Partnership Performance Between Northern and Southern Mediterranean Countries in the First 2 Years of PRIMA Programme Implementation

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Abstract
The article evaluates the performance of the partnership between European and non-European participating states after 2 years of implementation of the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) programme. A total of 742 participating entities were involved in 83 funded projects based on two funding calls of 2018 and 2019. The results show that while extensive partnerships were established between southern and northern Mediterranean countries, there was lower project coordination by non-European states. As a result, the grant distribution was in favour of European countries which received the majority of funds. A networking analysis was performed, and it demonstrates low cooperation between Northern African countries and Eastern Mediterranean countries. Italy, France and Spain are clustered with Northern African countries; however, Germany and Portugal are more affiliated with Eastern Mediterranean countries. The private sector analysis shows an excellent participation of SMEs in Sect. 1 (funded by PRIMA) for both calls in 2018 and 2019. SMEs received 22% of EU funds — well in line with Horizon 2020 target — demonstrating the vital role that PRIMA plays for the development of SMEs. However, for Sect. 2 (funded by participating states), the participation of SMEs was low and received only 6.4% of participating state funds. The participation of SMEs from non-European countries was low and represented 30% in Sect. 1 of the total number of SMEs and only 15% in Sect. 2.

Keywords PRIMA · Research · Innovation · Non-European countries · European countries

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Introduction

Over the last two decades, several projects have been supported by the European Commission (EC) to develop the Euro-Med science and technology (S&T) cooperation. In order to strengthen the Euro-Med S&T collaboration, the EC introduced the adoption of European Research Area Networks (ERA-NET) and ERA-NET-COFUND to bring Research, Development and Innovation (RDI) funding organizations together, for coordinated research programming and funding initiatives in a trans-national setting.

Thanks to the ERANET and ERANET-COFUNDS, collaborations in the domain of water and agriculture have been strengthened in the Med region (ARIMET, ERANETMED, WATERWORKS). The added value of these initiatives primarily lies in strengthening trans-national collaboration, building long-lasting relationships across countries, and creating a critical mass of resources to address common challenges. The ERA-NET scheme also contributes to increasing competition in research leading to higher quality and excellence. It allows countries to access complementary knowledge and/or research capacity from other countries to address specific societal challenges (Gøtke et al., 2016).

Based on the success of the previous Euro-Med initiatives and following a request of nine countries, the EC established a new public-public Partnership for Research and Innovation in the Mediterranean Area (PRIMA) as an Article 185 initiative on 18 October, 2016, for climate resilient, efficient, cost-effective and environmentally and socially sustainable resource provision and management, and to contribute to solving water scarcity, food security, nutrition, health, well-being and migration problems.

PRIMA is a major EU and participating state effort at science diplomacy using research and innovation projects to build bridges across the two shores of the Mediterranean and thereby contributes to strengthening political relations. PRIMA is an intergovernmental partnership based in Barcelona and receives €220 million from the EU’s Horizon 2020 research programme to fund Sect. 1 projects. Section 2 is funded by the 19 participating states: Portugal, Spain, France, Italy, Malta, Slovenia, Croatia, Greece, Cyprus, Turkey, Lebanon, Jordan, Israel, Egypt, Tunisia, Algeria, Morocco, Germany and Luxembourg. Section 3, known as States Initiated actions (PSIAs), is funded and managed by participating states. The overall objectives of the PRIMA programme are to develop knowledge and common innovative solutions for sustainable agro-food systems, for integrated water provision and management in the Mediterranean area.

The PRIMA Foundation launched its first three calls for proposals in 2018, 2019 and 2020. After 2 years of implementation of the programme (in 2018 and 2019), 83 proposals have been funded (out of 983 submitted proposals) connecting 742 partners from the 19 participating states. The objective of this paper is to evaluate the performance of the partnership between European and non-European participating states after 2 years of implementation of the PRIMA programme.
Methodology

Proposal Evaluation Process

According to road maps for administrative capacity building developed by the European commission (European Commission, 2020), a document has been prepared to provide inspiration for Member State administrations seeking to develop roadmaps for building their own administrative capacities in order to facilitate the programme implementation and to encourage good practices. According to this document, four indicators have been used to assess the proposals’ evaluation process steps and timelines through four indicators: (1) time to inform (TTI) that refers to the duration from the final date for submission of completed proposals to the notification on evaluation outcome; (2) time to sign (TTS), which is the duration from the notification to the grant; (3) time to grant, which is the sum of TTI and TTS; and (4) time to pay (TTP) that refers to the time needed from signature of grant agreement to payment.

Activity Performance 2018–2019

The second part of the article analyses the activities performed by PRIMA during the first 2 years of implementation. It examines the performance of the partnership between Southern and Northern Mediterranean countries through a comparative analysis based on the number of submitted and funded projects and the number of participating entities.

Networking Analysis

The third part of the article analyses the networking between PRIMA participating states based on common funded projects. The dataset is a matrix (0, 1) where the countries are in rows and projects in columns. 0 is assigned when the country has no projects and 1 when a given country is involved in a funded project.

Cluster analysis was performed using appropriate R functions (R core team, 2020); the dist() function was used to obtain a distance matrix of pairwise simple match binary distance and then a tree dendrogram was built using the Ward’s algorithm (function hclust with ward.D2 as algorithm) (Ward, 1963).

Venn diagrams were drawn for each group by triplets or quadruplets using the ggVennDiagram R-package.

SMEs Participation Analysis

The last part of this paper analyses the participation of SMEs in funded projects of 2018 and 2019. We focused on SMEs since they represent 99% of private entities and are the backbone of the economy of the Mediterranean Region. Participants from funded SMEs were invited to respond to an online survey on April 20, 2020. The questionnaire included questions on main motivations and drivers to participate to PRIMA Programme, SME contribution in funded projects,
opportunities and benefits and main social development goals that were targeted. Almost 65% of SMEs participating in PRIMA provided their responses to the questionnaire.

## Results

### Proposal Evaluation Process Steps and Timelines

PRIMA showed high efficiency regarding the four indicators (TTI, TTG, TTS, and TTP). In 2018 and 2019, the time to inform (TTI) is in line with the H2020 target of 153 days (Fig. 1). With respect to time to grant (TTG), for 2018, the Grant Agreement Preparation for Sect. 1 exceeds the H2020 target (245 days) but in 2019, it was less (227 days). The first 3 years of Horizon 2020 have shown a significant improvement demonstrated by a clear reduction in the time elapsing between the closure of a call and signature of the grant agreement (i.e. time to grant), from an average of 303 days in FP7 to an average of 192.2 days, which is a decrease of 36.6% (more than 110 days).

The TTS in Sect. 1 slightly exceeds the H2020 target (of 3 months). However, for Sect. 2, TTS varies between 42 and 440 days. Considering that TTIs are within the H2020 target, then time to grant (TTI + TTS) is in line with H2020.

Based on these indicators, PRIMA has operated efficiently during the two first years and its performance against the four KPIs of Horizon 2020 is better than the set targets. Section 2 works with longer delays by reasons not attributable to PRIMA.

![Fig. 1 KPI indicators (data shown are average value)](image-url)
Overview of Funded Projects

The first call in 2018 attracted a large number of applicants in the two sections. The significant interest in PRIMA calls leads to a demand that was vastly outstripped by the funding that was available. In 2019, a 39% decrease in submissions in Sect. 1 pushed the total number of pre-proposals to 278, involving 2386 entities (compared to the 457 pre-proposals submitted in 2018). In Sect. 2, there was a 57% decrease in submissions in 2019 (of 155 eligible proposals with 1162 entities).

The lower number of submissions in 2019 combined with the higher budget led to a better success rate. Consequently, the overall success rate for Sect. 1 calls significantly increased from 2 to 6.45%. Similarly, the success rate for Sect. 2 call increased from 7.4 to 19.5%. Increasing the success rate of both Sect. 1 and Sect. 2 calls has been achieved through measures adopted in 2019 by increasing the budget for the calls, by focusing the topics and by reducing the targeted priorities. The success rate of Sect. 1 is below that of H2020, which itself dropped to 11.6% compared to FP7, which had an overall proposal success rate of 18.4%.

After 2 years of implementation of the programme, there are 83 funded projects in total. Among them, 27 are Actions according to H2020 provisions: 15 projects are Research Innovation Actions (RIAs); 11 are Innovation Actions (IAs) and 1 project is a Coordinated Support Action (CSA) selected in response to 2018- and 2019-year Sect. 1 calls (funded with EU funds following H2020 rules). All the Sect. 2 projects (56) are RIA. Among the 83 funded projects, 35 are affiliated to farming systems equal to 42% of the total number projects. Agro-food and water thematic areas shared almost the same percentages (27%). Among the funded projects of Sect. 1, 2 projects are addressing a Nexus approach which aims at integration management of resources and governance across sectors and scales. This approach has attracted a wide attention across academic research and policy sectors which could support the transition to green economy and contribute to the implementation of sustainable development goals (Leck et al., 2015; Rasul, 2016; Weitz et al., 2014) and climate adaptation and mitigation goals of the nationally determined contributions (NDCs) (Rasul & Sharma, 2015).

The analysis of partnership between European and non-European countries was based on the data obtained from the results of calls of 2018 and 2019. The number of projects in which each country is involved is presented in Fig. 2. The most active countries are Spain and Italy since their teams are involved in 68 and 61 projects out of 83 funded projects, respectively. Tunisia from Southern Mediterranean countries is ranked third with 52 projects out of 83 projects.

For Sect. 1 calls, participating entities from Southern and Eastern Mediterranean increased from 32% in 2018 to 41% in 2019. Almost the same figures were also observed for Sect. 2 where participation of partners from non-European countries varies between 37 and 41%.

The good participation from Southern Mediterranean countries could be explained both by the eligibility criteria that requires at least one country from the south and one from north and also by the traditional collaboration between the different research teams of the Mediterranean region through H2020, ERA-Nets and ENI-CBC-Med …
More than half of the funded projects are coordinated by Italy and Spain followed by France, Greece and Germany (Fig. 3). The coordination of projects by non-EU PRIMA participating states is very low in particular in the second stage of the evaluation process. While the percentage of coordination from non-EU PS

![Figure 2](image_url)

**Fig. 2** The total number of projects by participating states for Sect. 1 and Sect. 2 (2018–2019)

![Figure 3](image_url)

**Fig. 3** Number of coordinated projects per country and per thematic area
entities in 2019 calls increased from 3% in 2018 to 7.4% in 2019, it remains at a low level.

In Sect. 2 proposals, the percentages of coordination by Non-EU PRIMA PS entities are higher than Sect. 1, approximately 13.6% and 19.5% in stage 1 for 2018 and 2019, respectively. In stage 2, the percentage of coordination increased from 1% in 2018 to 13.5% in 2019. At final stage, non-European countries coordinated 4 proposals in 2019 (out of 30 funded proposals), but one coordination in 2018. However, 3 of them are coordinated by H2020-associated countries Tunisia, Turkey and Israel.

In order to achieve a more balanced geographical distribution between non-EU PS and EU PS entities in PRIMA calls, PRIMA performed several additional actions. These actions included training activities in South Eastern Mediterranean countries; developing knowledge, know-how and partnership strengthening synergies with other regional initiatives and organizations. These actions will be hopefully translated into an increase of the participation of non-European countries in 2020 calls.

**Networking Analysis**

A cluster analysis (for Sect. 1) based on the common projects between countries shows that the most active countries are grouped in the same cluster and shared more than 10 projects together (Fig. 4). Tunisia, the third most active country, is also clustered with Spain and Italy. These three countries shared 7 common projects together. Interestingly, all projects from Tunisia were shared with projects from Spain (Fig. 5). This can be explained by the fact that teams and networking are already established through traditional cooperation in the framework of bilateral projects and international projects. Besides, Tunisia joined H2020 as an associated country since 2015.

Southern countries such as Algeria, Morocco and Tunisia share their projects with European countries and there is a limited cooperation between these countries and Eastern Mediterranean countries (Jordan, Lebanon and Turkey) which are mainly affiliated with the group of Germany, Greece and Portugal.

For Sect. 2, the dendrogram analysis reveals a lack of collaboration between Southern Mediterranean countries. As represented in Fig. 6, Northern African countries are in general grouped with France, Italy and Spain; however, Germany together with Greece and Portugal is grouped with Eastern Mediterranean countries. The Venn diagram represented in Fig. 7, for Sect. 1, shows that the most active countries share the highest number of projects together. Italy, Spain and Tunisia shared ten projects in 2018 and eleven in 2019. This result confirms strong cooperation between these three countries.

**SMEs Participation Analysis**

Section 1 attracted a significantly higher number of small- and medium-sized enterprises (SMEs) compared to Sect. 2.
Fig. 4 Cluster of countries according to the number of shared projects (Sect. 1)

Fig. 5 Venn Diagram: case of Italy, Spain and Tunisia
Overall, 81.5% of funded projects from 2018 to 2019 calls of Sect. 1 involved at least one SME. However, the percentage of involvement was lower in Sect. 2 (53.6%). This could be explained by the constraints imposed by the regulations of some funding agencies that do not authorize funds for the private sector. Moreover, SMEs are more attracted by innovation actions rather than research and innovation action. This was evident by the calls results. For example, the agro-food innovation action encompassed half of the total number of SME beneficiaries.

There was a broad geographical distribution of SME beneficiaries across all participating states. SMEs participating in funded projects are from 16 and 14 countries for Sect. 1, 2, respectively. The countries with the highest SME involvement in 2018–2019 calls were Spain, Italy, France and Greece. A lower participation was observed in non-European countries where Egypt and Turkey were the most active countries. Further mobilization of SMEs is possible in those countries, considering their vast resource potential in agro-food systems.

![Cluster of countries according to the number of shared projects (Sect. 2)](image_url)
Based on the questionnaire sent to funded SMEs, more than 67% are very interested in boosting research and development and innovation capabilities (Fig. 8). The majority of SMEs are interested in production of new products/solutions and services (Fig. 9) and will contribute mainly to the implementation of SDGs 2, 6, 12 and 13.

SMEs for Sect. 1 (2018 together with 2019) represented 26% of entities and received 22% of EU funds. For Sect. 2, SMEs represented around 10% of the total number of entities and received 6.4% of allocated funds from participating

![Diagram de VENN for the group 1](image)

**Fig. 7** Diagram de VENN for the group 1

![Bar chart for PRIMA motivations](image)

**Fig. 8** Main motivations and drivers to participate in PRIMA programme
Based on available data from 2018, PRIMA has higher SME participation and funding rates than other initiatives like IMI2 and CESAR (Fig. 10). It is clear that SME’s participation in Sect. 1 is in line with H2020 target (around 20% in participation and 15% of funding) demonstrating the vital role that PRIMA plays for the development of SMEs and their contribution in boosting innovation in the Mediterranean region.
Discussion, Conclusions and Recommendations

The core competence of PRIMA programme is the creation of effective and efficient partnerships among 19 participating states in European and non-European countries. The aim of such broad collaborations is to find innovative solutions for the urgent societal challenges facing the region. PRIMA evaluation procedure is governed by the H2020 rules and regulations based on transparency and fair competition.

This article relied on the results of PRIMA programme after 2 years of implementation in 2018 and 2019 and on the performance of partnership between Southern and Northern Mediterranean countries. Our analysis is based on data generated by two annual work plans which allowed us to examine the performance of partnership in terms of participation of research teams and involvement of the private sector (mainly SMEs).

After 2 years of implementation in 2018 and 2019, PRIMA has operated efficiently and its performance against the four KPIs of Horizon 2020 (time to inform, time to sign, time to grant and time to sign) is better than the set targets.

The participation of non-European states based on several parameters (number of entities, number of projects, involvement of SMEs …) is quite good, demonstrating a real partnership between southern and northern Mediterranean countries. Among the non-European countries, Tunisia is ranked as the third country after Italy and Spain with a high number of proposals and entities. This is due a particular emphasis in the re-orientation of the research system towards economic activities of the country (Arvanitis & Mhenni, 2008).

The coordination of proposals by non-European states is very low for both sections despite the slight increase in 2019. Indeed, only 6 projects are coordinated by teams from non-European countries out of 83 selected proposals, and 5 of them belong to H2020-associated countries. These results demonstrate a deviation from the key principles of PRIMA and require exploration of potential reasons that hinder scientists from non-EU Mediterranean partner countries to be PRIMA project coordinators.

The administrative and legal constraints are the main causes of non-coordination by non-European countries. Research and innovation activities in the Middle Eastern and Maghreb countries depended upon the dialectic between the state, some large institutions devoted to research activities, mainly universities, and individual researchers. The latter have had an immense role in shaping the system, and in particular because they have had training in foreign countries and at their initiative, they strongly influence policies and orientations (Arvanitis & Mhenni, 2008). Overall, although there are some improvements in policies and governance in MENA regions, several bureaucratic constraints continue to hinder researchers in coordinating international proposals (Arvanitis et al., 2010).

The networking analysis clearly shows a lack of south-south cooperation mainly between Northern African Mediterranean countries and Eastern Mediterranean countries. In the last few years, there was a rapid change not only in development cooperation between the countries of the south through bilateral-cooperation (example, Tunisia-Egypt) but also beyond conventional development cooperation, covering areas
such as trade, investment and technology exchange. In Mashreq countries, NGOs and international organizations have had a decisive influence by promoting service-oriented research, as well as research run under the mode of expertise (Arvanitis & Mhenni, 2010). Researchers from Southern Mediterranean countries are always moving beyond the barriers imposed by institutions, moving in and out of their academic positions, playing often the role of experts, and occupying and leaving official positions. This relative fluid movement of highly trained personnel has been not only shaping the systems; it also permitted to surpass the institutional difficulties, the rigidities of political decisions and bureaucratization (Arvanitis & Mhenni, 2010).

The budget of Sect. 2 provided by non-European countries is low (22%) as compared to that committed by European countries. This is due to the weak funding capacity of Southern and Eastern Mediterranean countries and also due to the low number of coordinated proposals by these countries. With the exception of Turkey and Israel, the remaining countries allocate less than a 1% GDP to research and innovation. These countries are characterized by a weak innovation capacity; the R&D to GDP ratio is very low and only a few patents are deposited in the European and American offices of patents. Moreover, the share of the Maghreb countries does not exceed 0.2% of the global scientific publications (Observatoire des sciences et de la technologie, 2006).

Some of these countries, mainly Tunisia and Egypt, have experienced turbulence and political turmoil following the Arab spring revolution. Although, the Egyptian and Tunisian constitutions include clauses which recognize the importance of building a knowledge economy and emphasize the need to support scientific research, innovation and creativity, the two countries allocate less than 1% GDP to research and innovation. According to Bizri (2018), the science and technology innovation (STI) systems in the majority of Arab countries were subjected to frequent and radical changes in governance arrangements, particularly over the past decade. Besides, STI policies were not supported by adequate implementation strategies, with specific goals, work plans, benchmarks and clear evaluation modalities.

The COVID-19 crisis will further create challenges for Southern Mediterranean countries, and it may affect the entire programme. Urgent actions should be taken to ensure meaningful participation from these countries and consequently improve the partnership north–south and south–south (Lal, 2019). Researchers from the Global North should acknowledge that since the establishment of the sustainable development goals (SDGs), all nations can be considered as developing countries, as a country may be rich in terms of GDP but may fail to reach environment-related SDGs (Gore, 2015). In the twenty-first century, a global focus on development is tempting as it offers opportunities for addressing universal issues such as climate change, and food security, holistically (Horner, 2019).

SME participation of non-European countries is low for Sect. 1, but it is very low for Sect. 2 because several national regulations prevent funding to the private sector (example cases of Tunisia, Morocco, Algeria). Some non-European countries, such as Tunisia and Morocco, have placed a large emphasis on SMEs and on new technologies, as well as on parallel review and reform of academic research institutions, and promotion of technical research centres and industrial and technology
clusters (Arvanitis & Mhenni, 2010). However, funding of private sector continues to be a problem in several some Southern and Eastern Mediterranean countries. The absence of funding private sector in particular SMEs is due the lack of mechanisms and incentives strategies in these countries where up to, now a small contribution of private sector in R&D activities (Nour, 2014).

SMEs are the backbone of European and non-European economy. They significantly contribute to employment and economic growth. SMEs serve two key purposes: (1) they play a dynamic role in economic development, by stimulating innovation, increasing competition, boosting wages and creating a middle class of small businesses; (2) SMEs also perform an indirect yet crucial political function in generating the demand for essential public goods, such as reduced corruption, the universal application of the law, improved infrastructure, public services, and good governance in general (European Union, 2011).

Non-European PRIMA participating countries often lack the resources to invest in innovation to fuel productivity and development. SMEs provide effective project coordination and leadership, helping to lead the projects smoothly. SMEs not only perform core research and technological tasks but also provide fundamental services including project management, communication of project results and commercial exploitation, preparation of reports, and life cycle assessments. In this respect, vibrant SME activity is now considered a sine qua non for the development of knowledge-based economies, no matter what the development level of the economy, with SMEs often proving to be more flexible and innovative (Aghion & Griffith, 2005).

In order to encourage participation of SMEs from non-European countries, efforts should be directed at changing national regulations and towards finding suitable mechanisms of collaboration between public and private entities. Such collaboration helps to bring a broader set of skills and talents and a more responsive work culture into public sector organizations, along with innovative thinking and creativity. It also helps private companies to innovate more effectively and to achieve their concrete goals in a more efficient way. It is important to encourage enterprises and industrial support institutions to integrate innovation, technology transfer and R&D into their strategies. The idea of creation of technology parks to support start-ups and to favour the incubation and creation of innovative enterprises by promoting the results of research developed Tunisia (El Elj, 2012) could be considered as lesson learned for the other Southern Mediterranean countries. Besides modernizing and improving the competitive capacity of the national industrial system accelerates the integration of the country into the free-trade zone with Europe.

The findings of this paper highlight the performance of partnership between the two shores of the Mediterranean countries and shows the high involvement of human capital, research teams, infrastructure and private sector in research and innovation projects. Although this article shows a good partnership between European and non-European countries, we recommend for governments and policy makers in Southern and Eastern Mediterranean countries to revise their national regulations, policies and strategies to provide incentives for research teams and enhance private sector involvement particularly SMEs in research programmes.
References

Aghion, P., & Griffith, R. (2005). Competition and growth: Reconciling theory and evidence, Cambridge: MIT Press; Schramm, C.J. 2004. Building Entrepreneurial Economies Foreign Affairs, 83(4), 104–115.

Arvanitis, R., & Mhenni, H. (2008). Innovation policies in the context of North-Africa: New trends in Morocco and Tunisia. Munich Personal RePEc Archive, Online at https://mpra.ub.uni-muenchen.de/17939/ MPRA Paper No. 17939, posted 18 Oct 2009 17:53 UTC.

Arvanitis, R., & M’henni, H. (2010). Monitoring research and innovation policies in the mediterranean region. Science Technology & Society, 15, 233.

Arvanitis, R., M’Henni, H., & Tsipouri, L. (2010). Y a-t-il une gouvernance des systèmes d’innovation dans les pays d’Afrique du Nord et du Moyen-Orient? Maghreb-Machrek, Hiver, 2009–10(202), 65–84.

Bizri, O. F. (2018). Science, technology, and innovation policies and institutional landscapes. Book Chapter Science, Technology, Innovation, and Development in the Arab Countries, 2018, P111-361.

El elj M. (2012). Innovation in Tunisia: Empirical analysis for industrial sector. Journal of Innovation Economics & Management., 2012(9), 183–197.

European Commission. (2020). Roadmaps for administrative capacity building. Praticla toolkit prepared by the European Commission, (p. 47).

European Union. (2011). The role of small and medium-sized enterprises in the Mediterranean. Catalogue number: QG-32–13–097-EN-N ISBN: 978–92–895–0668–7, (p. 32). https://doi.org/10.2863/69773.

Gore, C. (2015). The post-2015 moment: Towards sustainable development goals and a new global development paradigm. Journal of International Development, 27(6), 717–732.

Gøtke, N., Amanatidou, E., Isapa, I., Julkowska, D., & Serrano, J. (2016). Analysis of ERA-NET Cofund actions under Horizon 2020. Final report of the expert group, (p. 69).

Horner, R. (2019). Towards a new paradigm of global development? Beyond the limits of international development Prog. Human Geography, 44(2019), 415–436.

Lal, R. (2019). Promoting “4 per thousand” and “adapting African agriculture” by south-south cooperation: Conservation agriculture and sustainable intensification. Soil Tillage Res., 188(2019), 27–34.

Leck, H., Conway, D., Bradshaw, M., & Rees, J. (2015). Tracing the water-energy-food nexus: Description, theory and practice. Geography Compass, 9, 445–460. https://doi.org/10.1111/gec3.12222

Nour, S. S. O. M. (2014). Regional systems of innovation and economic structure in the Arab Region. Journal of the Knowledge Economy, 5, 481–520.

Observatoire des sciences et de la technologie (OST). (2006). Indicateurs de Sciences et Technologies. Rapport de l’observatoire des sciences et des techniques. Éditions Economica & OST. Paris, 2008, pp. 483.

R Core Team. (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Rasul, G. (2016). Managing the food, water, and energy nexus for achieving the sustainable development goals in South Asia. Environment and Behaviour, 18, 14–25. https://doi.org/10.1016/j.envdev.2015.12.001

Rasul, G., & Sharma, B. (2015). The nexus approach to water-energy-food security: An option for adaptation to climate change. Climate Policy, 16, 682–702. https://doi.org/10.1080/14693062.2015.1029865

Ward, J. H., Jr. (1963). Hierarchical grouping to optimize an objective function. Journal of the American Statistical Association, 58, 236–244.

Weitz, N., Nilsson, M., & Davis, M. (2014). A nexus approach to the post-2015 agenda: Formulating integrated water, energy, and food SDGs. SAIS Rev. Int. Affairs, 2, 37–50. https://doi.org/10.1353/sais.2014.0022

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