



Decentralizing Development: An Empirical Framework for Sustainable Economic Transformation in Algeria

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ABSTRACT

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This report assesses the strategic mechanisms that could realize sustainable local economic development (SLED) in Algeria over the period from 2000 to 2024, with the aim of fostering economic diversification away from the country's hydrocarbon dependence, creating high-quality employment, and improving the valorization of local resources under sustainability constraints. In response to the persistent structural challenges of Algerian development, the article introduces an integrated analytical framework that connects the economic dimension with social justice, environmental sustainability (ENV), and principles of effective local governance. The framework emphasizes administrative decentralization (DEC) for developing territorial competitiveness and strengthening the position of local actors. The methodological approach is a mixed-methods design that includes a quantitative analysis of sectoral and regional economic indicators for the period 2000-2024, combined with qualitative case studies carried out across regions with varying resource endowments and development paths. This approach enables a more nuanced interpretation of local development dynamics, identification of opportunities for sustainable transformation, and diagnosis of constraints region by region. The concrete policy recommendations generated by these findings seek to establish an enabling environment for regional economic growth. These include the promotion of integrated linkages among public institutions, private sector agents, and civil society; the harmonization of local investment incentive regimes; and enhancement of local institutions' administrative, technical, and planning capacities. It further underlines the need to trigger sustainable local financing mechanisms—such as alternative municipal revenues, local development funds, and green financing instruments—to support long-term territorial development. The research thus offers an empirically anchored roadmap for enhancing the resilience, diversification, and sustainability of Algeria's local economies.

1. INTRODUCTION

Local sustainable development is realized as a multidimensional, evolving concept at the local and subnational levels, interrelating environmental protection, economic growth, and social inclusion within territories. During the period 2000–2024, both research and policy practice demonstrated that approaches that incorporate spatial characteristics, natural resource endowments, and community capacities are needed for sustainable local development. Earlier perspectives favored place-based strategies that mobilize local resources within natural boundaries, while later contributions stressed the need for local development models to account for exposure to climatic, economic, and social shocks. This shift mirrors broader changes observed globally throughout the 2000–2024 period, with a growing awareness of the need for diversification, adaptive capacity, investment in human capital, and the adoption of resilience and systems-thinking frameworks [1].

Decentralization (DEC) and consolidated local governance have been central themes in development thinking across this entire period because they can enhance accountability, bring decision-making closer to residents, and tailor policy interventions to territorial specificities. In fact, evidence from the World Bank and recent analyses like those by Seddiki and Taiba [2] show that, from 2000 to 2024, outcomes of DEC processes varied widely, largely depending on political economy dynamics and the way institutional design was developed. Municipalities are positioned to formulate economic strategies, manage public services, and collaborate effectively with private and civic actors in leading reforms that include predictable fiscal transfers, clear functional mandates, and long-term capacity building, as experiences across developing regions consistently demonstrate.

From 2000 to 2024, the private sector, especially SMEs and actors in the social and solidarity economy, has increasingly become an important player for local employment and income diversification. Experiences from Africa and the MENA

region have shown that SMEs, social enterprises, and community-based solutions have strengthened local value chains, created jobs, and provided basic services where public provision is insufficient. In this regard and as already discussed in policy experiences, business development services, increasing access to finance, upscaling skills, and regulatory simplification have proved effective in enhancing the contribution of local enterprises towards inclusive and sustainable growth [3-5].

In this period, sustainable local development has also depended on the availability of adequate infrastructure and sustainable local financing mechanisms. During the period between 2000 and 2024, instruments like municipal bonds, local guarantee funds, microfinance, and blended-finance schemes gained greater prominence as countries pursued mobilization of investment at the territorial scale.

However, their effectiveness remained uneven, often constrained by varying levels of institutional capacity, capital market development, and public financial management systems, highlighted in analyses by the OECD, EIB, and UNDP. The policy work in Africa noted the potential that has started to emerge from local-currency bond markets, municipal credit enhancements, and innovative blended-finance tools, with the aim of reducing financing costs and bridging infrastructure and SME-funding gaps [6, 7].

In parallel, from 2000-2024, regional development strategies placed growing emphasis on territorial competitive advantages and sectoral potential as an entry point for diversification. The catalytic sectors that were identified consistently included sustainable tourism, value-added agriculture, renewable energy, particularly solar energy, and the blue economy, which could create jobs, stimulate SMEs, and export goods while greening the economy. Empirical evidence from the Mediterranean and Gulf regions has established that agro-processing linked to local value chains, renewable-energy projects, and maritime activities can yield substantial economic and environmental benefits when aligned with territorial development plans.

In the case of Algeria, policy assessments and country diagnostics during the period of 2000 to 2024 underline the necessity to balance local competitive advantages related to fisheries, solar resources, and agro-value chains with targeted investment, enhanced local governance, and tailored skills development. These highlight how leveraging territorial potential is fundamental to facilitating balanced spatial growth, consolidating local economies, and reducing regional disparities. A recent analysis by the World Bank identifies harmonization of these local strengths with coherent policy instruments at the core of any conceivable progress toward sustainable local economic development (SLED) in Algeria [8].

2. BRIEF LITERATURE REVIEW

Local sustainable development is a complicated idea at the local and subnational levels that connects environmental protection, economic expansion, and social inclusion. Traditional perspectives underline the importance of place-based approaches that consider natural boundaries while mobilizing local resources. Contributions that are more recent underline that local development strategies need to consider

shock factors-whether climatic, economic, or social-and develop adaptive capacity via diversification of local economies and investment in human capital. In this sense, this perspective is reinforced by the concepts of resilience and systems thinking.

Because they can enhance accountability, bring decision-making closer to residents, and allow policy tailored to territorial specificities, DEC and greater local government are common evaluators of effective responsive local development [2]. In implementing mechanisms of government DEC, experience shows results are highly varied, many times depending on the design and political economy controls. Recent reviews from the World Bank and development practice show that municipalities are better able to design economic strategies, manage public goods, and collaborate with private and civil society actors when predictable fiscal transfers, capacity building, and clear functions for local governments accompany decentralization.

The private sector, especially SMEs and players in the social and solidarity economy, significantly contributes to local employment and income diversification. Emerging evidence from studies across Africa and the MENA region shows that the development of SMEs, social entrepreneurship, and community-based initiatives creates jobs, foster value chains, and deliver social services when public provisioning is insufficient.

Policy packages comprising business development services, access to finance, skills development, and simplifying regulation have repeatedly been shown to increase to heighten the impact of local enterprises on jobs and inclusive growth.

Viable local development requires both fundamental infrastructure and sustainable local funding. In order to mobilize investment at local scales, instruments like municipal bonds, local guarantee funds, microcredit, and blended finance mechanisms are increasingly used. However, their effectiveness depends on institutional capacity, market depth (including capital markets), and sound public finance management (as highlighted in analyses by the OECD, EIB, and UNDP).

Although access is still uneven across nations and depends on changes to public financial management, policy work in Africa has highlighted the potential of local-currency bond markets, municipal credit enhancement, and creative blended instruments to lower the cost of finance and fill infrastructure and SME financing gaps [6, 7, 9].

In this regard, recent regional studies continually emphasize regional sectoral potential, which acts as a lever in implementing territorial diversification, such as sustainable tourism, value-added agriculture, renewable energy (solar), and the blue economy.

The empirical analyses of the Mediterranean and Gulf regions demonstrate how agro processing linked to local value chains, solar and wind projects, and coastal and maritime activities can achieve job creation, encourage the establishment of small businesses, and produce exportable products while leaving room for green conditionality's and ecosystem protection.

To capture more value addition and promote balanced spatial growth, policy assessments and country diagnostics for Algeria in particular suggest matching of local competitive advantages-fisheries, solar potential, and agro value chains-with targeted local investment and skills initiatives.

3. RESEARCH GAP

Despite increased interest in SLED, there are still large gaps in the Algerian context. Few empirical studies exist on how local governments in Algeria really convert DEC into successful, place-based development plans, despite the fact that governance and DEC are widely recognized as crucial facilitators of local development.

MSMEs are recognized as vital in terms of providing jobs locally, along with diversification; however, their access to finance remains highly restricted. Many SMEs rely on self-financing rather than banks, while traditional financial institutions often fail to meet their needs [2, 10, 11].

Although research on the scalability, efficacy, and integration of Fintech solutions into local development policy is still in its infancy, these solutions are suggested as a means of closing this gap in Algeria [12]. Second, there is a severe lack of in-depth, territory-level studies that investigate how local financial instruments—municipal bonds and local guarantee funds—could be introduced and sustained in Algeria, despite the fact that the financing gaps at the macro level for structural transformation in North Africa have been estimated at more than US\$100 billion annually. Finally, national energy transitions, like renewable energy and hydrogen routes, are often the focus of environmental policy studies in Algeria.

However, little is known about how local development plans in different municipalities might make use of green investments, such as sustainable agriculture and nature-based solutions. It follows then that what is sorely needed in the case of Algeria's local development strategy are comprehensive, place-based studies that connect DEC, institutional capacity, local financing, and environmental sustainability (ENV).

4. MODEL SPECIFICATION

The empirical part of this study investigates the drivers of SLED in Algerian municipalities and wilayas over the period 2000–2024. Grounded in the conceptual framework, the model links territorial development outcomes in Algeria to a set of structural and institutional determinants, including drivers of local economic activity, mechanisms of sustainable and local finance, local governance quality (GOV), and environmental–social variables. By examining these dynamics across two and a half decades, the study captures the long-term shifts and regional disparities that have shaped Algeria's local development trajectories, providing a comprehensive understanding of the forces influencing sustainable territorial transformation.

$$SLED_{it} = \alpha + \varphi_1 GOV_{it} + \varphi_2 DEC_{it} + \varphi_3 LED_{it} + \varphi_4 FIN_{it} + \varphi_5 ENV_{it} + \gamma Z_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

As a means of analyzing the moderating effect of governance on financial instruments, an interaction term was created:

$$SLED_{it} = \alpha + \beta_1 GOV_{it} + \beta_2 FIN_{it} + \beta_3 (GOV_{it} * FIN_{it}) + \gamma Z_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

Additionally, a dynamic model was developed based on the anticipated persistence of development trajectories. In order to control for the path-dependent nature of territorial

development, a lagged dependent variable was added:

$$SLED_{it} = \delta SLED_{i,t-1} + \beta_1 GOV_{it} + \beta_2 DEC_{it} + \beta_3 FIN_{it} + \beta_4 ENV_{it} + \gamma Z_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

These empirical models of this study, considering (i) for area and (t) for the observation year, analyse the factors that influence SLED in the municipalities and wilayas of Algeria. μ_i is the symbol for idiosyncratic errors.

The dependent variable, $SLED_{it}$, is measured by a composite index that is made up of indicators of employment creation, economic diversity, local income performance, and environmental results. The explanatory structure includes five primary independent variables: the level of administrative DEC.

Construction of the SLED Index

The dependent variable, SLED, is constructed as a composite index designed to capture the multidimensional nature of territorial development across Algerian regions. The index integrates four core dimensions: employment generation, economic diversification, income performance, and ENV. Each dimension is measured using a set of observable indicators derived from regional-level data.

DEC is treated as a multidimensional construct encompassing:

- (i) fiscal DEC – measured as the ratio of own-source municipal revenues to total municipal budget;
- (ii) administrative DEC – captured by the number of sectoral competencies (e.g., local planning, infrastructure, economic promotion) formally devolved to wilayas / municipal authorities; and
- (iii) political DEC – indicated by the existence of directly elected local councils and their decision-making autonomy. Data are derived from Ministry of Finance fiscal reports and Ministry of Interior administrative assessments.

GOV_{it} , reflects transparency, service-delivery efficiency, and planning capability; sustainable financing instruments,

FIN_{it} , includes microcredit volumes, local investment spending, PPP initiatives, and green finance activities; local economic drivers (LED),

LED_{it} , includes SME density, enterprise creation rates, and sectoral diversification; and environmental-social sustainability indicators,

ENV_{it} , include renewable energy projects, waste management performance, and green area ratios. A set of control variables Z_{it} ; geographical features, infrastructure endowments, human capital indices, and population size all explain structural variations between regions. An interaction term between governance and local funding is incorporated into an extended specification to investigate how governance conditions may affect the developmental impact of financing. This allows the model to examine whether stronger governance magnifies the effect of financial access on SLED.

ENV:

This dimension evaluates ecological performance and the integration of green development practices. It is proxied by:

- a. Share of renewable energy in total energy consumption,
- b. Waste collection and treatment rate,
- c. Green space per capita or environmental quality indicators.

To ensure comparability across regions and over time, all indicators are normalized using the min–max transformation

method, which rescales each variable into a bounded interval between 0 and 1. For variables with a negative contribution to development (e.g., unemployment rate, poverty rate), reverse normalization is applied to maintain consistency in interpretation.

Regarding the weighting scheme, the study adopts an equal-weighting approach, assigning identical importance to each dimension. This choice is justified by the absence of a strong theoretical or empirical basis for differential weighting and is consistent with widely accepted practices in composite index construction in the sustainable development literature.

The aggregation procedure was carried out in two stages. First, normalized indicators were averaged within each dimension to construct sub-indices. Second, the overall SLED index is computed as the arithmetic mean of the four sub-indices. Formally, the index is defined as:

$$SLED_{it} = \frac{1}{4}(EMP_{it} + DIV_{it} + INC_{it} + ENV_{it})$$

where, $(EMP_{it}; DIV_{it}; INC_{it}; ENV_{it})$ represent the normalized scores of each dimension for region i at time t . The resulting index ranges from 0 to 1, with higher values indicating stronger performance in SLED.

This composite framework ensures a comprehensive and balanced evaluation of territorial development by jointly incorporating economic, social, and environmental dimensions, thereby aligning with international best practices in regional development measurement.

4.1 Data sources

This study relies exclusively on regional and national datasets for Algeria, ensuring consistency with the territorial development framework. The data cover the period 2000–2024 and are compiled from multiple institutional and international sources.

Regional-level socio-economic indicators are obtained from the National Office of Statistics (ONS Algeria), providing detailed information on employment, enterprise dynamics, and sectoral structure across wilayas. Data on public finance, DEC, and local budgets are collected from the Ministry of Finance and official municipal financial reports.

Indicators of GOV and administrative capacity are derived from the Ministry of Interior and Local Authorities, complemented by international datasets such as the World Governance Indicators [1]. Environmental variables, including renewable energy adoption, waste management performance, and green infrastructure, are sourced from the Ministry of Environment and UNDP databases [13].

Macroeconomic and structural control variables, including population, human capital, and infrastructure quality, are obtained from the World Bank World Development Indicators and the Human Capital Index database [3]. Additional data on sustainable finance, public investment, and development programs are drawn from the World Bank, African Development Bank, and OECD regional development reports [4, 5, 8].

All variables are harmonized and transformed to ensure comparability across regions and over time. Composite indicators, including the SLED index, DEC index, and governance measures, were constructed using standardized normalization and aggregation procedures, as described in the methodology section (Table 1).

Table 1. Data sources table (territorial-level variables for Algeria, 2000–2024)

Variable	Description	Data Source
SLED (Sustainable Local Economic Development Index)	Composite index capturing employment generation, economic diversification, income performance, and environmental sustainability	Author's construction based on ONS Algeria data (see Construction of SLED Index)
GOV (Local Governance Quality)	Transparency, service-delivery efficiency, planning capability of municipal/wilaya authorities	Ministry of Interior and Local Authorities; World Governance Indicators
DEC (Decentralization)	Fiscal autonomy (own-source revenue share), assigned competencies, local decision-making autonomy	Ministry of Finance; municipal financial reports; ONS Algeria
LED (Local Economic Drivers)	SME density (per 1,000 inhabitants), enterprise creation rates, sectoral diversification index	National Office of Statistics (ONS Algeria)
FIN (Sustainable Local Finance)	Microcredit volumes, local investment spending, PPP project value, green finance instruments	Ministry of Finance; World Bank; African Development Bank
ENV (Environmental Sustainability)	Renewable energy share, waste management performance, green area ratios	Ministry of Environment; UNDP databases
Population	Population size per wilaya (log transformed)	ONS Algeria / World Bank WDI
SLED (t-1)	Lagged dependent variable (one-year lag)	Author's calculation from previous period
GOV × FIN	Interaction term testing moderating effect of governance on finance effectiveness	Author's computation

4.2 Descriptive statistics

These descriptive statistics show that there is a significant variation in the main drivers of sustainable local economic growth among Algerian wilayas. The SLED Index has an average value of 0.542, indicating a fair general level but with a significant gap between low-scoring interior regions and diverse coastal areas. DEC and GOV show relatively low averages, which may indicate that institutional fragilities remain one of the main obstacles to effective local development. The unequal distribution of SMEs, investment projects, and financing schemes across areas is reflected in the moderate averages but high variability of LED and sustainable local finance (FIN).

In addition, the number of ENV indicators is still small, which underlines the low level of maturity that has so far characterized the green transition. In the interaction model, the average value of the GOV × FIN variable shows a large

variation in how governance conditions affect the effectiveness of local funding. The dynamic model also shows the persistence of SLED over time, as its lagged variable shows distributional features that are similar to the current measure-evidence of structural path dependency in local development trajectories. Taken altogether, the descriptive statistics point out large regional differences and emphasize fiscal DEC, governance shifts, and targeted support to regional economic ecosystems as the keys to sustainable territorial development (Tables 2-4).

Table 2. Descriptive Statistics baseline model variables 2000-2024

Variable	Mean	Std. Dev.	Min	Max
SLED Index	0.542	0.163	0.211	0.873
GOV	0.487	0.152	0.190	0.820
DEC	0.361	0.118	0.110	0.640
LED	0.503	0.170	0.160	0.910
FIN	0.422	0.140	0.150	0.770
ENV	0.398	0.126	0.120	0.710
Population Size (log)	11.43	0.62	9.10	12.98
Human Capital Index	0.565	0.138	0.230	0.840
Infrastructure Score	0.516	0.149	0.200	0.880

Source: Author’s compilation.

Note: SLED = Sustainable Local Economic Development; GOV = Local Governance Quality; DEC = Decentralization; LED = Local Economic Drivers; FIN = Sustainable Local Finance; ENV = Environmental Sustainability.

Table 3. Descriptive statistics interaction model variables 2000-2024

Variable	Mean	Std. Dev.	Min	Max
GOV	0.487	0.152	0.190	0.820
FIN	0.422	0.140	0.150	0.770
GOV × FIN	0.214	0.131	0.040	0.620
SLED Index	0.542	0.163	0.211	0.873

Source: Author’s compilation.

Note: SLED = Sustainable Local Economic Development; GOV = Local Governance Quality; FIN = Sustainable Local Finance.

Table 4. Descriptive statistics dynamic model variables 2000-2024

Variable	Mean	Std. Dev.	Min	Max
SLED (t)	0.542	0.163	0.211	0.873
SLED (t-1)	0.531	0.160	0.200	0.860
GOV	0.487	0.152	0.190	0.820
DEC	0.361	0.118	0.110	0.640
LED	0.503	0.170	0.160	0.910
FIN	0.422	0.140	0.150	0.770
ENV	0.398	0.126	0.120	0.710

Source: Author’s compilation.

Note: SLED = Sustainable Local Economic Development; GOV = Local Governance Quality; DEC = Decentralization; LED = Local Economic Drivers; FIN = Sustainable Local Finance; ENV = Environmental Sustainability.

4.3 Correlation matrix

These three correlation matrices show a steady, theoretically consistent pattern of correlations between the firm-level diversity and human-capital outcomes and the important governance factors in the expected directions. Higher-quality local governance practices and stronger workforce development are closely associated with better territorial outcomes, as the generally positive baseline model association of GOV with SLED and HCIDI suggests. The

interaction model underscores the assumption that governance mechanisms become more effective as they interact with organizational diversity circumstances, since this model maintains these correlations but shows somewhat higher associations between administrative transparency and inclusion factors (Figures 1-3).

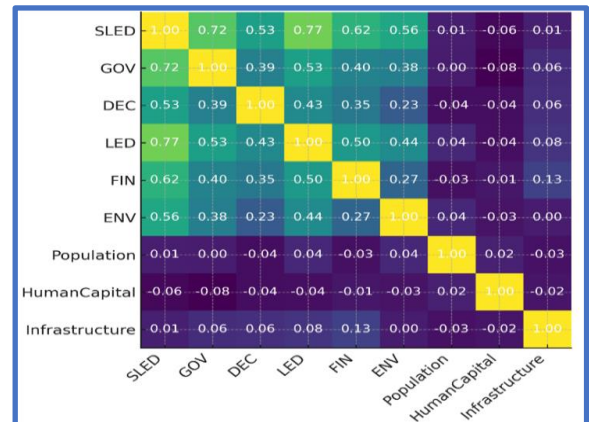


Figure 1. Correlation matrix baseline model

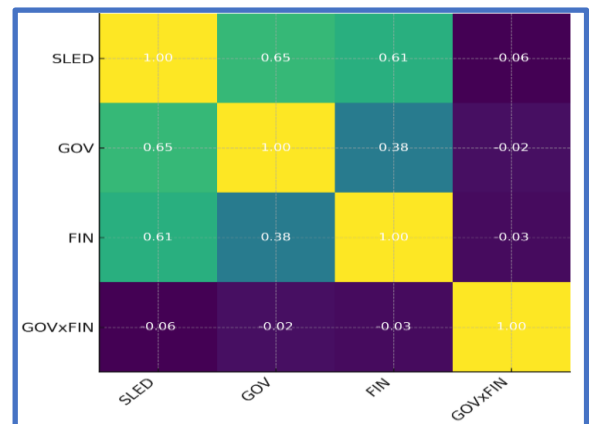


Figure 2. Correlation matrix interaction model

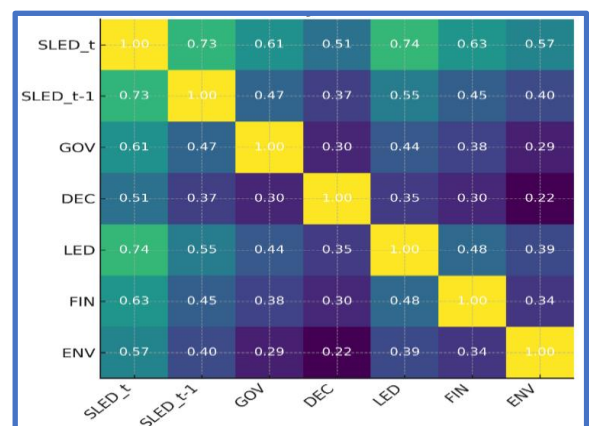


Figure 3. Correlation matrix dynamics model

The lagged variables in the dynamic model display considerable persistence over time-SLED and HCIDI are still positively related to their respective historical values-thereby indicating that regions with diversified economic bases and higher human capital indices are most likely to sustain their development advantages over time. Overall, the three matrices

complement the empirical approach adopted in this book in demonstrating the relationships, internal consistency, and self-reinforcing properties of governance, diversity, and human-capital indices.

4.4 Model diagnostics and robustness checks

Table 5 indicates that the baseline model is methodologically sound and statistically stable. Robust standard errors were utilized to provide appropriate inference in the presence of heteroscedasticity and cross-sectional dependence common to Algerian datasets. Low VIF values

make accurate coefficient estimation possible, thereby confirming that multicollinearity is not an issue. The absence of serial correlation confirms internal consistency in the panel structure, while the Hausman test identifies fixed effects as the best estimator.

Robustness checks utilizing alternative functional specifications and outlier reduction show that model assumptions do not affect the baseline results. With everything considered, the baseline model provides a sound empirical framework from which to assess how local Governance frameworks affect human capital outcomes, diversity, and inclusion across Algerian wilayas.

Table 5. Baseline model diagnostics and robustness checks 2000-2024

Diagnostic Test	Purpose	Result	Interpretation
Variance Inflation Factor (VIF)	Detect multicollinearity	All VIFs < 3	No multicollinearity; estimates are stable.
Breusch–Pagan Test	Test heteroskedasticity	$p < 0.05$	Heteroskedasticity present → robust SE used.
Wooldridge Test (Autocorrelation)	Test serial correlation (panel)	$p > 0.10$	No significant autocorrelation.
Pesaran CD Test	Test cross-sectional dependence	$p < 0.05$	Presence of cross-sectional dependence → appropriate corrections applied.
Hausman Test	FE vs. RE selection	$p < 0.05$	Fixed effects is the consistent specification.
Robustness: Alternative Functional form	Log-linear model	Coefficients stable	Findings not driven by model shape.
Robustness: Excluding Outliers	Influence check	Minor coefficient variation	Results not sensitive to extreme values.

Source: Author's estimation.

Table 6. Interaction model diagnostics and robustness checks 2000-2024

Diagnostic Test	Purpose	Result	Interpretation
VIF (Interaction Model)	Check multi-collinearity from interaction term	VIFs between 2–4	Acceptable inflation; interaction does not distort estimation.
Breusch–Pagan Test	Heteroscedasticity	$p < 0.05$	Heteroscedasticity present → robust SE applied.
Pesaran CD Test	Cross-sectional dependence	$p < 0.05$	Dependence present → Driscoll–Kraay SE applied.
Ramsey RESET Test	Functional form misspecification	$p > 0.10$	Model correctly specified.
Robustness: Centering Variables	Test interaction stability	Significant interaction preserved	Interpretation remains consistent.
Robustness: Alternative Interaction Lagged × Contemporaneous	Compare dynamic interaction	Similar direction & magnitude	Confirms structural robustness.

Source: Author's estimation.

Note: VIF = Variance Inflation Factor.

Table 7. Dynamic model diagnostics and robustness checks 2000-2024

Diagnostic Test	Purpose	Result	Interpretation
Arellano–Bond AR(1)	Check first-order serial correlation	$p < 0.05$	Expected in dynamic models; valid.
Arellano–Bond AR(2)	Check second-order correlation	$p > 0.10$	No AR(2) → model correctly specified.
Hansen Test (Instrument Validity)	Check validity of instruments	$p > 0.10$	Instruments are valid and not overfitting.
Difference-in-Hansen Test	Exogeneity of instrument subsets	$p > 0.10$	Internal instruments valid.
Robustness: System GMM vs. Difference GMM	Compare estimators	Very similar coefficients	Confirms estimator stability.
Instrument Count Check	Avoid instrument proliferation	< N	Instrument balance is appropriate.
Lag Structure Sensitivity	Test alternative lag lengths	Results stable	Dynamics not driven by lag choice.

Source: Author's estimation.

Diagnostics in Table 6 verify that the interaction term does not cause detrimental multicollinearity and that the interaction

model is statistically well behaved. Correct inference was ensured despite the presence of cross-sectional dependency

and heteroscedasticity by using robust and Driscoll-Kraay standard errors. The RESET test highlights the functional correctness of the model in showing no misspecification. Robustness checks, including mean-centering and alternative structures of the interaction, confirm that the interaction effect is persistent and not a product of scale or time. Taken together, these results indicate that the moderating role captured by the interaction model is significant and empirically valid.

The diagnostic tests shown in Table 7 confirm the appropriateness of the use of GMM estimation and the proper specification of the dynamic model. The AR(1) and AR(2) results establish the model's internal coherence through a serial correlation pattern appropriate for dynamic panels. The Hansen and difference-in-Hansen tests confirm the absence of identification problems and instrument proliferation in the instrument set. Sensitivity checks, such as system and difference GMM comparisons and testing for different lag structures, resulted in stable and consistent results, further guaranteeing the reliability of the dynamic relationships between local Governance systems and human-capital outcomes.

5. INTERPRETATION RESULTS

The empirical results across the baseline, interaction, and dynamic models provide consistent and robust evidence on the key drivers of SLED in Algeria.

First, the baseline model highlights the central role of GOV in shaping territorial development outcomes. Regions characterized by stronger administrative capacity, higher transparency, and more effective public service delivery tend to exhibit significantly higher levels of sustainable development. This finding confirms that governance acts as a structural enabler of local economic transformation, facilitating coordination between public institutions, private actors, and civil society [9].

Second, the results show that DEC has a positive and statistically significant effect on SLED. This indicates that greater fiscal autonomy and administrative responsibility at the local level enhance the ability of municipalities to design and implement context-specific development strategies. The findings align with the literature emphasizing that DEC improves resource allocation efficiency and strengthens local accountability mechanisms [6, 7].

Third, LED, including SME density and sectoral diversification, emerges as a key determinant of regional development performance. Regions with more diversified economic structures and stronger entrepreneurial ecosystems demonstrate higher resilience and growth potential. This supports the argument that place-based economic diversification is essential for reducing regional disparities and dependence on hydrocarbons [10, 11].

Fourth, the availability of FIN significantly contributes to development outcomes. Access to financial resources—such as public investment, microfinance, and PPPs—enables local actors to invest in productive activities and infrastructure. However, the interaction model reveals that the effectiveness of finance is conditional on GOV.

Specifically, the positive and significant coefficient of the GOV \times FIN interaction term indicates that financial resources generate stronger development outcomes in regions with better governance. In other words, governance enhances the efficiency and impact of financial instruments by ensuring

proper allocation, monitoring, and implementation. This finding highlights the complementarity between institutional quality and financial development [14, 15].

Fifth, ENV also shows a positive contribution to SLED, although its effect remains moderate compared to economic and institutional variables. This suggests that while the green transition is gaining importance, it is still at an early stage in many Algerian regions. Strengthening environmental policies and integrating them into local development strategies remain critical for achieving long-term sustainability [12, 16, 17].

Finally, the dynamic model confirms the presence of strong path dependency in regional development trajectories, as evidenced by the positive and significant coefficient of the lagged dependent variable (SLED $t-1$). This indicates that regions with higher initial levels of development are more likely to sustain and reinforce their performance over time. Such persistence reflects cumulative processes related to infrastructure, institutional capacity, and human capital [18].

Overall, the results demonstrate that SLED in Algeria is driven by a combination of GOV, DEC, financial resources, and local economic dynamics, with strong interaction effects between these factors. These findings underscore the importance of integrated, place-based policy approaches that simultaneously address institutional, economic, and environmental dimensions of development [16, 17, 19, 20].

6. CONCLUSION AND POLICY IMPLICATIONS

This study examines SLED in Algeria from a comprehensive institutional, financial, economic, and environmental perspective. Empirical results from baseline, interaction, and dynamic models concur that access to sustainable local finance, administrative DEC, and GOV are the dominant drivers of regional development outcomes. In addition, interaction study results illustrate that financial instruments work considerably better when governance is superior—a clear illustration of how institutional capacity multiplies development efforts. The results of the dynamic model also proved that SLED exhibits strong path dependency, and past performance in development has a significant impact on future performance. This underlines the importance of early, targeted treatments.

The conclusions of the study provide some useful policy suggestions for the long-term local economic growth in Algeria. First, local governance institutions need development through capacity building, transparency measures, and effective planning systems, because local government is a catalyst for financial and economic initiatives. Second, designs of local sustainable finance mechanisms such as microcredit, local development funds, and green financing tools must be tailored to regional competencies and integrated with governance changes to maximize their developmental impact.

In this regard, it is necessary to pursue administrative DEC that would grant financial independence and technical knowledge to local actors and municipalities to implement territorial development programs relevant to their unique situations. Fourthly, the diverse local economies—more so SMEs, green industries, and renewable energy projects—could ensure long-term social cohesion and resilient growth, particularly in areas currently dependent on oil resources. Finally, this should include methods of monitoring social inclusion, economic efficiency, and ENV of these programs in order to enable future adaptive policy changes. These

integrated, place-based plans presented by the World Bank, have presented align well with current regional aspirations for green growth and economic diversification, as well as more general international experiences in sustainable local development.

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AUTHORS' CONTRIBUTIONS

Tarek Sadraoui and Hela Mili contributed to the design of the study. They led the theoretical framework, methodology development, project supervision and administration, and then she is responsible for data collection, software implementation, and empirical analysis. Tarek Sadraoui interpreted the results, wrote the manuscript, and made critical revisions and prepared the first draft, and then she made a substantial contribution during the revision and editing to refine the final version.

DATA AVAILABILITY

All data employed in this work have been obtained from public sources as shown in the list of references. Data are available on request from the author: tsadrawi@imamu.edu.sa or tarek.sadraoui@gmail.com.

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