



**Universiteit  
Leiden**  
The Netherlands

## **The transformation of science systems in the Middle East and North Africa**

El Ouahi, J.

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# Summary

The analysis of scientific publications is what gave rise to *scientometrics*. Scientific publications are the most popular ways for disseminating scientific information within the scientific community. With the increasing use of scientometric data in research management and research evaluation, numerous analyses can be conducted to better understand different aspects of scientific activities. On the one hand, the analysis of scientific publications in the Middle East and North Africa region opens up a range of possibilities to characterize the science systems of this specific region. Large scale analysis of multiple metadata provided by bibliometric platforms capture the stories of how the scientific workforce is connected, funded and mobile within diverse science systems. On the other hand, scientometric data is also used as a guide to transform the science systems.

The main objective of this PhD dissertation is to better understand the transformation of science systems in the Middle East and North Africa region in the recent years by examining several of their facets and their recent evolution. This dissertation consists of seven chapters:

**Chapter 1** presents a general introduction to the science system in the Middle East and North Africa region. This chapter starts with a brief history of science in this specific region. Then the chapter reviews the recent investments made in science and technology capacity and the recent increase in scientific output in many MENA nations. The chapter proposes to document the transformation of science systems in this region, from the global perspective where research institutions in MENA try to become part of the so-called ‘global science system’. This chapter systematically review the relevant literature regarding such transformation and how it reflects in several aspects of the science systems, including publishing, collaboration, mobility, research evaluation, and gender differences between scholars. Finally, considering the challenges and opportunities, this chapter puts forward the motivations and the research questions to be addressed.

**Chapter 2** presents a blueprint methodology of how scientometric studies can inform the collaboration and mobility linkages of specific countries and geographical regions. Such method complements very well other types of mobility data such as survey data which suffer



from limitations of coverage, lack of standardization or completeness. The globalization of the economy, proximities (geographical, social, cultural, linguistic and socio-political), the democratization of mobility as well as the internationalization all influence the scientific mobility as well as collaboration. The MENA region is highly connected with Europe based on the number of mobile scientists. Europe is the first mobility destination and origin with 37% of the flows from/to MENA, followed by North America (24%), MENA (20%) and Asia (16%). Finally, this chapter analyses the demographic characteristics of mobile scientists, more specifically their gender and their academic age, where we observe that male scholars represent the largest group of migrants in MENA and they are relatively senior.

**Chapter 3** focuses on the topic of women's empowerment in the Middle East and North Africa region in science. Recent gender policies in the Middle East and North Africa (MENA) region have improved legal equality for women with noticeable effects in some countries. This study investigates the engagement with gender policies in MENA and its potential influence on gender disparities in scientific research output through a bibliometric lens. First, we used bibliometric indicators to analyze the gaps between men and women in the shares of researchers, the research output and the authorship position. Overall, men authors obtain higher representation, research productivity, and seniority. We also find that men publish on average between 11% and 51% more than women, with this gap increasing over time. Finally, men reached on average a more senior position faster than women. We reveal some uptrends in specific countries, however, changes in science systems are still too early to see in MENA countries that recently engaged with gender policy.

**Chapter 4** analyzes the funding acknowledgements found in 2.3 million scientific publications published between 2008 and 2021 by researchers affiliated with institutions located in MENA. Chapter 4 identifies the major funding agencies and their contribution to national scientific publications. Overall, countries in MENA differ in terms of proportions of publication with funding acknowledgments. Also, the number of funding agencies appearing in scientific publications varies greatly across the region due to the size of the respective country in terms of funding capacity, publication level but also international co-authorship. A classification of funding agencies reveals that the government and academic sectors are the main contributors acknowledged by researchers in scientific publications. By distinguishing between international and domestic publications, chapter 4 also shows that



some countries are dominated by one or a few major funding agencies, whereas other countries benefit from several major funders of diverse types.

**Chapter 5** explores the use of scientometric data and indicators by research managers in several countries located in the Middle East and North Africa region. The central argument posits that research managers set rules based on scientometrics that inform the transformation of science systems. Specifically, the study examines how research managers adopt scientometrics as "global standards" and how various scientometric data and indicators are adopted via a process of "glocalization". Finally, the results show how research managers use such data to inform decision-making and policymaking processes. This research makes a significant contribution to the broader understanding of the use of scientometric indicators in assessing research institutions and researchers on the basis of their publishing activities. Additionally, this chapter examines how such data transforms and adapts local science systems in order to meet the so-called "global standards".

**Chapter 6** examines the structure of ARCI, the Arabic Citation Index and its potential use in research evaluation. This indexation brings several benefits to the scientific community. This new index provides access to Arabic journals publishing mainly scientific content in Arts & Humanities and Social Sciences categories. These two categories represent 81% of ARCI's total coverage and Egypt, Algeria, Iraq and Saudi Arabia contribute to most research categories. The topic analyses provide a better understanding of the underlying structure of ARCI, by highlighting the topics covered in this database. Finally, this chapter discusses the implications of the development of such regional citation index in terms of research discovery but also in terms of research management and research evaluation often conducted by using sources like the Web of Science which provides a partial picture of research publishing activities, particularly for non-English scientific publications.

**Chapter 7** summarizes the main findings presented in chapters 2 through 6 and further discusses their implications and some potential future research directions. Research on the scientific linkages in the Middle East and North Africa (chapters 2) demonstrates that this region is highly connected to Europe and North America but also shows growing mobility flows and collaboration with China. Research on the scientific workforce (chapter 3) reveals some of the differences between men and women in terms of representation, productivity,



leadership and seniority. The study of funding acknowledgements found in scientific publications (chapter 4) reflects the state of funding structure in MENA with an important distinction between domestic and international research. Research on the usage of scientometric data by research managers in the region (Chapter 5) shows that such data is adopted as 'glocal' standards which guide the transformation of science systems. The study of Arab scientific literature indexed in the Arabic Citation Index also provides some insights to better understand the regional scientific literature (Chapter 6). To better characterize the nature of the diverse science systems in MENA, chapter 7 also proposes some directions for future research, particularly analyses with a higher granularity of scientific mobility, research funding and researchers' contribution at the institutional level. Besides, it would be an important future step to conduct these studies by using a broader range of scientific publications sources, especially local scientific journals. Finally, chapter 7 presents some general reflections about the global and emerging science systems.