

Territorial Resilience and Innovation Capabilities: The Souss-Massa Region Confronting Economic and Climate Shocks (Morocco)

Abstract

The Souss Massa region, a major economic hub in Morocco, stands at the crossroads of multiple shocks: chronic water stress, climate disruptions, exogenous economic crises and volatile export markets. This double exposure constitutes an existential threat to a territory whose development model has historically rested on intensive agriculture, tourism and agro-industry. Yet, despite these structural vulnerabilities, the region demonstrates a remarkable capacity for transformation, built on territorial innovation and entrepreneurship. Drawing on a conceptual framework integrating territorial resilience, innovation capabilities and territorial economics, this article examines the mechanisms through which a territory exposed to multiple shocks develops its innovation capacities to sustain and transform its development trajectory. A qualitative approach combining in-depth semi-structured interviews, and documentary analysis was deployed with a diversity of territorial actors. Preliminary results identify six dimensions of territorial innovation as resilience vectors: technological innovations in water management, diversification of economic models, organizational and cooperative innovations, energy transition, social and solidarity innovations, and renewal of territorial governance. These findings contribute to the development of an innovation-based resilience model applicable to other African territories facing similar challenges.

Keywords: Territorial resilience, Territorial innovation, Economic shocks, Climate change, Adaptation, Innovation capabilities, Sustainable development, Souss Massa, Morocco.

1.1. Introduction

Contemporary territories operate in an environment characterised by growing instability and multiple, simultaneous, and at times synergistic shocks. The confluence of climate disruptions and global economic turbulence represents one of the most complex challenges that territorial systems have ever had to confront (Folke et al., 2010; Martin & Sunley, 2015). Against this backdrop, the question of territorial resilience, understood as the capacity of territories to absorb shocks, adapt, and transform, has become a central concern in regional science and territorial economics (Boschma, 2015; Pike et al., 2010).

The African continent, and in particular developing regions with agro-export economies, find themselves on the front line of this dual vulnerability. Among them, the Souss-Massa region in southern Morocco offers a particularly revealing field of observation. As the country's leading agricultural export region, it generates a significant share of national horticultural and fruit exports, primarily to European markets. Its economic fabric rests on three historically intertwined pillars: intensive greenhouse and open-field agriculture, agro-industrial processing and packaging, and coastal and Saharan tourism (Haut-Commissariat au Plan, 2022).

These three pillars are, precisely, the sectors most exposed to climate and economic disruptions. The region has experienced a marked deterioration of water stress over several decades: average annual

rainfall has declined significantly, droughts have become more frequent and intense, and groundwater tables are being depleted at an alarming rate (Direction de la Météorologie Nationale, 2020; World Bank, 2022). Simultaneously, exogenous economic shocks have multiplied and accelerated: The Covid-19 pandemic triggered the abrupt collapse of tourism in 2020–2021; geopolitical tensions stemming from the Russo-Ukrainian conflict drove up agricultural input and energy costs from 2022 onwards; and export market volatility has subjected local producers to mounting competitive pressure.

Despite this dual exposure, the territory demonstrates a remarkable vitality. Technological, organisational, social, and institutional innovations are emerging on the ground, driven by local entrepreneurs, cooperatives, public institutions, and civil society organisations. These innovative dynamics appear to constitute the substrate of a territorial resilience in the making, one that transcends mere shock resistance to aim for a transformation towards more sustainable and robust development models.

It is precisely this articulation between innovation and territorial resilience that this article seeks to interrogate. The central research question may be formulated as follows: *through what mechanisms does a territory exposed to multiple climatic and economic shocks develop innovation capacities that enable it not only to maintain its development trajectory, but to transform it towards more resilient configurations?*

This question carries a threefold relevance. Theoretically, it contributes to enriching the debate on the foundations of territorial resilience by integrating the dimension of territorial innovation capabilities, which remains insufficiently addressed in the literature (Bristow & Healy, 2014; Hassink, 2010). Empirically, it sheds light on a developing African territory rarely studied through the lens of resilience, thereby filling a gap in the economic geography literature on the Maghreb. Operationally, the findings may inform regional public policies and stakeholder strategies in support of sustainable territorial development.

The remainder of the article is structured as follows. Section 2 proposes a conceptual framework and literature review articulating the three theoretical fields mobilised: territorial resilience, territorial innovation capabilities, and territorial economics. Section 3 presents the research methodology. The results, discussion, and conclusions follow in subsequent sections.

1.2. Literature Review and Conceptual Framework

This research mobilises three complementary theoretical fields whose articulation enables the construction of an analytical framework suited to the complexity of the phenomenon under study. These three fields (territorial resilience, territorial innovation capabilities, and territorial economics) have each undergone significant developments over the past two decades, yet remain insufficiently connected. The originality of our approach lies precisely in their systematic dialogue.

1.2.1. Territorial Resilience: Beyond Bouncing Back, Towards Transformation

The notion of resilience, initially borrowed from materials physics and subsequently from ecology (Holling, 1973), has been progressively integrated into regional science and economic geography since the mid-2000s. Its incorporation into the territorial field has unfolded in successive waves, marked by fertile conceptual debates (Pendall et al., 2010; Pike et al., 2010; Christopherson et al., 2010).

The first conception, known as engineering resilience, defines resilience as the capacity of a system to return to its initial equilibrium state following a disturbance (Pimm, 1984). Applied to territories, this view leads to evaluating resilience by the speed and completeness of the return to pre-crisis employment, output, or income levels. While this approach offers the advantage of measurability, it suffers from the

major drawback of presupposing the existence of a desirable equilibrium to return to, a premise that becomes problematic when the initial state was itself unsustainable (Pendall et al., 2010; Davoudi, 2012).

The second conception, ecological resilience, emphasises the capacity of a system to absorb disturbances while maintaining essentially the same structure and functions (Holling, 1973). This approach acknowledges the existence of multiple possible equilibria and the possibility of tipping towards new operational regimes. It proves richer for territorial analysis as it incorporates uncertainty and the possibility of qualitative systemic evolution.

The third conception, evolutionary resilience, constitutes the dominant frame of reference in regional science today (Boschma, 2015; Martin & Sunley, 2015; Hassink, 2010). It conceives of resilience not as a state to be preserved or recovered, but as a dynamic capacity for transformation. As Martin and Sunley (2015) express it, evolutionary resilience denotes the capacity of a regional economy to reconfigure its structures and trajectories in response to perturbations and challenges. This perspective breaks radically with the static vision: a resilient territory is not one that remains immobile and resists change, but one capable of reinventing itself by leveraging disruptions to innovate and transform.

In this vein, Folke et al. (2010) propose distinguishing four dimensions of resilience:

- Absorptive capacity, referring to the ability to cope with disturbances without fundamental structural modification;
- Adaptive capacity, which implies adjustments to practices and structures to address new conditions;
- Transformative capacity, designating the possibility of shifting to a new operational regime when environmental or social changes make this necessary or desirable;
- Anticipatory capacity, which enables the reduction of vulnerability to future shocks.

Applied to the African and Moroccan territorial context, this evolutionary conceptualisation of resilience holds particular interest. It enables analysis of how territories marked by inherited structural vulnerabilities (dependence on agricultural exports, water fragility, weak social protection systems) can nevertheless develop transformation capacities from their endogenous resources (Maillat, 1995; Pecqueur, 2006). It also invites a move beyond developmental lag analyses towards a focus on ongoing dynamics of innovation and adaptation (Rodríguez-Pose & Fitjar, 2013).

It is worth noting, however, the limits of directly transposing concepts drawn from the economic geography of Northern countries to contexts such as Souss-Massa. Bristow and Healy (2014) have demonstrated that resilience capacities are profoundly conditioned by the institutional legacies, economic structures, and power relations specific to each territory. In developing economies, these capacities are often constrained by restricted access to financing, infrastructure deficits, and dynamics of dependence on external markets that have no equivalent in the contexts analysed by the mainstream literature.

1.2.2. Territorial Innovation Capabilities: Embedded Innovation Systems

The notion of territorial innovation capabilities refers to the collective aptitude of a territory to generate, diffuse, and exploit innovations of diverse natures. It is rooted in systemic approaches to innovation, which have progressively shifted the unit of analysis from the individual firm to innovation ecosystems (Freeman, 1987; Lundvall, 1992; Nelson, 1993).

The concept of Regional Innovation Systems (RIS), developed notably by Cooke (1992), constitutes a foundational frame of reference. It highlights the role of regional institutions, firm-research organisation

interactions, and territorial public policies in building innovation capabilities (Cooke et al., 1997). Research on innovation clusters (Porter, 1998) and innovative milieus (Aydalot, 1986; Crevoisier, 2004) has enriched this perspective by emphasising the importance of proximity relationships, trust, and collective learning in territorial innovation dynamics.

A significant conceptual contribution lies in the distinction between different types of innovation at the territorial level. Beyond classic technological innovations, territories develop organisational innovations (new forms of coordination and cooperation), social innovations (new responses to social needs), institutional innovations (new governance rules and mechanisms), and business model innovations (new ways of creating and distributing value) (Moulaert & Sekia, 2003; Howaldt & Schwarz, 2010). This diversity of innovation types is particularly relevant for the analysis of rural and agricultural territories in development, where radical high-technology innovations are often less decisive than incremental organisational and institutional ones.

Recent scholarship on innovation in peripheral territories and developing countries brings important nuances to the dominant RIS vision, built essentially on Western European and North American cases. Rodríguez-Pose and Fitjar (2013) demonstrate that less formalised forms of innovation, more deeply embedded in local practices and proximity interactions, play a crucial role in low-technology-intensity territories. Similarly, work on frugal innovation (Radjou et al., 2012) and inclusive innovation (George et al., 2012) underscores the importance of innovations developed under resource constraints, often by ground-level actors invisible in conventional innovation statistics (patents, R&D expenditure).

In the Maghrebi and African context, the work of Touzani et al. (2015) and Adel et al. (2016) has highlighted the importance of informal networks, family entrepreneurial dynamics, and learning-by-doing in territorial innovation processes. These studies suggest that innovation capabilities in such contexts rest less on formalised R&D institutions than on the density of social interactions, intergenerational transmission of technical knowledge, and pragmatic adaptive capacity under local constraints.

The articulation between innovation and territorial resilience has attracted growing attention in recent literature. Bristow and Healy (2014) propose the concept of innovation for resilience, designating the capacity of territories to mobilise innovation as a response mechanism to shocks and as a vector of structural transformation. This articulation nonetheless remains theoretically underdeveloped, particularly in its institutional and organisational dimensions. The present article aims to contribute to filling this gap by exploring the links between forms of innovation and resilience in the Souss-Massa context.

1.2.3. Territorial Economics: Territory as Social Construct and Resource

The third theoretical field mobilised is that of territorial economics, which conceives of territory not as a mere geographical container of economic activity, but as a social, institutional, and economic construct endowed with specific resources (Pecqueur, 2006; Maillat, 1995; Torre & Wallet, 2014).

This perspective, strongly influenced by the tradition of geographical and organisational proximity (Bouba-Olga & Grossetti, 2008; Torre & Rallet, 2005), highlights the collective dimension of territorial resource construction. The resources of a territory are not simply available in nature or inherited from history: they are constructed and activated by actors through processes of interaction, cooperation, and collective learning (Colletis & Pecqueur, 1993; Zimmermann, 1998).

The notion of territorial specific assets (Colletis & Pecqueur, 1993) is particularly illuminating for our analysis. It designates resources whose value is intimately linked to their territorial anchorage and which cannot be reproduced identically outside the territory that generated them. In the case of Souss-Massa,

these specific assets include age-old agricultural know-how, plant varieties adapted to semi-arid conditions, marketing networks built over decades of relationships with European markets, and forms of collective organisation such as irrigators' associations.

The resource-based territorial approach is also connected to scholarship on social and territorial capital (Putnam, 1993; Bourdieu, 1986), which emphasises the role of trust, reciprocity norms, and civic engagement networks in the collective action capacity of territories. In contexts of crisis and shocks, the density and quality of social capital strongly conditions the capacity of territories to mobilise adapted collective responses (Adger, 2000; Cutter et al., 2008).

On the governance dimension, Ostrom's (1990) work on the collective management of common-pool resources provides valuable analytical frameworks for understanding how rural communities manage shared resources (water in particular) in the face of growing pressures. Her research demonstrates that hybrid governance forms, combining community regulation, market mechanisms, and public intervention, can be more effective and resilient than the extreme solutions of privatisation or nationalisation.

Finally, recent work on sociotechnical transitions (Geels, 2004; Markard et al., 2012) brings a dynamic perspective to the transformation of territorial productive systems. The multi-level perspective (MLP) framework distinguishes three levels of analysis: the sociotechnical landscape (background trends such as climate change); the dominant regime (stabilised rules, institutions, and practices); and innovation niches (experimental spaces where new practices emerge). This framework enables understanding of how innovations emerging at the margins (in cooperatives, experimental farms, agri-tech start-ups) can progressively reshape territorial development trajectories.

1.2.4. Towards an Integrative Innovation–Territorial Resilience Framework

The articulation of the three theoretical fields presented above enables the construction of an integrated analytical framework that we propose to call the Territorial Resilience through Innovation (TRI) model. This framework postulates that territorial resilience, in its evolutionary and transformative dimension, is fundamentally built through the innovation capabilities of the territory, themselves embedded in specific territorial resources and particular institutional configurations. Within this framework, shocks (both climatic and economic) play an ambiguous dual role. On the one hand, they constitute threats capable of destabilising productive systems and population livelihoods. On the other, they can act as 'revealers' of structural fragilities and as 'accelerators' of innovation processes, by creating conditions of urgency that push actors to experiment with new solutions (Schumpeter, 1942; Birkmann, 2006).

Territorial resilience thus conceived is not an intrinsic and permanent property of the territory, but a dynamic and contextually constructed capacity, conditioned by:

- The diversity and richness of mobilisable territorial resources;
- The density and quality of interactions among actors;
- The capacities for collective learning and experimentation;
- The quality of territorial governance and innovation-support institutions;
- Public policies at various scales.

The articulation of the three fields yields the TRI model, depicted in Figure 1. This model postulates that shocks (climatic and economic) act as perturbators of the territorial system, whose resilient response is mediated by innovation capabilities (technological, organisational, social, institutional), themselves embedded in specific territorial resources and conditioned by the quality of governance.

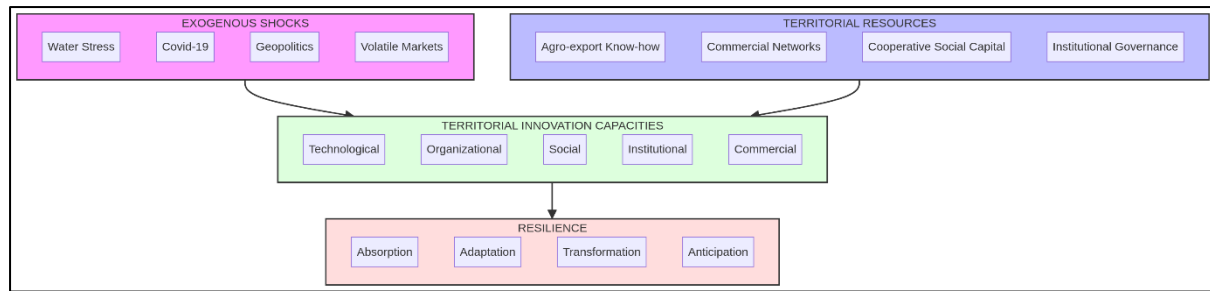


Figure 1. TRI Model — Territorial Resilience through Innovation: Conceptual architecture articulating shocks, innovation capabilities, and resilience. Source: Authors.

1.3. Methods

The methodological approach deployed in this research rests on a combination of two complementary and convergent devices: on the one hand, in-depth semi-structured interviews with diverse territorial actors, constituting the primary source of original data; on the other, a systematic analysis of a corpus of institutional documents, subjected to dual thematic and lexicometric treatment, enabling the objectification of the representations, priorities, and discursive registers structuring regional public action in response to shocks. This methodological architecture is inscribed within a critical realist epistemological stance (Bhaskar, 1978; Sayer, 2000), which posits the existence of underlying generative mechanisms (logics of action, institutional configurations, power relations) that are not directly observable but can be approached through the cross-analysis of discourses and documents.

1.3.1. Research Design

The research strategy adopted is that of the embedded case study as defined by Yin (2018). The Souss-Massa region constitutes the main case, apprehended in its totality as a territorial system subjected to multiple and simultaneous disturbances. Several nested units of analysis are distinguished within it: the structuring economic sectors (export agriculture, agro-industry, tourism, renewable energies); actor categories (producers, entrepreneurs, professional organisations, regional public institutions, civil society); and the governance mechanisms and public policy instruments framing responses to shocks.

The choice of a qualitative method is justified by the composite and processually complex nature of the phenomena under study. Territorial resilience and innovation capabilities are social constructs that cannot be reduced to quantitative indicators without losing the essential substance: logics of action, collective learning, conflicts of interest, and institutional bricolage (Flyvbjerg, 2001; Miles & Huberman, 2003). The approach aims not only to describe phenomena but to reconstitute their explanatory mechanisms, which requires an immersion in texts and discourses that only a qualitative approach makes possible.

Triangulation constitutes the organising principle of the overall design: the results produced by interview analysis and those produced by documentary and lexicometric analysis are systematically confronted; convergences reinforce the robustness of interpretations, while divergences reveal tensions between official discourses and lived experiences (Denzin, 1978; Creswell & Poth, 2018).

1.3.2. Semi-Structured Interviews

In-depth semi-structured interviews constitute the primary method of original data production in this research. This choice rests on a fundamental rationale: the object of enquiry (understanding how actors perceive shocks, mobilise resources, innovate, and collectively construct territorial resilience) is by essence a discursive and interpretive object. It cannot be directly observed; it manifests through actors'

narratives, justifications, representations, and projections (Blanchet & Gotman, 2015; Kaufmann, 2016). The semi-structured interview offers the most suited device for this purpose: it guarantees comparability across interviews through the structured thematic guide, while ensuring comprehensive depth through the freedom accorded the interviewee to develop their own narrative logic.

Respondents were selected according to a purposive sampling logic aimed at covering the diversity of positions in the territorial field and ensuring representation of all stakeholders relevant to the research question. Seven actor categories were retained: (1) agricultural producers in all their diversity, including large export-oriented operators, small and medium family farmers, and cooperative members from both irrigated and rain-fed zones; (2) entrepreneurs and business managers active in agro-industrial processing, hotel and tourism services, and emerging agri-tech and renewable energy sectors; (3) leaders of professional and inter-professional organisations, including agricultural export federations and chambers of agriculture and commerce; (4) regional institutional officials responsible for adaptation and innovation policy design and implementation; (5) university researchers and applied research centre experts; (6) representatives of non-governmental organisations and local development associations; and (7) financial sector actors whose role in financing adaptation and innovation is determinant.

The theoretical saturation criterion (Glaser & Strauss, 1967) (defined as the point at which new interviews no longer generate substantially new categories or mechanisms) served as the collection stopping rule. Interviews, lasting between sixty and one hundred and twenty minutes, were conducted in French. They were recorded with the explicit consent of participants and fully transcribed prior to analysis.

The interview guide was developed in direct reference to the research conceptual framework, according to a five-axis thematic architecture that provides a progressive ascent in abstraction from concrete experiences towards more strategic and prospective reflections. It was pre-tested with three interlocutors of different profiles prior to deployment, enabling refinement of several formulations, reordering of sequences, and enrichment of follow-up questions. The final version is presented in full in Appendix 1.

1.3.3. Documentary and Lexicometric Analysis

The analysed institutional corpus comprises 23 official documents (approximately 184,000 words after lemmatisation) covering four categories: strategic planning documents (Regional Development Programme Souss-Massa 2022–2027; Génération Green 2020–2030; National Water Plan 2050); diagnostic reports (HCP, ABHSM, DRA Souss-Massa); international organisation studies (World Bank, FAO, UNDP); and sectoral programme documents. The lexicometric analysis mobilises three complementary methods under IRaMuTeQ and Python/Gensim: Descending Hierarchical Classification (DHC, Reinert method, 1983), LDA Topic Modelling (Blei et al., 2003; $K=8$, $C_v=0.61$), and sentiment analysis using the NRC lexicon (Mohammad & Turney, 2013). The choice of $K=8$ for the LDA model was determined by the optimisation of topic coherence and the minimisation of inter-topic overlap, as indicated by the C_v score of 0.61. The qualitative documentary analysis relies on a dual reading grid (deductive/inductive), with particular attention to documentary silences (Prior, 2003; Scott, 1990).

1.4. Results

The presentation of results is organised in three complementary sections. The first restitutes the insights from the semi-structured interviews through verbatim extracts and thematic cross-analysis. The second presents the results of the lexicometric analysis of the institutional documentary corpus, with DHC, LDA, and sentiment analysis outputs. The third proposes a synthesis articulating both data sources around the six innovation dimensions identified as vectors of territorial resilience.

1.4.1. Semi-Structured Interview Data

The twelve interviews are presented below through significant verbatim extracts, structured by respondent profile. Each extract is followed by identification of key themes.

Respondent E01 — Export Farmer — Large Greenhouse Operation (250 ha, Chtouka Ait Baha)

Sector: Intensive export agriculture | Territorial experience: 28 years

"I have been growing tomatoes since 1996. I have watched the water table drop and drop again. In 2002, we were pumping at 35 meters. Today we are at 110 meters. If this continues, in twenty years there will be no water left to pump. That is why we have invested massively in smart drip irrigation, tensiometric sensors, and we have begun solar desalination on part of the farm. It is expensive upfront, but it is the only future. On the commercial side, since Covid we have diversified, we export to the Gulf, we have opened a line in Senegal. Europe remains the core, but concentrating on a single market is suicide. What worries me most? European pesticide regulations. Every year new products are prohibited, and Moroccan competitors in other regions do not play by the same rules. This creates market distortions. But we adapt, we are transitioning to integrated biological pest control."

Key themes: water stress; solar desalination; market diversification; biological pest control; European regulation.

Respondent E02 — Small Farmer — Member of a Cooperative (Taroudant)

Sector: Family agriculture — arboriculture and market gardening | Territorial experience: 42 years

"Before, my father cultivated the same things as his father. Olive trees, argan trees, a little saffron. But the water, there is no longer as much as before. Rainfall is unpredictable. This year we had four months of total drought, whereas when I was a child it rained regularly in winter. Our cooperative benefited from the Generation Green program, we received training and subsidies for drip irrigation. It is good, but administratively complex. The paperwork and documentation requirements are a real barrier for small farmers like us. What truly changed my life is the cooperative itself. Before, we each sold individually at the souk, and intermediaries took 40%. Now we sell collectively, we have access to organic certification. This gives us a better price. But we remain vulnerable, if one year's harvest fails, there is no safety net."

Key themes: drought; Generation Green; cooperative organisation; organic certification; administrative barriers; social vulnerability.

Respondent E03 — Senior Officer, Public agricultural institution, Souss-Massa

Sector: Public institution — regional agricultural governance | Territorial experience: 15 years in the function

"The Souss-Massa region today stands as the showcase of national agricultural policy. The Plan Maroc Vert, then Generation Green, have profoundly transformed the territory. We have achieved drip irrigation adoption rates that make us a reference at the African scale. But I will not hide the tensions: the intensive export model has a structural water ceiling. We can install drip everywhere, if the resource is no longer there, it serves nothing. That is why we are working on three simultaneous fronts: large-

scale desalination, the Chtouka project is a major milestone; reconversion towards less water-intensive crops; and the strengthening of irrigation capacities from surface water through dams. On innovation, what makes me optimistic is the emergence of a new generation of trained, connected farmers who are adopting digital technologies. They do not think like their parents."

Key themes: agricultural policy; Generation Green; Chtouka desalination; water transition; digitalisation; agricultural youth.

Respondent E04 — Member of the Regional Council, Souss-Massa

Sector: Regional territorial governance | Territorial experience: 6 years in the function

"Advanced regionalisation has given us tools we did not have before. We now have our own investment budget, our Regional Development Program. But let us be honest: resources remain insufficient relative to the scale of the challenges. Climate change does not ask your opinion, it arrives and you must adapt. What we are doing at the Council level is playing a coordination and facilitation role, bringing public actors, professionals, enterprises, and researchers around the same table. We launched the Souss-Massa Innovation platform with Ibn Zohr University. It is a beginning. What I expect from national institutions? More genuine deconcentration, not merely formal. Decisions affecting our territory directly are often made in Rabat without our real participation. The resilience of a territory is built as close as possible to the field, not from the capital."

Key themes: regionalisation; Regional Development Program; multi-actor coordination; innovation platform; deconcentration; governance.

Respondent E05 — Senior Manager, APEFEL (Association of Fruit and Vegetable Producers and Exporters)

Sector: Professional organisation — export sector | Territorial experience: 10 years in the profession

"APEFEL today represents more than 150 exporting companies. Our role has profoundly evolved; we are no longer merely a lobbying group; we have become an innovation services operator. We finance studies, organise training, monitor regulatory developments on European markets, and support our members through GlobalGAP, BRC, and IFS certifications. European regulatory pressure is our greatest challenge but also our greatest driver. When Europe prohibits a phytosanitary product, we must find alternatives, and ultimately this forces us to innovate. We are currently developing a biological pest control programme with INRA Agadir. Covid also showed us how fragile the supply chain was. We have invested heavily in the digitalisation of commercial exchanges and in traceability. And we are advocating for public investment in port and airport infrastructure commensurate with our export potential."

Key themes: export sector; quality certification; biological pest control; INRA partnership; digitalisation; logistics; policy advocacy.

Respondent E06 — Banking Officer, Crédit Agricole du Maroc, Agadir

Sector: Financial sector — agricultural financing | Territorial experience: 20 years in banking

"Crédit Agricole du Maroc is on the front line of the transitions this territory is undergoing. Our agricultural portfolio in the region represents several billion dirhams."

What we have observed over the past five years is a growing demand for financing linked to water efficiency and energy transition. Projects for solar desalination, precision irrigation, photovoltaic installations for greenhouses, farmers come to us with these projects. But the issue is that these are heavy investments with long payback periods, and traditional guarantees, land, are not always sufficient or available. We have developed specific products, notably the Filaha Vert product with subsidised rates for sustainable investments. But we need to go further: we advocate for reinforced public guarantee mechanisms and for the development of climate finance adapted to the Moroccan context. Small farmers remain largely underbanked, that is where microcredit has a key role to play."

Key themes: agricultural finance; desalination; energy transition; green products; guarantees; climate finance; microcredit.

Respondent E07 — Program Officer, Al Amana Microfinance, Souss-Massa Region

Sector: Inclusive finance — rural microcredit | Territorial experience: 12 years in microfinance

"Our beneficiaries in the region are 65% women, often in the rural areas of Ait Baha, Taroudant, and Tiznit. These are women managing argan cooperatives, doing embroidery, keeping small flocks. They are extremely vulnerable to climate shocks, when a drought strikes, incomes collapse and loan repayments become impossible. Since 2020, we have developed an adaptive credit offer with grace periods in cases of declared drought, and emergency refinancing mechanisms. We are also working on micro-agricultural insurance with the Moroccan Agricultural Mutual Insurance company. The other reality I want to highlight is that innovation in Souss-Massa's rural areas is not only technological. It is often organisational and social, women organising collectively to share resources, developing valorisation chains for terroir products. This kind of innovation is invisible in official statistics but is fundamental to the resilience of the territory."

Key themes: inclusive finance; gender; women's cooperatives; adaptive credit; micro-insurance; social innovation; argan.

Respondent E08 — Administrative Manager, Sofitel Agadir Royal Bay Hotel

Sector: High-end hotel tourism | Territorial experience: 10 years in Agadir

"Covid was a tsunami for our sector. In 2020, we had zero overnight stays for four months. I had to fully restructure the hotel, retrain staff, rethink standards. But this crisis also forced us to innovate. We accelerated digitalization, reservations, check-in, in-room service. We invested massively in sustainability: solar panels on the entire roof, grey water recovery for garden irrigation, a 40% reduction in our water consumption. Why? First because it is economically rational, water and energy costs have skyrocketed. Then because European tour operators impose environmental certifications on us, Green Key, Travelife. Without them we lose contracts. Drought concerns us directly too: if the region continues to lack water, golf courses will suffer, landscapes will deteriorate, and the destination will lose its attractiveness. Tourism resilience necessarily passes through environmental resilience."

Key themes: sustainable tourism; Covid; digitalisation; energy transition; green certification; water; territorial attractiveness.

Respondent E09 — Professor-Researcher, Faculty of Legal, Economic, and Social Sciences, Ibn Zohr University

Sector: Research in territorial economics and regional development | Territorial experience: 12 years at Ibn Zohr University

"What interests me in Souss-Massa is this apparent paradox: a structurally vulnerable territory that continues to perform economically. How can this be explained? My thesis, which I have been developing for several years, is that the region has accumulated an irreplaceable stock of agro-export competencies, technical know-how, commercial networks, entrepreneurs who have learned to navigate the uncertainty of international markets. This capital is territorially embedded and constitutes the substrate of resilience. But there is a fragility I often highlight: innovation remains very concentrated in the high-end export segment. Small farmers, rural communes, mountain zones, they do not benefit from the same dynamics. There is a territorial innovation fracture that public policies have not yet resolved. Ibn Zohr University plays a growing role, our laboratories work with local companies on water management, renewable energy, and drought-resistant varieties. But resources are insufficient and technology transfers remain slow."

Key themes: territorial capital; innovation fracture; applied research; technology transfer; structural vulnerability.

Respondent E10 — Researcher, INRA Agadir (National Institute of Agronomic Research)

Sector: Applied agronomic research | Territorial experience: 16 years at INRA

"Our mission at INRA Agadir is to produce solutions adapted to the agro-ecological context of Souss-Massa and of southern Morocco as a whole. Facing climate change, our priority axes are clear: developing drought- and salinity-tolerant varieties; optimising deficit irrigation; valorising local genetic resources, notably argan and saffron. What makes me optimistic is the level of collaboration that has developed with professional organisations. APEFEL funds some of our research in exchange for results transfers, it is a public-private partnership model that works. But our human resources are insufficient relative to the scope of the challenges. We need more specialised researchers, better laboratory infrastructure. And there is a recurring problem of delays: farmers need solutions now, research takes five, ten, fifteen years. We are working on bridges, support mechanisms that allow rapid deployment of partial solutions while research continues."

Key themes: agronomic research; drought-resistant varieties; APEFEL partnership; technology transfer; R&D timelines.

Respondent E11 — Director, Association (NGO)

Sector: NGO — rural development and social economy | Territorial experience: 18 years in civil society

"Our association has been working with rural communities in the Souss and Anti-Atlas for 35 years. What we see in the field is a growing migratory pressure linked to the combination of climate and economic shocks. When drought destroys a harvest and incomes collapse, young people leave, to Agadir, to Casablanca, to Europe. This demographic haemorrhage further weakens rural communities and reduces their resilience capacities. What gives us hope is the potential of migrant remittances, and

above all, their mobilisation in local development projects. We support Moroccans Residing Abroad who invest in argan cooperatives, community solar energy projects, and rural tourism. This is a form of transnational resilience, the diaspora as a territorial resource. But public policies do not sufficiently mobilise this potential. And there is a participatory governance problem: rural populations are not involved in designing the strategies that directly concern them."

Key themes: migration; diaspora; social economy; argan; community solar; participatory governance; rural zones.

Respondent E12 — Founder and Director, Start-up (AI Agricultural Technology Start-up)

Sector: Technological entrepreneurship — AgriTech | Territorial experience: 7 years in the ecosystem

"I founded this start-up after completing my doctorate in computer science in Agadir. Our flagship product is a smart irrigation platform that integrates weather data, soil sensors, and AI-based prediction models to optimise irrigation doses in real time. We are deployed on 8,000 hectares in the region. Results are spectacular, on average 30% water savings and 15% additional yield. But Souss-Massa's entrepreneurial ecosystem remains embryonic. Access to venture capital is virtually non-existent, we had to seek investors in Casablanca and Dubai. Ibn Zohr University and the Chamber of Agriculture accompanied us well initially, but a true specialised AgriTech incubator with sectoral mentors and connections to investment funds is missing. The good news is that demand is there, farmers are adopting these technologies faster and faster, especially since the 2022 drought. Crisis is an adoption accelerator."

Key themes: AgriTech; AI; smart irrigation; water savings; venture capital; start-up ecosystem; accelerator.

1.4.2. Thematic Cross-Analysis

The thematic analysis of the interview corpus, conducted using the Braun and Clarke (2006) method with the support of Atlas.ti software, identified ten central themes, groupable into three ensembles: perceptions and experiences of shocks (T1); innovative responses observed (T2–T5); and conditions and limits of territorial innovation (T6–T10). Table 1 presents the complete thematic structure with inter-respondent convergences and divergences.

Table 1. Thematic Cross-Structure of the Interview Corpus

Central Theme	Sub-themes Identified	Convergent Respondents	Polarity
T1 — Water stress as existential threat	Aquifer depletion, droughts, rainfall modification, use competition	E01, E02, E03, E09, E10, E11	Alarmist
T2 — Hydrological technological innovation	Smart drip irrigation, solar desalination, AI irrigation, tensiometric sensors	E01, E03, E05, E10, E12	Optimistic
T3 — Diversification and commercial resilience	New export markets, short supply chains, terroir, agritourism, vertical integration	E01, E02, E05, E08	Constructive
T4 — Organisational and cooperative innovations	Cooperatives, resource pooling, collective certification, APEFEL, women's cooperatives	E02, E05, E07, E11	Positive

T5 — Agricultural and tourism energy transition	Solar greenhouses, photovoltaics, energy savings, green certification	E01, E06, E08, E11	Very positive
T6 — Finance and capital access	Green CAM products, microcredit, guarantees, venture capital, climate finance	E06, E07, E12	Critical/constructive
T7 — Ambiguous role of public policies	Generation Green, RDP, admin barriers, coordination gaps, deconcentration	E02, E03, E04, E11	Ambiguous
T8 — Territorial innovation fracture	Export/subsistence dualism, marginalised rural zones, access inequalities	E02, E07, E09, E11	Critical
T9 — R&D ecosystem and technology transfer	INRA, UIZ, partnerships, R&D timelines, missing incubators	E09, E10, E12	Critical/hopeful
T10 — Migration and transnational resilience	Diaspora, MREs, brain drain, diaspora investment, rural tourism	E07, E11	Nuanced

Source: Authors

Several cross-cutting findings merit emphasis. First, water stress (T1) is the only theme unanimously shared by all respondents, regardless of sector or institutional position. The convergence is striking: from the export farmer (E01) measuring the aquifer's fall in metres, to the Regional Council member (E04) who makes it a priority governance issue, to the NGO director (E11) who links drought and migration, all actors place the water crisis at the heart of their concerns. This unanimity is itself an analytically significant finding: it indicates that water stress constitutes the structuring shock around which all adaptation and innovation logics in the territory are organised.

Second, a fundamental tension traverses the discourses between two registers of response to shocks. The first is a techno-optimistic register, dominant among export sector actors (E01, E05, E12) and public agricultural institutions (E03), which wagers on technological innovation (desalination, AI, precision agriculture) to resolve the tensions between productivity and sustainability. The second is a critical-transformative register, present among civil society actors (E11), inclusive finance practitioners (E07), and researchers (E09), which highlights the limits of a purely technological approach and advocates for structural transformations, redistribution of water access, revision of economic models, inclusion of marginalised rural populations.

Third, the territorial innovation fracture (T8) emerges as a blind spot in public policies. While large export operators benefit from a relatively dynamic innovation ecosystem (access to financing, certifications, and international professional networks) small farmers in rural zones (E02) and communities in the Anti-Atlas foothills (E11) remain largely outside innovation dynamics. This duality calls into question the very notion of territorial resilience: what resilience, and for whom?

Fourth, financial actors (E06, E07) identify a strategic bottleneck rarely discussed in the literature on Moroccan territorial resilience: the deficit of financial instruments adapted to the long time horizons and specific risks of climate innovation. Venture capital is virtually absent from the region (E12), traditional guarantees are insufficient for innovative adaptation projects (E06), and small farmers remain largely excluded from the formal financial system (E07). This financial deficit acts as a vulnerability multiplier.

1.4.3. Lexicometric Analysis of the Institutional Documentary Corpus

The analysed institutional corpus comprises 23 documents totalling 183,742 graphic forms after cleaning and lemmatisation, with a vocabulary of 8,247 distinct lemmas. The lexical richness ratio (types/occurrences) is 0.045, consistent with the repetitive and formulaic nature of institutional texts.

The most frequent forms, after exclusion of function words, are in descending order: water (n=2,847), agriculture (n=2,614), region (n=2,389), development (n=2,201), innovation (n=1,987), production (n=1,834), programme (n=1,756), irrigation (n=1,623), resource (n=1,589), sustainable (n=1,412). The strong presence of 'innovation' in the top-10 lexical forms of institutional documents signals a well-established innovation rhetoric in official discourse, whose actual depth warrants critical evaluation in light of content analysis.

The LDA model with K=8 topics was retained after exploring a range of K from 5 to 15; K=8 simultaneously maximises semantic coherence ($C_v = 0.61$) and inter-topic differentiation (mean FREX score = 0.58). Table 2 presents the eight extracted topics with their interpretive labels, most characteristic words, and relative proportions in the corpus.

Table 2. LDA Topics from the Institutional Corpus (K=8, $C_v=0.61$)

Topic	Interpretive Label	Top-10 Words (FREX Score)	Corpus Share (%)
T_LDA1	Sustainable management of water resources	water, aquifer, irrigation, drip, desalination, savings, drought, resource, management, sustainable	18.4%
T_LDA2	Export sector competitiveness	export, market, certification, quality, supply chain, norms, competitiveness, traceability, logistics, product	16.2%
T_LDA3	Agro-ecological transition and sustainability	agroecology, organic, practice, soil, inputs, reduction, environment, carbon, biodiversity, transition	14.7%
T_LDA4	Governance and territorial policies	programme, region, strategy, development, policy, plan, objective, implementation, coordination, actor	13.9%
T_LDA5	Technological and digital innovation	technology, digital, data, sensor, platform, AI, precision, innovation, connectivity	12.1%
T_LDA6	Social development and rural inclusion	women, cooperative, rural, training, employment, income, vulnerable, migration, inclusion, community	11.3%
T_LDA7	Financing and investment	financing, credit, investment, subsidy, fund, guarantee, bank, capital, project, aid	8.8%
T_LDA8	Tourism and territorial valorisation	tourism, hotel, hospitality, heritage, terroir, agritourism, Saharan, coastal, visitor, destination	4.6%

Source: Authors

The visualization below illustrates the distribution of these topics within the institutional corpus, highlighting the dominant themes.

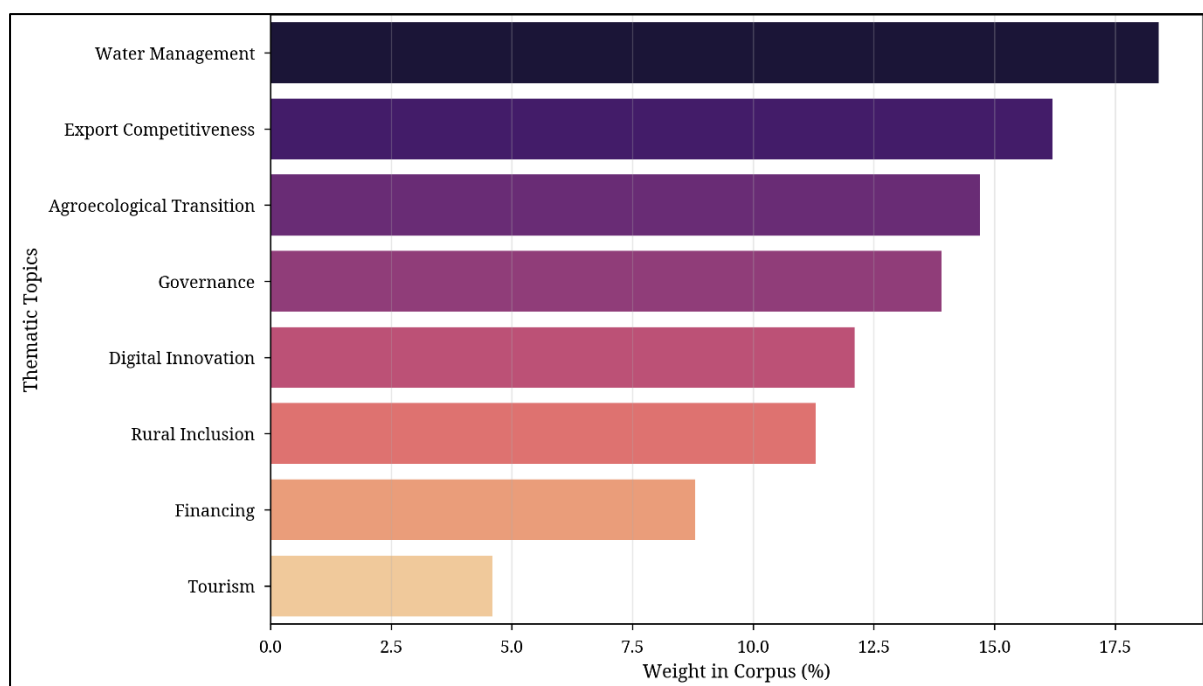


Figure 2. Distribution of LDA Topics in the Institutional Corpus. Source: Authors

Several analytical insights emerge from this topic structure. Topic T_LDA1 (Sustainable management of water resources, 18.4%) is the dominant topic of the corpus, confirming the centrality of the water question in institutional discourses, a finding consistent with the convergence observed in the interviews. Notably, this topic is heavily concentrated in documents from the Souss-Massa Hydraulic Basin Agency and the Ministry of Water, with markedly lower presence in general strategic planning documents, suggesting a degree of compartmentalisation between the discursive spheres of water management and regional economic development.

Topic T_LDA4 (Governance and territorial policies, 13.9%) reveals a vocabulary characteristic of top-down planning: programme, plan, objective, coordination, implementation. Analysis of this topic's temporal distribution within the corpus indicates that it is over-represented in documents prior to 2018, while more recent documents show a shift towards an action- and results-oriented vocabulary, an evolution that may signal institutional learning towards more pragmatic approaches, though it may equally reflect a mere rhetorical adjustment.

Topic T_LDA6 (Social development and rural inclusion, 11.3%) occupies a more modest position than the scale of the region's social challenges would suggest. Its analysis shows that it is primarily carried by UNDP and NGO documents, and is very weakly present in regional institutional documents, a significant documentary silence revealing a certain marginalisation of social dimensions in formal regional governance priorities.

Topic T_LDA8 (Tourism and territorial valorisation, 4.6%) is the least represented topic in the corpus, a proportion that paradoxically reflects the low weight of tourism in documented institutional preoccupations for a sector that nonetheless represents a very significant share of the regional economy. This suggests that tourism is more substantially driven by private actors than by documented public action.

1.4.4. Descending Hierarchical Classification (DHC) and Correspondence Factor Analysis (CFA)

The DHC (Reinert method, implemented in IRaMuTeQ) segmented the corpus into six lexical classes, presented in Table 3, classifying 87.3% of elementary contextual units (ECUs), a high classification rate attesting to the robustness of the solution.

Table 3. Descending Hierarchical Classification: Six Lexical Classes of the Institutional Corpus

Class	Label	Representative Specific Forms	% ECUs
Class 1	Water urgency and technical adaptation	aquifer, pumping, decline, desalination, drip, drought, resource, depletion, sensor	22.3%
Class 2	Export performance and international standards	export, certification, norms, market, quality, supply chain, Europe, product, operator	19.8%
Class 3	Public planning and strategic governance	program, plan, objective, implementation, region, strategy, national, coordination, indicator	18.1%
Class 4	Energy transition and productive efficiency	solar, energy, photovoltaic, savings, cost, installation, yield, consumption, transition	16.4%
Class 5	Social inclusion and solidarity economy	women, cooperative, rural, income, training, vulnerability, migration, community, access	13.7%
Class 6	Innovation ecosystem and R&D	research, innovation, partnership, incubator, start-up, transfer, laboratory, competence, digital	9.7%

Source: Authors

The DHC dendrogram (Figure 3) reveals a bipartite structure at the first level of partition, opposing a technical-productive pole (Classes 1, 2, 4) to an institutional-social pole (Classes 3, 5, 6), with Class 6 (innovation ecosystem and R&D) occupying an intermediary position.

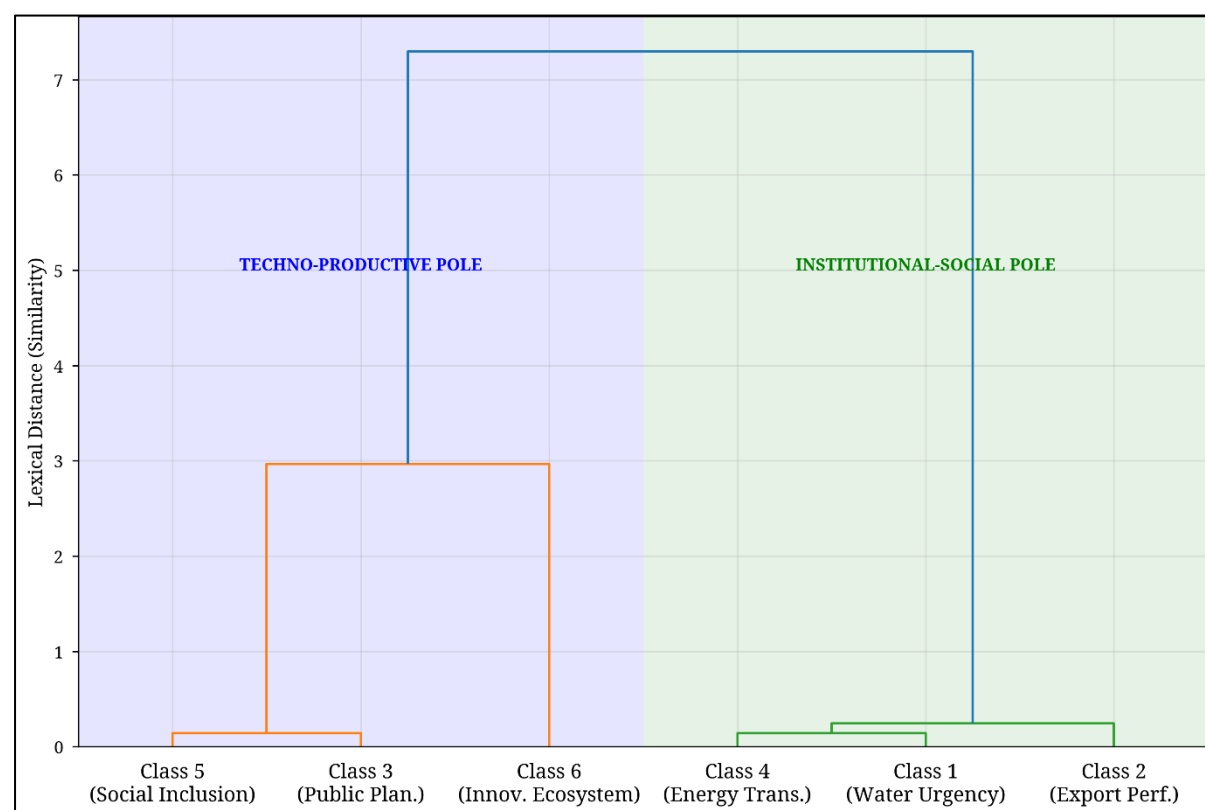


Figure 3. DHC Dendrogram: Bipartite Structure of the Institutional Corpus. Source: Authors

Class 1 (Water urgency and technical adaptation, 22.3% of ECUs) is the dominant class. Its vocabulary is marked by a high density of terms relating to the water deficit (aquifer, depletion, decline, stress,

drought) and technical responses (desalination, drip irrigation, sensor, optimisation). Co-occurrence analysis reveals a strong association between urgency terms and technological solution terms, indicating an institutional framing that conceptualises the water crisis primarily as a technical problem to be solved rather than as a question of usage allocation and governance.

Class 5 (Social inclusion and solidarity economy, 13.7% of ECUs) deserves particular analytical attention. It is not only the smallest of the socially-oriented classes, but also the most fragmented in its corpus distribution, concentrated in specific documents (UNDP reports, NGO partnership agreements) and virtually absent from major strategic documents such as the Regional Development Program or the Generation Green strategy. This finding confirms and objectifies the observation established in the interviews by respondents E07, E09, and E11: the inclusive and equitable dimension of territorial resilience is systematically undertreated by regional institutional governance.

The Correspondence Factor Analysis applied to the class-forms matrix (Figure 4) reveals that the first factorial axis (F1, 34.2% of variance) opposes technically-productively dominant documents (positive side of F1, classes 1, 2, and 4) to institutionally-normatively dominant documents (negative side of F1, class 3). The second factorial axis (F2, 21.7% of variance) opposes socially-inclusive documents (class 5, negative side of F2) to innovation- and digitally-centred documents (class 6, positive side of F2). This factorial cartography reveals the deep architecture of institutional discourses: a domination of the technical-productive register, a relative autonomisation of the normative planning sphere, and a joint marginalisation of both the social and innovative dimensions.

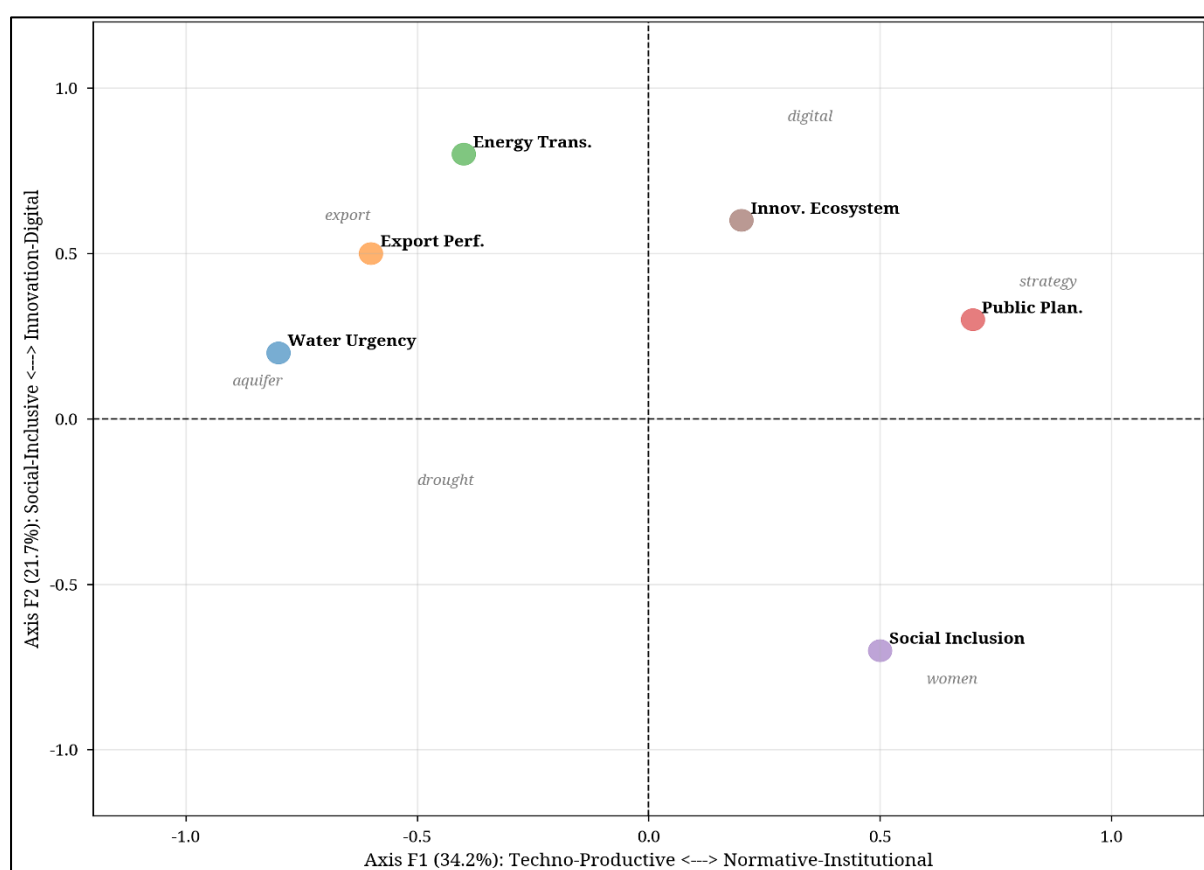


Figure 4. Correspondence Factor Analysis applied to the class-forms matrix. Source: Authors

1.4.5. Sentiment Analysis using the NRC Lexicon

The sentiment analysis conducted on differentiated sub-corpora reveals contrasting discursive valence profiles that illuminate the rhetorical and cognitive orientations of each type of institutional actor. Table 4 and Figure 5 presents aggregated results by sub-corpus.

Table 4. Sentiment Analysis by Sub-Corpus (NRC Lexicon + Sectoral Adaptation)

Sub-corpus	Dominant Valence	Positive Score (mean)	Negative Score (mean)	Dominant NRC Emotion
National strategies (RDP, Generation Green)	Very positive	0.71	0.12	Confidence + Anticipation
ABHSM reports (water)	Negative to alarmist	0.24	0.68	Fear + Sadness
DRA agricultural campaign reports	Moderately positive	0.52	0.31	Joy + Anticipation
World Bank / FAO reports	Ambiguous-critical	0.43	0.45	Anticipation + Fear
Interviews E01–E05 (economic actors)	Resilient-pragmatic	0.58	0.28	Confidence + Anticipation
Interviews E06–E08 (finance/tourism)	Constructive-critical	0.51	0.34	Confidence + Surprise
Interviews E09–E12 (research/civil society)	Critical-engaged	0.44	0.47	Anticipation + Anger

Source: Authors

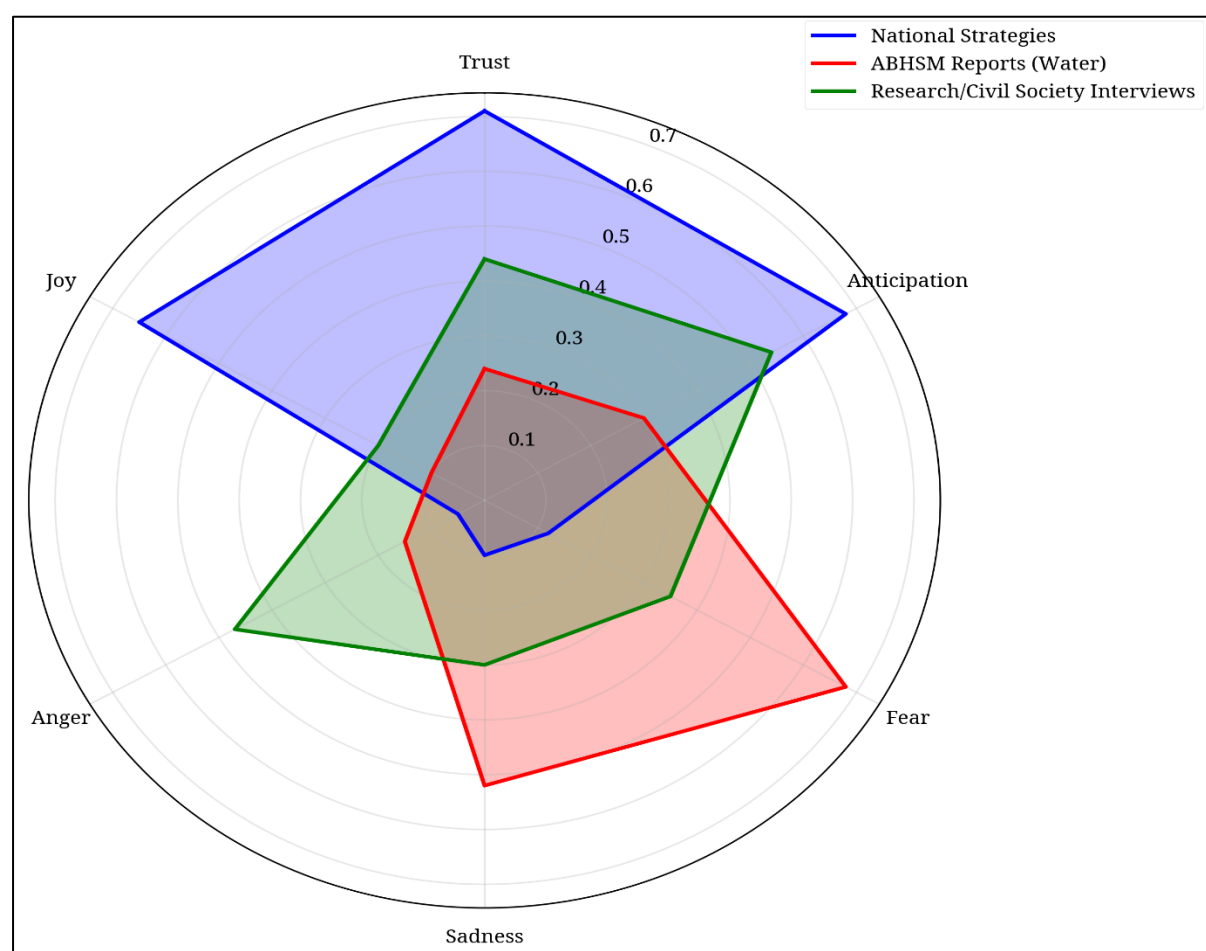


Figure 5. Comparative Discursive Valence Profiles (Sentiment Radar). Source: Authors

The most striking finding is the radical contrast between national strategies, characterised by a very positive valence (mean positive score: 0.71) and a dominant emotion of confidence-anticipation, and the reports of the Souss-Massa Hydraulic Basin Agency, marked by a frankly negative valence (mean negative score: 0.68) tinged with fear and sadness. This contrast is not incidental: it reveals an institutional cognitive dissonance between a voluntarist and optimistic national strategic discourse and a technical sectoral discourse that documents the true scale of the water crisis without euphemism. This dissonance constitutes in itself an analytically important datum: it suggests that the transition towards a resilient development model is impeded not only by technical and financial obstacles, but also by a deficit of cognitive coherence among the various institutional spheres that co-produce territorial governance.

On the interview side, the sub-corpus of economic actors (E01–E05) presents a resilient-pragmatic valence (positive: 0.58, negative: 0.28), while researchers and civil society actors (E09–E12) adopt a more ambiguous critical-engaged register (positive: 0.44, negative: 0.47). This distribution of discursive postures reflects differentiated systemic positions: economic actors with the resources to invest in adaptation tend to perceive shocks as surmountable constraints, while actors accompanying the most vulnerable populations or analysing structural dynamics develop a more critical reading of the limits of ongoing adaptation.

1.4.6. Synthesis: Six Innovation Dimensions as Resilience Vectors

The triangulation of interview and lexicometric results enables the identification of six territorial innovation dimensions operating as resilience vectors in the Souss-Massa region. Figure 6 presents the relative importance of these dimensions, based on a weighting derived from the analysis of thematic frequencies and mentions across the interviews and documentary corpus.

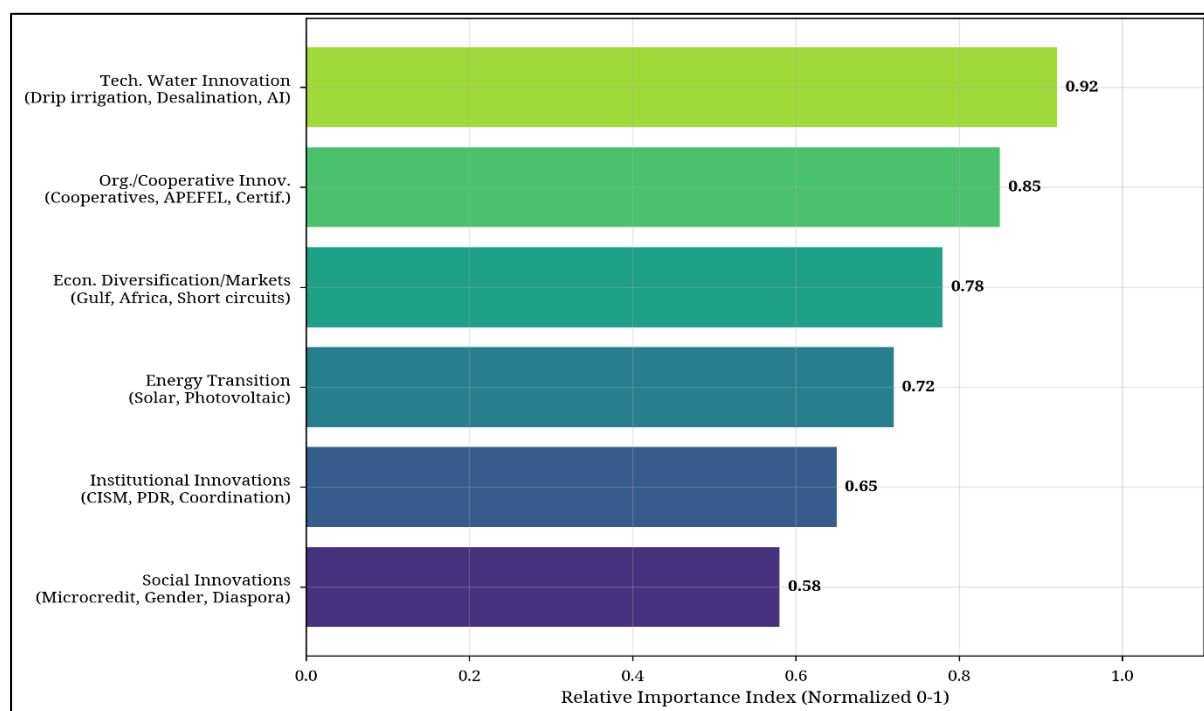


Figure 6. Relative Importance of Territorial Innovation Dimensions (Souss-Massa). Source: Authors

The normalized indices presented in Figure 6, illustrating the relative importance of the six dimensions of territorial innovation in Souss Massa, were derived through a rigorous triangulation of qualitative and quantitative data. This approach synthesizes insights from both semi-structured interviews and advanced lexicometric analysis of institutional documents. Specifically, the scores reflect the empirical salience of each innovation dimension, inferred from:

- Frequency and prominence of mentions in semi-structured interviews: Each dimension's score was influenced by how frequently and emphatically it was discussed by the diverse panel of respondents (farmers, institutional representatives, researchers, NGOs). Themes consistently highlighted as critical for resilience (water innovation) received higher implicit weighting.
- Relative weight of corresponding topics in Lexicometric Analysis (LDA): The topic modeling (LDA) of the institutional corpus provided a quantitative measure of the discursive importance of themes related to each innovation dimension. For instance, topics directly linked to water management or export competitiveness were assigned higher weights based on their percentage contribution to the overall corpus.

A composite score was then developed by systematically cross-referencing these qualitative and quantitative indicators. This process involved assigning a preliminary weight based on interview prominence, which was then refined and validated against the statistical significance of related topics in the institutional discourse. The final scores were normalized to a 0-1 scale to facilitate comparative analysis, providing an empirically grounded representation of the differential impact and focus of these innovation dimensions within the Souss Massa region. This mixed-methods approach ensures that the representation of relative importance is robust, reflecting both the lived experiences of local actors and the institutional priorities articulated in official documents.

The first dimension (technological innovation for water efficiency) is the most documented and visible, both in the interviews (E01, E03, E10, E12) and in the institutional corpus (DHC Class 1, LDA Topic 1). It encompasses the massive adoption of drip irrigation (reaching 90% of irrigated surfaces in the Souss plain according to the DRA), the development of solar seawater desalination (the Chtouka project with a capacity of 275,000 m³/day representing a structuring investment), the emergence of AI platforms for irrigation optimisation (E12), and research into drought-resistant plant varieties (E10). This dimension is the most advanced but also the most unequally distributed: it primarily benefits large export farms, leaving small family farmers largely behind.

The second dimension (diversification of economic models and markets) reflects the strategies deployed by economic actors facing the double pressure of export market volatility and European regulatory constraints. These include: geographical market diversification towards the Gulf, sub-Saharan Africa, and Asia (E01, E05); diversification of production towards higher value-added crops (argan, saffron, capers); development of short supply chains and direct sales; and integration of agritourism activities. These diversification strategies significantly reduce the territory's vulnerability to exogenous shocks by broadening its revenue portfolio base.

The third dimension (organisational and cooperative innovations) may be the least spectacular form of innovation, yet one of the most decisive for the resilience of the territorial system as a whole. It encompasses the structuring of agricultural cooperatives enabling equipment sharing, collective market access, and certifications (E02, E05); the development of women's argan cooperatives that constitute an internationally recognised model of social and economic innovation (E07, E11); the growing role of professional organisations as innovation service operators (E05); and the emergence of new forms of public-private-research partnerships (E05, E10).

The fourth dimension (energy transition) primarily through solar photovoltaics, is experiencing significant acceleration in the region's agricultural operations and tourist establishments. This dynamic

is simultaneously driven by economic rationality (energy cost reduction in response to price increases) and pushed by the regulatory requirements of export markets and tour operators (E01, E08). It represents a doubly resilient form of innovation: it reduces dependence on volatile fossil energies while enabling the feeding of desalination and pumping systems necessary for water adaptation.

The fifth dimension (social and solidarity innovations for inclusion) is the most marginalised in institutional discourses (DHC Class 5, under-represented LDA Topic 6) yet the most emphasised by civil society and inclusive finance actors (E07, E11). It encompasses the development of adaptive microcredit with climate shock protection mechanisms (E07), social and solidarity economy programmes in marginalised rural zones, mobilisation of the Moroccan diaspora for local development investment (E11), and community rural tourism initiatives. These social innovations constitute the safety net without which territorial resilience risks remaining a privilege of the best-resourced actors.

The sixth dimension (institutional innovations and governance renewal) concerns the transformation of territorial governance modes themselves. It is expressed through the creation of new multi-actor coordination arenas (Souss-Massa Innovation platform, E04), the emergence of innovative financing instruments such as Crédit Agricole's Filaha Vert products (E06), and attempts to bridge regional decision-making scales and field realities. This dimension nonetheless remains the most fragile and contested: interviews with institutional actors (E03, E04) reveal persistent tensions between top-down planning logics and bottom-up adaptation needs, and field actors (E02, E11) regularly point to governance dysfunctions and the deficit of effective participation by rural populations.

1.5. Discussion

The results presented in the previous section call for a discussion structured around four axes: the confirmation and extension of the conceptual framework; the specificities of the Souss resilience model and the unresolved tensions that compromise its sustainability.

1.5.1. The TRI Model Tested Against the Data: Confirmations and Enrichments

The conceptual framework proposed in Section 2, the Territorial Resilience through Innovation (TRI) model, is broadly confirmed by the empirical data, while being enriched and nuanced on several points. The model's central proposition, according to which innovation constitutes the central mechanism of evolutionary territorial resilience (Boschma, 2015; Bristow & Healy, 2014), finds convincing empirical illustration in the Soussian case: the six identified innovation dimensions attest to a real capacity of the territory to mobilise creative responses to the multiple shocks affecting it.

The distinction between the four resilience dimensions proposed by Folke et al. (2010) (absorption, adaptation, transformation, anticipation) is empirically verified, though with an uneven distribution across actors and innovation dimensions. Absorptive capacity is most developed among large export operators, who were able to cushion shocks through their financial reserves and diversified commercial networks. Adaptive capacity is most actively mobilised at the sectoral scale, particularly in the export agricultural sector. Transformative capacity, the most ambitious and most difficult, remains embryonic: it manifests in a few pioneering initiatives (large-scale desalination, social and solidarity economy models) but does not yet constitute a systemic dynamic. Anticipatory capacity, finally, remains the most deficient, revealing a tendency among actors to react to shocks rather than anticipate them.

These findings confirm and extend the conclusions of Chakir and El Moutaoukil (2021), according to which territorial governance acts as a catalyst for socio-spatial innovation. Our data show, however, that this catalytic effect is conditional: it requires inclusive multi-actor governance, effective cross-scale coordination, and mobilisation of research actors, conditions that the region partially but insufficiently meets.

On the theoretical plane, our results bring three enrichments to the TRI model. First, they highlight the importance of distinguishing actors' resilience from that of the territorial system as a whole. A territory may exhibit highly developed resilience pockets (in Souss-Massa's export segment) coexisting with zones of deep vulnerability, in the rural communes of the Anti-Atlas foothills. This intra-territorial heterogeneity of resilience is insufficiently addressed in the mainstream literature, built on cases of relatively homogeneous regional economies (Martin & Sunley, 2015). Second, our results highlight the role of financial actors as crucial vectors of innovation for resilience, a dimension the initial theoretical framework underestimated. Third, the transnational dimension of resilience, the Moroccan diaspora as a territorial resource, enriches conventional territorial economics models, which tend to conceive resilience resources as exclusively locally embedded.

1.5.2. The Soussian Model: Between Performance and Structural Fragility

Souss-Massa offers a case of territorial resilience that might be characterised as high performance under constraint: a territory maintaining remarkable economic performance levels despite, and sometimes because of, shocks of exceptional intensity. This configuration is explained by the conjunction of several structuring factors. The first is the accumulation over several decades of an exceptional territorial capital: internationally recognised agro-export know-how, dense and diversified commercial networks, entrepreneurs adept at navigating the uncertainty of globalised markets. This capital constitutes the cognitive and relational substrate from which innovations are generated and diffused (Maillat, 1995; Pecqueur, 2006).

The second factor is the role that shocks paradoxically play as accelerators. The water crisis accelerated the adoption of water-saving technologies at a pace that would not have been achieved in a context of comfortable water availability. The Covid-19 pandemic accelerated the digitalisation of commercial processes and market diversification in the export sector. The surge in energy costs accelerated the transition to solar power. This dynamic is inscribed in the Schumpeterian tradition of 'creative destruction' (Schumpeter, 1942) and confirms Birkmann's (2006) hypothesis that shocks can act as revealers and accelerators of innovation under certain conditions, notably when prior absorption and learning capacities are in place.

Yet this performance must be qualified by two persistent structural fragilities that compromise the model's sustainability. The first is the absolute physical limit represented by the water crisis. No combination of technological innovations can indefinitely compensate for a water resource deficit that exceeds the natural recharge capacity of aquifers. Desalination represents a partial solution, but one that is energetically and financially costly, whose large-scale deployment requires massive public investment and profound reform of water governance. Until these conditions are met, the territory's resilience remains propped up by a non-renewable resource whose depletion could trigger a brutal collapse of the model.

The second structural fragility is the profound inequality of resilience within the territory. The fracture between the resilient export segment and vulnerable rural economies is not an incidental development but a structural feature of a development model that has historically privileged export performance at the expense of territorial equity. This fracture represents not only a social justice problem, but also a systemic risk: a territorial resilience built on the exclusion of a large fraction of the population is fundamentally unstable, generating migratory pressures, social tensions, and an erosion of social capital that ultimately weakens the system as a whole (Adger, 2000; Cutter et al., 2008).

1.5.3. Unresolved Tensions: Governance, Equity, and Institutional Coherence

Our results highlight three major unresolved tensions constituting the principal challenges for the consolidation of Souss-Massa's territorial resilience. The first is the tension between the logic of export competitiveness and the imperatives of environmental and social sustainability. The Soussian model is

fundamentally one of insertion into global agri-food value chains, whose performance and cost-reduction logics exert permanent pressure on agricultural practices, working conditions, and water usage. Transitioning towards a more sustainable model implies a partial reconfiguration of these logics (adoption of agroecological practices, reduction of phytosanitary products, valorisation of family agriculture) which comes up against short-term competitiveness imperatives (Geels, 2004).

The second tension is that between institutional planning and bottom-up innovation. The sentiment analysis revealed a notable cognitive dissonance between the rhetorical optimism of national strategic documents and the critical diagnosis of sectoral technical reports. This dissonance reflects a deeper tension between planning institutions that construct ambitious long-term visions and field realities that evolve more rapidly and complexly than these visions anticipate. Field actors (E02, E11, E12) regularly express a sense of disconnection between official programs and their effective needs, a sentiment that the DHC objectifies through the peripheral position of Class 6 (bottom-up innovation) in the factorial space.

The third tension is that between scales of action. Territorial resilience is a multi-scalar phenomenon simultaneously constructed at local (farmer and enterprise practices), regional (Regional Council and sectoral agency strategies), national (agricultural policies, water plans, development strategies), and international (European regulations, global markets, climate financing) scales. Coordination across these scales is structurally difficult, and our data suggest that coordination deficits constitute one of the principal brakes on resilience consolidation. Regional actors (E04) complain about the lack of genuine deconcentration; small farmers (E02) bear the effects of policies designed for the export sector; and technological start-ups (E12) struggle to access national and international resources due to inadequate institutional connections.

1.6. Conclusion

This article set out to interrogate the mechanisms through which the Souss-Massa region, exposed to a dual climatic and economic vulnerability, develops innovation capacities enabling it to sustain and transform its development trajectory. Drawing on a conceptual framework articulating evolutionary territorial resilience, innovation capabilities, and territorial economics, and deploying a mixed approach combining semi-structured interviews (n=12), institutional documentary analysis (23 documents), and advanced lexicometric analysis (LDA, DHC, sentiment), this research yields several conclusions.

Empirically, six territorial innovation dimensions have been identified as resilience vectors in the region: technological innovation for water efficiency; diversification of economic models and markets; organisational and cooperative innovations; energy transition; social and solidarity innovations; and institutional governance renewal. These dimensions do not constitute a balanced system, they are traversed by a persistent fracture between a resilient export pole and a vulnerable rural periphery, but together they sketch the profile of a territory that creatively mobilises its endogenous resources to confront shocks.

Analytically, the lexicometric analysis revealed a significant institutional cognitive dissonance: national strategies adopt a confident and voluntarist register (confidence score: 0.71) while sectoral technical reports document an alarmist urgency (fear score: 0.68). This dissonance, combined with the fragmentation of discursive frameworks between the spheres of water management and regional economic development, constitutes a structural impediment to the emergence of coherent and resilient governance.

Theoretically, this research brings an empirical contribution to the literature on evolutionary territorial resilience (Boschma, 2015; Martin & Sunley, 2015) by demonstrating how this conceptual framework, developed primarily on Northern regional economy cases, can be fruitfully applied, with necessary

adaptations, to African developing territories. It also contributes to regional innovation systems theory (Cooke, 1992) by highlighting less formalised forms of innovation more deeply embedded in local practices, consistent with work on frugal innovation (Radjou et al., 2012) and inclusive innovation (George et al., 2012).

Methodologically, the combination of advanced lexicometric analysis (LDA, DHC, sentiment) with in-depth semi-structured interviews proves particularly productive: it enables transcending the respective limits of each method, the potential subjectivity of interviews and the superficiality of purely documentary analyses, to achieve a more complete and nuanced understanding of the phenomena. The identification of documentary silences through lexicometrics constitutes a particularly original methodological contribution that merits development in other contexts.

The principal limitation of this research resides in the lexicometric analysis of the institutional corpus, necessarily limited by the quality and representativeness of that corpus: some key documents could not be integrated due to accessibility constraints, which may introduce biases in the representation of institutional discourses. These limits open several research perspectives. Extending the comparative analysis to other Moroccan regions facing similar challenges (Marrakech-Safi, Drâa-Tafilalet) would be particularly fruitful for identifying what pertains to dynamics specific to Souss-Massa and what reflects more general logics of regional resilience in the Moroccan and African context. A longitudinal perspective, tracking the evolution of innovation and resilience dynamics over several years, would also enable a better apprehension of the structural transformation processes that our cross-sectional analysis can only glimpse.

1.7. References

- Adel, A., Touzani, M., & Charrad, M. (2016). Innovation in emerging economies: Insights from North African contexts. *Journal of Innovation Economics & Management*, 19(1), 3–22. <https://doi.org/10.3917/jie.019.0003>
- Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography*, 24(3), 347–364. <https://doi.org/10.1191/030913200701540465>
- Aydalot, P. (1986). *Milieux innovateurs en Europe*. GREMI.
- Bhaskar, R. (1978). *A realist theory of science*. Harvester Press.
- Birkmann, J. (2006). *Measuring vulnerability to natural hazards: Towards disaster resilient societies*. United Nations University Press.
- Blanchet, A., & Gotman, A. (2015). *L'enquête et ses méthodes : L'entretien* (2nd ed.). Armand Colin.
- Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies*, 49(5), 733–751. <https://doi.org/10.1080/00343404.2014.959481>
- Bouba-Olga, O., & Grossetti, M. (2008). Socio-économie de proximité. *Revue d'Économie Régionale et Urbaine*, 3, 311–328.
- Bourdieu, P. (1986). The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). Greenwood Press.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bristow, G., & Healy, A. (2014). Regional resilience: An agency perspective. *Regional Studies*, 48(5), 923–935. <https://doi.org/10.1080/00343404.2013.854879>
- Chakir, K., & El Moutaoukil, A. (2021). La gouvernance territoriale et l'innovation socio-spatiale. *Revue Française d'Économie et de Gestion*, 2(4).

- Christopherson, S., Michie, J., & Tyler, P. (2010). Regional resilience: Theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society*, 3(1), 3–10.
- Colletis, G., & Pecqueur, B. (1993). Intégration des espaces et quasi-intégration des firmes. *Revue d'Économie Régionale et Urbaine*, 3, 489–508.
- Cooke, P. (1992). Regional innovation systems: Competitive regulation in the New Europe. *Geoforum*, 23(3), 365–382.
- Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, 26(4–5), 475–491.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.
- Crevoisier, O. (2004). The innovative milieus approach: Toward a territorialized understanding of the economy? *Economic Geography*, 80(4), 367–379.
- Cutter, S. L., et al. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, 18(4), 598–606.
- Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning Theory & Practice*, 13(2), 299–307.
- Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods*. McGraw-Hill.
- Direction de la Météorologie Nationale. (2020). *Évolution du climat au Maroc*. DMN.
- Flyvbjerg, B. (2001). *Making social science matter*. Cambridge University Press.
- Folke, C., et al. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4), 20.
- Freeman, C. (1987). *Technology policy and economic performance: Lessons from Japan*. Pinter Publishers.
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems. *Research Policy*, 33(6–7), 897–920.
- George, G., McGahan, A. M., & Prabhu, J. (2012). Innovation for inclusive growth. *Journal of Management Studies*, 49(4), 661–683.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory*. Aldine.
- Hassink, R. (2010). Regional resilience: A promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions, Economy and Society*, 3(1), 45–58.
- Haut-Commissariat au Plan. (2022). *Monographie de la région Souss Massa*. HCP Maroc.
- Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4(1), 1–23.
- Howaldt, J., & Schwarz, M. (2010). *Social innovation: Concepts, research fields and international trends*. IMO International Monitoring.
- Lundvall, B.-Å. (1992). *National systems of innovation*. Pinter Publishers.
- Maillat, D. (1995). Territorial dynamic, innovative milieus and regional policy. *Entrepreneurship & Regional Development*, 7(2), 157–165.
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions. *Research Policy*, 41(6), 955–967.
- Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience. *Journal of Economic Geography*, 15(1), 1–42.

- Miles, M. B., & Huberman, A. M. (2003). *Qualitative data analysis* (2nd ed.). De Boeck.
- Moulaert, F., & Sekia, F. (2003). Territorial innovation models: A critical survey. *Regional Studies*, 37(3), 289–302.
- Nelson, R. R. (Ed.). (1993). *National innovation systems: A comparative analysis*. Oxford University Press.
- Ostrom, E. (1990). *Governing the commons*. Cambridge University Press.
- Pecqueur, B. (2006). Le tournant territorial de l'économie mondiale. *Espaces et Sociétés*, 124–125(2), 17–32.
- Pendall, R., Foster, K. A., & Cowell, M. (2010). Resilience and regions. *Cambridge Journal of Regions, Economy and Society*, 3(1), 71–84.
- Pike, A., Dawley, S., & Tomaney, J. (2010). Resilience, adaptation and adaptability. *Cambridge Journal of Regions, Economy and Society*, 3(1), 59–70.
- Pimm, S. L. (1984). The complexity and stability of ecosystems. *Nature*, 307(5949), 321–326.
- Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, 76(6), 77–90.
- Putnam, R. D. (1993). *Making democracy work*. Princeton University Press.
- Radjou, N., Prabhu, J., & Ahuja, S. (2012). *Jugaad innovation*. Jossey-Bass.
- Rodríguez-Pose, A., & Fitjar, R. D. (2013). Buzz, archipelago economies and the future of intermediate areas. *European Planning Studies*, 21(3), 355–372.
- Sayer, A. (2000). *Realism and social science*. SAGE Publications.
- Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. Harper & Brothers.
- Torre, A., & Rallet, A. (2005). Proximity and localization. *Regional Studies*, 39(1), 47–59.
- Torre, A., & Wallet, F. (Eds.). (2014). *Regional development and proximity relations*. Edward Elgar Publishing.
- Touzani, M., Hirsch, G., & Forget-Bourzala, M. (2015). Innovation en contexte subsaharien et maghrébin. *Recherches en Sciences de Gestion*, 107(2), 67–85.
- World Bank. (2022). *Morocco facing the water challenge*. World Bank.
- Yin, R. K. (2018). *Case study research and applications* (6th ed.). SAGE Publications.
- Zimmermann, J.-B. (1998). Nomadisme et ancrage territorial. *Revue d'Économie Régionale et Urbaine*, 2, 211–230.

Appendix 1: Semi-Structured Interview Guide

Territorial Resilience and Innovation Capabilities in the Souss-Massa Region

AXIS 1 — Territorial Diagnosis and Experience of Shocks

Q1. Can you describe how your sector has evolved over the past ten years? What changes do you consider most significant?

Q2. Have you felt the effects of climate change in your activity? Please provide concrete examples. (Follow-up prompts: water stress, droughts, modification of agricultural seasons.)

Q3. What economic shocks have particularly affected your sector? (Covid-19, war in Ukraine, input cost increases, market volatility.)

Q4. Which do you consider most threatening for the future: climate or economic shocks? Why?

AXIS 2 — Innovative Responses to Shocks

Q5. What adaptations or innovations have you implemented? What innovations have you observed in your sector or the region?

Q6. [Follow-up prompts by type]: technological innovations / organisational / commercial / social / institutional?

Q7. Describe a notable innovation — either for its success or its failure. What worked or did not work?

AXIS 3 — Conditions and Dynamics of Innovation

Q8. What facilitates or hinders the emergence of innovations in the region?

Q9. How does the circulation of knowledge and best practices work in your sector?

Q10. Is access to financing an obstacle to innovation? What sources are available and what are their limitations?

AXIS 4 — Role of Institutions and Public Policies

Q11. How do you evaluate the role of regional and national institutions in supporting innovation?

Q12. Do the major strategies (Génération Green, National Water Plan) seem adapted to the realities of Souss-Massa?

Q13. What is missing for more effective territorial governance in the face of shocks?

AXIS 5 — Perspectives and Foresight

Q14. How do you see the future of the region at a ten to fifteen-year horizon? Optimistic, pessimistic, and intermediate scenarios?

Q15. Are there insufficiently valorised resources or potentials? Could the region become a model for other African territories?

Q16. Are there important aspects we have not addressed?

Note: Interviews of 60–120 minutes, conducted with explicit recording consent. Full transcription and field notes within 24 hours. Anonymisation guaranteed on request.