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# Climate Change Vulnerability and Inequality: A Study on Mediterranean Countries [*]


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# 1. Executive Summary

The Mediterranean region faces a dual challenge: the increasing impacts of climate change and persistent socio-economic inequalities. These two forces are intertwined, with climate change acting as a threat multiplier, increasing existing disparities and threatening the well-being of the most vulnerable, affecting them disproportionately. This brief examines climate vulnerability and inequality in sixteen Mediterranean countries, highlighting the urgent need for policy interventions.

While extensive research has explored the effects of climate change and economic output, its relationship to within-country income inequality remains underexplored. This study addresses this gap by investigating the link between climate vulnerability and income inequality in sixteen Mediterranean countries from 1995 to 2021, using the Notre Dame Global Adaptation Initiative (ND-GAIN) Vulnerability Index. The analysis reveals that increased climate vulnerability is positively associated with rising income inequality.

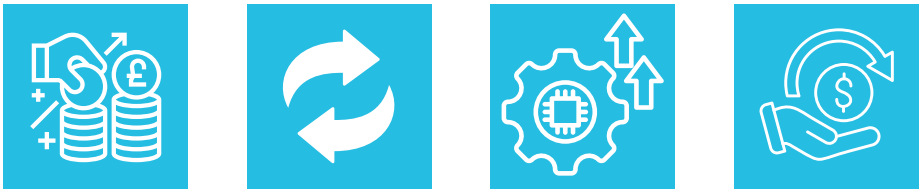
Key findings indicate that food vulnerability emerges as the most significant driver of inequality, reflecting the region's reliance on agriculture and food imports, this is especially true for northern African countries. Furthermore, the study examines the interaction between institutional quality and climate vulnerability, demonstrating that institutions, in these countries, do not necessarily mitigate the negative effects of climate change on inequality. Additionally, the agricultural sector plays a crucial role in this dynamic, as employment in agriculture amplifies the adverse distributional effects of climate change.

These findings hold important policy implications. Addressing climate-induced inequality requires a multidimensional approach, incorporating climate-resilient agricultural practices, enhanced social safety nets, and improved governance frameworks. Policymakers should prioritize investments in drought-resistant crops, sustainable irrigation, and localized food production to reduce reliance on imports. Moreover, strengthening institutional frameworks and promoting equitable resource distribution are essential to mitigating the socioeconomic divide exacerbated by climate change.

By shedding light on the intricate relationship between climate vulnerability and inequality, this study underscores the urgency of integrating equity considerations into climate policies. Without targeted interventions, climate change will continue to increase income disparities, disproportionately affecting the most disadvantaged communities in the region. This research provides a crucial foundation for policymakers seeking to design more inclusive and sustainable climate adaptation strategies.

# 2. Introduction

Climate change, driven primarily by human activities, has rapidly transformed the natural environment, affecting ecosystems and human societies across the globe. The Intergovernmental Panel on Climate Change (IPCC) reports that global surface temperatures have increased by 1.1°C over the past decade, compared to the baseline period from 1850 to 1900. This temperature rise has triggered profound alterations in the atmosphere, oceans, and ecosystems, leading to significant environmental, economic, and social consequences. Although climate change impacts have been felt around the globe, its effects are unevenly distributed. Vulnerable populations, often the least responsible for causing climate change, endure the most of these adverse effects.



Studies have found that, vulnerability to climate change is not only determined by geographic location or environmental conditions but also by socioeconomic factors that shape the individuals and communities' ability to cope with climate risks. Rural, low-income communities, women, and marginalized groups are disproportionately affected.

Several mechanisms explain why these populations experience greater climate vulnerability. First, the unequal distribution of economic activities across regions means that poorer households are more likely to live in areas prone to climate hazards. Second, these groups often lack the financial resources or social capital to prepare for or recover from climate-related events. Third, inequalities in access to education, healthcare, and infrastructure limit the ability of these populations to adapt to changing climate conditions. While much attention has been paid to climate change's impact on inequality between countries, within-country inequality remains underexplored. Most existing literature has focused on global trends and aggregate data, treating countries as homogeneous entities.

This research contributes to the growing body of literature on climate change and inequality by providing empirical evidence from the Mediterranean region, an area that faces several shared environmental challenges, including rising temperatures, water scarcity, desertification, and the threat of rising sea levels. By using the climate vulnerability index developed by the Notre Dame Global Adaptation Initiative (ND-GAIN), this research adds to the literature by providing a nuanced analysis of how climate change amplifies or mitigates vulnerabilities across different socioeconomic groups.

This study also explores the role of two critical transmission channels: the agricultural sector and institutional quality. As agriculture, a key economic sector in many Mediterranean countries is highly sensitive to climate change, and fluctuations in agricultural productivity can further increase income disparities. Additionally, institutional quality, encompassing governance, corruption controls, judicial effectiveness, and political stability, can either mitigate or worsen the adverse effects of climate change. In countries with weak institutions, the poor are less likely to benefit from state support, further deepening inequality.

Our study use a Feasible Generalized Least Squares (FGLS) one-way fixed effects model to examine a panel of 16 Mediterranean countries and assess the relationship between climate vulnerability and income inequality. Preliminary findings suggest a positive correlation between climate vulnerability and rising inequality; we control for economic and demographic factors. Furthermore, the study reveals that countries with a higher share of agricultural employment experience greater inequality due to the sector's vulnerability to climate-induced disruptions. To add to that, the analysis underscores the failure of institutional mechanisms in these countries to mitigate climate-related inequalities.

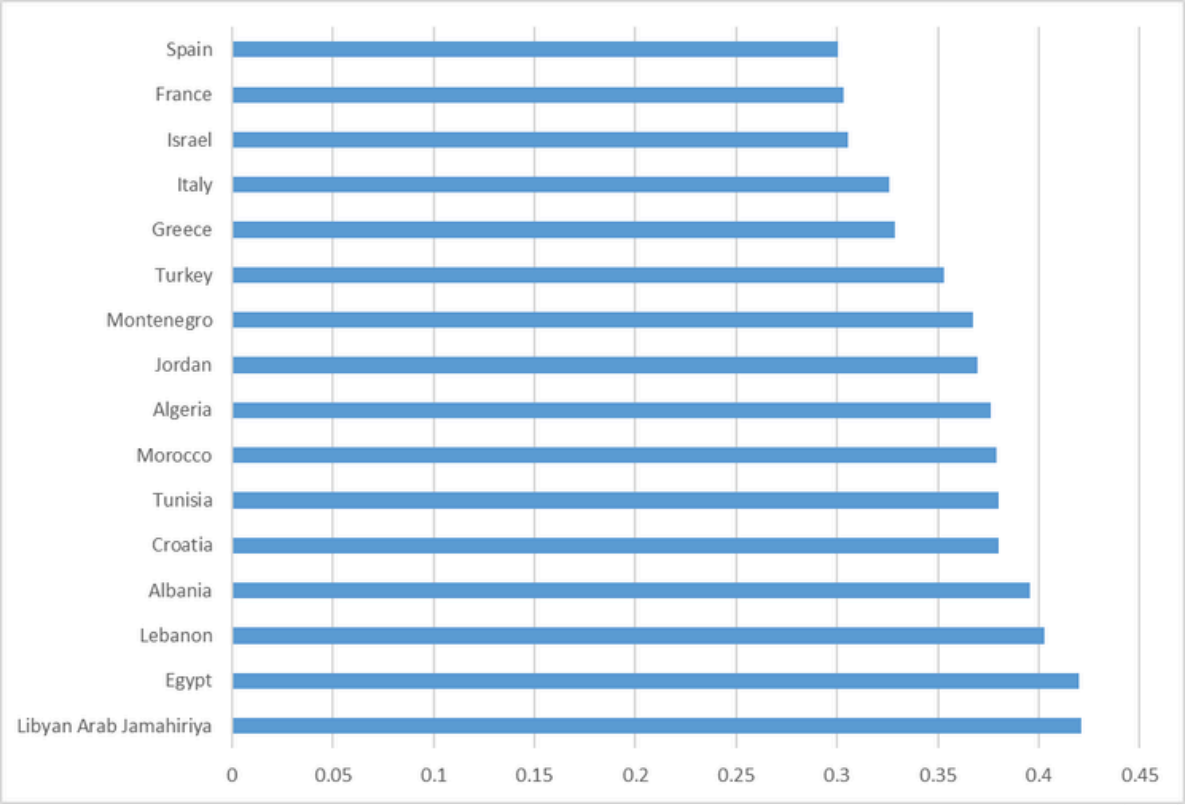
The findings of this research carry significant implications for policy design, as climate policies that fail to address inequality may inadvertently increase the challenges faced by vulnerable populations. That is why addressing climate change from an ecological, economic, and inequality perspective is critical to ensuring that climate adaptation and mitigation strategies benefit all segments of society, particularly the most vulnerable.

The results from this study can support the design of policies that promote integrating considerations of climate vulnerability into the broader policy framework, so that governments can create more inclusive and effective responses to the challenges posed by climate change. To add to that, the Oxfam issue brief [1] warns that climate policies that ignore social justice may end up increasing inequality instead of fixing it, some mechanisms like the Social Climate Fund and climate dividends could help make climate policies more inclusive.

[1] Oxfam America. How to take climate action and tackle inequality: Federal policy recommendations. Oxfam America (2024). https://www.oxfamamerica.org/explore/research-publications/how-to-take-climate-action-and-tackle-inequality-federal-policy-recommendations/

# 3. A Region at Risk: Climate Vulnerability in the Mediterranean

The Mediterranean, a cradle of civilization and a biodiversity hotspot, is now facing a major challenge: climate change. This region, with its diverse landscapes, economies, and societies, experiences varying levels of climate vulnerability, as shown by the ND-GAIN Vulnerability Index. While countries like Israel, France, and Spain are better equipped to handle climate disruptions, others, such as Libya and Egypt, face serious risks due to extreme weather events like floods and storms.



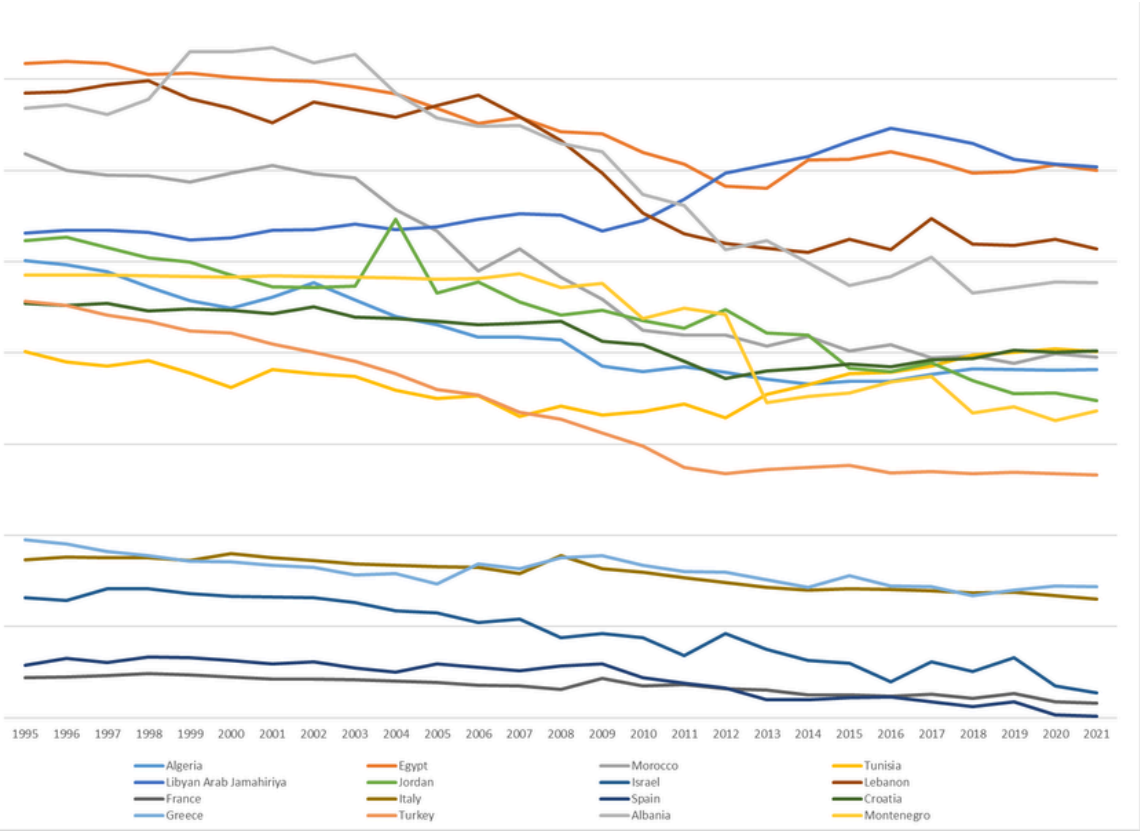



***Figure 2.1.1:*** *Vulnerability across countries of our sample*

**Source:** authors' calculations

The Mediterranean's climate challenges stem from its semi-arid environment, dense populations, and economic reliance on agriculture, tourism, and coastal infrastructure. Rising temperatures, decreasing rainfall, and more frequent extreme weather events are already straining food, water, health, and infrastructure; issues central to climate vulnerability. Nevertheless, while the region faces pressing threats, there are also examples of resilience. Morocco, for instance, has improved its climate adaptability by reducing reliance on food imports and enhancing urban living conditions. However, challenges remain, such as its increasing dependence on imported energy.

One of the biggest concerns is how climate change worsens inequality. Poorer countries suffer the most, with lower-income populations facing the consequences of income losses, health risks, and lack of essential services. In Egypt and Libya, the poorest communities are the most exposed to climate hazards and have the fewest resources to recover. Even in wealthier nations like France and Spain, economic disparities make certain populations more vulnerable. Addressing climate change in the Mediterranean is not just about environmental policies, it requires targeted efforts to reduce inequality and strengthen social resilience.

# 4. Approach and Results

Drawing on existing literature, this study investigates the empirical relationship between climate change and income inequality while controlling for other economic variables, using a panel dataset of sixteen[2] Mediterranean countries from 1995 to 2021. The model we used is a fixed effect one-way (individual) Feasible Generalized Least Squares (FGLS) model.

The regression model we employ is as follows:

$$Inequality_{it} = \alpha Vulnerablity_{it} + \beta X_{it} + \eta_i + \varepsilon_{it} \ (1)$$

In this model, the top 10/bottom 50 ratio is our dependent variable, with data sourced from the World Inequality Database (WID). Our primary independent variable is vulnerability, with data available from the Notre Dame University [3] website. The vector  represents our control variables, including real GDP growth, trade openness, population, population density, employment in agriculture (as a percentage share of total employment), and quality of institutions (measured by the Worldwide Governance Indicators from the World Bank).[4] The data we use are from the IMF dataset, the World Bank, and the ND-GAIN dataset.  is the individual fixed effect of our model, and  is our idiosyncratic error term.

Building on the literature review, we recognize that people's increased exposure and vulnerability to climate hazards are significantly influenced by a combination of economic, political, and social factors that both create and exacerbate inequalities. To better understand this dynamic, we explore the interaction between a country's vulnerability, employment in agriculture, and the quality of its institutions (i.e., vulnerability * employment in agriculture[5]; vulnerability * quality of institutions)[6]. This in-depth analysis aims to provide a more comprehensive understanding of the complex nature of climate vulnerability and its impact on inequality. Accordingly, we proceed to estimate equations (2) and (3):

$$Inequality_{it} = \alpha(Vulnerablity_{it} * quality\ of\ institutions_{it}) + \beta X_{it} + \eta_i + \varepsilon_{it} \ (2)$$

$$Inequality_{it} = \alpha(Vulnerablity_{it} * employment\ in\ agriculture_{it}) + \beta X_{it} + \eta_i + \varepsilon_{it} (3)$$

[2] Algeria, Egypt, Morocco, Tunisia, Libya, Jordan, Israel, Lebanon, France, Italy, Spain, Croatia, Greece, Turkey, Albania and Montenegro.

[3] https://gain.nd.edu/our-work/country-index/

[4] These indicators include corruption control, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability.

[5] Hallegatte and Rozenberg (2017) and Rao et al. (2017) suggest that agriculture is one of the primary channels through which climate change impacts poverty and income inequality.

[6]The quality of institutions significantly affects the allocation of resources and opportunities among domestic social groups, ultimately shaping the distributive patterns of countries (Chong & Gradstein, 2007; Levy & Temin, 2007; Ostry et al., 2018).

The results show that, in equation (1), climate vulnerability has a positive and statistically significant coefficient ($p < 0.05$). This suggests that increased climate vulnerability leads to greater income inequality. Specifically, a one-unit increase in the vulnerability index in the previous period (t-1) is associated with a 0.3143% increase in the income gap between the top 10% and bottom 50%. This finding aligns with previous research using the ND-GAIN index.

Further analysis using the individual components of the vulnerability index reveals that food vulnerability has the largest and most significant positive coefficient. This highlights the crucial role of food security in the relationship between climate change and inequality. The high food vulnerability in the region is likely due to agricultural dependence, reliance on food imports, climate event sensitivity, and government intervention. This is further supported by the Global Food Insecurity Index, which shows relatively high food insecurity scores.

Equation (2) shows a positive and significant ($p < 0.001$) coefficient for the interaction between climate vulnerability and institutional quality. This suggests that, contrary to some studies in other regions, institutional quality, in our sample of countries, does not appears to mitigate the impact of climate vulnerability on income inequality.

Equation (3) reveals a positive and significant ($p < 0.001$) coefficient for the interaction between climate vulnerability and agricultural employment. This confirms the importance of the agricultural sector as a channel through which climate change affects inequality. A higher proportion of agricultural employment intensifies the effect of climate vulnerability on income disparities, likely because agricultural households are particularly susceptible to climate-related income losses.

# 5. Conclusion

Our study confirms the significant role of climate vulnerability in increasing income inequality in Mediterranean countries. We demonstrate that the impact of climate vulnerability on inequality is amplified by both high agricultural employment and institutional quality. To add to that, the vulnerability of the food sector is a key driver of this relationship. These results emphasize the complex and multifaceted nature of the climate-inequality nexus and suggest the need for integrated policies that address both climate change adaptation and the structural factors that contribute to inequality in the region. Further research could explore the specific mechanisms through which institutional quality interacts with climate vulnerability to influence income distribution. In addition, studies focusing on individual countries could provide a deeper understanding of the issue.

# 6. Implications & Recommendations

### Climate Change and Rising Inequalities in Southern Europe and North Africa

This study confirms that climate change is exacerbating inequalities in Southern Europe and North Africa. The food sector vulnerably emerges as the primary factor: rising food prices, caused by climate shocks, make it harder for low-income families to afford basic nutrition. Climate-related migration, both within and across borders, adds more strain on social and economic systems. To add to that, climate adaptation efforts often focus on cities and wealthier populations, leaving rural and marginalized groups behind. This leads to unequal access to services like water, energy, and transportation, deepening social inequalities.

## Protecting Vulnerable Groups from Food Price Shocks

One urgent priority is protecting vulnerable people from food price increases due to climate change. This can be done through food security programs funded by European and national budgets. Low-income families should receive direct assistance during food crises. Additionally, price stabilization mechanisms for essential foods can help prevent extreme price fluctuations that hurt the poor the most. Spain's policies to monitor energy poverty and improve affordability can serve as a model for similar food security efforts.

## Climate Change and Agricultural Employment

Another major problem is the impact of climate change on jobs in agriculture. Many rural communities depend on farming, but climate change is making it harder to grow crops. Droughts, soil degradation, and unpredictable weather are making agricultural work unstable, leaving many workers without a steady income. A recommendation was given by a study,[7] which suggested that redistributing carbon revenue, such as giving equal per-person financial support could help reduce inequality in the short term by nearly two Gini points. On top of that, the Oxfam report[8]highlights that job creation is crucial for climate justice. So establishing a "Green Agricultural Employment Program" could provide training and job opportunities in sustainable farming, agroforestry, and water conservation. A similar initiative in the U.S., called the 21st-century Civilian Conservation Corps, shows how employment programs can support both climate adaptation and economic stability.

[6] Emmerling, J., Andreoni, P., Charalampidis, I. et al. A multi-model assessment of inequality and climate change. Nat. Clim. Chang. 14, 1254–1260 (2024). https://doi.org/10.1038/s41558-024-02151-7

[7] Oxfam America. How to take climate action and tackle inequality: Federal policy recommendations. Oxfam America (2024). https://www.oxfamamerica.org/explore/research-publications/how-to-take-climate-action-and-tackle-inequality-federal-policy-recommendations/

## Making Climate Policies More Socially Inclusive

To reduce the social impact of climate change, governments must focus on inequality in climate adaptation and mitigation strategies. A report from the European Parliament[9] highlighted that current climate policies do not focus enough on social issues, causing some groups to bear a heavier burden. This means that governments, from now on, must provide targeted financial aid, improve governance, and hold corporations accountable.

## Prioritizing Rural and Marginalized Communities

Another key step is investing in climate adaptation for rural and disadvantaged communities. Currently, most climate finance goes to urban projects, leaving rural areas behind. Future funding should prioritize projects that benefit marginalized groups. Investments in sustainable farming, better irrigation, and water management should focus on regions struggling with droughts and extreme weather. (Slovakia's climate vulnerability assessments can serve as an example.)

## Community Participation in Climate Decision-Making

Another important step is ensuring that climate policy decisions include the voices of those most affected: farmers, low-income workers, and vulnerable households. National and local governments should set up participatory climate councils, where community representatives can contribute to adaptation planning. Netherlands has used this approach successfully in its climate strategies. In addition, national adaptation plans should require mandatory consultations with affected communities to improve transparency and accountability.

[9] Gancheva, M., Akbaba, B., Geraci, M. et al. Policy instruments to tackle social inequalities related to climate change. Eur. Parliam. Rep. 740.081 (2023).

## Social Impact Assessments and Fair Climate Finance

Finally, climate funding should include social impact assessments before being approved. Many funding programs focus only on environmental goals without considering social consequences. By incorporating inequality metrics into climate finance decisions, policymakers can make sure that funds go to projects that both tackle climate change and reduce inequality. Austria's renovation subsidies for low-income households provide a good example of how financial support can help vulnerable groups while also meeting climate goals.

## Financing Climate Justice Through Taxation

To finance these efforts, governments should strengthen taxation policies. Oxfam has proposed progressive taxes on large agribusinesses and high-income individuals to raise money for rural climate adaptation programs. By reducing corporate influence on climate policy and increasing financial transparency, governments can ensure that climate funds help those most in need rather than benefiting the wealthy.

## Institutional Quality, Governance, and Climate Inequality

In the study, we also concluded that, institutional quality does not help mitigate the impact of climate change on inequality. Ideally, strong institutions should protect vulnerable populations from the effects of climate change. However, corruption and poor governance often divert climate funds to politically connected elites instead of those who need them most. This is important given that, institutional quality plays a crucial role in addressing climate change. Directly, strong institutions shape human activities, reducing $CO_2$ emissions and enhancing environmental quality (Goel, Herrala, & Mazhar, 2013; Huynh & Hoang, 2020). They also foster renewable energy innovation and amplify the positive effects of outward foreign direct investment (OFDI) on green energy efficiency (Ren, Hao, & Wu, 2022). However, corruption, as a dimension of institutional quality, worsens $CO_2$ emissions, especially where environmental regulations are weak (Xie et al., 2023). Indirectly, institutions mitigate climate change through two channels: attracting green FDI with clean technology (Cheung & Lin, 2004; Hong Hiep et al., 2023) and reducing the shadow economy, which otherwise contributes to pollution (Huynh & Nguyen, 2020).

## Conclusion: Toward a Just and Resilient Future

To conclude, solving climate vulnerability in Southern Europe and North Africa requires cooperation between the European Union, national governments, financial institutions, and civil society. The success of climate policies depends on their ability to provide fair solutions that protect disadvantaged communities while promoting sustainable economic growth. By integrating social justice into climate policies, Europe and its partners can turn climate challenges into opportunities for a more just and resilient future.

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## About FEMISE

FEMISE, the Forum Euroméditerranéen des Instituts de Sciences Économiques, is a Euro-Mediterranean network of over 100 economic and social research institutes from both shores of the Mediterranean. Established in Marseille, France, in 2005 as an NGO, FEMISE promotes dialogue on economic and social policies to foster cooperation and mutual benefit between Europe and its Mediterranean partners. Coordinated by the Economic Research Forum (ERF) in Egypt, FEMISE focuses on strengthening research capacity, fostering public-private dialogue, disseminating research findings, and building partnerships to support regional collaboration and sustainable development.

## About IEMed

The European Institute of the Mediterranean (IEMed), founded in 1989, is a think-and-do tank focused on Euro-Mediterranean relations. Guided by the Euro-Mediterranean Partnership (EMP), European Neighbourhood Policy (ENP), and Union for the Mediterranean (UfM), it promotes cooperation, mutual understanding, and intercultural dialogue to build a shared space of peace, stability, and prosperity. IEMed is a consortium of the Catalan Government, the Spanish Ministry of Foreign Affairs, the EU, and the Barcelona City Council, with contributions from civil society through its Board of Trustees and Advisory Council.

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The Economic Research Forum (ERF), established in 1993, is a regional network promoting high-quality economic research for sustainable development in Arab countries, Iran, and Turkey. Based in Cairo, Egypt, with a branch in Dubai, UAE, ERF builds research capacity, supports independent studies, and disseminates findings through publications, seminars, and the ERF Policy Portal. As a non-profit organization, ERF is supported by regional and international donors and guided by a distinguished Board of Trustees and a network of researchers.

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