les principales contributions empiriques sur le sujet ; une analyse empirique où les effets des variations linéaires et asymétriques des prix du pétrole sont évalués, et où l'impact du régime de subvention et de l'indexation progressive sur la croissance économique marocaine est analysé à l'aide de données trimestrielles couvrant la période de 1998 à 2022.

Revue de la littérature

Les effets asymétriques des fluctuations des prix du pétrole sur la croissance économique ont suscité un intérêt croissant parmi les chercheurs. L'étude pionnière de Hamilton (1983) a mis en évidence un effet négatif des hausses des prix du pétrole sur la croissance aux États-Unis. Mork (1989) a élargi cette analyse en examinant les fluctuations jusqu'en 1988, période marquée par l'effondrement des prix en 1985. En séparant les hausses et les baisses de prix, il a conclu que seules les augmentations de prix ont une influence significative sur la croissance, ce qui confirme l'existence d'un comportement asymétrique des économies face aux chocs pétroliers. D'autres chercheurs, tels que Mory (1993), Ferderer (1996) et Hooker (1996), ont soutenu cette asymétrie, soulignant l'impact différencié des variations de prix sur la croissance. Kilian et Vigfusson (2011) ainsi que Raheem (2017) associent également cet effet asymétrique aux incertitudes, aux effets différenciés selon les secteurs économiques et aux politiques monétaires anti-inflationnistes. Par exemple, Hamilton (2009) explique que les chocs pétroliers incitent les consommateurs des secteurs énergivores à réduire leurs dépenses, ce qui affecte la demande. De plus, Jiménez-Rodríguez et Sanchez (2005) confirment que les hausses de prix ont un impact significatif plus que les baisses de prix, en particulier dans les économies industrialisées comme celles de l'OCDE.

En effet, Mgbame et al. (2015) avancent que les fluctuations des prix du pétrole ont des répercussions notables sur le bien-être de l'économie mondiale. Toutefois, certains travaux, comme celui de Gershon et al. (2019),

suggèrent que les politiques économiques peuvent atténuer ces impacts. Odhiambo (2020) ajoute que l'effet des variations de prix dépend à la fois des spécificités structurelles des pays et de la période d'analyse considérée.

La littérature présente des résultats divergents : d'une part, pour les pays exportateurs, une hausse des prix du pétrole tend à stimuler les revenus, l'investissement et la consommation, soutenant la croissance du PIB (Foudeh, 2017; Dabachi et al., 2020). À l'inverse, certaines études montrent qu'une augmentation des prix réduit les revenus des pays importateurs de pétrole, entravant leur croissance (Arouri, Jouini & Nguyen, 2010; Murshed et Tanha, 2021 ; Rahman et Majumder, 2021). Ghalayini (2011) souligne que cet impact dépend de la sensibilité de la demande à la variation des prix (élasticité-prix) et de la durée des fluctuations. De plus, les banques centrales peuvent adopter des politiques restrictives pour contrer l'inflation, ce qui réduit l'investissement et limite la croissance du PIB réel. Par exemple, Papapetrou (2001) en Grèce et Miguel et al. (2003) en Espagne observent une corrélation négative entre les prix du pétrole et la croissance du PIB, tandis que Bouzid (2012) montre que pour la Tunisie, une hausse de 10 % du prix mondial du pétrole entraîne une baisse de 3,4 % de la croissance. Zouri et al. (2019) démontrent également qu'une hausse de 70 % du prix du pétrole au Maroc provoque une contraction du PIB et de la consommation dans les secteurs énergivores (transport, électricité, eau, Bâtiment et Travaux Publics) en raison de la hausse des coûts et de l'érosion du pouvoir d'achat. De même, Ritahi et Echaoui (2025) analysent les effets macroéconomiques de la hausse des prix du pétrole sur l'économie marocaine. Leur étude souligne que les chocs pétroliers ont un impact négatif significatif sur la croissance économique du Maroc, en ralentissant le PIB à court et long terme.

La volatilité des prix du pétrole suscite également une attention particulière. Okonju (2009) note que le pétrole présente une volatilité élevée, influençant négativement la production. El-Anshasy et al. (2017) concluent que la volatilité des revenus pétroliers a un effet défavorable sur la croissance, mais que cet effet peut être atténué lorsqu'un cadre fiscal adapté est en place. Van Eyden et al. (2019) trouvent un impact négatif significatif de la variation des prix du pétrole sur la croissance, tandis que Bjornland (2000) observe un effet positif pour la Norvège, pays exportateur. D'autres chercheurs, comme Akinlo et Apanisile (2010), soutiennent l'existence d'un effet positif conditionné par la stabilité macroéconomique dans certains pays d'Afrique subsaharienne.

Bien que la littérature se concentre souvent sur les économies développées, plusieurs études analysent les pays émergents et en développement. El-Anashasy et al. (2005) trouvent une corrélation entre les variations de prix et divers agrégats au Venezuela, tandis que Farzanegan et Markwardt (2009) explorent le cas de l'Iran. De plus, des études régionales,

comme celles de Mehrara et Oskui (2007) et Berument et al. (2010) pour la région MENA, montrent que les variations de prix sont une source d'instabilité macroéconomique. Par ailleurs, Selim et Zaki (2016) indiquent que la qualité institutionnelle joue un rôle déterminant pour modérer la « malédiction des ressources » en renforçant la capacité des États à mettre en œuvre des politiques contracycliques efficaces.

En somme, la littérature converge sur un point fondamental : les effets des fluctuations des prix du pétrole sur la croissance économique sont largement conditionnés par le statut énergétique des pays (exportateur ou importateur), leur dépendance structurelle au pétrole, et la robustesse de leurs institutions. Les politiques économiques, en particulier fiscales et monétaires, ainsi que la qualité des institutions permettent de modérer les impacts des chocs pétroliers, fournissant ainsi des indications utiles aux décideurs.

Méthodologie empirique

Cet article a pour objectif d'analyser l'impact des fluctuations des prix du pétrole sur le PIB du Maroc. En outre, il examine comment l'intégration du régime de subvention peut influencer cette relation. L'étude repose sur le modèle de base proposé par Mork (1989), qui permet d'incorporer deux variations asymétriques des prix du pétrole: d'une part, la fluctuation positive (Δoil_t^+) du prix du pétrole et, d'autre part, la fluctuation négative du prix du pétrole (Δoil_t^-). Nous ajoutons également la variation linéaire du prix du pétrole. Ce choix se justifie par la pertinence de ce cadre dans les économies où les variations des prix de l'énergie n'ont pas les mêmes impacts symétriques sur la croissance, comme c'est le cas du Maroc, importateur net de pétrole.

Par ailleurs, afin de prendre en considération les spécificités institutionnelles relatives aux politiques de subvention adoptées par le Maroc, une variable dichotomique a été introduite dans la modélisation. Celle-ci permet de distinguer la période durant laquelle le système de compensation était en vigueur (2002T4-2013T4), caractérisée par une relative stabilité des prix à la consommation grâce aux subventions publiques, de la phase post-réforme (2014T1-2022T4), marquée par la mise en œuvre de la décompensation progressive et l'indexation des prix domestiques sur les cours internationaux. Concrètement, la variable prend la valeur 1 durant la phase de subvention active (2002T4-2013T4) et 0 durant les périodes sans subvention généralisée (1998T1-2002T3 et 2014T1-2022T4). Cette approche vise ainsi à capturer les effets différenciés des régimes de subvention sur les canaux de transmission des chocs pétroliers à l'économie nationale.

Définition et description des variables

Notre recherche s'appuie sur une collecte rigoureuse de données provenant de sources multiples et fiables, telles que le Haut-Commissariat au Plan, Bank Al-Maghrib et le Fonds Monétaire International. Cette diversité de sources nous permet d'obtenir une vision exhaustive des mécanismes économiques en jeu. La littérature économique met en évidence l'importance de considérer les effets asymétriques des chocs pétroliers. Nous avons donc choisi d'explorer différentes spécifications des prix du pétrole afin de mieux comprendre la nature non linéaire de cette relation. En effet, les augmentations et les baisses des prix du pétrole n'ont pas nécessairement les mêmes conséquences sur la croissance économique. Nous définissons ainsi les variables relatives aux variations linéaires et asymétriques du prix du pétrole, telles que suit :

Variable linéaire de la variation réelle du prix de pétrole en dirhams marocain : LOILDH

$$LOILDH = LnOILDH_t - LnOILDH_{t-1}$$

LOILDH : c'est la variation trimestrielle du prix réel (en MAD) du pétrole, exprimée en logarithm.

Les variables asymétriques du prix du pétrole

Selon Mork (1989), la spécification asymétrique distingue la variation positive du prix du pétrole, d'une part, et sa variation négative en MAD (Dirham marocain) d'autre part. Cette distinction est une nécessité impérieuse, car une hausse du prix du pétrole peut avoir un effet significatif sur l'économie, sans que l'effet de la baisse soit symétrique, et vice versa.

Ces spécifications sont présentées comme suit :

Δoil_t^+ (Oil_increase: real oil price increases),

$\Delta oil_t^+ = \max(0, \Delta oil_t)$, elle représente la hausse réelle (variation positive) du prix du pétrole.

Δoil_t^- (Oil_decrease: real oil price decrease),

$\Delta oil_t^- = \min(0, \Delta oil_t)$, elle représente la baisse réelle (variation négative) du prix du pétrole.

Δoil_t : c'est la variation trimestrielle du prix réel du pétrole en logarithm.

Dans cette section, nous examinons la relation dynamique entre les variations linéaires et asymétriques du prix du pétrole et la croissance économique dans le contexte marocain. Pour ce faire, nous avons choisi d'utiliser la croissance du Produit Intérieur Brut réel (DLPIB) comme variable endogène dans chaque modèle. Cette variable sera analysée en tenant compte de ses valeurs retardées, ainsi que des fluctuations du prix réel du pétrole (DLOILDH). De plus, nous explorerons par la suite les spécifications

asymétriques du prix du pétrole, en les abordant une à une (Δoil_t^+ ; Δoil_t^-) afin d'évaluer comment chacune de ces dynamiques influence la croissance économique au Maroc. Ces diverses fluctuations nous permettront de mieux cerner les effets distincts sur l'économie marocaine.

Les analyses économétriques que nous allons réaliser reposent sur l'hypothèse fondamentale de l'exogénéité du prix du pétrole, telle que discutée par Barsky et Kilian (2004) et Baumeister et Kilian (2016). Cette hypothèse est particulièrement pertinente pour le cas du Maroc, car c'est un pays qualifié de "*Price-Taker*", ce qui signifie qu'il n'a pas de pouvoir d'influence sur les marchés pétroliers internationaux, ni sur le plan politique, ni sur le plan économique.

En effet, le Maroc est fortement tributaire des fluctuations des prix du pétrole, et son statut de pays importateur renforce cette vulnérabilité. À l'inverse, des pays comme la Chine, premier importateur mondial de pétrole avec une quantité de 13,8 millions de barils par jour en 2023 (Statista Research Department, 2025) exerce une influence considérable sur les marchés pétroliers. En effet, la Chine joue un rôle déterminant dans la formation des prix du pétrole, influençant l'offre et la demande à l'échelle mondiale (Zhu, X. et al., 2021). La dynamique de l'offre et de la demande, exacerbée par la croissance rapide de la consommation en Chine, a des répercussions directes sur les prix mondiaux du pétrole, ce qui peut avoir des effets d'entraînement sur d'autres économies dépendantes du pétrole, comme le Maroc (Lu, Quanying et al, 2020).

Dans le cadre de chaque modèle, nous intégrons une variable dichotomique codée comme suit :

- Valeur 0 pour la période allant de 1998T1 à 2002T3,
- Valeur 1 pour la période de 2002T4 à 2013T4,
- Valeur 0 de nouveau pour la période de 2014T1 à 2022T4.

Cette variable vise à capturer les changements de régime de subvention du pétrole instauré par le gouvernement marocain au cours des deux dernières décennies. Plus précisément :

- La valeur 0 correspond aux périodes sans subventions, notamment à partir de 2014T1, lorsque le gouvernement marocain a lancé une politique de décompensation.
- Cette stratégie d'indexation visait à ajuster les prix intérieurs en fonction du marché international, en supprimant les subventions directes.

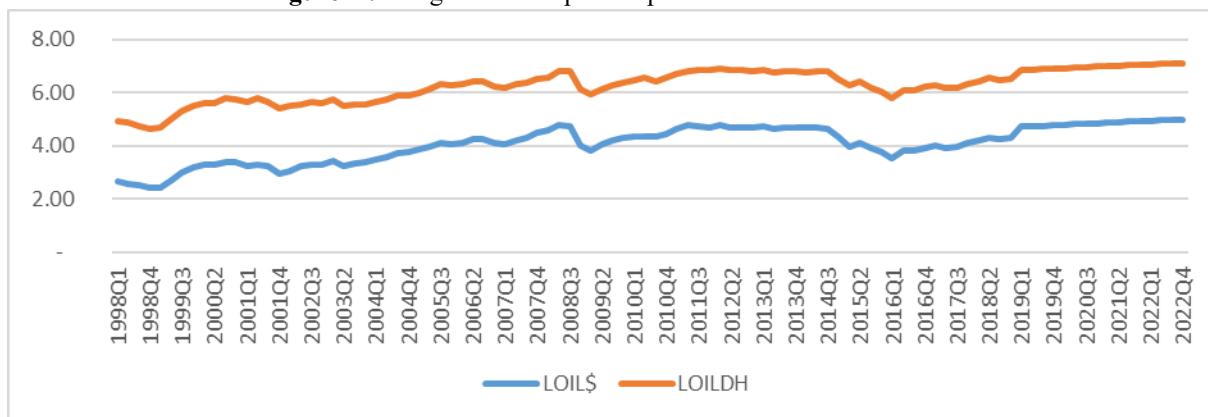
Son inclusion nous permettra d'évaluer si l'alternance entre subvention et décompensation a un effet significatif sur la croissance économique. Cela pourrait révéler des dynamiques importantes en matière de consommation, d'investissement, et de réaction des agents économiques face aux chocs

pétroliers. Elle met en lumière l'importance d'une gestion adéquate des prix dans un contexte de vulnérabilité externe.

Description représentative des variables du prix du pétrole

La littérature empirique sur ce sujet examine principalement deux approches pour évaluer l'impact des prix du pétrole sur l'économie des différents pays, y compris le Maroc. D'une part, certains chercheurs s'intéressent au prix mondial du pétrole brut, exprimé en dollars (USD), qui influence directement l'économie de nombreux pays importateurs (Papapetrou, 2001 ; Khan et al., 2019 ; Fuinhas et al., 2019). D'autre part, une autre approche consiste à convertir le prix du pétrole en monnaie locale en tenant compte du taux de change effectif réel, pour mieux refléter l'impact sur les économies émergentes comme celle du Maroc (Cunado & Gracia, 2005 ; Elsayed et al., 2024 ; Moussa et al., 2024 ; Malik, 2008). Dans cette étude, nous avons choisi cette dernière approche car elle permet de mieux refléter l'impact réel des variations des prix du pétrole sur l'économie marocaine. En tenant compte des fluctuations du taux de change, elle prend en considération les spécificités monétaires locales, essentielles pour une économie émergente comme celle du Maroc, vulnérable aux chocs externes.

Figure 1 : le logarithme du prix du pétrole réel en USD et en DH



Source : Calculs de l'auteur

Par ailleurs, l'introduction de la matrice de corrélation présentée dans le tableau 1 vise principalement à vérifier la cohérence et l'interaction entre les prix du pétrole exprimés en dirhams et en dollars, notamment pour s'assurer que la conversion monétaire n'introduit pas de distorsions significatives dans les données. La lecture du tableau n°1 démontre que le prix du pétrole converti par le taux de change (en dirhams, MAD) est fortement corrélé avec le prix en USD (coefficient = 0,99). En outre, la figure n°1 montre que les deux prix du pétrole (en logarithme) captent les chocs négatifs (1998,

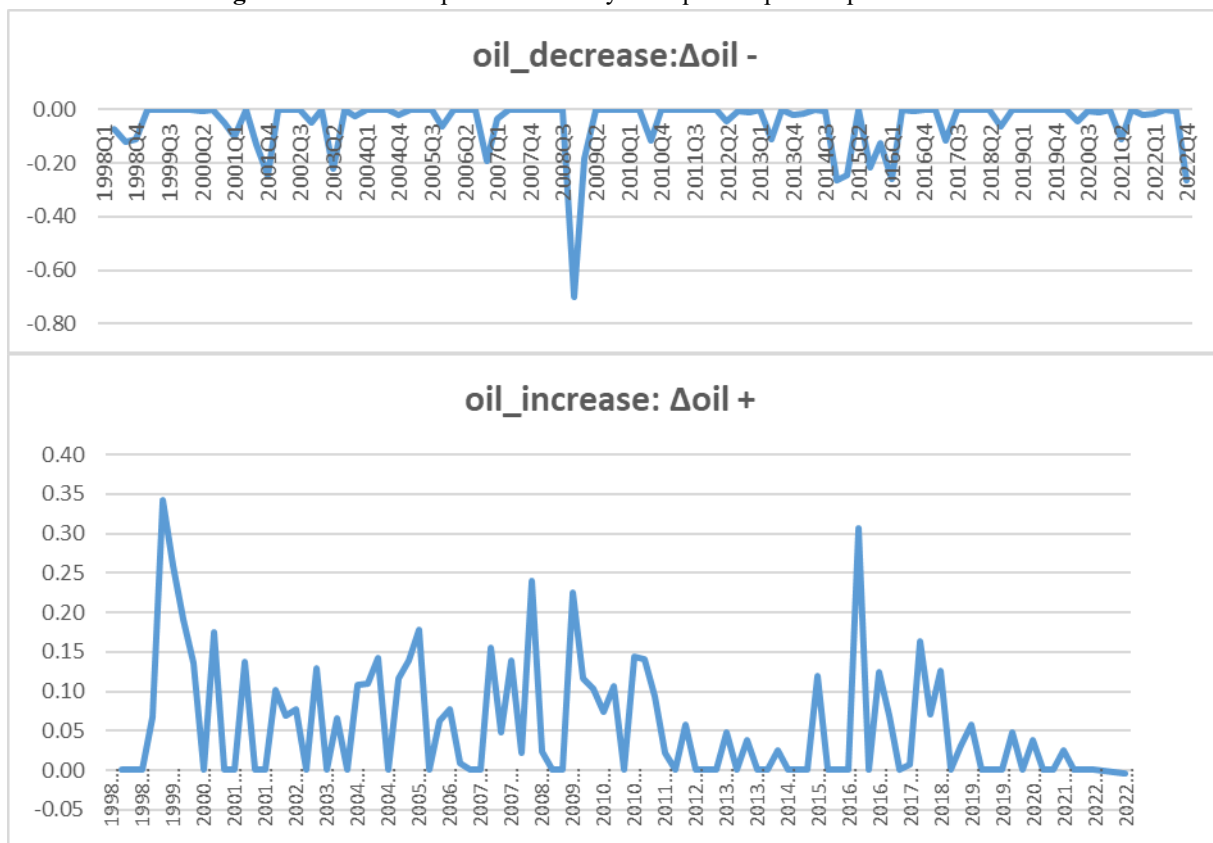
2009, 2015 et 2019) et positifs (2000, 2008, 2012, 2016 et 2018), illustrant l'asymétrie des chocs pétroliers.

Tableau 1 : Matrice de corrélation entre le logarithme du prix de pétrole en DH et celui en dollars USD

	LOIL\$	LOILDH
LOIL\$	1	0,990869
LOILDH	0,990869	1

Source : Calculs de l'auteur

Figure 2 : Les deux spécifications asymétriques du prix du pétrole en MAD



Source : élaboré par nos soins

Les variables asymétriques ($\Delta \text{oil}+$ et $\Delta \text{oil}-$) introduites par Mork (1989) permettent de capturer les effets différenciés des variations de prix du pétrole, en distinguant les hausses ($\Delta \text{oil}+$) et les baisses ($\Delta \text{oil}-$). Cette distinction est essentielle car les augmentations et les diminutions du prix du pétrole ne produisent pas nécessairement les mêmes effets sur la croissance économique.

Modèle d'analyse et techniques d'estimation

Le modèle dynamique adopté est présenté comme suit :

$$y_t = \sum_{i=1}^p \alpha_i y_{t-i} + \sum_{i=1}^q \beta_i x_{t-i} + c + \varepsilon_t$$

y_t : La *variable endogène* de notre modèle : taux de croissance de PIB réel au trimestre t ;

α_i : Les *coefficients de la variable* : taux de croissance de PIB réel retardée sur plusieurs périodes ;

β_i : Les *coefficients des variables exogènes* représentées par les différentes spécifications des prix de pétrole ;

x_t : Les *variables exogènes* (différentes spécifications des prix de pétrole) ;

C : la constante du modèle ;

ε_t : L'erreur du modèle.

Test de stationnarité

La première étape de notre analyse consiste à examiner les propriétés statistiques de chaque série temporelle afin d'en déterminer le degré d'intégration, c'est-à-dire de vérifier si les séries sont stationnaires ou non. Cette étape est cruciale, car elle permet d'établir la nature des données et d'orienter les choix méthodologiques pour les analyses ultérieures. Pour cela, nous avons appliqué divers tests de racine unitaire afin de détecter la présence ou l'absence de stationnarité, ce qui est fondamental pour éviter les erreurs de modélisation.

En particulier, nous avons privilégié le test de Dickey-Fuller (ADF), l'un des outils les plus courants pour évaluer la stationnarité des séries. Ce test aide à vérifier si les séries comportent une racine unitaire, indiquant ainsi si elles suivent un processus non stationnaire ou stationnaire. Les résultats de ces tests, présentés dans le tableau, fournissent des informations essentielles pour valider nos hypothèses initiales et affiner notre compréhension des séries temporelles analysées.

Pour rappel, les séries étudiées couvrent une période étendue, allant du premier trimestre de 1998 au quatrième trimestre de 2022, ce qui offre une perspective temporelle riche pour observer les tendances et les cycles économiques. Après cette première étape de vérification de la stationnarité, nous appliquerons ensuite des tests supplémentaires aux séries disponibles pour compléter notre diagnostic et déterminer les transformations éventuelles nécessaires avant de poursuivre avec des modèles économétriques plus complexes.

Tableau 2 : Test de Dickey fuller (Augmented Dicky Fuller DFA) de la racine unité

Variable	Niveau		Première différence		Ordre d'intégration
	Statistique	Valeurs critiques du test de Dickey Fuller au seuil de 5%*	Statistique	Valeurs critiques du test de Dickey Fuller au seuil de 5%*	
<i>Variation positive du prix de pétrole : $\Delta oil+$</i>	-8.144578	-2.897223			I(0)
<i>Variation négative du prix de pétrole : $\Delta oil-$</i>	-7.639615	-2.897223			I(0)
<i>Prix pétrole en DH, $Loildh$</i>	-2.062565	-2.896779	-7.607974	-1.944811	I(1)
<i>Le taux de croissance du produit intérieur brut réel, $LPIB$</i>	4.626777	-1.944762	-11.23045	-2.897223	I(1)

* : Les valeurs critiques de MacKinnon données par Eviews

Source : élaboré par nos soins

D'après les résultats du tableau, les statistiques du test de Dickey-Fuller Augmenté (DFA) appliquées aux séries en niveau montrent que certaines d'entre elles ne rejettent pas l'hypothèse de racine unitaire, même au seuil de 10 %. Cela indique que plusieurs séries ne sont pas stationnaires en niveau. Toutefois, certaines séries, comme $\Delta oil+$ et $\Delta oil-$, sont stationnaires en niveau, ce qui signifie que l'hypothèse de racine unitaire est rejetée pour celles-ci.

Détermination du nombre de retards

Dans la deuxième étape de notre analyse, nous avons déterminé le nombre de retards optimaux pour chaque modèle, une décision cruciale pour assurer la validité et la pertinence des résultats. Pour sélectionner ce nombre de retards, nous nous sommes fondés sur deux critères d'information largement utilisés : le critère d'Akaike (AIC, 1981) et le critère de Schwarz (SC, 1978), présentés dans le tableau n°03. Ces deux critères visent à évaluer la qualité des modèles en mesurant l'écart entre les résidus issus de la régression par moindres carrés ordinaires et une distribution gaussienne.

Le critère d'Akaike et le critère de Schwarz permettent donc de sélectionner les modèles les plus adéquats, ceux qui minimisent l'écart entre les valeurs observées et les valeurs prédites. En pratique, un écart très faible indique que le modèle possède un bon pouvoir de prévision, reflétant ainsi une bonne adéquation entre les données et le modèle ajusté. Le choix du nombre de retards optimal selon ces critères nous garantit donc une meilleure précision des estimations et une prédiction plus fiable des dynamiques des séries économiques étudiées. De plus, ces critères permettent de déterminer les combinaisons de retards P et Q offrant le meilleur équilibre entre ajustement du modèle et simplicité.

$$AIC = \log \log \left(\frac{1}{n} \sum_{i=1}^n \hat{\varepsilon}_i^2 \right) + \frac{2p}{n}$$

$$SC = \log \log \left(\frac{1}{n} \sum_{i=1}^n \hat{\varepsilon}_i^2 \right) + \frac{p \log n}{n}$$

Tableau 3 : Choix du nombre optimal des retards pour chaque modèle sur la base des critères AIC et SC

Nombre de retards	Critère	Modèle 1 : PIB- prix de pétrole OilDH	Modèle 2 : PIB- augmentation de prix de pétrole $\Delta \text{oil}+$	Modèle 3 : PIB- baisse de prix de pétrole $\Delta \text{oil}-$
P=1 ; Q=0	AIC	-4.840767	-4.854241	-4.851513
	SC	-4.723366	-4.736840	-4.734112
P=2 ; Q=0	AIC	-4.803993	-4.816972	-4.815900
	SC	-4.656188	-4.669166	-4.668094
P=3 ; Q=0	AIC	-4.776337	-4.792048	-4.789102
	SC	-4.597685	-4.613396	-4.610450
P=1 ; Q=1	AIC	-4.841646	-4.860961	-4.836495
	SC	-4.694895	-4.714210	-4.689744
P=2 ; Q=1	AIC	-4.805041	-4.823822	-4.800840
	SC	-4.627675	-4.646455	-4.623473
P=3 ; Q=1	AIC	-4.774964	-4.795726	-4.773617
	SC	-4.566537	-4.587298	-4.565190

P : Nombre de retards de la variable de la croissance économique DLPIB.

Q : Nombre de retards des variables linéaires et asymétriques représentant le prix du pétrole pour chaque modèle.

Source : élaboré par nos soins.

Ce tableau présente une analyse des retards optimaux pour trois modèles économiques relatifs aux effets des prix du pétrole sur le PIB, sur la base des critères d'information d'Akaike (AIC) et de Schwartz (SC). Le modèle 1 évalue la relation directe entre le PIB et le prix du pétrole (OilDH), le modèle 2 se concentre sur l'effet d'une augmentation des prix du pétrole ($\Delta \text{oil}+$) sur le PIB, et le modèle 3 sur celui d'une baisse des prix ($\Delta \text{oil}-$).

Après avoir procédé à la transformation des séries initiales non stationnaires en séries stationnaires, nous avons pu garantir que les variables ne présentent plus de tendance temporelle. Cette étape est essentielle, car les séries stationnaires facilitent des estimations économétriques fiables et permettent d'éviter les problèmes liés à la non-stationnarité, tels que les régressions fallacieuses. Une fois les séries stationnaires obtenues, nous avons déterminé le nombre optimal de retards pour chaque modèle en utilisant des critères d'information d'Akaike (AIC) et critère de Schwarz (SC).

Par la suite, les spécifications retenues pour chaque modèle reposent sur l'estimation du PIB en fonction de différentes variables représentant les fluctuations des prix du pétrole. Chaque modèle a été conçu pour isoler l'impact de différents types de variations dans les prix pétroliers. Par exemple, un modèle analyse l'effet direct du prix moyen du pétrole sur le PIB, tandis que d'autres modèles se concentrent sur les effets asymétriques des hausses et des baisses du prix du pétrole. Cette distinction entre variations positives et négatives des prix permet d'étudier les asymétries potentielles, c'est-à-dire les situations où une hausse ou une baisse des prix du pétrole pourrait affecter différemment la croissance économique. En analysant séparément les effets des hausses et des baisses de prix, nous obtenons une vue plus nuancée de l'impact des chocs et contre-chocs pétroliers sur le PIB marocain, ce qui peut être essentiel pour formuler des politiques économiques adaptées aux contextes de volatilité des prix des matières premières.

Modèle1 : Effet du prix nominal de pétrole sur la croissance du PIB au Maroc

$$\Delta \ln(PIB)_t = c + a_1 \Delta \ln(PIB)_{t-1} + a_2 \Delta \ln(Oildh)_t + a_3 \Delta \ln(Oildh)_{t-1} + a_4 Régim_Subv_t + \varepsilon_t$$

Modèle 2 : Effet d'une variation positive du prix de pétrole sur la croissance du PIB au Maroc

$$\Delta \ln(PIB)_t = c + a_1 \Delta \ln(PIB)_{t-1} + a_2 Oil_increase_t + a_3 Oil_increase_{t-1} + a_4 Régim_Subv_t + \varepsilon_t$$

Modèle 3 : Effet d'une variation négative du prix de pétrole sur la croissance du PIB au Maroc

$$\Delta \ln(PIB)_t = c + a_1 \Delta \ln(PIB)_{t-1} + a_2 Oil_increase_t + a_3 Régim_Subv_t + \varepsilon_t$$

Résultats et discussion

Les résultats des estimations de l'effet linéaire et asymétrique du prix de pétrole sur la croissance économique au Maroc

Le tableau ci-dessous présente les résultats des analyses effectuées, offrant une synthèse claire des principales estimations.

Tableau 4 : Tableau récapitulatif des résultats des estimations des coefficients des modèles 1, 2 et 3 avec leurs significations et les tests de validation

Variables	Coefficient (Modèle 1)	Coefficient (Modèle 2)	Coefficient (Modèle 3)	Significativité
DLPIB(-1)	-0.271428	-0.256758	-0.271792	***
DLPIB(-2)	—	—	—	—
DLOILDH	0.001996	—	—	NS
DLOILDH(-1)	-0.021516	—	—	NS
Oil_increase	—	0.034418	—	**
Oil_increase(-1)	—	-0.045381	—	NS
Oil_decrease	—	—	-0.020824	NS
Oil_decrease(-1)	—	—	—	—
REGIME SUBVENTION	0.011514	0.011167	0.011474	**
Constante	0.008394	0.008776	0.007066	* à NS
R²	0.134633	0.151187	0.121974	—
Prob(Fisher-statistic)	0.023628	0.012390	0.016862	**
Test d'autocorrélation BG	0.8067	0.7259	0.8891	NS
Test d'hétéroscédasticité BP	0.5390	0.4206	0.3190	NS

*** Significativité au seuil de 1 %, ** au seuil de 5 %. * au seuil de 10 %.

Source : Auteur

Cette section présente l'estimation de trois modèles analysant l'impact des variations des prix du pétrole sur la croissance économique mesurée par le taux de croissance du PIB (DLPIB). Ces modèles examinent successivement : 1) la relation entre le PIB et le prix agrégé du pétrole, 2) l'effet des hausses de prix du pétrole sur le PIB, et 3) l'effet des baisses de prix du pétrole sur le PIB. Les résultats obtenus, y compris les coefficients, la significativité statistique et les tests de diagnostic, permettent de mieux comprendre l'impact différencié des fluctuations pétrolières sur l'économie marocaine.

Dans tous les modèles, la variable DLPIB(-1), qui représente le PIB retardé d'une période, est négativement associée à la croissance du PIB actuel, avec des coefficients significatifs au seuil de 1 % dans les trois cas. Cette relation négative peut refléter un mécanisme de correction à la moyenne, indiquant que les périodes de forte croissance économique sont suivies de périodes de modération, en ligne avec les fluctuations cycliques du PIB. Ce type de relation est couramment observé dans des séries macroéconomiques présentant des cycles économiques.

Dans le modèle 1, qui évalue l'impact du prix global du pétrole (DLOILDH), le coefficient associé à cette variable n'est pas statistiquement significatif ($p = 0,8811$), indiquant que les variations agrégées des prix du pétrole n'ont pas d'effet direct à court terme sur la croissance du PIB. Ce résultat peut s'expliquer par les mécanismes de stabilisation en place comme les subventions publiques, qui atténuent les effets des fluctuations des prix du pétrole sur l'économie nationale.

Le modèle 2, qui se focalise sur les hausses de prix du pétrole (Oil_increase) montre un coefficient positif et significatif au seuil de 5% ($p = 0.0479$). Cela suggère qu'en certaines circonstances, une hausse des prix peut stimuler modérément la croissance économique, possiblement via :

- Une transmission des hausses dans des secteurs bénéficiaires (ex. secteur énergétique, recettes publiques),
- Ou un effet de revenus pour l'État, accru par les recettes issues des taxes sur les produits pétroliers.

Cependant, cet effet ne persiste pas dans le temps, comme l'indique la non-significativité de la variable retardée Oil_increase(-1).

Dans le modèle 3, la variable représentant les baisses de prix du pétrole (Oil_decrease) ne montre aucun effet statiquement significatif ($p = 0,4878$) sur la croissance du PIB, à court terme. Ce résultat pourrait s'expliquer par une inertie économique ou par des mécanismes de compensatoires, tant au niveau de la demande que de l'offre, qui rendent les baisses de prix moins percutantes pour la croissance.

Dans tous les modèles, la variable REGIME_SUBVENTION, représentant les subventions énergétiques, est statistiquement significative au seuil de 5 % et présente un coefficient positif (coefficient de l'ordre de **0,011**). Ce résultat montre que le régime de subvention joue un rôle stabilisateur crucial, soutenant la croissance économique malgré la volatilité des prix pétroliers. Les subventions semblent donc atténuer les impacts des fluctuations pétrolières, en maintenant le pouvoir d'achat et la consommation intérieure.

Les coefficients de détermination (R^2), bien que modestes (entre 0,12 et 0,15), montrent que les modèles expliquent une part non négligeable de la variation du PIB à court terme, ce qui est attendue dans une approche macroéconomique sur les données temporelles, mais cohérent dans une analyse de court terme où d'autres variables influencent également la croissance économique.

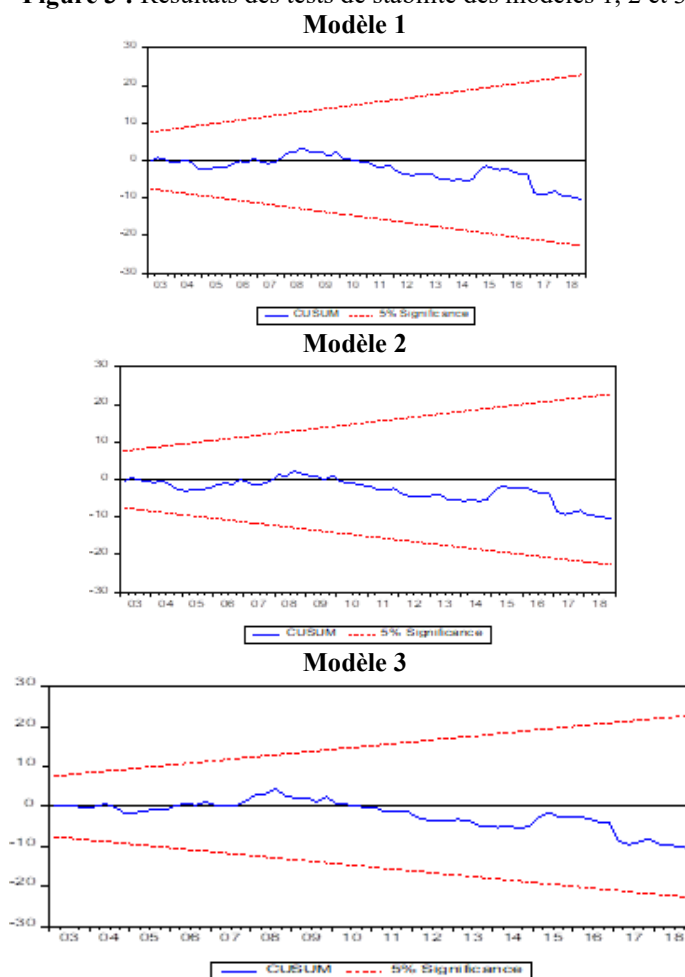
Les tests de robustesse confirment la qualité des estimations.

- Les tests d'autocorrélation de Breusch-Godfrey révèlent une absence d'autocorrélation des résidus, avec des p-valeurs supérieures à 0,7 pour tous les modèles, ce qui garantit l'indépendance des erreurs.
- Les tests d'hétéroscédasticité de Breusch-Pagan-Godfrey révèlent l'homoscédasticité des résidus ($p > 0,3$), ce qui renforce la validité des modèles estimés.

En conclusion, les estimations montrent que les fluctuations des prix du pétrole n'ont pas d'effet uniforme ni permanent sur la croissance économique du Maroc. Les hausses de prix ont un effet marginal positif à court terme, tandis que les baisses de prix n'ont pas d'effet significatif. Le régime de subvention est cependant déterminant pour amortir les fluctuations des prix

et soutenir le PIB, illustrant l'importance des politiques de soutien dans les économies sensibles aux chocs pétroliers.

Figure 3 : Résultats des tests de stabilité des modèles 1, 2 et 3



Les tests du CUSUM (Cumulative Sum of Recursive Residuals) sont utilisés pour vérifier la stabilité des coefficients d'un modèle au fil du temps. Dans le cadre de cette étude, les résultats des tests du CUSUM confirment la stabilité des modèles tout au long de la période d'estimation. En effet, la courbe des résidus récurrents, représentée en bleu, reste constamment à l'intérieur des deux droites de confiance, définies au niveau de confiance de 5 %.

Cela signifie que les coefficients des modèles ne présentent pas de ruptures significatives au cours de la période analysée, ce qui est un indicateur de leur stabilité.

Cette stabilité des modèles est cruciale, car elle garantit que les résultats obtenus ne sont pas affectés par des changements structurels ou des

variations irrégulières durant la période d'estimation. Par conséquent, les modèles restent valides et appropriés pour l'analyse et l'interprétation des données économiques. Ainsi, les conclusions tirées de ces modèles peuvent être considérées comme fiables et solides, renforçant leur utilité pour la formulation de politiques économiques adaptées et l'étude des effets des fluctuations des prix du pétrole sur l'économie marocaine.

Discussion des résultats

Cette étude démontre que les modèles économétriques développés (modèles 1, 2 et 3) sont bien interprétables et statistiquement robustes, conformément aux standards de validation des séries temporelles.

- Les tests appliqués confirment la solidité des hypothèses : Le test CUSUM révèle l'absence de ruptures structurelles majeures, garantissant la stabilité des coefficients estimés sur l'ensemble de la période (1998T1–2022T4) ;
- Le test de Breusch-Godfrey montre l'absence d'autocorrélation des résidus, validant l'indépendance des erreurs ;
- Le test Breusch-Pagan-Godfrey confirme l'homoscédasticité des erreurs, condition indispensable à la fiabilité des estimations.

Cette étude couvre la période de 1998 T1 à 2022 T4, marquée au Maroc par l'ouverture économique progressive et une libéralisation des échanges, avec des phases de croissance et de stabilité. En tant qu'importateur de pétrole, le Maroc reste vulnérable aux fluctuations des prix internationaux du pétrole, ce qui rend l'analyse pertinente dans le contexte actuel. Les résultats montrent que les variations linéaires des prix du pétrole (DLOIDH) n'ont pas d'effet direct et significatif sur la croissance du PIB marocain. Ce résultat s'explique en partie par les politiques de compensation énergétique mises en place dès les années 2000, visant à protéger les ménages et les entreprises des effets inflationnistes liés à l'énergie (Ait Lahcen & Ouladsine, 2016).

En revanche, les résultats montrent un impact modéré mais significatif des hausses de prix du pétrole (ΔOil^+) sur la croissance économique du Maroc. Ce constat est contraire aux études de Mork (1989) et de Jiménez-Rodríguez et Sanchez (2005) qui démontrent que les chocs pétroliers positifs ont généralement des effets plus marqués que les chocs négatifs, en particulier dans les pays importateurs. Toutefois, contrairement à ces études menées sur des économies de l'OCDE, l'impact observé au Maroc est atténué, notamment en raison des dispositifs publics de stabilisation comme la Caisse de compensation. Les périodes de hausse, bien que modérées, pourraient signaler des effets économiques différés, par exemple via une hausse de l'inflation et un affaiblissement de la balance commerciale. Entre 2005 et 2014, la Caisse

de compensation a joué un rôle majeur en amortissant ces effets pour les secteurs à forte consommation d'énergie.

Par ailleurs, avec la fermeture de la raffinerie de la SAMIR, le Maroc a intensifié sa dépendance aux importations de produits pétroliers, ce qui amplifie les effets négatifs des hausses de prix internationaux. Cette situation a entraîné une augmentation des coûts de production pour plusieurs secteurs, tels que l'industrie et le transport, ce qui a intensifié les effets récessifs à court terme sur la croissance économique et a entraîné la pression inflationniste.

Les réformes des subventions initiées en 2014, sous l'impulsion de la Banque mondiale et du FMI, ont conduit le gouvernement marocain à se désengager progressivement du financement direct des produits pétroliers. Ces réformes pourraient expliquer pourquoi les baisses de prix n'ont pas entraîné de croissance notable, tandis que les hausses n'ont eu qu'un effet limité. Le consommateur ne bénéficie pas toujours des gains, absorbés par les marges ou par d'autres effets compensateurs (Ben Aïssa & Rejeb, 2021). Les périodes de prix élevés, notamment en 2008, 2011 et 2014, ont révélé les limites des subventions pour protéger pleinement l'économie, bien qu'elles aient renforcé la résilience du PIB. Ce résultat renforce l'idée que l'asymétrie des effets pétroliers dépend fortement des politiques publiques en vigueur.

Cette situation contraste avec les observations faites dans d'autres pays de la région MENA, comme ceux étudiés par Mehrara et Oskui (2007) et Berument et al. (2010), où les fluctuations pétrolières provoquent une instabilité macroéconomique marquée. L'expérience marocaine montre que l'adaptation des politiques économiques, en particulier en matière de subventions, peut amortir les effets déstabilisateurs des hausses de prix sans pour autant les éliminer totalement.

En conclusion, les résultats de cette étude confirment que l'impact des variations des prix du pétrole sur la croissance dépend fortement du cadre institutionnel et budgétaire national. Le contexte économique marocain, caractérisé par des réformes et une intervention étatique modérée, explique en grande partie la neutralisation relative de l'impact des prix du pétrole sur le PIB. Ce constat rejoint les conclusions de Ratti & Vespignani (2016) selon lesquelles les réponses macroéconomiques aux chocs énergétiques varient selon la nature des politiques de stabilisation mises en œuvre.

Conclusion

Cette étude visait à analyser l'impact des fluctuations des prix du pétrole sur la croissance économique du Maroc entre le premier trimestre 1998 et le quatrième trimestre 2022, en intégrant l'effet des politiques de subventions énergétiques et des réformes récentes. Les résultats montrent que les hausses des prix du pétrole ont un effet modéré mais significatif sur la croissance du PIB, particulièrement dans les secteurs à forte intensité

énergétique comme l'industrie et le transport. Toutefois, l'impact de ces hausses reste atténué par les mécanismes de stabilisation publique, notamment le régime de subventions.

Les réformes engagées depuis 2014, avec la libéralisation progressive des prix à la pompe, ont certes réduit l'ampleur de ces effets, mais n'ont pas permis d'assurer une résilience complète de l'économie marocaine face à la volatilité pétrolière. Cette limite s'explique notamment par les contraintes des politiques d'indexation, qui, en l'absence de mesures d'accompagnement ciblées (ex : soutien aux secteurs vulnérables), continuent de laisser subsister des fragilités structurelles. Comparativement, des pays comme la Tunisie, l'Égypte ou la Jordanie ont connu des trajectoires similaires, où les réformes des subventions ont permis une stabilisation budgétaire mais avec des effets sociaux et économiques différenciés, appelant à des stratégies d'ajustement plus adaptées.

Sur le plan des implications politiques, cette étude souligne l'importance de concevoir des politiques énergétiques différenciées selon les secteurs et les catégories sociales les plus exposées aux chocs exogènes. Elle invite également à renforcer les instruments d'amortissement macroéconomique pour limiter l'impact des fluctuations pétrolières, tout en favorisant la transition vers des énergies alternatives afin de réduire la dépendance aux hydrocarbures importés. De plus, une analyse approfondie des interactions entre les prix du pétrole et d'autres facteurs externes (comme les politiques commerciales ou les variables macroéconomiques) pourrait ouvrir de nouvelles pistes de réflexion pour une meilleure gestion des vulnérabilités économiques du Maroc.

Enfin, plusieurs perspectives de recherche se dessinent et mériteraient d'être approfondies :

- Quels sont les effets sectoriels différenciés des fluctuations des prix du pétrole sur l'économie marocaine ?
- Comment évaluer l'efficacité des politiques d'indexation post-2014 dans un contexte de réformes budgétaires et d'ajustement structurel ?
- Dans quelle mesure les interactions entre les prix du pétrole, les variables macroéconomiques (inflation, taux de change) influencent-elles la résilience économique du Maroc ?
- Quels enseignements peut-on tirer des expériences de pays comparables (Tunisie, Égypte, Jordanie) pour enrichir les stratégies d'adaptation aux chocs pétroliers au Maroc ?

Conflit d'intérêts : Les auteurs n'ont signalé aucun conflit d'intérêts.

Disponibilité des données : Toutes les données sont incluses dans le contenu de l'article.

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Analyse financière des systèmes de production du Riz dans la région de GAO

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Resumé

La région de Gao est l'une des régions du nord du Mali où la riziculture est la plus pratiquée. Malgré l'énorme potentiel de riz semé, la production rizicole diminue d'année en année dans la région de Gao. L'objectif de cette étude est de mener une analyse financière des systèmes de production rizicole dans la région de Gao. Le but est d'évaluer la performance des systèmes de production et d'évaluer les préférences des producteurs en matière de systèmes de production. Cette étude a été menée dans la région de Gao auprès de 253 agriculteurs avec une marge d'erreur de 6 %. La méthodologie a utilisé des approches de recherche qualitatives et quantitatives intégrées. Les données ont été collectées auprès des riziculteurs et des services techniques. L'étude montre que le système de production le plus répandu est la riziculture en inondation. Elle est adoptée par une large majorité, 74 % des riziculteurs. Le rendement et le revenu net varient selon la variété et le système de production : en maîtrise totale, les variétés améliorées produisent un rendement moyen de 1 780 kg/ha avec un revenu net de 730 USD/ha ; En submersion contrôlée, les variétés améliorées atteignent 1 730 kg/ha et 726 USD/ha, contre 1 359 kg/ha

et 347 USD/ha pour les variétés locales. En submersion non contrôlée, seules les variétés locales sont utilisées, avec un rendement moyen de 1 331 kg/ha et un revenu net de 329 USD/ha. L'indicateur de rentabilité montre que les variétés améliorées sont rentables, contrairement aux variétés locales qui ne le sont pas.

Mots clés: Analyse Financiere, Système de production, variété améliorée, variété locale, Gao

Financial Analysis of Rice Production Systems in the GAO Region

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Abstract

The Gao region is one of the most widely cultivated regions in northern Mali. Despite the enormous potential for sown rice, rice production is declining year after year in the Gao region. The objective of this study is to conduct a financial analysis of rice production systems in the Gao region. The goal is to assess the performance of production systems and evaluate producers' preferences regarding production systems. This study was conducted in the Gao region with 253 farmers, with a margin of error of 6%. The methodology used integrated qualitative and quantitative research approaches. Data were collected from rice farmers and technical services. The study shows that the most widespread production system is flooded rice cultivation. It is adopted by a large majority, 74% of rice farmers. Yield and net income vary depending on the variety and production system: under full control, improved varieties produce an average yield of 1,780 kg/ha with a net income of USD 730/ha; under controlled submersion, improved varieties achieve 1,730 kg/ha and USD 726/ha, compared to 1,359 kg/ha and USD 347/ha for local varieties. Under uncontrolled submersion, only local varieties are used, with an average yield of 1,331 kg/ha and a net income of USD 329/ha. The profitability indicator shows that improved varieties are profitable, while local varieties are not.

Keywords: Financial Analysis, Production system, improved variety, local variety, Gao

Introduction

Le Mali est un pays enclavé de l'Afrique de l'Ouest avec une superficie de 1,241 million de km² (7ème en Afrique) et une population de 22,3 millions en 2022 (RGPH5, 2022).

Le riz est la principale alimentation de base et considéré comme un produit stratégique en raison de son importance pour la sécurité alimentaire et aussi pour le développement économique du pays. Sa place prépondérante dans la production, l'emploi agricole et la création de revenus pour les agriculteurs est bien connue de tous. Il représente 4,7% du PIB du pays et 13,3% du Produit intérieur Brut (PIB) agricole (FAO, 2023). L'Enquête Agricole de Conjoncture de 2019, a montré qu'il y a dans le pays 190 000 exploitations rizicoles sur les 1 493 061 exploitations agricoles recensées au Mali, soit environ 12,7% du total.

Le riz continue d'occuper une place importante dans la production céréalière malienne. Selon les projections du Commissariat à la Sécurité Alimentaire du Ministère du Développement Rural et du plan triennal de campagne agricole consolidé et harmonisé pour la période 2022-2024, il se situe actuellement au deuxième rang en termes de production. Avec un pourcentage de 28,6%, il se classe derrière le maïs, qui représente 41,1% de la production de céréales maliennes.

Plusieurs politiques et stratégies ont été mises en place pour contribuer au développement de la production de riz afin d'atteindre l'autosuffisance alimentaire et exporter vers les pays de la sous-région.

Ces stratégies ont permis d'augmenter les superficies aménagées pour la riziculture et mis à la disposition des riziculteurs des engrais et des équipements agricoles subventionnés et des semences certifiées, ce qui a contribué à augmenter les rendements et la production. Cependant, malgré la tendance haussière de la production, les objectifs gouvernementaux n'ont pas été atteints.

Au Mali, malgré les résultats encourageants issus des dernières réformes tant au niveau des quantités produites qu'au niveau de l'approvisionnement des marchés et des prix aux producteurs et à la consommation, la production n'arrive pas à couvrir le besoin national et le pays continue toujours d'importer des quantités de plus en plus importantes de riz. Cette situation intrigue des ressources de l'Etat à travers les subventions malgré les grandes potentialités en eaux et terres aptes à l'irrigation et aussi dans un contexte difficile de finances publiques et de balance de paiement.

Dans la région de Gao, selon le rapport de la direction régionale de l'Agriculture de Gao 2020, le riz représente 55,53% des emblavures totales en céréales et la production de riz représente 73% de la production totale de céréales. En effet, en raison des sécheresses cycliques de ces dix dernières années dans la région, la seule possibilité de culture sans gros investissements est la culture fluviale. La tradition rizicole des populations pourrait sans doute expliquer pourquoi le riz est davantage ancré dans les habitudes alimentaires et consommé plus fréquemment que le sorgho et le mil. On consomme à Gao 3 fois le riz par jour, et c'est à défaut de riz que les autres céréales sont consommées.

Bien que la région de Gao dispose d'un immense potentiel pour la culture du riz, sa production diminue chaque année. Cette baisse s'explique par divers obstacles freinant le développement de la filière, notamment le changement climatique, la dégradation des sols, le manque de technologies adaptées et l'insuffisance de terres aménagées.

Devant la pauvreté et les impacts du changement climatique, il est crucial de trouver des solutions adaptées pour remédier aux difficultés de la région de Gao.

Pour faire face à ces insuffisances, il est urgent de mettre en évidence le système de production de riz le plus rentable dans la région de Gao afin de booster la productivité des riziculteurs.

La définition des systèmes de culture rizières

Il existe trois systèmes de culture agro-climatiques qui permettent de produire du riz dans la région de Gao. Ils sont répartis sur le territoire en fonction des potentialités géophysiques et climatiques :

- Maîtrise totale de l'eau : sur les grands et les petits périmètres irrigués:
 - Grands périmètres irrigués : La gestion de l'eau consiste à apporter de l'eau d'irrigation à la parcelle en quantité rationnelle et en temps voulu sans perte d'eau. Les besoins en eau exprimés par les agriculteurs sont satisfaits par le gestionnaire du réseau hydraulique à travers un système de canaux et de vannes. Les tours d'eau sont organisés de telle sorte que chaque agriculteur reçoit la quantité d'eau dont il a besoin selon un calendrier précis. Dans ce système d'irrigation intensif, les agriculteurs utilisent des semences sélectionnées et des engrais minéraux et organiques.
 - Périmètres Irrigués Villageois (PIV) : dans ce système l'alimentation en eau est assurée par pompage directement du fleuve.
- Ce système cultural intensif a permis d'obtenir des rendements élevés (6.0 t/ha en 2021) et dans certaines zones il est possible

- d'avoir deux récoltes par an : la récolte de saison et la récolte de contre saison.
- Maîtrise partielle de l'eau : submersion contrôlée et riziculture de bas-fonds,
 - Le système d'irrigation en submersion contrôlée consiste à ériger des digues de ceinture pour protéger les parcelles rizicoles contre les crues précoces. La maîtrise est partielle car dans ce système il n'est pas possible d'admettre et de vidanger l'eau selon le cycle de la plante. Les risques liés à l'irrigation et les difficultés de vidange de l'eau sont à l'origine de la réticence des agriculteurs à utiliser des engrais organiques et minéraux, ce qui se traduit par des rendements faibles (2,3 t/ha en 2021).
 - Le système d'irrigation de bas-fonds : dans ce système, il y'a généralement un ouvrage de retenue d'eau et un canal principal assurant l'entrée d'eau dans les rizières. Les variétés utilisées sont des variétés locales adaptées à la hauteur de la lame d'eau. Dans ce système, l'utilisation d'engrais minéraux dépend du degré de maîtrise de l'eau. Les rendements sont généralement faibles (2,2 t/ha en 2021).
 - Riziculture en submersion libre : la submersion fluviale libre ou riziculture flottante est la forme la plus ancienne de riziculture. Elle est pratiquée au Mali depuis 1 500 avant Jésus-Christ. C'est une forme de culture extensive, soumise aux conditions naturelles et sans sécurité. La culture est pratiquée dans les dépressions inondées pendant 3 à 6 mois, le long du fleuve Niger dans les régions de Mopti, Tombouctou et Gao. Le riz est semé avec les premières pluies, et sa croissance doit suivre la montée des eaux lors de la crue. Avec le changement climatique, l'irrégularité des pluies surtout en début de saison et l'incertitude de la crue rendent ce système d'irrigation assez aléatoire. Pour cela des variétés rustiques pouvant s'adapter aux conditions naturelles sont utilisées, mais ces variétés ont des rendements faibles. Étant donné les risques liés à cette culture, les agriculteurs n'apportent pas de fertilisation organique ni minérale, ce qui contribue aux très faibles rendements observés pour ce système d'irrigation. (1,2 t/ha en 2021).

Méthodes

Choix des sites d'étude :

La Région de Gao est choisie du fait de la place qu'occupe la riziculture dans la vie active de la population. Elle est la céréale la plus cultivée et plus consommée dans la région(DRA-G, 2021). Elle est pratiquée par la majorité des agriculteurs de façon traditionnelle (en submersion libre, la riziculture en décrue et la riziculture de mares) et moderne dans les

aménagements hydro-agricoles (en submersion contrôlée et en maîtrise totale de l'eau). Sur les 110 000ha en potentiel seulement 30% sont mis en valeurs. Elle est l'une des régions la plus impactée par le changement climatique. La région de Gao est moins arrosée et possède un climat du type sahélien. La région est traversée de bout en bout par le fleuve Niger, d'où l'importance des eaux de surface dont la qualité dépend des crues annuelles. La région compte par ailleurs de grandes mares, dont celles de Tessit, Amalawlaw, Indélimane, Tintichiori dans le cercle d'Ansongo ; Samit à N'Tillit, Zankabilo à Gabéro dans le cercle de Gao(SEYDOU F. 2016).

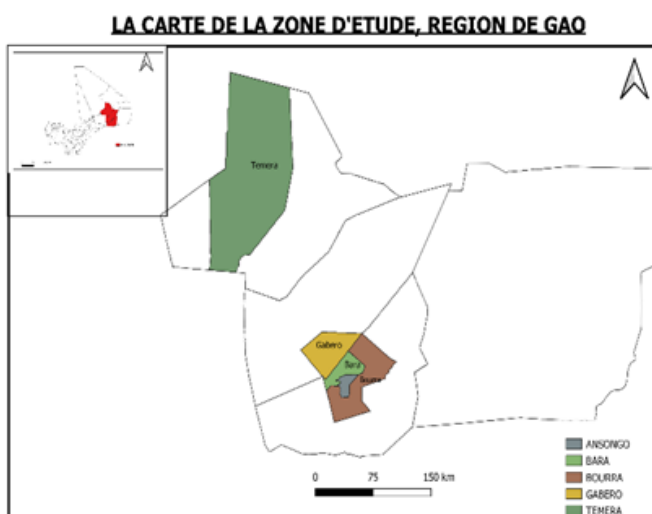


Figure 1: carte de la zone d'étude

Echantillonnage

La taille de l'échantillonnage est définie selon les moyens financiers de l'étude. Elle a été calculée par la formule suivante :

$$n = (1,96)^2 \times N / [(1,96)^2 + I^2 \times (N-1)]$$

n : la taille de l'échantillon

N : la Taille de la population

I : Marge d'erreur (ou intervalle de confiance)

La méthodologie utilisée a intégré les approches de recherche qualitative et quantitative. Les enquêtes formelles ont été réalisées à travers des entretiens individuels sur la base d'un questionnaire semi-structuré administré auprès des exploitants rizicoles.

Le choix de l'échantillon s'est déroulé en deux étapes : la première étape a consisté à choisir les communes de collecte. Le choix des communes a été fait sur la base de la productivité, les superficies emblavées, le nombre d'exploitants, les systèmes de production pratiqués dans la commune et sur la

base du contexte sécuritaire. Ainsi les communes de Ansongo, Bourra, Bara, Gabero et Temera ont été choisies. La deuxième étape a consisté à choisir les exploitants dans les communes cités ci-haut.

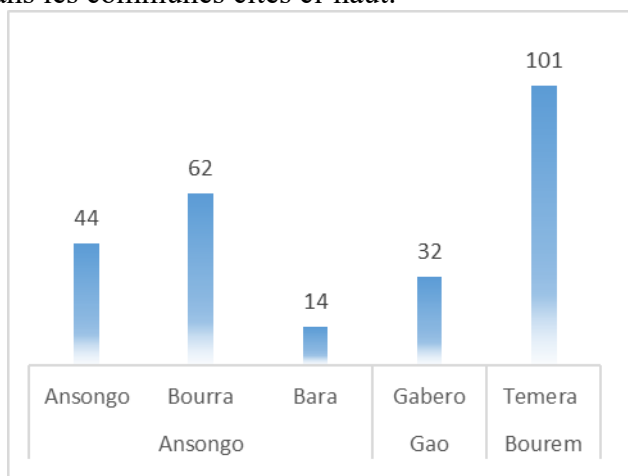


Figure 2: Répartition de l'échantillon

Les exploitants rizicoles ont été identifiés à travers la méthode d'échantillonnage dite l'échantillon aléatoire systématique. C'est ainsi qu'un échantillon de 253 exploitants sur 170 000 exploitants (population mère) a été retenu pour notre étude avec une marge d'erreur de 6%.

L'échantillonnage a pris en compte les femmes, hommes, jeunes, vieux pour une bonne représentativité.

Collecte des données

Les données primaires ont été collectées individuellement et en focus group par voie d'interview d'Octobre 2022 à Mars 2023, à l'aide de questionnaires semi structuré préétablis et de guide d'entretien. Les données ont été collectées auprès des riziculteurs. Les données secondaires ont été collectées auprès des services techniques (DRA-GAO, IER et les secteurs d'Agriculture de Bourem et Ansongo). Le consentement éclairé de l'enquêté est demandé avant le début de l'entrevue.

Les principales données collectées ont concerné les caractéristiques socioéconomiques des exploitations (taille ou population, activités économiques, éducation, organisations des producteurs, etc.), les données sur la performance des systèmes de production résilients au climat (Superficie en hectare, Rendement, intrants, Prix, Quantité produite), les données de l'évaluation des préférences des producteurs concernant les systèmes de production résilients au climat (les préférences par rapports aux systèmes de productions, les pratiques de production résiliente au climat, les raisons de la préférence de la pratique, les variétés du riz performantes et résilientes).

Analyse des données

Les données collectées ont été analysées et traitées à travers les logiciels SPSS 21, Stata 14 et Excel2019. Le choix SPSS, STATA et Excel pour l'analyse des données dépend de plusieurs facteurs, notamment les besoins spécifiques de l'analyse, les compétences de l'utilisateur et les fonctionnalités offertes par chaque logiciel. Le logiciel SPSS version 21 a été utilisé dans les analyses des Caractéristiques socio-économiques des exploitants, la proportion de l'utilisation des systèmes de production et de lieu de production. Stata version 14 a permis d'analyser la Préférence des systèmes de production. le logiciel Excel 19 a permis de faire les comptes d'exploitations et les graphiques.

Methodologie de Calcul

L'analyse de la rentabilité des systèmes de production du riz résilients au climat, en tenant compte des aspects de genre, vise à évaluer leur performance économique selon un rapport bénéfice/coût. Cette étude implique le calcul des indicateurs correspondant à chaque système de production identifié:

Le rendement (Rdt), kg/ha : $Rdt = \frac{QTp}{SUPc}$;

Où QTp =quantité totale récoltée (kg) pour la spéculation considérée ;
Sup=superficie (ha) totale de la spéculation

Les coûts variables de production (CV), :

$$CV = \sum_i^n Q_i PU_i ;$$

Où : Q_i =quantité de l'intrant i; PU_i =prix unitaire de l'intrant i; n=nombre d'intrants utilisés

Le produit brut en valeur (PBV) :

$$PBV = Rdt * PU$$

Où : Rdt=rendement ; PU=prix unitaire de vente de la production

La marge brute (MB) :

$$MB = PBV - CV$$

Où : PBV= produit brut en valeur ; CV=coûts variables

Le coût de production (CP), FCFA/kg :

$$CP = \frac{CV}{Rdt}$$

Où : CV=coûts variables ; Rdt= rendement

Ratio bénéfice/cout (R b/c) : Le ratio bénéfice/coût, également connu sous le nom d'indice de rentabilité, est un indicateur financier utilisé pour évaluer la rentabilité d'un projet ou d'un investissement. Il compare les bénéfices attendus aux coûts totaux associés à la réalisation du projet. Le R

b/c permet de déterminer si un projet vaut la peine d'être entrepris d'un point de vue financier. Le ratio bénéfice/coût mesure la valeur créée par un investissement par rapport à son coût. Un R b/c supérieur à 1 indique que les bénéfices surpassent les coûts, ce qui suggère que le projet est rentable.

Résultats

Caractéristiques socio-économiques :

Les caractéristiques générales des producteurs enquêtés, illustrées dans le Tableau 1, révèlent que 88 % d'entre eux sont des hommes mariés. L'analyse de variance indique une différence notable selon le sexe concernant l'appartenance des parcelles. Le niveau d'instruction des producteurs est relativement bas, avec 50 % ayant fréquenté l'école coranique. De plus, une différence significative entre les producteurs selon les zones d'étude a été mise en évidence par l'analyse de variance.

Tableau 1: Caractéristiques socio-économiques

Caractéristiques	Ensemble site								Valeur	Ddl	Signification asymptotique
	Ansongo		Bourem		Gao						
	N	(%)	N	(%)	N	(%)	N	(%)			
Sexes											
Homme	97	81	94	93	31	97	222	88	10,476 ^a	2	,005***
Femme	23	19	7	7	1	3	31	12			
Ethnies											
Peulh	-	-	-	-	20	63	20	8	194,642 ^a	6	,000***
Sonrhäï	120	100	75	74	12	38	207	82			
Tamasheq	-	-	26	26	-	-	26	10			
Niveau d'instruction											
Alphabétisation fonctionnelle	1	1	-	-	2	6	3	1	173,470 ^a	8	,000***
Aucun	-	-	83	82	20	63	103	41			
Ecole coranique	104	87	15	15	7	22	126	50			
Primaire	10	8	2	2	1	3	13	5			
Secondaire	5	4	1	1	2	6	8	3			
Statut Matrimonial											
Célibataire	-	-	1	1	-	-	1	,4	1,511 ^a	2	,470
Marié(e)	120	100	100	99	32	100	252	99,6			

* significatif à 10 % ; ** significatif à 5% ; *** significatif à 1%

Système de production

Le système de production du riz le plus répandu est la riziculture de submersion libre. Il est adopté par une majorité significative, soit 74% des riziculteurs. Le système de riziculture de submersion contrôlée est utilisé par 25%. Il est à noter que le système de riziculture de la maîtrise total d'eau est le moins courant, utilisé par seulement 1% des producteurs. Ce système est plus utilisé dans les PIV (Périmètres Irrigués Villageois). Cette répartition des choix de système de production reflète les préférences et les pratiques agricoles des producteurs.

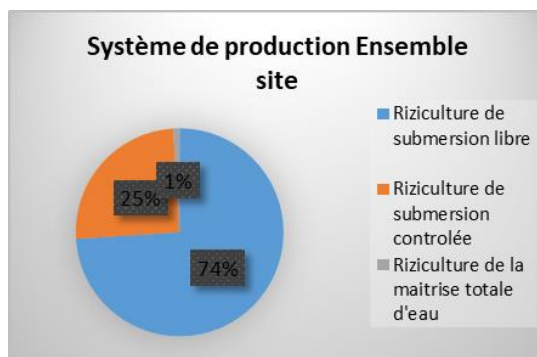


Figure 3: Système de production

Lieu de Production du Riz

Il ressort de l'enquête que les lieux de production du riz varient significativement en fonction des zones et des producteurs. La majorité de producteurs, soit 52% cultive dans les périmètres rizicoles. En revanche, une proportion de 40% cultive dans les bas-fonds, tandis que 8% cultive dans les plaines. Ces résultats soulignent une diversité marquée dans lieux de production du riz. Le système de production du riz dépend du lieu de production et de la disponibilité en eau : les zones irriguées permettent une production intensive, tandis que les plaines inondables et les bas-fond dépendent des crues et des précipitations. Enfin, chaque système de production est adapté aux conditions climatiques locales pour optimiser les rendements et assurer la durabilité de la production.

Lieu de production du riz Ensemble site

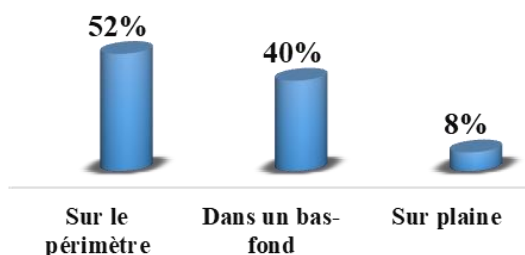


Figure 4: Lieu de culture du Riz

Les indicateurs de production

Le rendement moyen varie en fonction du système de production et par type de variétés.

En Maîtrise totale d'eau, les variétés améliorées sont les seules utilisées. Le rendement moyen est de 1 780Kg/ha. Le revenu net d'exploitation est 421 378F CFA/ha contre 222 481 F CFA/ha en seuil de rentabilité. La marge de sécurité est fixée à 509 269F CFA/ ha.

En submersion contrôlée, les variétés améliorées et locales sont utilisées. Le rendement moyen pour les variétés améliorées est 1 730kg/ha contre 1 359kg/ha pour les variétés locales. Le revenu net d'exploitation pour les variétés améliorées est 418 828F CFA/ha contre 200 071F CFA/ha pour les variétés locales. La marge de sécurité pour les variétés améliorées est de 499 855kg/ha contre 296 944Kg/ha pour les variétés locales.

En submersion libre, seules les variétés locales sont utilisées. Le rendement moyen est de 1 331 Kg/ha. Le revenu net d'exploitation est de 189 655F CFA/ha contre 183 034F CFA/ha pour le seuil de rentabilité. La marge de sécurité est de 283 643F CFA/ha.

Suivant l'analyse, l'indicateur de rentabilité montre que la production des variétés améliorées dans les différents systèmes de production est rentable contrairement à la variété Locale qui n'est pas rentable dans les différents systèmes de production. Le ratio bénéfice/cout est de 1.33 pour les variétés améliorées et 0.7 pour les variétés locales.

Tableau 2: Compte d'exploitation

Caractéristiques	Maitrise Totale de l'eau	Submersion contrôlée		Submersion libre	Ensemble	
	Améliorée (PIV)	Améliorée	Locale	Locale	Améliorée	Locale
Rendement (Kg/ha)	1 780	1 730	1 359	1 331	1 755	1 345
Prix Unitaire de vente (F CFA/kg)	411	427	354	351	419	352
Produit brut (F CFA/ha)	731 750	739 250	481 290	466 677	735 500	473 984
Charges variables (F CFA/ha)	124 794	117 094	135 853	130 949	120 944	133 401
Marge brute (F CFA/ha)	606 956	622 156	345 438	335 729	614 556	340 583
Charges fixes (F CFA/ha)	185 578	203 328	145 367	146 063	194 453	145 715
Marge nette (F CFA/ha)	466 425	472 624	223 467	213 062	469 525	218 265
Productivité du Travail (F CFA/hjr)	160 044	98 718	53 442	77 770	129 381	65 527
Revenu brute d'exploitation (F CFA/ha)	466 425	472 624	223 467	213 062	469 525	218 265
Revenu net d'exploitation (F CFA/ha)	421 378	418 828	200 071	189 665	420 103	194 868
Ratio bénéfice/coût	1,36	1,31	0,71	0,68	1,33	0,70

Préférence des systèmes de production

La pratique culturale plus résiliente au climat et la disponibilité de l'eau sont les principales raisons du choix du système de production avec 19%

de citation. La pratique culturelle plus résiliente au climat et l'accès à l'eau sont les raisons du choix des 33% de producteurs au niveau du submersion libre contre 1% pour la submersion contrôlée. Les pratiques culturelles moins couteuses et la disponibilité des variétés plus adoptées sont les raisons du choix des 31% de producteurs au niveau du submersion libre contre 1% pour la submersion contrôlée.

Cependant, l'analyse de variance a montré une différence hautement significative au seuil de 1% au niveau des paramètres suivant les systèmes de production pour les raisons de choix.

Tableau 3: Raison du choix du système de production en fonction du système de production

Caractéristiques	Submersion contrôlée		Submersion libre		Ensemble Site		Valeur	Ddl	Signification asymptotique
	N	(%)	N	(%)	N	(%)			
Pratique culturelle plus maîtrisée	1	1	30	21	31	12	45,178 ^a	4	,000***
Pratiques culturelles plus résilientes au climat	1	1	46	33	47	19	45,133 ^a	4	,000***
Pratique culturelle moins couteuse	1	1	44	31	45	18	45,137 ^a	4	,000***
Meilleur rendement	-	-	41	29	41	16	45,499 ^a	4	,000***
Disponibilité des variétés plus adoptées	-	-	44	31	44	17	45,725 ^a	4	,000***
Aspect culturelle	1	1	40	28	41	16	45,146 ^a	4	,000***
Disponibilité des emblavures	1	1	36	26	37	15	45,156 ^a	4	,000***
Accès à l'eau	1	1	46	33	47	19	45,133 ^a	4	,000***
Inondations	1	1	26	18	27	11	45,197 ^a	4	,000***
Sécheresse	1	1	24	17	25	10	45,209 ^a	4	,000***

* significatif à 10 % ; ** significatif à 5% ; *** significatif à 1%

Discussion

La majorité des producteurs enquêtés sont des hommes mariés avec un faible niveau d'instruction (50 % ayant fréquenté l'école coranique). Ceux qui explique une faible adoption des variétés améliorées et des bonnes techniques culturelles. Ce résultat confirme ceux de (Ngom et al. 2016) d'une part qui stipulent que l'instruction peut permettre au riziculteur de choisir les quantités d'intrants convenables et de faire un bon choix compte tenu des techniques culturelles disponibles puis ceux de (Nuama, 2006) d'autre part qui a montré que le producteur instruit a facilement la maîtrise des techniques modernes de production et il a aussi l'opportunité d'avoir les informations nécessaires sur les prix de marché et d'acheter ses inputs à moindre prix.

Les principaux acteurs identifiés dans l'exploitation rizicole dans la région de Gao sont des hommes qui héritent des terres de production. Ce résultat confirme celui de (Olounlade et al. n.d.) qui ont montré que l'héritage des terres affecte positivement le revenu du producteur et offre aux producteurs un plan de production à long terme. Cela montre que l'exploitation rizicole est une activité majoritairement masculine dans la région. Ce résultat confirme le constat fait par de nombreux auteurs que dans la région de Gao les hommes sont les principaux acteurs de l'exploitation rizicole (Toure, 2016). Les quelques femmes productrices sont le plus souvent des veuves ou des femmes cheffe de famille sans assez de main d'œuvre dans leur exploitation. (Ouedraogo, 2012) qui avait montré que la taille des ménages contribue à la satisfaction des besoins en main d'œuvre qui constitue une contrainte dans le système d'agriculture extensive et surtout dans les systèmes irrigués.

Le système de production du riz dépend du lieu de production et de la disponibilité en eau : les zones irriguées permettent une production intensive, tandis que les plaines inondables et les bas-fonds dépendent des crues et des précipitations. Il ressort de l'enquête que les lieux de production du riz varient significativement en fonction des zones et des producteurs. La majorité de producteurs, soit 52% cultive dans les périmètres rizicoles. En revanche, une proportion de 40% cultive dans les bas-fonds, tandis que 8% cultive dans les plaines. Ces résultats soulignent une diversité marquée dans les lieux de production du riz.

Le système de production du riz le plus répandu est la riziculture de submersion libre. Il est adopté par une majorité significative, soit 74% des riziculteurs. Le système de riziculture de submersion contrôlée est utilisé par 25%. Il est à noter que le système de riziculture de maîtrise totale d'eau est le moins courant, utilisé par seulement 1% des producteurs. Ce système est plus utilisé dans les PIV. Le rapport annuel de la DRA de Gao confirme également que, sur les 16 490 hectares cultivés en 2023, 12 200 hectares étaient en submersion libre. Cette répartition des choix de système de production reflète les préférences et les pratiques agricoles des producteurs.

Les résultats de l'étude nous montrent une variation des rendements en fonction des variétés et des systèmes de production. Ces résultats vont dans le même sens que ceux de Adegbola et al. (2003) qui ont conclu dans leur étude de la compétitivité de la riziculture béninoise que la rentabilité du riz peut être fonction de la zone d'étude et du système de production pratiqué. En maîtrise totale d'eau, les variétés améliorées sont les seules utilisées. Le rendement moyen est de 1 780Kg/ha. Le revenu net d'exploitation est 421 378F CFA/ha. En submersion contrôlée, les variétés améliorées et locales sont utilisées. Le rendement moyen pour les variétés améliorées est 1 730kg/ha contre 1 359kg/ha pour les variétés locales. Le revenu net d'exploitation pour les variétés améliorées est 418 828F CFA/ha contre 200 071F CFA/ha pour les

variétés locales. En submersion libre, seules les variétés locales sont utilisées. Le rendement moyen est de 1 331 Kg/ha. Le revenu net d'exploitation est de 189 655F CFA/ha. Les producteurs n'utilisent pas des engrais minéraux, celles quelques-uns utilisent à faible quantité de l'engrais organique fertinova en submersion maitrise totale d'eau La culture en submersion libre est particulièrement affectée par le retard des premières pluies, les poches de sécheresse et le faible débit du fleuve Niger. Ce qui pourrait expliquer que les faibles productions observées dans le monde rural sont liées l'utilisation de variétés à faible rendement et les conditions de production. Cela pourrait nous amener à avoir la même conclusion que DIEDHIOU (2019) qui affirme dans son étude que le rendement varie en fonction de types des variétés et du système de production. Ces résultats sont également en phase avec ceux de (Styger, 2009) qui a trouvé une augmentation du rendement du système de riziculture intensif (SRI) à plus de 66 % par rapport aux rendements des pratiques paysannes au Mali.

Les prix de vente sont plus élevés pour les variétés améliorées produites en contre saison en maitrise totale d'eau que pour les variétés locales produites en saison. Cela s'explique par le fait qu'en contre-saison, l'offre sur le marché est inférieure à la demande, tandis qu'en saison de production, le marché est saturé par la production locale.. Ce pendant la variété locale est plus préférée par les consommateurs du fait de son gout et n'est pas disponible sur le marché pendant toute l'année.

Pour les coûts de production, ils sont plus élevés pour les variétés améliorées que pour les variétés locales. En maitrise totale d'eau, le repiquage et la redevance eau sont les principales charges. Par contre, en submersion contrôlée et libre, l'arrosage et la récolte constituent les principales charges. Suivant l'analyse, l'indicateur de rentabilité montre que la production des variétés améliorées dans les différents systèmes de production est rentable contrairement à la production des variétés Locale qui n'est pas rentable dans les différents systèmes de production. Le ratio bénéfice/cout est de 1.33 pour les variétés améliorées et 0.7 pour les variétés locales. Bien que la variété améliorée engendre plus de charges, il génère néanmoins un bénéfice plus important que les variétés locales (Gbenou, 2013). Ce résultat confirme ceux de (Yabi et al. 2012) qui ont montré que dans la commune de Malanville, la riziculture est économiquement rentable en termes de couverture des coûts de production variables et fixes. Le TRI des riziculteurs est supérieur à 24% qui est la moyenne du taux d'intérêt des institutions de micro finance de la zone d'étude. Donc les producteurs de riz sont aussi rentables du point de TRI.

La pratique culturale plus résilientes au climat et la disponibilité de l'eau sont les principales raisons du choix du système de production avec 19% de citation. La pratique culturale plus résiliente au climat et l'accès à l'eau sont les raisons du choix des 33% de producteurs au niveau du submersion libre

contre 1% pour la submersion contrôlée. Les pratiques culturales moins couteuse et la disponibilité des variétés plus adoptées ont les raisons du choix des 31% de producteurs au niveau du submersion libre contre 1% pour la submersion contrôlée. Ainsi il faut comprendre que le choix du système de production dépend directement des ressources disponibles et de l'environnement local.

Conclusion

La région de Gao est l'une des régions du Nord-Mali où la riziculture est plus pratiquée. Elle est la céréale la plus cultivée et plus consommée dans la région. Elle est confrontée à plusieurs problèmes qui freinent le développement de la filière Riz. Le changement climatique, la pauvreté du sol, le manque de technologie et l'insuffisance des terres aménagées sont les facteurs impactant.

Il ressort des résultats que le système de production du riz le plus répandu est la riziculture de submersion libre. Il est adopté par une majorité significative, soit 74% des riziculteurs. Le système de riziculture de submersion contrôlée est utilisé par 25%. Il est à noter que le système de riziculture de maîtrise totale d'eau est le moins courant, utilisé par seulement 1% des producteurs. Ce système est plus utilisé dans les PIV.

Suivant l'analyse, l'indicateur de rentabilité montre que la production des variétés améliorées dans les différents systèmes de production est rentable contrairement à la production des variétés Locale qui n'est pas rentable dans les différents systèmes de production. Le ratio bénéfice/coût est de 1.33 pour les variétés améliorées et 0.7 pour les variétés locales. Ces résultats constituent un guide précieux pour encourager la culture du riz dans le cadre des défis posés par le changement climatique dans la région de Gao.

Pour développer la filière riz dans la région de Gao, il est essentiel d'améliorer la gestion des ressources en eau et promouvoir l'utilisation de variétés à haut rendement. Le développement des infrastructures d'irrigation adaptées aux différentes zones de production, ainsi que l'accès aux intrants agricoles et la valorisation de la production en contre-saison, joueront un rôle clé dans l'amélioration de la rentabilité et la durabilité des exploitations.

Enfin, des mesures financières et une meilleure organisation des circuits de commercialisation permettront d'assurer une production pérenne et adaptée aux réalités locales.

Conflit d'intérêts : Les auteurs n'ont signalé aucun conflit d'intérêts.

Déclaration de financement : Les auteurs n'ont obtenu aucun financement pour cette recherche.

Disponibilité des données : Toutes les données sont incluses dans le contenu de l'article. Les données utilisées dans cette étude ont été analysées exclusivement dans le cadre du projet et de l'article en question. Aucune base de données en ligne n'est disponible.

Études humaines : La participation à cette étude était volontaire. Chaque personne rencontrée a donné son consentement libre et éclairé de façon verbale après avoir été rassuré de l'utilisation des données collectées dans le strict respect du secret statistique et de la confidentialité des informations produites.

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Innovation technologique verte et durabilité économique des coopératives agricoles au Maroc : analyse du rôle modérateur de la finance verte dans un contexte de transition énergétique - cas de la province de Kelaa des Sraghna

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Résumé

Cette étude examine l'impact de l'innovation technologique verte (ITV) sur la durabilité économique des coopératives agricoles marocaines, en mettant en exergue le rôle modérateur exercé par la finance verte dans un contexte de transition énergétique. L'analyse repose sur un échantillon de 185 coopératives implantées dans la province de Kelaa des Sraghna, territoire reconnu pour son potentiel agricole et son engagement croissant en faveur des énergies renouvelables. En mobilisant une approche méthodologique mixte, la recherche combine une phase qualitative exploratoire – fondée sur une

démarche inductive – à une phase quantitative fondée sur l'estimation de modèles économétriques. L'investigation qualitative s'appuie sur 20 entretiens semi-structurés réalisés auprès de dirigeants de coopératives, 10 représentants d'institutions financières et 5 acteurs territoriaux, ainsi que sur cinq études de cas approfondies de coopératives engagées dans l'adoption de solutions technologiques vertes. Cette phase met en lumière une série d'obstacles (insuffisance de financement, déficits de sensibilisation, contraintes techniques), mais aussi des leviers d'action (soutien public, gains d'efficacité énergétique, renforcement de la résilience économique). Ces résultats ont permis la formulation d'hypothèses testées économétriquement. L'analyse quantitative, fondée sur des modèles de régression linéaire et à effets fixes, révèle que l'ITV exerce un effet significatif et positif sur la durabilité économique, notamment à travers l'optimisation de l'usage des ressources et la réduction des coûts d'exploitation. En outre, l'accès accru aux instruments de finance verte amplifie cet effet, en facilitant l'adoption de l'ITV et en consolidant la robustesse économique des structures coopératives. L'étude enrichit ainsi la littérature sur les déterminants de la durabilité des organisations agricoles en contexte rural et formule des recommandations à destination des décideurs publics, des bailleurs de fonds et des institutions de soutien à l'économie sociale.

Mots-clés : Coopératives agricoles, innovation verte, finance verte, durabilité économique, transition énergétique

Green Technological Innovation and Economic Sustainability of Agricultural Cooperatives in Morocco: Analysis of the Moderating Role of Green Finance in a Context of Energy Transition - Case of the Province of Kelaa des Sraghna

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Abstract

This study examines the impact of green technological innovation (GTI) on the economic sustainability of Moroccan agricultural cooperatives, highlighting the moderating role of green finance in the context of energy transition. The analysis is based on a sample of 185 cooperatives located in the province of Kelaa des Sraghna, a region renowned for its agricultural potential and growing commitment to renewable energy. Using a mixed-methods approach, the research combines an exploratory qualitative phase, based on an inductive methodology, with a quantitative phase grounded in econometric model estimation. The qualitative investigation draws on 20 semi-structured interviews with cooperative leaders, 10 financial institution representatives, and 5 local stakeholders, as well as five in-depth case studies of cooperatives that have adopted green technological solutions. This phase reveals a series of obstacles (limited funding, lack of awareness, technical constraints), as well as key enablers (public support, energy efficiency gains, enhanced economic resilience). These findings informed the formulation of hypotheses tested through econometric methods. The quantitative analysis, based on linear and fixed-effects regression models, shows that GTI has a significant and positive effect on economic sustainability, particularly through resource optimization and reduced operating costs. Furthermore, greater access to green finance instruments amplifies this effect by facilitating the

adoption of GTI and strengthening the economic robustness of cooperative structures. The study thus contributes to the literature on the determinants of sustainability in rural agricultural organizations and provides recommendations for policymakers, donors, and institutions supporting the social and solidarity economy.

Keywords: Agricultural cooperatives, green technological innovation, green finance, economic sustainability, energy transition

1. Introduction

Les coopératives agricoles jouent un rôle central dans la structuration du développement durable des économies rurales, en particulier dans les pays du Sud, où elles contribuent à la résilience territoriale, à la lutte contre la pauvreté et à la sécurité alimentaire (Oulamine et al., 2024). Au Maroc, elles constituent un levier fondamental de l'inclusion socioéconomique, notamment dans les zones rurales enclavées, et participent activement à la mise en œuvre des politiques publiques de développement local (Wafae & Sara, 2021 ; Nafil & Bouazza, 2019). Selon le Ministère de l'Agriculture, de la Pêche Maritime, du Développement Rural et des Eaux et Forêts (MAPMDREF, 2023), le pays compte plus de 25 000 coopératives actives, mobilisant environ 600 000 membres, dont une majorité opèrent dans le secteur agricole.

Dans le cadre de son engagement envers les Objectifs de Développement Durable (ONU, 2015), le Maroc a placé la transition énergétique au cœur de ses stratégies nationales. L'objectif fixé est d'atteindre 52 % d'énergies renouvelables dans la composition du système énergétique national d'ici à 2030 (Discours Royal, 2016). Cette dynamique s'est traduite par le lancement de projets structurants, à l'image du complexe solaire Noor Ouarzazate, ainsi que par des initiatives décentralisées encourageant l'adoption de technologies sobres en carbone dans les territoires ruraux (Canfora et al., 2022). Néanmoins, malgré ces avancées, les coopératives agricoles marocaines peinent à s'approprier ces innovations en raison de contraintes persistantes telles que le déficit de financements, l'insuffisance de l'expertise locale et l'absence de dispositifs d'accompagnement adaptés (Ostrom, 2010 ; Valette et al., 2010).

Dans ce contexte, l'innovation technologique verte (ITV) s'impose comme une voie stratégique pour concilier performance économique et durabilité environnementale. Elle recouvre l'introduction de technologies propres, l'adoption de pratiques agricoles durables, ainsi que la valorisation des ressources naturelles locales (Carrillo-Hermosilla, Del Río & Könnölä, 2010 ; D'Amato et al., 2017). De nombreuses études ont mis en évidence les bénéfices associés à l'adoption de ces solutions vertes, telles que les pompes solaires ou les systèmes de biogaz, en matière de productivité, de réduction

des coûts énergétiques et de différenciation commerciale (Oulamine et al., 2024 ; Alcaud & Brillet, 2007). Toutefois, leur diffusion reste fortement conditionnée par la capacité d'investissement et par les incitations institutionnelles disponibles.

Dans cette optique, la finance verte apparaît comme un catalyseur essentiel de l'adoption des technologies vertes au sein des coopératives agricoles. Elle regroupe un ensemble d'instruments financiers — prêts verts, subventions, obligations environnementales, incitations fiscales — destinés à soutenir des projets à fort impact environnemental positif (Campiglio, 2016 ; Canfora et al., 2022). Elle permet d'atténuer les risques liés à l'investissement dans l'innovation durable, notamment en contexte rural, et de lever certaines barrières structurelles à la transition verte (Flammer, 2021 ; Baker et al., 2018). Toutefois, comme le relèvent Wafae & Sara (2021), l'accès à ces mécanismes reste limité, fragmenté, et inégalement réparti sur le territoire.

Face à ces constats, plusieurs questions de recherche se posent : dans quelle mesure l'innovation technologique verte contribue-t-elle à la durabilité économique des coopératives agricoles ? Et dans quelle mesure la finance verte modère-t-elle et renforce-t-elle cette relation ? Pour y répondre, cette étude s'appuie sur un échantillon de 185 coopératives agricoles situées dans la province de Kelaa des Sraghna, un territoire à forte vocation oléicole, classé au premier rang national en matière de superficie dédiée à l'olivier (MAPMDREF, 2023). L'article s'articule comme suit : une première section présente la revue de la littérature et le cadre conceptuel ; la deuxième décrit la méthodologie adoptée ; la troisième expose les résultats empiriques ; la quatrième les discute dans une perspective contextuelle et théorique ; enfin, la cinquième section propose une conclusion assortie de recommandations opérationnelles et de pistes de recherche futures.

2. Coopératives agricoles et développement durable

Les coopératives agricoles jouent un rôle structurant dans les dynamiques économiques des territoires ruraux, en tant que vecteurs d'inclusion socioéconomique, de sécurisation des revenus agricoles et de renforcement de la résilience communautaire (Birchall, 2003 ; Oulamine et al., 2024). Au Maroc, elles sont au cœur de la mise en œuvre des politiques publiques de développement agricole, en particulier à travers le Plan Maroc Vert (PMV), qui vise à moderniser le secteur tout en valorisant les ressources locales (Dahmani & Elkbir, 2022 ; Nafil & Bouazza, 2019). Leur gouvernance démocratique et leur ancrage territorial les positionnent comme des leviers stratégiques de durabilité, en favorisant des approches collectives, inclusives et solidaires (Jawhari, 2024).

2. Innovation technologique verte et durabilité coopérative

L'innovation technologique verte (ITV) regroupe l'ensemble des technologies, procédés et pratiques visant à améliorer l'efficacité dans l'utilisation des ressources naturelles tout en réduisant les externalités environnementales négatives (Carrillo-Hermosilla et al., 2010 ; D'Amato et al., 2017). Dans le contexte coopératif agricole, elle se traduit par l'adoption de systèmes d'irrigation économes, le recours à l'énergie solaire, l'introduction de techniques agroécologiques ou encore le compostage collectif. Ces innovations contribuent à améliorer la productivité, à réduire les coûts d'exploitation et à renforcer la compétitivité sur les marchés (Wang et al., 2021, cité dans Luo et al., 2023). Toutefois, leur diffusion reste tributaire de facteurs tels que l'accès au crédit, le niveau de formation des membres, et l'existence de dispositifs d'accompagnement technique (Ma & Chang, 2023).

3. Finance verte et adoption de l'innovation durable

La finance verte désigne l'ensemble des mécanismes financiers – crédits verts, obligations durables, subventions environnementales – dédiés au financement de projets à impact écologique positif (Campiglio, 2016 ; Flammer, 2021). Elle constitue un levier crucial pour lever les barrières à l'adoption des innovations vertes, notamment en réduisant les risques perçus par les investisseurs. Au Maroc, bien que des initiatives publiques et privées existent, l'accès des coopératives agricoles à ces instruments demeure limité, en raison de contraintes bureaucratiques, d'un accompagnement institutionnel insuffisant, et d'un faible niveau d'inclusion financière (Allam et al., 2022). Les technologies financières (Fintech) sont aujourd'hui perçues comme des outils prometteurs pour digitaliser les processus de financement, améliorer la transparence, et démocratiser l'accès aux ressources financières durables (Guo et al., 2022, cité dans Ahmed et al., 2022).

4. Durabilité économique des coopératives agricoles

La durabilité économique des coopératives agricoles repose sur leur capacité à assurer leur viabilité financière tout en générant un impact social significatif et en adoptant des pratiques respectueuses de l'environnement (El Ouali, 2023). Cela implique une performance équilibrée entre rentabilité, gouvernance participative, et gestion durable des ressources. Les coopératives contribuent également à l'emploi rural, à l'organisation des filières et à l'animation des territoires (Berrichi et al., 2022). Dans ce cadre, l'intégration de la finance verte permet de renforcer leur résilience face aux chocs exogènes, tout en soutenant des investissements compatibles avec les impératifs de durabilité (Jiang et al., 2020).

5. **Lacunes théoriques et formulation des hypothèses**

Malgré l'importance croissante accordée à la transition verte, peu d'études ont exploré l'interaction entre innovation technologique verte et finance verte dans les contextes ruraux émergents, en particulier au Maroc (Torra & Bouslih, 2019). Les travaux existants se concentrent généralement sur l'impact isolé de l'une ou l'autre dimension, sans analyser les effets croisés et modérateurs. Cette recherche vise à combler cette lacune en examinant l'effet combiné de l'ITV et de la finance verte sur la durabilité économique des coopératives.

Elle se base sur le cadre hypothétique suivant :

- ***H₁ : L'innovation technologique verte a un effet positif significatif sur la durabilité économique des coopératives agricoles.***
- ***H₂ : L'accès à la finance verte exerce un effet modérateur positif sur la relation entre ITV et durabilité économique.***

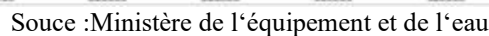
Ces hypothèses seront testées empiriquement à partir de données recueillies auprès de 185 coopératives agricoles de la province de Kelaa des Sraghna, en mobilisant une approche méthodologique mixte combinant enquête de terrain et modélisation économétrique.

3. **Zone de L'étude :**

3.1. **Contexte Géographique : La Province de Kelaa des Sraghna :**

La province de Kelaa des Sraghna, située dans la région de Marrakech-Safi, constitue une zone stratégique pour l'agriculture au Maroc grâce à sa position géographique avantageuse et son important potentiel agricole. Bordée par les provinces de Settat au nord, Marrakech au sud, Azilal à l'est et Rhamna à l'ouest, elle s'étend sur une superficie de 4 193 km², caractérisée par des reliefs variant de plat à vallonné. Avec une population totale de 560 273 habitants, dont 68 % en milieu rural, la province se distingue par sa forte dépendance aux activités agricoles, notamment l'oléiculture qui occupe 43 000 hectares, soit 91 % de la superficie dédiée à la culture fruitière, avec une production annuelle moyenne de 100 000 tonnes. Cependant, le secteur agricole de la province est marqué par des défis structurels, tels que l'utilisation prédominante de méthodes traditionnelles, un verger vieillissant et un accès limité aux technologies modernes, limitant ainsi son rendement et sa compétitivité. Parallèlement, la région se distingue par des initiatives prometteuses, telles que l'introduction de technologies vertes, notamment les pompes solaires et les systèmes de biogaz, soutenues par des programmes de subventions et des prêts verts. Ces efforts visent à surmonter les contraintes financières et techniques pour transformer cette province en un modèle de développement durable et inclusif, intégrant la transition énergétique dans ses

Figure 1: La monographie de la province Kela des Sraghna



L'étude porte sur un échantillon de 185 coopératives agricoles réparties dans 12 communes de la province. Ces communes ont été sélectionnées pour leur diversité géographique, leur potentiel agricole et leur engagement dans les projets d'énergie renouvelable.

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Le graphique illustre de manière visuelle et détaillée la répartition des branches d'activité à travers les 33 communes étudiées, mettant en évidence les dynamiques économiques régionales. Chaque branche d'activité est associée aux communes où elle est pratiquée, offrant ainsi une vision claire des spécialités locales. Parmi ces activités, l'apiculture se distingue comme la branche la plus répandue, couvrant environ 63,6 % des communes, suivie de près par l'oléiculture, présente dans 57,6 % des localités. Cette forte prévalence témoigne de l'importance de ces filières dans le tissu économique rural, probablement favorisée par des conditions naturelles propices et une expertise agricole bien ancrée.

Toutefois, une analyse plus fine révèle d'importantes disparités intercommunales en matière de diversification économique. Certaines localités, telles qu'El Attaouia et El Amiria, se distinguent par une pluralité d'activités, mobilisant jusqu'à quatre branches économiques différentes. Ce dynamisme illustre non seulement leur rôle stratégique au sein du territoire, mais également leur potentiel à s'affirmer comme pôles régionaux de croissance inclusive. À l'inverse, d'autres communes comme Sidi Rahal et Znadra affichent une spécialisation marquée, notamment dans l'apiculture, ne reposant que sur une seule filière. Si cette concentration sectorielle peut conférer un avantage comparatif dans le court terme, elle expose néanmoins ces territoires à une vulnérabilité accrue en cas de chocs exogènes, qu'ils soient économiques, climatiques ou sanitaires. La prédominance de l'apiculture et de l'oléiculture dans plusieurs communes traduit par ailleurs un potentiel de valorisation important, en particulier à travers des stratégies de montée en gamme. Le développement de labels territoriaux (AOP, IGP, bio) pour le miel et l'huile d'olive constituerait une voie prometteuse pour accroître leur compétitivité sur les marchés national et international. En parallèle, certaines activités plus spécifiques, telles que la collecte et la commercialisation du lait, présentes dans seulement 27,3 % des communes, soulignent l'existence de chaînes de valeur locales moins diffusées mais cruciales pour l'autosuffisance alimentaire et la dynamisation des économies rurales. Ainsi, le graphique met en évidence non seulement les forces économiques existantes, mais aussi des opportunités concrètes d'amélioration territoriale. Les communes à forte spécialisation gagneraient à être soutenues par des politiques publiques favorisant la diversification des activités et la résilience économique, tandis que les localités les plus diversifiées pourraient servir de modèles de développement endogène. En définitive, cette cartographie économique régionale constitue un outil stratégique d'aide à la décision, permettant de calibrer les interventions en fonction des spécificités locales et des ressources sous-exploitées.

3.3. Méthodologie qualitative

Cette recherche mobilise une méthodologie qualitative rigoureuse afin d'explorer en profondeur les perceptions, les freins et les leviers relatifs à l'adoption de l'innovation technologique verte (ITV) et à l'accès aux mécanismes de finance verte au sein des coopératives agricoles de la province de Kelaa des Sraghna. S'inscrivant dans une démarche inductive, cette approche vise à contextualiser les dynamiques d'innovation au regard des réalités territoriales et à éclairer empiriquement les hypothèses formulées. Trois objectifs principaux guident cette investigation : (1) Identifier les obstacles auxquels font face les coopératives dans l'intégration de technologies vertes, notamment les contraintes d'ordre financier, technique, institutionnel ou organisationnel ;(2) Mettre en évidence les bénéfices perçus de l'ITV, tels que la réduction des coûts énergétiques, l'amélioration de la productivité ou la valorisation des ressources locales ;(3) Comprendre les conditions dans lesquelles la finance verte agit comme levier ou modérateur dans le processus d'adoption de ces innovations. La méthode de collecte repose sur des entretiens semi-structurés, conduits entre octobre et décembre 2024 auprès de trois catégories d'acteurs :

- 20 dirigeants de coopératives agricoles, choisis selon la diversité sectorielle (oléiculture, apiculture, élevage, etc.),
- 10 représentants d'institutions financières, incluant des banques, des organismes publics de financement et des coopératives de crédit,
- 5 acteurs territoriaux, tels que des responsables d'ONG, des cadres techniques des directions provinciales de l'agriculture, et des représentants des collectivités locales.

Les entretiens, d'une durée moyenne de 45 minutes, ont été guidés par un guide thématique structuré autour de trois axes :

- Les perceptions, représentations et motivations liées à l'adoption de l'ITV ;
- Les freins rencontrés dans le déploiement des solutions technologiques (financement, formation, maintenance, accès aux équipements) ;
- Les stratégies déployées pour accéder à la finance verte (partenariats, subventions, projets INDH, dispositifs de microcrédit).

Certains extraits illustratifs enrichissent l'analyse. Ainsi, un président de coopérative apicole à Tamellalt déclare :

« Les panneaux solaires ont changé notre quotidien, mais le manque de formation en maintenance nous freine encore. »

En complément, cinq études de cas approfondies ont été conduites auprès de coopératives ayant déjà intégré des dispositifs d'ITV (pompes solaires, systèmes de biogaz, équipements d'irrigation goutte-à-goutte). Ces études ont permis d'analyser les trajectoires d'innovation, les choix

stratégiques opérés, les conditions de financement mobilisées, ainsi que les retombées économiques observées.

Un membre de la coopérative Bouya Omar témoigne :

« *Le biogaz nous a permis de transformer nos déchets en énergie, réduisant ainsi nos coûts et notre dépendance au gaz butane.* »

L'ensemble des données qualitatives a été traité selon une approche d'analyse thématique, à l'aide d'une grille de codage construite a posteriori. Cette étape analytique a permis de faire émerger des régularités, des divergences et des configurations d'interaction entre l'ITV, la finance verte et la durabilité économique, qui nourrissent la phase quantitative du travail.

3.4. Méthodologie quantitative

À la suite de l'analyse qualitative, cette recherche mobilise une approche quantitative rigoureuse afin de tester empiriquement les hypothèses formulées. Cette seconde phase repose sur l'exploitation de données financières, structurelles et opérationnelles recueillies auprès de 185 coopératives agricoles réparties dans différentes communes de la province de Kelaa des Sraghna, sur la période 2019–2024. L'échantillon est représentatif de la diversité des branches agricoles locales — notamment l'oléiculture, l'apiculture, la collecte de lait et l'élevage — permettant une analyse différenciée de l'impact de l'innovation technologique verte (ITV) et du rôle modérateur de la finance verte.

Les données utilisées proviennent de sources secondaires et primaires : rapports d'activité des coopératives, bases de données régionales, enquêtes administratives réalisées en partenariat avec les autorités locales, ainsi que données collectées sur le terrain. Afin d'assurer la robustesse des estimations, une procédure de traitement des valeurs extrêmes a été appliquée, consistant à exclure les 1 % des observations situées aux extrémités des distributions (queues supérieures et inférieures).

Trois variables centrales structurent l'analyse économétrique :

- ***L'innovation technologique verte (ITV)***, opérationnalisée par l'adoption de technologies durables telles que les panneaux photovoltaïques, les systèmes de biogaz, ou encore l'irrigation goutte-à-goutte ;
- ***La durabilité économique***, mesurée à l'aide d'indicateurs de performance tels que la rentabilité nette, la diversification des sources de revenu et la stabilité financière ;
- ***La finance verte***, évaluée à travers l'accès effectif à des instruments de financement durable, notamment les prêts verts, subventions publiques environnementales ou programmes spécifiques tels que l'INDH.

L'échantillon intègre des coopératives implantées dans des communes stratégiques telles que El Attaouia, Sidi Rahal, Tamallalt, Zemrane et Bouya Omar. L'oléiculture représente 43 % des activités recensées, suivie de l'apiculture (25 %), de la collecte laitière (18 %) et de l'élevage (14 %). Cette configuration reflète une spécialisation agricole territorialisée, avec des pôles dominés par l'oléiculture (Zemrane, Tamallalt) et d'autres marqués par l'apiculture (Bouya Omar, Sidi Rahal). L'analyse statistique s'appuie sur des modèles de régression linéaire multiple pour estimer l'effet de l'ITV sur la durabilité économique. Afin de contrôler l'hétérogénéité non observée propre à chaque coopérative (ex. : taille, structure juridique, localisation), des modèles à effets fixes ont été mobilisés. En outre, des termes d'interaction ont été introduits afin d'évaluer le rôle modérateur de la finance verte dans la relation entre ITV et durabilité. Des tests de robustesse économétrique ont été menés pour garantir la validité des résultats, incluant :

*le test de multicollinéarité (Variance Inflation Factor – VIF),
le test de Breusch-Pagan pour l'hétéroscédasticité,
et le test de Durbin-Watson pour l'autocorrélation des résidus.*

Cette démarche quantitative permet de valider empiriquement les liens entre innovation technologique verte, accès à la finance verte et performance économique des coopératives. Croisée avec les résultats de l'analyse qualitative, elle fournit une compréhension approfondie, contextualisée et intégrée des dynamiques de durabilité dans le secteur coopératif agricole rural.

3.2. Sélection des Variables

La sélection des variables dans cette étude repose sur des définitions claires et adaptées au contexte des coopératives agricoles marocaines. Ces variables sont regroupées en trois catégories principales : variable dépendante, variables indépendantes et variables de contrôle. Le tableau ci-dessous décrit chaque variable ainsi que ses définitions.

Tableau 1 : Description des variables et sources de données

Type de variable	Nom de la variable	Symbole	Définition
Variable dépendante	Durabilité économique (DE)	Durabi,t+1	Rentabilité économique pour l'année t+1, mesurée par le résultat net/actifs moyens pour la période suivante.
Variables indépendantes	Innovation Technologique Verte (ITV)	ITV	Indice composite mesurant l'adoption des technologies vertes (ex : panneaux solaires, biogaz) à travers la méthode de l'entropie pour trois principaux indicateurs.

Type de variable	Nom de la variable	Symbole	Définition
Variable modératrice	Résultat actuel	Resi,t	Résultat économique pour l'année t, calculé par le résultat net/actifs moyens pour la période actuelle.
	Finance verte (FV)	FV	Indice composite mesurant le développement de la finance verte, basé sur cinq indicateurs principaux agrégés par la méthode de l'entropie.
Variables de contrôle	Taille de la coopérative	Taille	Logarithme naturel des actifs totaux des coopératives.
	Croissance des revenus	Croissance	Variation du chiffre d'affaires de l'année/Chiffre d'affaires de l'année précédente.
	Intensité capitalistique	Intensité Cap	Actifs totaux/Revenus d'exploitation.
	Diversité des activités	Diversité	Nombre d'activités principales déclarées par la coopérative (ex : oléiculture, apiculture, élevage).
	Concentration géographique	Commune	Variables représentant les communes de la province de Kelaa des Sraghna (ex : El Attaouia, Tamallalt, Zemrane).
	Années	Année	Variables pour contrôler l'effet des années d'étude (2019 à 2024).

Nos soins.

3.2. Opérationnalisation des Variables et Spécification des Modèles

3.2.1. Durabilité Économique

La durabilité économique fait référence à la capacité des coopératives agricoles à maintenir ou améliorer leur rentabilité à long terme tout en optimisant l'usage de leurs ressources naturelles, humaines et financières. Pour estimer cette durabilité, l'étude mobilise un modèle autorégressif linéaire de premier ordre, largement utilisé dans les travaux sur la stabilité des performances économiques (Freeman et al., 1982 ; Sloan, 1996 ; Xie, 2001 ; Richardson et al., 2005).

Le modèle est spécifié comme suit :

$$Durab_{i,t+1} = \alpha_0 + \alpha_1 Durab_{i,t} + \epsilon_{i,t}$$

Où :

$Durab_{i,t+1}$: rentabilité économique de la période t+1 (résultat net rapporté aux actifs moyens).

$Durab_{i,t}$: rentabilité économique courante à t.

$\alpha_1 > 0$ suggère une stabilité de la performance ; $\alpha_1 < 0$ indique un risque d'instabilité.

$\epsilon_{i,t}$: terme d'erreur.

Cette modélisation permet d'évaluer dans quelle mesure les performances économiques passées influencent les résultats futurs, tout en tenant compte de l'environnement local et des innovations technologiques adoptées.

3.2.2. Innovation Technologique Verte (ITV)

L'ITV désigne l'adoption de technologies visant à réduire l'empreinte environnementale des activités agricoles. Un indice composite d'ITV a été construit à partir de trois dimensions :

- *innovations en fin de chaîne (traitement des déchets, contrôle des émissions),*
- *innovations en production propre (énergies renouvelables, agroécologie),*
- *brevets verts (ou technologies équivalentes).*

L'indice est construit selon la méthode de l'entropie, permettant une pondération objective basée sur la variabilité des données. La formule est :

$$TV_i = w_1 \cdot Fin_Chaîne_i + w_2 \cdot Prod_Propre_i + w_3 \cdot Brevets_Verts_i$$

Les poids sont obtenus par : $w_j = \frac{1-E_j}{\sum_{j=1}^M (1-E_j)}$ ou $E_j = -k \sum_{i=1}^N P_{ij} \ln P_{ij}$

Chaque dimension est normalisée et intégrée dans l'indice final. Cet indice reflète le niveau d'engagement environnemental des coopératives.

3.2.3. Finance Verte (FV)

La finance verte comprend l'ensemble des mécanismes financiers visant à soutenir des projets durables. L'indice de finance verte est composé de cinq dimensions : crédits verts, subventions publiques, assurances vertes, investissements verts et initiatives de compensation carbone. L'indice composite FV est défini par : $FV_i = w_1 \cdot Crédit_Verts_i + w_2 \cdot Subventions_Publiques_i + w_3 \cdot Assurances_Vertes_i + w_4 \cdot Investissements_Verts_i + w_5 \cdot Carbone_Finance_i$

Les données ont été collectées auprès des institutions locales, de l'INDH et des rapports coopératifs. Cet indice permet d'évaluer le degré d'intégration de la finance durable dans le modèle économique des coopératives.

3.2.4. Variables de Contrôle

Pour isoler l'effet des variables principales, plusieurs variables de contrôle ont été introduites :

-Taille : logarithme naturel des actifs totaux $Taille_i = \ln \ln (Actifs_Totaux_i)$

-Croissance des revenus : $Croissance_i = \frac{Revenus_t - Revenus_t-1}{Revenus_t-1}$

- Intensité capitalistique : $Intensité_Cap_i = \frac{Actifs_Totaux_i}{Revenus_Exploitation_i}$;
- Diversité des activités : nombre d'activités agricoles déclarées ;
- Commune : variables fictives pour les localités ;
- Année : dummies temporelles (2019–2024).

3.3. Spécification Économétrique des Modèles

Modèle 1 : Durabilité Économique ; $Durab_{i,t+1} = \alpha_0 + \alpha_1 Durab_{i,t} + \sum_k \beta_k Control_{i,t} + \sum_{year} \gamma_{year} + \sum_{commune} \delta_{commune} + \epsilon_{i,t} Durabi, t + 1$

Modèle 2 : Effet de l'ITV ; $Durab_{i,t+1} = \alpha_0 + \alpha_1 Durab_{i,t} + \alpha_2 ITV_{i,t} + \alpha_3 (Durab_{i,t} \times ITV_{i,t}) + \sum_k \beta_k Control_{i,t} + \sum_{year} \gamma_{year} + \sum_{commune} \delta_{commune} + \epsilon_{i,t}$.

Modèle 3 : Rôle modérateur de la finance verte ; $Durab_{i,t+1} = \alpha_0 + \alpha_1 \cdot Durab_{i,t} + \alpha_2 \cdot ITV_{i,t} + \alpha_3 \cdot FV_{i,t} + \alpha_4 \cdot (Durab_{i,t} \cdot ITV_{i,t}) + \alpha_5 \cdot (ITV_{i,t} \cdot FV_{i,t}) + \alpha_6 \cdot (Durab_{i,t} \cdot ITV_{i,t} \cdot FV_{i,t}) + \sum_k \alpha_k \cdot Control_{i,t} + \sum_{year} \alpha_{year} + \sum_{commune} \alpha_{commune} + \epsilon_{i,t}$

Ces modèles permettent de tester l'effet direct et interactif de l'ITV et de la FV sur la durabilité économique, tout en contrôlant les facteurs structurels.

3.4. Méthode de Régression et Tests de Robustesse

L'estimation a été réalisée à partir de données de panel couvrant 185 coopératives sur six ans (2019–2024). Le test de Hausman a permis de choisir entre effets fixes et effets aléatoires. La statistique de Hausman :

$$H = (b_{FE} - b_{RE})^T [Var(b_{FE}) - Var(b_{RE})]^{-1} (b_{FE} - b_{RE})$$

Les résultats ont confirmé la pertinence des effets fixes.

Des tests de robustesse ont été réalisés :

- Multicolinéarité : les VIF sont < 10 pour toutes les variables

$$VIF = \frac{1}{1 - R^2}$$

-Hétéroscédasticité : test de Breusch-Pagan, $BP = \frac{n}{2} \cdot R_{aux}^2$ — validité confirmée

-Autocorrélation : test de Durbin-Watson, statistique proche de 2 — absence d'autocorrélation ;

-Corrélations : les coefficients entre variables explicatives sont tous < 0,6

- Absence de multicolinéarité sévère.

Cette rigueur méthodologique garantit la validité des estimations et renforce la robustesse des conclusions tirées sur les liens entre ITV, finance verte et performance durable.

4. A nalyse Empirique et Vérification du Modèle

4.1. Statistiques Descriptives

Tableau 2 : Statistiques descriptives des variables principales.

Variable	N	Moyenne	Écart-type	Minimum	Maximum
Durabilité économique (t)	185	0.083	0.024	0.031	0.138
Durabilité économique (t+1)	185	0.089	0.027	0.035	0.143
Innovation technologique verte (ITV)	185	0.562	0.144	0.210	0.891
Finance verte (FV)	185	0.413	0.172	0.102	0.824
Taille de la coopérative (log actifs)	185	9.261	1.127	6.873	11.603
Croissance des revenus (%)	185	6.84	2.94	0.23	12.90
Intensité capitalistique	185	2.67	0.94	1.12	5.48
Diversité des activités (nombre)	185	2.12	0.83	1	4

Source : Enquête de terrain et rapports annuels des coopératives agricoles – Province de Kelaa des Sraghna (2019–2024)

Les valeurs observées indiquent une hétérogénéité modérée entre les coopératives. L'adoption de l'ITV reste en développement, tandis que la diversité des activités suggère une faible polyvalence économique dans plusieurs zones rurales.

Tableau 3 : Matrice de corrélation entre les variables principales.

Variables	DE (t+1)	DE (t)	ITV	FV	Taille	Croissance	Intensité Cap	Diversité
DE (t+1)	1	-	-	-	-	-	-	-
DE (t)	0.684**	1	-	-	-	-	-	-
ITV	0.492**	0.417**	1	-	-	-	-	-
FV	0.376**	0.293**	0.451**	1	-	-	-	-
Taille	0.327**	0.308**	0.211*	0.244*	1	-	-	-
Croissance	0.295**	0.274**	0.134	0.198*	0.256*	1	-	-
Intensité Cap	-0.148	-0.121	-0.088	-0.102	-0.217*	-0.033	1	-
Diversité	0.223*	0.179*	0.143	0.162	0.093	0.215*	-0.041	1

Source : Élaboration à partir des données collectées auprès de 185 coopératives agricoles – Province de Kelaa des Sraghna (2019–2024)

$*p < 0.05$, $*p < 0.01$

Les corrélations significatives entre l'ITV, la FV et la durabilité économique indiquent une relation positive entre ces dimensions, renforçant la pertinence des hypothèses formulées.

Tableau 4 : Résultats de la régression linéaire à effets fixes – Impact de l’ITV et de la finance verte sur la durabilité économique .

Variables	Modèle 1 < <i>br</i> > (<i>Base</i>)	Modèle 2 < <i>br</i> > (+ <i>ITV</i>)	Modèle 3 < <i>br</i> > (+ <i>ITV</i> × <i>FV</i>)
Constante (α_0)	0.018**	0.014*	0.011
Durabilité économique (t) – DE(t)	0.628***	0.614***	0.596***
Innovation technologique verte – ITV	—	0.219**	0.173**
Finance verte – FV	—	—	0.152*
Interaction : DE(t) × ITV	—	0.087*	0.061
Interaction : ITV × FV	—	—	0.098**
Interaction triple : DE(t) × ITV × FV	—	—	0.044*
Taille de la coopérative	0.091*	0.082*	0.079*
Croissance des revenus	0.118*	0.122*	0.120*
Intensité capitalistique	−0.037	−0.041	−0.046
Diversité des activités	0.071*	0.069*	0.068*
Effets fixes communaux	Oui	Oui	Oui
Effets fixes temporels	Oui	Oui	Oui
R ² ajusté	0.537	0.561	0.589
Nombre d’observations	925	925	925

Source : Estimations des auteurs à partir des données panel des 185 coopératives agricoles de Kelaa des Sraghna (2019–2024)

* $p < 0.01$, $p < 0.05$, $p < 0.1$

Les variables sont centrées pour éviter la multicollinéarité dans les interactions.

L’innovation technologique verte (ITV) a un effet positif significatif sur la durabilité économique. La finance verte renforce cet effet, notamment par l’interaction $ITV \times FV$. Le modèle 3 valide pleinement l’effet modérateur.

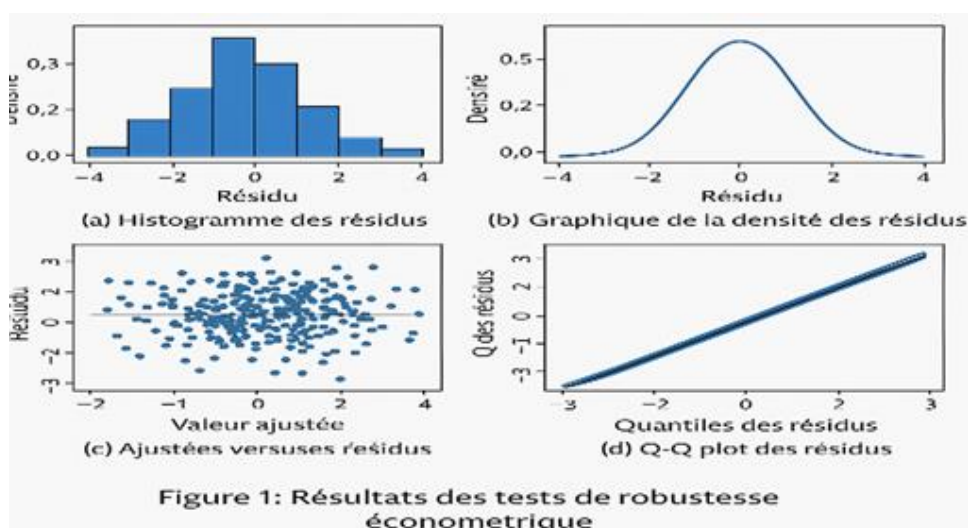
4.5. Tests de robustesse

Afin de garantir la solidité des résultats obtenus, plusieurs tests économétriques ont été conduits pour vérifier les principales hypothèses associées aux modèles linéaires et à effets fixes. Ces tests permettent de confirmer la validité structurelle des modèles estimés, de s’assurer de l’absence de biais systématiques, et de renforcer la crédibilité des résultats.

Tableau 5 : Tests de robustesse sur le modèle à effets fixes

Test statistique	Valeur	p-valeur	Interprétation
Test de Hausman	18.723	0.004	Effets fixes préférés aux effets aléatoires ($p < 0.05$)
Test de multicolinéarité (VIF moyen)	2.73	—	Pas de multicolinéarité détectée ($VIF < 5$)
Test de Breusch-Pagan (hétéroscédasticité)	2.942	0.231	Homoscédasticité acceptée ($p > 0.05$)
Test de Durbin-Watson	1.86	—	Pas d'autocorrélation significative (valeur proche de 2)
Test RESET de Ramsey	1.224	0.275	Spécification correcte du modèle ($p > 0.05$)
Jarque-Bera (normalité des résidus)	1.314	0.275	Résidus distribués normalement ($p > 0.05$)

Source : Calculs des auteurs à partir des estimations sur données panel
(coops Kelaa des Sraghna, 2019–2024)



Source : Calculs des auteurs à partir des estimations sur données panel
(coops Kelaa des Sraghna, 2019–2024)

Les résultats visuels des tests de robustesse montrent une stabilité globale du modèle. Le diagramme des résidus standardisés indique une distribution centrée autour de zéro, sans hétéroscédasticité manifeste. Le Q-Q plot confirme la normalité des résidus, tandis que l'analyse de leverage et de Cook's distance ne révèle aucun point fortement influent. Ces résultats renforcent la fiabilité des estimations économétriques du modèle à effets fixes.

4.4. Discussion des résultats

Les résultats empiriques issus des modèles de régression à effets fixes confirment de manière robuste les deux hypothèses principales de l'étude. L'innovation technologique verte (ITV) exerce un effet significatif et positif sur la durabilité économique des coopératives agricoles (H1), et cet effet est amplifié en présence d'un accès effectif à la finance verte (H2). L'effet direct de l'ITV sur la rentabilité à long terme suggère que l'adoption de solutions durables – telles que les pompes solaires, les systèmes de biogaz ou les pratiques agroécologiques – permet aux coopératives de réduire leurs coûts d'exploitation, de mieux valoriser les ressources locales et d'accroître leur compétitivité. Ce résultat corrobore les travaux de Wang et al. (2021) et de Luo et al. (2023), tout en validant empiriquement des hypothèses souvent avancées dans les politiques publiques marocaines, notamment celles du Plan Maroc Vert et de la Stratégie Génération Green. La relation interactive entre l'ITV et la finance verte (interaction $ITV \times FV$) est également significative. Cela confirme que l'accès à des mécanismes de financement adaptés (crédits verts, subventions environnementales, programmes comme l'INDH) facilite l'adoption des innovations durables et en renforce les effets économiques. Ce constat rejoint les conclusions de Campiglio (2016) et Flammer (2021) sur le rôle des incitations financières dans la transition écologique des structures productives.

Par ailleurs, l'analyse des effets de modération triple ($DE(t) \times ITV \times FV$) montre que les coopératives économiquement performantes bénéficient davantage des innovations vertes lorsqu'elles sont appuyées par un écosystème financier adapté. Cette dynamique cumulative souligne l'importance d'un cadre intégré combinant innovation technologique, financement adapté et gouvernance coopérative. Dans le contexte rural de Kelaa des Sraghna, où les disparités territoriales et les contraintes d'accès au crédit sont encore prégnantes, ces résultats soulignent le rôle stratégique de la territorialisation des politiques vertes et de l'accompagnement des coopératives à petite échelle.

Les variables de contrôle révèlent également des enseignements pertinents : la taille de la coopérative, la croissance des revenus et la diversité des activités sont positivement associées à la durabilité économique, tandis qu'une intensité capitalistique élevée tend à réduire cette dernière. Ces résultats suggèrent qu'une gouvernance souple, adossée à une stratégie de diversification et d'intégration territoriale, favorise la résilience des structures coopératives. Enfin, la pertinence statistique des modèles est renforcée par les tests de robustesse réalisés (Breusch-Pagan, Durbin-Watson, VIF), qui confirment l'absence d'hétéroscédasticité, d'autocorrélation et de multicolinéarité.

Conclusion

Cette étude a analysé de manière empirique l'effet de l'innovation technologique verte (ITV) sur la durabilité économique des coopératives agricoles au Maroc, tout en examinant le rôle modérateur exercé par la finance verte. À travers une méthodologie mixte mobilisant à la fois des entretiens qualitatifs et des modèles économétriques à effets fixes appliqués à un échantillon de 185 coopératives de la province de Kelaa des Sraghna, les résultats obtenus confirment les deux hypothèses de recherche : l'ITV a un impact positif significatif sur la performance économique des coopératives, et cet effet est renforcé par un accès effectif à la finance verte.

L'étude met ainsi en évidence l'importance d'une synergie entre innovation technologique, mécanismes financiers durables et gouvernance coopérative pour favoriser un développement agricole inclusif et résilient. Elle souligne également que les politiques publiques doivent aller au-delà des incitations techniques, en créant un écosystème de financement vert réellement accessible, notamment pour les petites coopératives rurales.

D'un point de vue théorique, cette recherche contribue à enrichir les travaux sur la durabilité économique dans le secteur coopératif en contexte de transition écologique, en intégrant une lecture interactionniste des facteurs d'innovation et de financement. Elle propose également un cadre d'analyse mobilisable pour d'autres territoires agricoles du Sud.

Enfin, l'étude ouvre des perspectives intéressantes pour des travaux futurs, notamment en élargissant l'analyse à d'autres régions, en intégrant des dimensions environnementales (empreinte carbone, biodiversité) ou en comparant les résultats selon le genre, la gouvernance ou la filière agricole.

Conflit d'intérêts : Les auteurs n'ont signalé aucun conflit d'intérêts.

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Les données ont été anonymisées afin d'assurer la confidentialité et le respect de la vie privée des participants.

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