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Scientific Research in Geography in Morocco: Origins, Challenges and Perspectives

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Abstract: Geographical research in Morocco plays a strategic role in understanding territorial transformations, urban expansion, rural migration, and climate-related challenges. Since the colonial period, the discipline has evolved from descriptive mapping to an applied science integrated within national universities. Moroccan geographers have contributed to sustainable resource management, urban planning, and major development projects, linking scientific knowledge with public policy. Despite these advances, the field faces structural, financial, and methodological constraints, limiting its international visibility and practical impact.

The adoption of digital tools such as GIS, remote sensing, and artificial intelligence has enhanced predictive and analytical capacities. Future development depends on methodological innovation, multidisciplinary collaboration, and innovative funding mechanisms. Strengthening international networks and improving training programs are essential to align research with societal needs. Applied skills and digital competencies will empower graduates to support territorial governance and sustainable development. Overall, Moroccan geography is poised to address contemporary environmental, social, and digital transitions while promoting spatial justice.

Keywords: Geography in Morocco, Digital transformation, Remote sensing and GIS, Educational reform, Sustainable territorial development.

الملخص: يحتل البحث الجغرافي في المغرب دورا استراتيجيا في فهم التحولات المجالية، والتوسع الحضري، والهجرة القروية، والتحديات المرتبطة بالتغير المناخي. منذ الحقبة الاستعمارية، تطورت الجغرافيا من علم وصفي يركز على الخرائط إلى علم تطبيقي متكامل ضمن الجامعات الوطنية. حيث أسهم الجغرافيون المغاربة في تدبير الموارد الطبيعية المستدامة، والتخطيط الحضري، ومشاريع التنمية الكبرى، مع ربط المعرفة العلمية بالسياسات العمومية. ورغم

هذه الإنجازات، يواجه المجال إكراهات هيكلية ومالية ومنهجية تحد من إشعاعه الدولي وفاعليته العملية.

كما ساهمت أدوات التحول الرقمي، مثل نظم المعلومات الجغرافية، والاستشعار عن بعد، والذكاء الاصطناعي، في تعزيز القدرات التنبؤية والتحليلية. وهكذا يعتمد المستقبل على الابتكار المنهجي، والتعاون متعدد التخصصات، وتعبئة آليات تمويل مبتكرة. كما أن تعزيز الانفتاح على الشبكات العلمية الدولية وتحسين برامج التكوين ضروري لمواءمة البحث مع حاجيات المجتمع. ستمكن المهارات التطبيقية والكفاءات الرقمية الخريجين من دعم الحكامة الترابية والتنمية المستدامة. بوجه عام، تتجه الجغرافيا المغربية لتلبية التحولات البيئية والاجتماعية والرقمية، مع المساهمة في تعزيز العدالة المجالية.

الكلمات المفاتيح: الجغرافيا في المغرب، التحول الرقمي، الاستشعار عن بعد ونظم المعلومات الجغرافية، إصلاح التعليم، التنمية الترابية المستدامة.

Introduction

Scientific research in geography in Morocco occupies a strategic position in understanding territorial dynamics and the complex interactions between society and the environment. Emerging in a context marked by national development and spatial planning challenges, geographical research has gradually established itself as a key field of analysis and decision support for public authorities. However, despite its undeniable potential, it continues to face several structural, institutional, and methodological constraints that limit its impact and visibility within the national research system.

The central problematic addressed in this article is the following: To what extent does scientific research in geography in Morocco succeed in reconciling its academic foundations with the practical needs of territorial development? In other words, how can this discipline renew its approaches, tools, and fields of investigation to effectively respond to the rapid transformations of Moroccan territories?

To answer this question, the study adopts an analytical and critical methodology, combining a review of recent academic works, an institutional analysis of research frameworks, and a reflective observation of the main trends shaping Moroccan geographical production. This approach aims to highlight the main patterns of scientific output, identify the obstacles hindering progress, and explore possible avenues for renewal.

The objectives of this article are threefold:

• To trace the origins and major evolutionary stages of geographical research in Morocco;

• To identify and analyze the current challenges that constrain its scientific and institutional development;

• To propose perspectives and strategies that could strengthen the role of geography in national research and in territorial policy-making.

Through this reflection, the article seeks to contribute to a deeper understanding of the role, limits, and future directions of geographical research in Morocco, positioning it as a discipline that supports both knowledge production and sustainable territorial development.

I. Genesis and Trajectory of Geographical Research in Morocco

The history of geographical research in Morocco cannot be understood without revisiting its historical and intellectual foundations. Since its introduction during the colonial period, the discipline has undergone a gradual process of institutionalization before opening up to diverse paradigms that reflect the country's socio-economic and territorial transformations. This trajectory highlights a discipline in constant adaptation, oscillating between colonial legacies, national needs, and scientific innovations.

1-1 Colonial Origins and Early Scientific Anchors

The emergence of scientific geography in Morocco cannot be dissociated from the colonial dynamics that shaped its formation. Before the establishment of the French Protectorate in 1912, several reconnaissance and espionage missions were already conducted on Moroccan soil by European explorers, notably French officers such as Charles de Foucauld in the late nineteenth century. These early expeditions, which combined geographical observation with strategic and military objectives, laid the groundwork for the later territorial knowledge that would serve colonial ambitions.

With the formal installation of the Protectorate, colonial authorities launched extensive cartographic and topographic surveys of the country, accompanied by systematic studies of its natural resources. These efforts were primarily oriented toward military control and economic exploitation, particularly through the inventory of soils, water reserves, and agricultural potential. Geography thus emerged as a science in the service of colonial administration, seeking to rationalize spatial domination and optimize the exploitation of strategic regions.

However, despite its instrumentalization, this colonial production laid the methodological and technical foundations of modern geographical research in Morocco. The mapping techniques, field survey methods, and analytical tools developed during that period were later re-appropriated and reinterpreted by Moroccan scholars in the post-independence era. In this sense, the colonial legacy simultaneously represented an ideological constraint and a technical springboard for the subsequent institutional and scientific development of geography in Morocco.

1-2 Institutionalization after Independence

Following independence in 1956, geography progressively became integrated into Morocco's national university system. The creation of the Faculty of Letters and Human Sciences in Rabat in 1957 was a foundational milestone, establishing the first national academic structure dedicated to

research in the humanities[1]. Shortly afterward, geography departments were created in Fès, Casablanca, and Marrakech, reinforcing the dissemination of the discipline across the country.

These institutions trained the first generation of Moroccan geographers, whose research focused on local realities, breaking with the colonial perspective centered on resource exploitation. Their studies addressed rural planning, demographic dynamics, and the organization of urban spaces. This process of scientific appropriation was accompanied by efforts to adapt inherited methodological tools to a context marked by profound socio-economic transformations. As a result, the Moroccan university system became the driving force behind national geographical research, contributing to the consolidation of an autonomous scientific identity[2].

1-3 Evolution of Paradigms and Schools of Thought

Since the 1960s, geographical research in Morocco has experienced successive paradigms that mirror territorial transformations and societal needs. Initially, a naturalistic approach (1960s–1970s) dominated, focusing on climate, soils, and water resources in order to provide scientific foundations for agricultural and energy policies (Bencheikh, 2018). From the 1980s onward, the acceleration of urbanization and rural exodus fostered the development of human geography, with a strong focus on major cities such as Casablanca and on social issues related to migration and spatial inequalities[3].

Finally, since the 1990s, the discipline has taken an applied turn, characterized by the integration of digital technologies such as Geographic Information Systems (GIS) and remote sensing. This orientation has enhanced environmental management, strengthened territorial planning, and supported public policies in spatial development (Boutte & El Ouizgani, 2024). The epistemological trajectory of geography in Morocco reflects a gradual methodological evolution. Initially confined to a purely descriptive approach inherited from the colonial tradition, geography primarily focused on observing and characterizing physical and human landscapes. Over time, however, Moroccan geographers progressively shifted toward a more descriptive-analytical method, integrating interpretation, comparison, and spatial analysis into their studies. This methodological renewal enabled the discipline to move beyond simple description and to engage more deeply with the causes, dynamics, and interrelations that shape territorial phenomena. As a result, geography in Morocco has increasingly positioned itself as a reflective and problem-oriented science, capable of contributing to the understanding of sustainable development and territorial transformation.

1 - Ezouine, M. (2015). *Recherche géographique et aménagement du territoire au Maroc*. Rabat: Université Mohammed V.

2 - El Gharbaoui, A. (1981). La recherche géographique au Maroc : Bilan et perspectives. Rabat: Publications de la Faculté des Lettres et Sciences Humaines.

3 - Harraq, A. (2019). *Politiques publiques et recherche en sciences sociales au Maroc*. Casablanca: La Croisée des Chemins.

II. Major Contributions of Geography to Moroccan Society

Geographical research in Morocco has not been confined to the theoretical analysis of spaces; it has also made tangible contributions to understanding territorial dynamics, ensuring the sustainable management of natural resources, and supporting public policies. As an applied discipline, geography has played a central role in interpreting spatial transformations and in formulating solutions adapted to the challenges of territorial and sustainable development.

2-1 Analysis of Territorial Dynamics

The study of territorial dynamics in Morocco reveals profound spatial inequalities that continue to shape the national landscape. From an analytical perspective, geography provides essential tools to understand the complex relationships between urban concentration and rural decline. The massive migration from the countryside to large cities has intensified demographic pressure, leading to rapid and often unregulated urban expansion. These transformations have produced significant challenges in terms of housing, mobility, and access to public services.

In contrast, rural regions have suffered from persistent marginalization. The lack of infrastructure, educational facilities, and health services has limited their capacity to retain populations and stimulate local development. This duality between dynamic urban centers and fragile rural hinterlands illustrates a broader pattern of territorial imbalance that continues to affect national cohesion.

In this context, geographical research helps to clarify the mechanisms of spatial polarization around major metropolitan areas such as Casablanca, Rabat, and Tangier. However, beyond merely describing these disparities, it invites a reflection on the models of territorial governance that could promote more inclusive and balanced development. By integrating spatial analysis with socio-economic diagnosis, geography contributes to rethinking regional planning in favor of territorial equity and social cohesion.

2-2 Sustainable Resource Management

The issue of natural resource management represents another strategic field of geographical inquiry in Morocco. The country's environmental fragility — expressed through soil degradation, desertification, and water scarcity — calls for renewed approaches that reconcile economic use and ecological preservation. Geography plays a crucial role here by identifying vulnerability zones and analyzing the dynamics of land use under growing human and climatic pressures.

At the same time, the study of traditional systems of resource regulation, such as the agdals, offers valuable insights into community-based models of sustainability. These ancestral practices, rooted in collective management and seasonal rotation, illustrate a form of local environmental governance that remains relevant today. Their revaluation contributes to bridging scientific analysis and indigenous knowledge, thus enriching the conceptual framework of sustainable development in Morocco.

Beyond diagnosis, geographical thinking encourages the formulation of adaptive strategies. By combining field observation, spatial modeling, and participatory analysis, it helps outline realistic pathways for balancing production, conservation, and social well-being. This integrative vision positions geography not only as a descriptive science but also as a discipline of action, contributing directly to environmental management and territorial resilience.

2-3 Contribution to Public Policies and Major Projects

Geography has also played a strategic role in supporting public policies and major development projects. Geographers have participated in the elaboration of urban master plans, which set the spatial development guidelines of Moroccan cities while accounting for demographic and economic dynamics[4]. The discipline has also supported structuring programs such as the "Cities without Slums" initiative, aimed at improving housing conditions for disadvantaged populations. More broadly, geography has contributed its expertise to sectoral policies such as the Plan Maroc Vert (2008), designed to modernize agriculture, as well as to the study of large-scale energy projects, most notably the Noor solar power plant in Ouarzazate, a symbol of the country's energy transition (Kousksou et al., 2015). These contributions demonstrate that the discipline goes far beyond the academic sphere, becoming a tool for political decision-making and strategic planning. By articulating scientific analysis with institutional needs, geography stands out as an essential lever for territorial and sustainable development.

III. Contemporary Challenges and Issues

Despite its achievements and contributions to territorial development, geographical research in Morocco continues to face multiple challenges. These constraints are not only financial but also concern scientific governance, the integration of research into public policies, and international visibility. Identifying these obstacles is an essential step in consolidating the strategic role of the discipline in a context shaped by globalization, digital transition, and territorial transformations.

3-1 Structural Constraints

The first major challenge for geographical research in Morocco lies in the weakness of its structural resources. The country allocates less than 0.8% of its GDP to scientific research, compared to more than 2% in emerging countries such as South Korea or China[5]. This situation severely limits investment capacities in field surveys, technical equipment, and researcher training. The scarcity of funding results in dependence on international resources, further increasing the fragility of research programs (Harraq, 2019). Moreover, the lack of coordination between universities, research centers, and territorial institutions leads to fragmented efforts. Thus, financial constraints are coupled

4 - Berriane, M. (2010). Urban planning and development in Morocco: The role of geography. *Revue de Géographie du Maroc*, 27(2), 45–62.

5 - World Bank. (2021). *World Development Indicators: Research and development expenditure (% of GDP)*. Washington, DC: World Bank.

with organizational deficits that prevent geographical research from reaching its full potential and effectively addressing the challenges of sustainable development.

3-2 Gap Between Research and Public Action

Another central challenge lies in the persistent gap between scientific production and its use by public decision-makers. While researchers produce a significant volume of dissertations, reports, and articles, these results often remain confined within academia without real translation into territorial planning (Becquet & Étienne, 2016). The absence of effective bridges between research and local governance reduces the potential impact of geography as a decision-making tool. Furthermore, local authorities, responsible for planning and local development, often lack mechanisms to integrate research data into their strategies (Ezouine, 2015). This situation fosters a paradox: a discipline capable of providing detailed analyses of territorial dynamics yet insufficiently mobilized in political decision-making processes. Overcoming this gap requires an institutionalized dialogue between researchers and public actors.

3-3 Methodological Challenges

Geographical research in Morocco also faces epistemological and methodological challenges. A significant portion of studies still maintains a descriptive character, favoring inventories and monographs over modeling and quantitative approaches[6]. While this descriptive tradition has provided a valuable knowledge base, it limits the discipline's ability to anticipate territorial changes or propose prospective scenarios. Comparative and interdisciplinary approaches integrating economics, sociology, or ecology remain underdeveloped (Harraq, 2019).

Moreover, the limited mastery of advanced digital and analytical tools continues to hinder the evolution of geographical research in Morocco. The weak integration of geomatics - which encompasses Geographic Information Systems (GIS), remote sensing, and spatial modeling - restricts the discipline's ability to move toward predictive and applied geography. These methodological gaps reduce the operational scope of research and highlight the urgent need to strengthen training programs, enhance scientific supervision, and promote the use of technological innovation in geographical studies.

3-4 Scientific Visibility and Language Barriers

Finally, the international visibility of Moroccan geographical research remains limited. According to official data, fewer than 2% of published articles appear in internationally indexed journals (Ministry of Higher Education, 2020). This situation is partly explained by the predominance of French and Arabic in scientific production, which restricts dissemination within anglophone networks that dominate global academic databases[7]. The lack of English-language publications limits Moroccan geographers' access to global scientific debates

6 - Noin, D. (1995). *La géographie: Concepts, méthodes et applications*. Paris: Armand Colin.

7 - Laghfiri, H. (2024). Teaching transversal skills in Moroccan higher education: The case of geography. *Complexus*, 1(4), 77–95.

and competitive funding opportunities. Moreover, the absence of nationally strong, indexed journals weakens the recognition of locally produced work. To overcome these barriers, it has become urgent to encourage researchers' linguistic training, promote co-publication with international teams, and strengthen partnerships with recognized journals. Only under these conditions can Moroccan geography enhance its visibility and assert its place on the global scientific stage.

IV. Transformations and Renewal of the Discipline in the Digital Age

The rise of digital technologies has profoundly transformed the practices of geographical research in Morocco. While the descriptive method remains the foundation of geographical analysis - enabling observation, interpretation, and generalization of spatial phenomena - modern tools such as Geographic Information Systems (GIS), remote sensing, artificial intelligence (AI), and Big Data provide significant added value. These technologies enhance the precision, predictive capacity, and prospective analysis of territorial dynamics, without replacing the essential descriptive and interpretive work. Beyond technical improvements, they also open new perspectives for understanding and managing territories, particularly through interdisciplinary approaches and participatory research methods.

4-1 Geographic Information Systems (GIS)

Geographic Information Systems (GIS) represent one of the most decisive tools in the renewal of geography in Morocco. They allow not only the production of dynamic and interactive maps but also the cross-referencing of multisectoral data to analyze spatial dynamics. For instance, GIS has been used in Marrakech to map flood-prone areas and anticipate climate change-related risks[8]. Similarly, in Casablanca, GIS has been mobilized to study urban sprawl and its consequences on mobility and infrastructure[9]. These applications demonstrate that GIS provides researchers and decision-makers with a territorial decision-making instrument capable of integrating prospective scenarios. More broadly, GIS strengthens territorial governance by offering greater clarity on spatial dynamics and supporting sustainable urban planning (Boutte & El Ouizgani, 2024).

4-2 Remote Sensing

Remote sensing has represented a major advancement in the study of Moroccan environments. By using satellite imagery, researchers can now closely monitor ecosystem changes, such as deforestation in the High and Middle Atlas or the dynamics of arid zones in the country's southeast. These observations provide crucial insights into the effects of climate change and human pressures on natural resources.

Another key advantage of remote sensing lies in its ability to generate updated, long-term, and comparable data. This capacity allows for continuous

8 - El Mezouari, A. (2019). Mapping flood-prone areas in Marrakech using GIS. *Moroccan Journal of Environmental Studies*, 3(2), 22–34.

9 - El Amrani, S. (2020). L'apport des SIG à l'étude de l'étalement urbain à Casablanca. *Revue Marocaine de Géomatique*, 12(1), 65–80.

monitoring of environmental transformations and complements traditional field surveys, which are often limited by financial and logistical constraints. By bridging gaps in data collection, remote sensing strengthens the methodological foundation of geographical research.

Finally, remote sensing contributes to the evolution of geography from a descriptive discipline toward a more analytical and predictive science. When integrated with field observations and spatial modeling, it enhances the capacity to interpret complex territorial dynamics and informs decision-making in environmental policies, natural resource management, and regional planning.

4-3 Artificial Intelligence and Big Data

More recently, the integration of artificial intelligence (AI) and Big Data has opened new perspectives for geographical research. In Casablanca, experimental projects have used AI to anticipate forest fires and improve prevention strategies[10]. The intersection of AI, GIS, and Big Data has also facilitated the production of real-time interactive maps, useful for managing sustainable mobility and modeling urban flows[11]. These technologies enable the processing of massive volumes of data and the identification of correlations invisible to traditional methods. They thus introduce a crucial prospective dimension into geographical research by providing tools adapted to the increasing complexity of contemporary territories. However, their deployment in Morocco remains constrained by financial and training limitations. Their broader adoption would represent a major opportunity to strengthen the influence of geography in territorial governance and sustainable development policies.

V. Future Perspectives and Orientations

The evolution of geography in Morocco cannot be envisioned without a forward-looking perspective on pathways for consolidation and innovation. In a context shaped by globalization, digital transformation, and environmental challenges, the discipline is called upon to reinvent itself, both methodologically and in its interactions with other sciences and socio-economic actors. Future orientations of geographical research therefore rest on several levers, ranging from methodological reinforcement to international openness, while also including the mobilization of innovative funding mechanisms and the improvement of student training to meet labor market needs.

5-1 Methodological Strengthening and Multidisciplinarity

For a long time, Moroccan geographical research was characterized by a descriptive approach, mainly focused on the inventory of facts and classical cartography. However, current transformations require moving beyond this framework toward analytical and predictive approaches. The introduction of spatial modeling, advanced statistical analysis, and quantitative methods enables a more refined understanding of territorial dynamics[12]. This methodological shift

10 - El Bouzidi, H. (2021). Artificial intelligence for wildfire prediction in Morocco. *Environmental Modelling and Software*, 142, 105094.

11 - Bahi, L., & Taltasse, A. (2022). Artificial intelligence and big data for sustainable urban mobility in Morocco. *Journal of Smart City Studies*, 4(2), 55–72.

12 - Mermet, L. (2011). *L'analyse prospective et les dynamiques territoriales*. Paris: L'Harmattan.

also implies a multidisciplinary openness, by engaging economics, sociology, ecology, or even computer science. For example, studying territorial resilience to climate change cannot be confined to a single geographical framework but requires contributions from climatologists, economists, and legal scholars. Multidisciplinarity thus becomes essential for enhancing both the scientific relevance and the operational effectiveness of research in geography.

5-2 Cooperation and Innovative Funding

One of the major challenges facing geographical research in Morocco remains the lack of stable and structured funding. The establishment of dedicated research funds, along with the mobilization of partnerships with local authorities, the private sector, and international organizations, constitutes a key condition for ensuring the sustainability of scientific projects[13]. Resorting to innovative funding mechanisms, such as public-private partnerships or competitive international funds (UNDP, World Bank), not only diversifies financial resources but also strengthens the legitimacy of Moroccan research on the international stage. Moreover, such inter-institutional cooperation fosters the transfer of know-how and technologies, while creating synergies between academic research and the concrete needs of territories.

5-3 International Openness and Visibility

Integrating Moroccan geography into international scientific networks is an indispensable strategic orientation. Participation in Mediterranean research programs, such as PRIMA, promotes transnational cooperation on shared themes such as water, sustainable agriculture, or urban planning (Leduc et al., 2020). However, this openness depends largely on Moroccan researchers' ability to produce and disseminate their work in high-impact international journals. This requires a particular effort in training for scientific writing in English, which has become the dominant language of academic production. Increasing visibility also entails participation in international conferences, co-publications with foreign scholars, and the creation of digital platforms that promote open access to research outputs.

5-4 Training and Employability

University training in geography in Morocco has undergone significant reforms over the past three years, aiming to better align curricula with labor market needs. New subjects and modules have been introduced within geography programs, focusing on applied skills such as Geographic Information Systems (GIS), remote sensing, spatial planning, and environmental management. These additions provide students with practical competencies and enhance their ability to respond to the demands of local authorities, consultancy firms, public institutions, and non-governmental organizations.

Moreover, several geography departments, such as the Faculty of Arts Ben M'sik in Casablanca, have established specialized tracks in GIS and remote sensing. These programs constitute a significant added value to the

13 - El Aoufi, N. (2019). *Financement de la recherche scientifique au Maroc: enjeux et perspectives*. Rabat: CERSS.

field of geography, enabling graduates to acquire both technical expertise and professional readiness for the job market. In addition, the integration of transversal skills—such as scientific communication, project management, and mastery of digital tools—further strengthens employability and prepares students for a variety of career paths.

Finally, reforms have also emphasized the importance of practical experience, compensating graduation research with internships or placements in relevant institutions and companies. This hands-on approach not only consolidates theoretical learning but also facilitates the transition from university to professional life, ensuring that geography graduates are better equipped to contribute to sustainable territorial development and contemporary societal needs.

Conclusion

Since independence, geographical research in Morocco has generated fundamental knowledge on territorial dynamics, contributing to urban planning, the sustainable management of natural resources, and the fight against desertification. These contributions have provided a better understanding of the transformations of both urban and rural areas, while informing certain public policies. However, the discipline continues to face structural, methodological, and institutional constraints that limit its scientific visibility and operational impact.

The future of Moroccan geography depends on its ability to undergo profound renewal, both methodologically, institutionally, and pedagogically. The adoption of multidisciplinary approaches, the strengthening of innovative funding and partnerships, integration into international scientific networks, and the adaptation of training programs to socio-economic needs constitute key levers for enhancing the relevance and effectiveness of the discipline.

Moreover, the integration of digital tools—such as Geographic Information Systems (GIS), remote sensing, and artificial intelligence-and the valorization of applied skills will help bring research closer to the concrete challenges of the territory. In this regard, Moroccan geography is called upon to play a strategic role in accompanying the country's territorial, climatic, and digital transitions, while contributing to the promotion of spatial justice and sustainable development.

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