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## Abstract

This paper examines the employment patterns of women within the blue economy in Egypt, Jordan, Lebanon, Sudan, Tunisia, and the United Arab Emirates (UAE). Using a comparative empirical approach and descriptive statistics, the findings reveal that women's participation in the Arab blue economy is limited but shows clear patterns. Women's share in employment is higher in the blue economy than the overall economy, especially in knowledge-intensive subsectors like research and biotechnology, while traditional marine activities remain male-dominated. They are also mainly in formal and salaried jobs, while men dominate self-employment in the informal sector. Medium and large firms offer more balanced gender representation than micro and small enterprises. These trends highlight how education, formality, firm size, and cultural factors shape women's roles. The findings also show disparities in the structures of economies in the region, most starkly in Sudan, which is highly informal versus which the UAE, which shows near-universal formality, as well as disparities within the blue economy which blends traditional marine work with emerging knowledge-based domains. These disparities affect gender employment dynamics. The paper concludes with policy recommendations aimed at improving women's access to stable, sustainable employment in the blue economy.

**Keywords:** Blue Economy, gender employment dynamics, formal and informal employment, Arab countries, women's economic participation, education and employment, and sustainable development

**JEL Classifications:** O3, J1

## ملخص

تتناول هذه الورقة البحثية أنماط توظيف المرأة في الاقتصاد الأزرق في مصر والأردن ولبنان والسودان وتونس والإمارات العربية المتحدة. وباستخدام منهج تجريبي مقارن وإحصاءات وصفية، تكشف النتائج أن مشاركة المرأة في الاقتصاد الأزرق العربي محدودة، لكنها تُظهر أنماطًا واضحة. فنسبة توظيف المرأة في الاقتصاد الأزرق أعلى منها في الاقتصاد ككل، لا سيما في القطاعات الفرعية كثيفة المعرفة كالبحث والتكنولوجيا الحيوية، بينما لا تزال الأنشطة البحرية التقليدية حكرًا على الرجال. كما أن النساء يشغلن في الغالب وظائف رسمية بأجر، في حين يهيمن الرجال على العمل الحر في القطاع غير الرسمي. وتوفر الشركات المتوسطة والكبيرة تمثيلًا أكثر توازنًا بين الجنسين مقارنةً بالمؤسسات الصغيرة والمتوسطة. وتُبرز هذه الاتجاهات كيف يُؤثر التعليم والرسمية وحجم الشركة والعوامل الثقافية في أدوار المرأة. كما تُظهر النتائج تباينات في هياكل الاقتصادات في المنطقة، أبرزها في السودان، الذي يتسم بطابع غير رسمي إلى حد كبير، مقارنةً بالإمارات العربية المتحدة التي تُظهر طابعًا رسميًا شبه شامل، فضلًا عن تباينات داخل الاقتصاد الأزرق الذي يمزج بين العمل البحري التقليدي والمجالات الناشئة القائمة على المعرفة. تؤثر هذه الفوارق على ديناميكيات التوظيف بين الجنسين. وتختتم الورقة بتوصيات سياساتية تهدف إلى تحسين فرص حصول المرأة على وظائف مستقرة ومستدامة في الاقتصاد الأزرق.

## 1. Introduction

The blue economy includes sectors such as fisheries, marine biotechnology, coastal tourism, maritime transport, renewable marine energy, and related services (World Bank, 2017; UNESCO and UN Women, 2025). Although the blue economy is increasingly recognized by policymakers and scholars as essential for economic growth, job creation, and ecological sustainability, significant gaps in understanding its socio-economic dimensions remain, particularly regarding gender equality and women's economic empowerment. The existing theoretical and empirical literature has primarily focused on ecological and economic aspects. However, the gendered employment patterns and the underlying factors that influence women's participation are insufficiently addressed, especially within specific regional contexts (Bennett et al., 2022; Yuan et al., 2024). This lack of empirical attention limits the effectiveness of policy responses aimed at inclusive and equitable development.

In the Arab region, coastal and marine resources are major economic assets that provide diverse employment opportunities. Countries such as Egypt, Jordan, Lebanon, Sudan, Tunisia, and the United Arab Emirates (UAE) have unique blue economy structures that are influenced by their specific economic conditions, regulatory frameworks, and institutional contexts (Sieghart et al., 2019; FAO, 2024). Despite these opportunities, women's economic participation in maritime sectors is inconsistent and is often limited by national policies, regulatory settings, sociocultural norms, and educational access (UN Women and ICSF, 2020; Williams, 2023). Previous studies have shown that overlooking women's contributions to marine-related sectors can exacerbate economic disparities and impede the achievement of broader development goals (Mangubhai et al., 2022; Mwakyambiki, 2024; Matovu et al., 2025a). Conversely, advancing gender equity within the blue economy could improve productivity, ecological outcomes, and economic resilience (Saggese, 2023; Doolittle-Llanos et al., 2025). However, there is a notable lack of detailed empirical analyses of women's employment dynamics within specific blue economy subsectors in Arab nations, leaving a critical gap in our understanding of how gender intersects with sectoral, institutional, and regulatory factors.

This study addresses a gap in the literature by pursuing the following objectives. First, it provides a comparative analysis of women's employment patterns in various blue economy subsectors in Egypt, Jordan, Lebanon, Sudan, Tunisia, and the United Arab Emirates (UAE). Second, it examines the correlation between education, vocational skills, and job formality and employment opportunities for women within blue economy sectors compared to broader economic sectors. Lastly, the study offers targeted policy recommendations based on empirical insights tailored to national and subsector contexts.

The remainder of the paper is structured as follows: Section 2 reviews literature on gender dynamics, educational attainment, employment formality, and sector-specific characteristics within the blue economy. Section 3 describes the methodological approach, detailing the data sources and analytical methods used. Section 4 presents the empirical findings through descriptive and comparative analyses. Section 5 contextualizes these findings within broader theoretical frameworks. Section 6 outlines practical recommendations. Section 7 suggests future research directions.

## 2. Literature review

Understanding gender dynamics within the blue economy is essential due to its implications for sustainable development, social equity, and economic resilience. Although women contribute significantly to maritime sectors worldwide, they are consistently underrepresented in skilled, higher-paying positions in fisheries, aquaculture, marine tourism, and renewable energy (World Bank, 2017; Ivanova et al., 2024; Rahman et al., 2024). For instance, women comprise about 21% of the global fisheries and aquaculture workforce, primarily holding informal and post-harvest roles. However, these roles are often undocumented and thus economically invisible (UNCTAD, 2023; FAO, 2024; UN Women and ICSF, 2020; Rizky et al., 2025). In regions such as the Mediterranean and Black Seas, critical tasks performed by women, including net mending, fish cleaning, and bookkeeping, are often absent from official statistics (Saggese, 2023). This could lead to vast underestimation in analysis presented later in this study. This pattern reflects broader occupational segregation<sup>1</sup>, which confines women to lower-paying coastal positions in seafood processing and tourism services while offshore roles are predominantly occupied by men (UN Women and ICSF, 2020; World Bank, 2022). Even in regions where women comprise a significant percentage of the coastal tourism workforce, such as the Caribbean, Pacific, and Indian Ocean, their roles tend to be informal and precarious with limited advancement opportunities (Jenkins and Brown, 2023; Rahaman et al., 2024). Similarly, women represent nearly 70% of the aquaculture workforce, primarily in informal, low-wage positions such as seaweed farming and fish processing, which exacerbates their economic vulnerability (Saggese, 2023; Yuan et al., 2024).

These patterns of occupational segregation and persistent informality are reinforced by structural and sociocultural barriers. Cultural norms often portray maritime work as masculine, which restricts women's economic opportunities, especially in roles that involve prolonged absences from home or extensive external interactions (Jenkins and Brown, 2023; Behera, 2024; Matovu et al., 2025a). Additionally, women often bear a disproportionate share of domestic and caregiving responsibilities, which further limits their access to formal employment and higher-paying roles in industries (World Bank, 2022; Jenkins and Brown, 2023). Educational disparities amplify these limitations, especially due to restricted access to specialized STEM training, which is critical for skilled sectors such as renewable ocean energy, marine biotechnology, and deep-sea research (Mangubhai et al., 2022; Gomes et al., 2024; Rahman et al., 2024). Addressing these educational disparities through targeted vocational training initiatives is essential to increasing women's economic integration and mobility in maritime industries (World Bank, 2022). Additionally, financial exclusion due to institutional gender biases in accessing credit significantly restricts women's participation in capital-intensive maritime sectors, constraining entrepreneurial opportunities and economic stability (Williams, 2023; Caroline, 2024; Rahaman et al., 2024).

These disparities are often overlooked in the regulatory environment, which lacks comprehensive, gender-sensitive frameworks to facilitate women's professional advancement and reduce informality (Das, 2023; Issifu et al., 2023). This informality is particularly prevalent in fisheries, aquaculture, and

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<sup>1</sup> Occupational segregation describes the persistent concentration of women and men in different types of jobs or subsectors, and often at different levels of responsibility, reflecting social norms, institutional constraints and discrimination rather than neutral choice.

coastal tourism and disproportionately exposes women to economic instability and environmental vulnerabilities (Jenkins and Brown, 2023; Yuan et al., 2024; Rizky et al., 2025). Grassroots and community-driven initiatives have become an effective means of promoting gender equity, particularly in culturally conservative regions that are resistant to formal policy interventions. These localized strategies include targeted vocational training, women-led cooperatives, and localized awareness campaigns (Jenkins and Brown, 2023; Mwakyambiki, 2024). Integrating gender considerations into blue economy policies enhances resource sustainability and aligns with the concept of blue justice, which emphasizes the equitable distribution of economic benefits and social inclusion (Bennett et al., 2022; Caroline, 2024; Doolittle Llanos et al., 2025). Lessons from parallel sectors, such as the green and digital economies, can also be applied to enhance gender equity in maritime contexts (Das, 2023; Ivanova et al., 2024).

Despite global insights, research focusing specifically on gender dynamics within the blue economy of the Arab region remains scarce. Existing regional literature primarily addresses broader gender disparities in employment, entrepreneurship, and financial access without explicitly focusing on marine sectors (Sieghart et al., 2019; Jenkins and Brown, 2023). Sociocultural norms and economic structures in the Arab region significantly impact Arab women's economic participation in marine industries, perpetuating informal employment and occupational segregation (World Bank, 2022; ILO, 2024a). Traditional gender norms largely confine women to informal or home-based economic roles, particularly in male-dominated sectors such as the maritime sectors in fisheries, shipping, and maritime tourism (Jenkins and Brown, 2023; Matovu et al., 2025a). Financial exclusion further restricts women's entrepreneurial and economic opportunities in the region as institutional biases severely limit their access to formal financial resources and credit (Williams, 2023; Caroline, 2024). Additionally, limited access to specialized educational and vocational programs perpetuates occupational segregation, restricting women's employment in high-skilled maritime sectors (Mangubhai et al., 2022; World Bank, 2022; Gomes et al., 2024). Addressing these disparities requires comprehensive, integrated policy frameworks combining regulatory reforms, financial inclusion initiatives, targeted educational programs, and community-level interventions tailored to Arab maritime contexts (UN Women and ICSF, 2020; Caroline, 2024; Matovu et al., 2025b; Rizky et al., 2025). Furthermore, the systematic collection of gender-disaggregated data and the development of robust statistical frameworks are crucial to accurately capturing women's contributions and informing targeted policymaking (Jenkins and Brown, 2023; Behera, 2024; FAO, 2024). Regional cooperation frameworks inspired by successful models, such as the South Asian Association for Regional Cooperation (SAARC), could provide strategic pathways for managing marine resources sustainably and achieving gender equity objectives within the Arab region (Alharthi and Hanif, 2020).

### **3. Data and methodology**

This study analyzes gender employment dynamics within the blue economy in six Arab countries: Egypt, Jordan, Lebanon, Sudan, Tunisia, and the UAE. These countries were chosen for their diverse economic structures, unique institutional frameworks, and varying levels of involvement in blue economy sectors. The examined period, from 2009 to 2023, was primarily determined by the availability of reliable, consistent data. The data were not available for all countries for the same years. In the analysis, the blue economy is disaggregated into six subsectors: direct marine and coastal activities,

tourism and coastal services, cultural heritage and recreation, research and biotechnology, support services, and marine equipment rental. The six blue-economy subsectors used in the empirical analysis are our own analytical aggregation of ISIC Rev.4 industries, informed by international definitions of the blue/ocean economy (World Bank, 2017), rather than a pre-existing named taxonomy. This timeframe encompasses critical socioeconomic events, including recovery from the global financial crisis, significant regional sociopolitical transformations, and economic disruptions caused by the pandemic. Analyzing gender employment trends throughout this period provides valuable insights into labor market resilience, employment structure adaptability, and the effects of gender-targeted policies. In all six countries, we rely on official Labour Force Surveys (LFS) produced by the respective national statistical offices. For this study we did not have access to individual-level microdata and instead used harmonised aggregated tabulations supplied by these offices or international partners. The period covered is 2009–2023 for Egypt (Labour Force Survey, CAPMAS), 2017–2023 for Jordan (Labour Force Survey, Department of Statistics), 2019 for Lebanon (Labour Force and Household Living Conditions Survey, Central Administration of Statistics), 2011 and 2022 for Sudan (Labour Force Survey, Central Bureau of Statistics), 2014–2023 for Tunisia (Enquête nationale sur la population et l’emploi / Labour Force Survey, INS), and 2017–2023 for the UAE (Labour Force Survey, Federal Competitiveness and Statistics Centre).

The methodological framework incorporates several key variables commonly used in labor economics research. The paper remains descriptive due to the lack of data. These include educational attainment, skill levels, employment status, job formality, and establishment size. Each variable directly informs our understanding of gender disparities in employment patterns specific to the blue economy. Educational attainment categories adhere to standard classifications: basic education refers to primary education or below, intermediate denotes secondary education, and advanced corresponds to tertiary-level education.<sup>2</sup> These classifications were selected due to their established influence on women’s labor market outcomes, notably affecting access to stable and formal employment (Gomes et al., 2024). The skill-level classifications adopted in this study reflect typical labor market categorizations. Low skills encompass manual labor or minimally trained roles. Medium skills represent vocational or specialized technical roles. High skills involve advanced technical expertise, which is especially relevant in biotechnology and other knowledge-intensive subsectors. The low, medium and high skill categories are constructed from the official occupational classifications used in each country’s Labour Force Survey (which are based on, or closely aligned with, ISCO occupational groups). The authors harmonised these occupational groups into three analytical categories : label low, medium and high skill. In other words, the categorisation is grounded in standard LFS/ISCO occupational data rather than being derived from wages or subjective assessment of individual jobs.

Employment status is another variable. There are two major categories of employment status: salaried employees and self-employed workers. Salaried employees typically enjoy regulated working conditions, , stable incomes and often social protection. In contrast, self-employment often involves

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<sup>2</sup>Basic education refers to primary education or below, intermediate denotes secondary education, and advanced corresponds to tertiary-level education. These three levels are harmonised across the six countries, but the underlying years of schooling differ by national system. In all cases, “basic” groups all categories up to completed lower secondary (typically 6–9 years of schooling), “intermediate” corresponds to completed upper secondary or post-secondary non-tertiary, and “advanced” includes any form of tertiary education

higher economic risks. Job formality, defined by the presence of regulated employment contracts, social protection coverage, and legal recognition, significantly impacts employment stability and economic security in contrast to informality. Prevalent particularly in fisheries and tourism-related activities in the region, informal employment exposes women to heightened economic uncertainty, thereby reinforcing gender disparities (ILO, 2024a). Lastly, establishment size categories which align with international standards defined by the World Bank: micro-enterprises (one to four employees), small-to-medium enterprises (five to 49 employees), and large enterprises (50 or more employees). Larger firms tend to provide more structured employment environments, clearer career advancement opportunities, and greater economic stability than micro-enterprises, which often perpetuate informality and economic vulnerability among female workers (World Bank, 2022).

To ensure clarity and precision, Table 1 provides definitions, classifications, and relevant details of the analytical variables used in this study.

**Table 1. Analytical variables, definitions, and classifications**

Variable	Definition and classification	Source / comparability notes	Relevance to gender dynamics in the blue economy
<b>Educational attainment</b>	Three harmonised levels: 1) Basic: primary education or below; 2) Intermediate: completed secondary education (general or vocational); 3) Advanced: any tertiary education.	Based on national Labour Force Survey (LFS) education variables, harmonised across countries into three levels in a way that is consistent with standard ISCED-type classifications. The underlying years of schooling differ by country (for example, 5+4+3 or 6+3+3 structures). All categories up to completed lower secondary are coded as “basic”, completed upper secondary or post-secondary non-tertiary as “intermediate”, and tertiary as “advanced”.	Determines women’s access to stable and formal employment opportunities and to higher-quality jobs in blue economy subsectors.
<b>Skill level</b>	Three occupational skill levels: 1) Low skills: manual labour or minimally trained roles; 2) Medium skills: vocational or specialised technical roles; 3) High skills: professional or managerial roles requiring advanced technical expertise.	Constructed from the occupation variable in each national LFS, using the official occupational classifications (aligned with ISCO-type major groups) and aggregated into three analytical categories labelled low, medium and high skill. We do not derive skill levels from wages or subjective judgment but from these standard occupational groupings.	Influences occupational segregation and women’s access to skilled employment roles, especially in knowledge-intensive blue economy subsectors.
<b>Employment status</b>	Two main categories of status in employment: 1) Salaried employees; 2) Self-employed (including employers, own-account workers and contributing family workers).	Based on the status-in-employment variable in each national LFS (employee, employer, own-account worker, contributing family worker), which follows ICSE-type classifications. Salaried employees correspond to “employees”; self-employed includes employers, own-account workers and contributing family workers.	Reflects differences in job stability, economic security and exposure to economic risk between women and men (for example, wage work versus vulnerable self-employment).
<b>Job formality</b>	Two categories of job formality: 1) Formal employment; 2) Informal employment.	Defined according to the formal / informal employment status reported in each country’s LFS. We code jobs as formal when the LFS classifies them as formal employment and as informal otherwise (including informal wage work, self-employment and unpaid family work). This follows national applications of ILO guidelines on measuring informal employment.	Central for economic security, access to social protection and the overall quality of women’s jobs in the blue economy.
<b>Establishment size</b>	Three enterprise-size classes: 1) Micro: 1–4 employees; 2) Small-to-medium: 5–49 employees; 3) Large: 50 or more employees.	Based on the establishment-size variable in national LFS, regrouped for this study into common bands (1–4, 5–49, 50+). National size categories may differ in official statistics, but are aggregated into these three classes to ensure cross-country comparability.	Indicates structural employment conditions and the degree of vulnerability. Women are more likely to be concentrated in micro and small enterprises, where informality and instability are typically higher.

The study uses an integrated analytical approach that includes descriptive, comparative, and trend analyses. The descriptive analysis characterizes gender-specific employment patterns across the selected countries. It focuses on educational attainment, skill levels, employment status, job formality, and establishment size. Additionally, the trend analysis captures employment patterns over time between 2009 and 2023. Identifying these employment trends points to persistent barriers and adaptive responses within the selected countries and subsectors, which supports the development of informed policy recommendations aimed at enhancing gender equity and economic resilience.

## 4. Empirical findings

### 4.1. Gender employment trends in the blue economy

#### 4.1.1. Comparative analysis of gender employment: Blue economy vs. Total economy

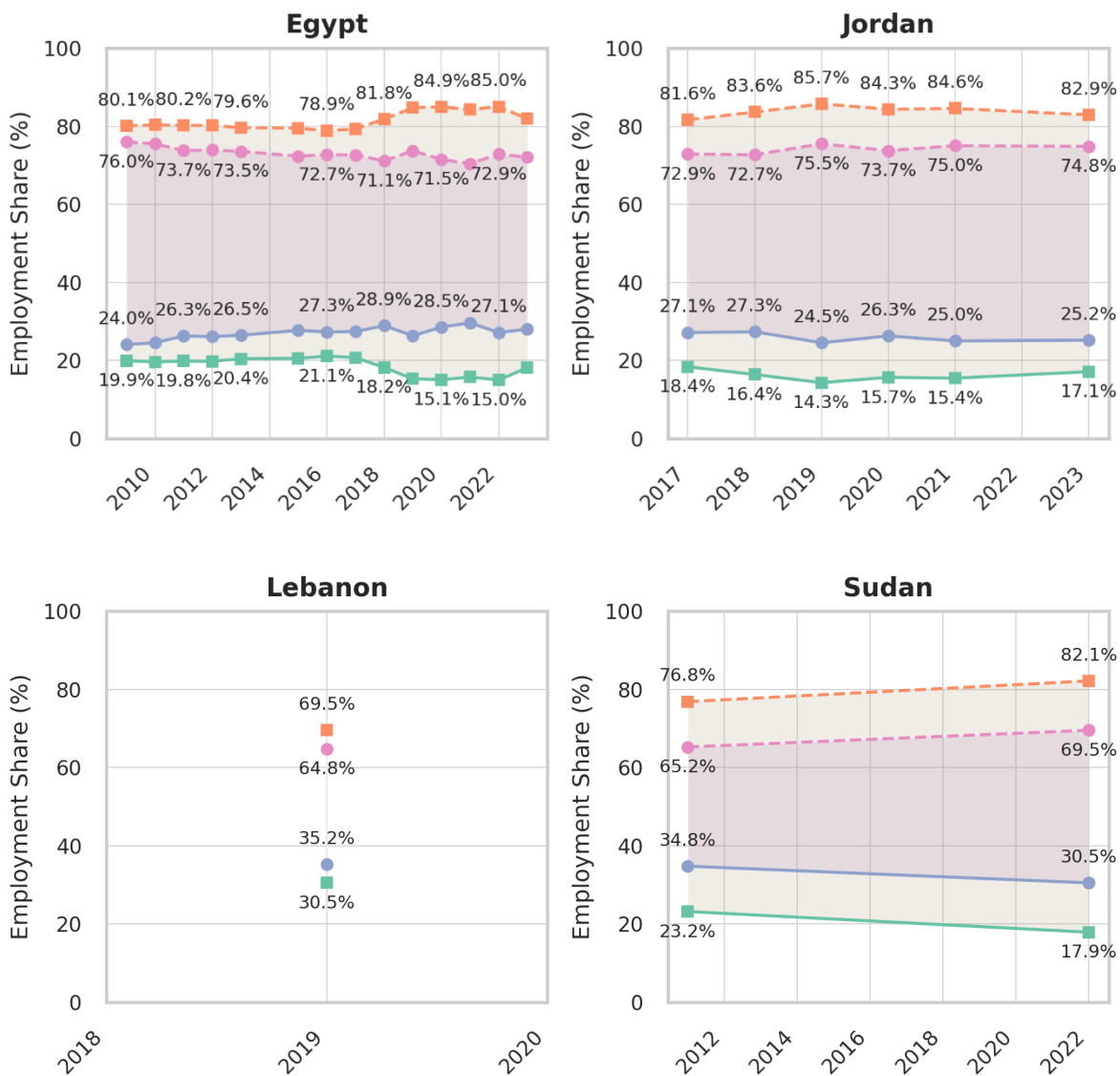
A comparative analysis of gender employment in the blue economy versus the overall economy in selected Arab countries reveals consistent trends that highlight the marine sector's potential for promoting gender inclusion (Figure 1a)<sup>3</sup>. In all examined countries, the blue economy has a higher proportion of female employees than the broader economic landscape. For example, in Egypt, the proportion of women employed in the blue economy increased from 24.04% in 2009 to 27.97% in 2023. This contrasts with a slight decline in female participation in the total economy during the same period, from 19.93% to 18.11%. Thus, there is a growing divergence between the two. Jordan exhibits a similar trend: the proportion of women employed in the blue economy remained consistently higher (between 27.12% and 25.19%) compared to a decline (from 18.35% to 17.11%) in the total economy during the same period. Tunisia experienced notable growth in female employment in marine sectors, with participation rates rising significantly from 16.57% in 2014 to 31.27% in 2023. This growth surpassed that of the total economy, which increased from 23.46% to 28.10%.

Despite limited data availability, Lebanon and Sudan have similar figures. In Lebanon, the share of female employment in the blue economy was 35.22% in 2019, which is significantly higher than the 30.49% recorded in the broader economy that same year. Similarly, Sudan's data from 2011 and 2022 indicate female employment shares in the blue economy of approximately 34.76% and 30.49%, respectively. These figures clearly surpass the broader economy's shares of 23.16% in 2011 and 17.86% in 2022. From 2021 to 2023, the UAE maintained relatively stable female participation in the blue economy, averaging around 28.5%. This figure consistently exceeded the total economy's declining rates, which fell from 23.67% in 2021 to 23.09% in 2023.

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<sup>3</sup>All figures labeled "a" show annual distributions by year, country, subsector, and gender. Figures labeled "b" illustrate the cumulative distribution (aggregated by country, subsector, and gender) across all available years. Figures labeled "c" depict the female employment share (aggregated across all available years) by country, subsector, and analyzed characteristics (education level, firm size, skill level, employment status, and job formality). Figures "a", "b", and "c" are available in the electronic supplement accompanying this article.

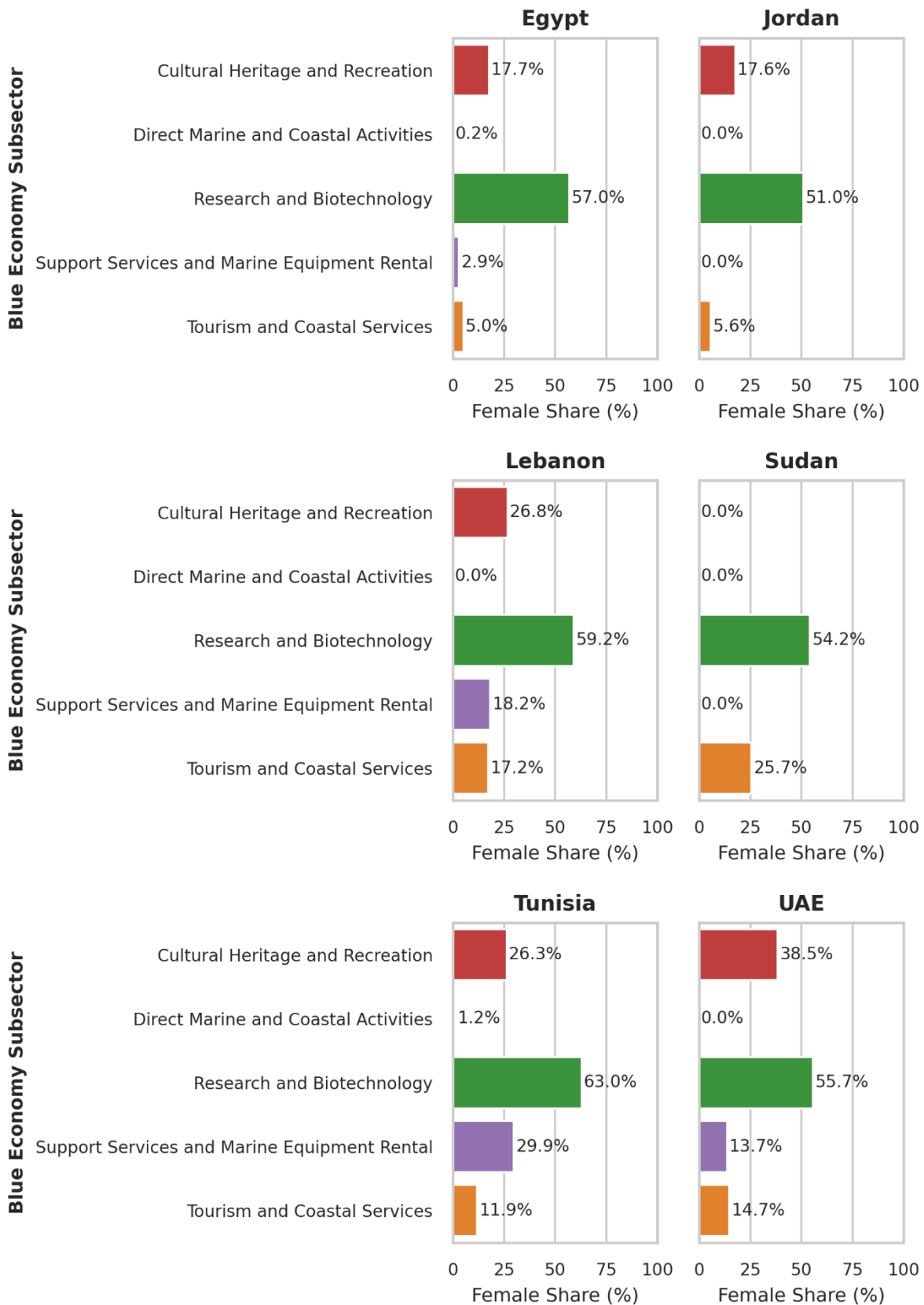
Figure 1a. Comparative analysis of gender employment - Blue Economy vs. Total Economy



4.1.2. Distribution of female employment across blue economy subsectors

Figure 1b shows the distribution of female employment in specific blue economy subsectors. The data are from all available years between 2009 and 2023, and are aggregated. The analysis reveals occupational segregation and substantial disparities in workforce access for women within these subsectors. In all countries analyzed, female employment notably clusters within research and biotechnology subsectors, which are characterized by high educational and technical skill requirements. For example, women constitute 57.01% of employment in research and biotechnology in Egypt. However, they are underrepresented in direct marine and coastal activities, accounting for only 0.16% of employment. Their representation remains modest in tourism and coastal services (5.05%) and support services (2.94%).

**Figure 1b: Distribution of female employment across blue economy subsectors (aggregated data, 2009-2023)**



Jordan exhibits a comparable occupational pattern, with women comprising 51.03% of employment in research and biotechnology. Meanwhile, direct marine activities and support services are dominated by male workers. Lebanon follows a comparable trend, with female employment reaching 59.18% in research and biotechnology. However, their participation is significantly lower in direct marine activities. Lebanon's cultural heritage (26.77%) and tourism services (17.24%) subsectors demonstrate moderate levels of female employment, indicating potential for increased inclusion.

In Sudan, women represent 54.16% of those involved in research and biotechnology. However, they are underrepresented in direct marine services and support services. Sudan's tourism services sector demonstrates comparatively higher female participation, at 25.7%. This suggests that targeted policy interventions in this area could enhance women's employment opportunities. Tunisia has the highest proportion of women employed in research and biotechnology at 63.03%. Moderate levels of female employment are also seen in Tunisia's cultural heritage sector (26.29%) and tourism services sector (11.86%). However, direct marine activities and support sectors continue to be predominantly male-dominated.

The UAE has a more diverse distribution of female employment, with significant proportions of women working in research and biotechnology (55.67%) and cultural heritage (38.46%). Direct marine activities remain male-dominated, and women are comparatively underrepresented in tourism and coastal services, accounting for only 14.72% of employment.

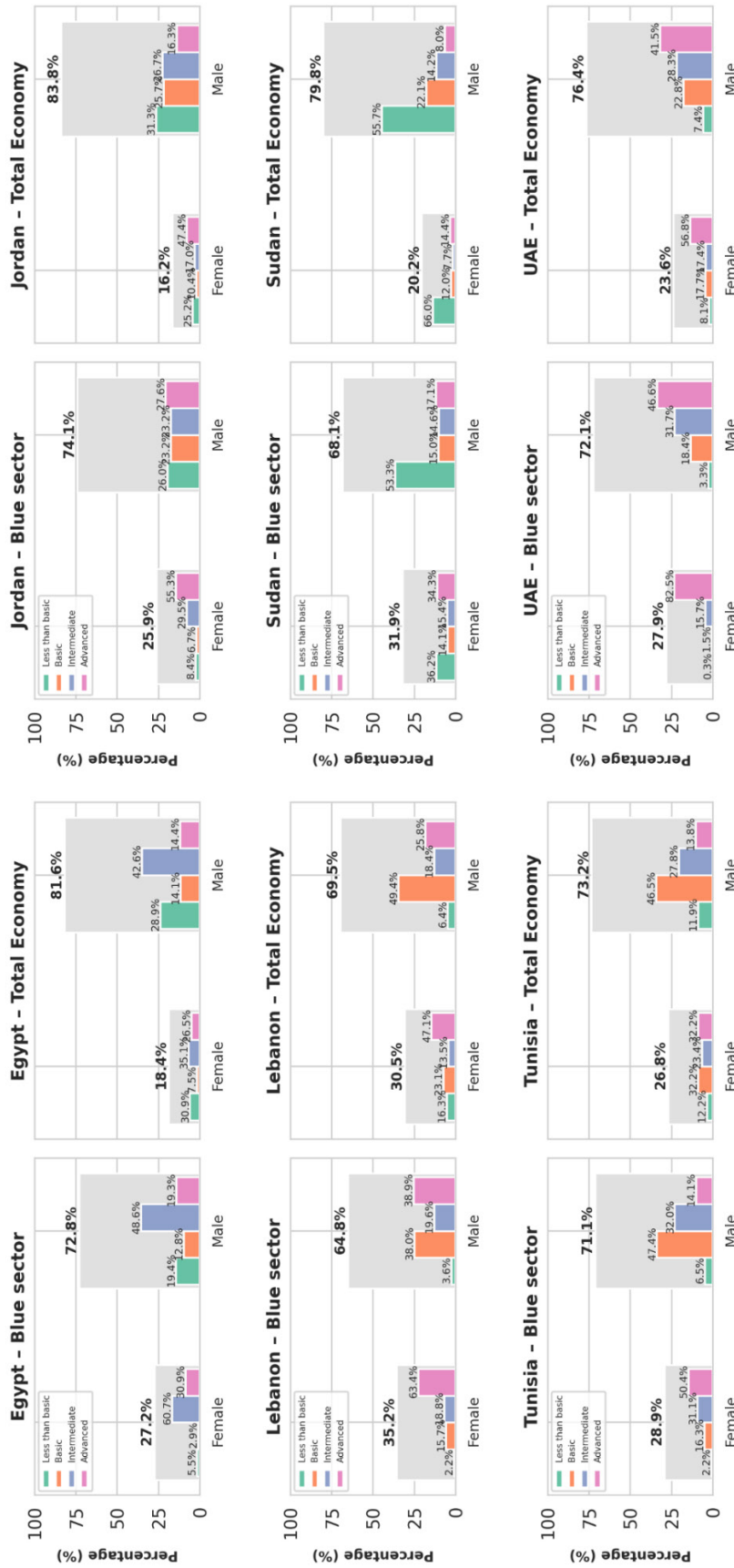
## *4.2. Educational attainment and access to skilled employment*

### *4.2.1. Comparative distribution of education levels in the blue economy and total economy*

The distribution of educational attainment among blue economy employees differs significantly from that of the broader economy, reflecting distinct sectoral skill requirements (Figure 2a). In Egypt, the proportion of women employed in the blue economy who had advanced education steadily increased from 30.6% in 2009 to 38.0% in 2023, surpassing the general economy's proportion of 26.3% by 2015. Concurrently, the proportion of women with less-than-basic education decreased sharply, from 7.3% in 2009 to 4.8% in 2023. Similarly, in Jordan, there was considerable growth in advanced educational attainment among women in the blue economy, rising from 48.9% in 2017 to 62.5% in 2023. This is significantly higher than the static rate of around 43% in the broader economy. Meanwhile, male educational levels remained stable in the blue economy, indicating distinct gender-specific dynamics in educational advancement and sectoral skill demands.

Lebanon has consistently demonstrated a high proportion of women with advanced education in the blue economy, maintaining rates above 63% since 2019. This figure is considerably higher than the approximately 47% observed in the country's broader economy. In Sudan, despite persistently lower overall educational attainment levels, significant improvements were observed. The percentage of women with advanced education increased from 24.3% in 2011 to nearly 40% by 2022. However, the percentage of women with less-than-basic education remained relatively high, at 39.5%. Tunisia showed consistent stability in advanced educational attainment among women in the blue economy, averaging close to 50% from 2014 to 2023. This rate is notably higher than the broader economy's rate of around

Figure 2a: Comparative distribution of education levels by gender in the blue economy versus the total economy (annual data for Egypt).



34.8%. Conversely, males in Tunisia maintained consistently high levels of basic education, around 44%, underlining different skill demands across genders. The UAE stood out with its exceptionally high educational standards for women in the blue economy, surpassing 74% consistently since 2021 and peaking at 98.2% in 2022. This sharply contrasts with the lower advanced education rate of 54.6% among women in the general economy.

The observed longitudinal trends demonstrate significant structural changes, notably a clear shift toward higher educational qualifications among women employed in blue economy sectors. These results indicate that within the blue economy women are not excluded because they are less educated than men; rather, women in blue-economy jobs tend to be more educated, and segregation arises from the limited number and narrow subsector concentration of these high-skill positions.

#### *4.2.2. Gendered distribution of education levels across blue economy subsectors*

Figures 2b and 2c show how educational attainment varies by gender across blue economy subsectors. Aggregated data from all available years between 2009 and 2023 demonstrate clear, subsector-specific variations. In Tunisia, women with advanced educational levels comprise 58.88% of the female workforce in research and biotechnology. This high proportion may reflect the country's historical emphasis on higher education in science and technology fields, supported by educational policies encouraging female participation in STEM disciplines (Sieghart et al., 2019; UNESCO and UN Women, 2025). Notably, the participation of females with intermediate and advanced educational levels is also high in Tunisia's support services and marine equipment rental subsectors, reaching 48.48% and 38.63%, respectively. This may indicate effective vocational training programs that correspond closely with the skills demanded by these subsectors (GIZ, 2021). However, women with advanced education are considerably underrepresented in direct marine and coastal activities, accounting for only 8.49% of employees. This is even more true among men in this sub-sector.

Similarly to other sectors, the research and biotechnology subsector in the UAE exhibits high female representation at advanced education levels, with approximately 90.41% of female employees possessing tertiary qualifications. This strong presence likely stems from strategic policies and educational investments that encourage women to participate in STEM and related fields (UN Women and ICSF, 2020). In the tourism and coastal services subsector, approximately 68.22% of women have advanced degrees, suggesting the existence of successful integration mechanisms for highly educated women in these fields. However, further qualitative research is necessary to identify the specific factors that enable this integration.

Comparative regional analysis reveals consistent educational patterns across subsectors (Figure 2c). The female employment proportions in the research and biotechnology subsectors in Tunisia, Lebanon, the UAE, and Jordan are substantial at advanced educational levels, with percentages of approximately 67%, 59%, 58%, and 48%, respectively. Similarly, the tourism and coastal services subsector demonstrates relatively high proportions of highly educated women, particularly in Lebanon (around 53%) and the UAE (nearly 70%). This could reflect targeted educational programs or labor market conditions favorable to women (UN Women and ICSF, 2020; Mangubhai et al., 2022). However, direct marine and coastal activities across all examined countries show minimal female

Figure 2b. Gendered distribution of cumulative education levels across blue economy subsectors (upper bar male, lower bar female)

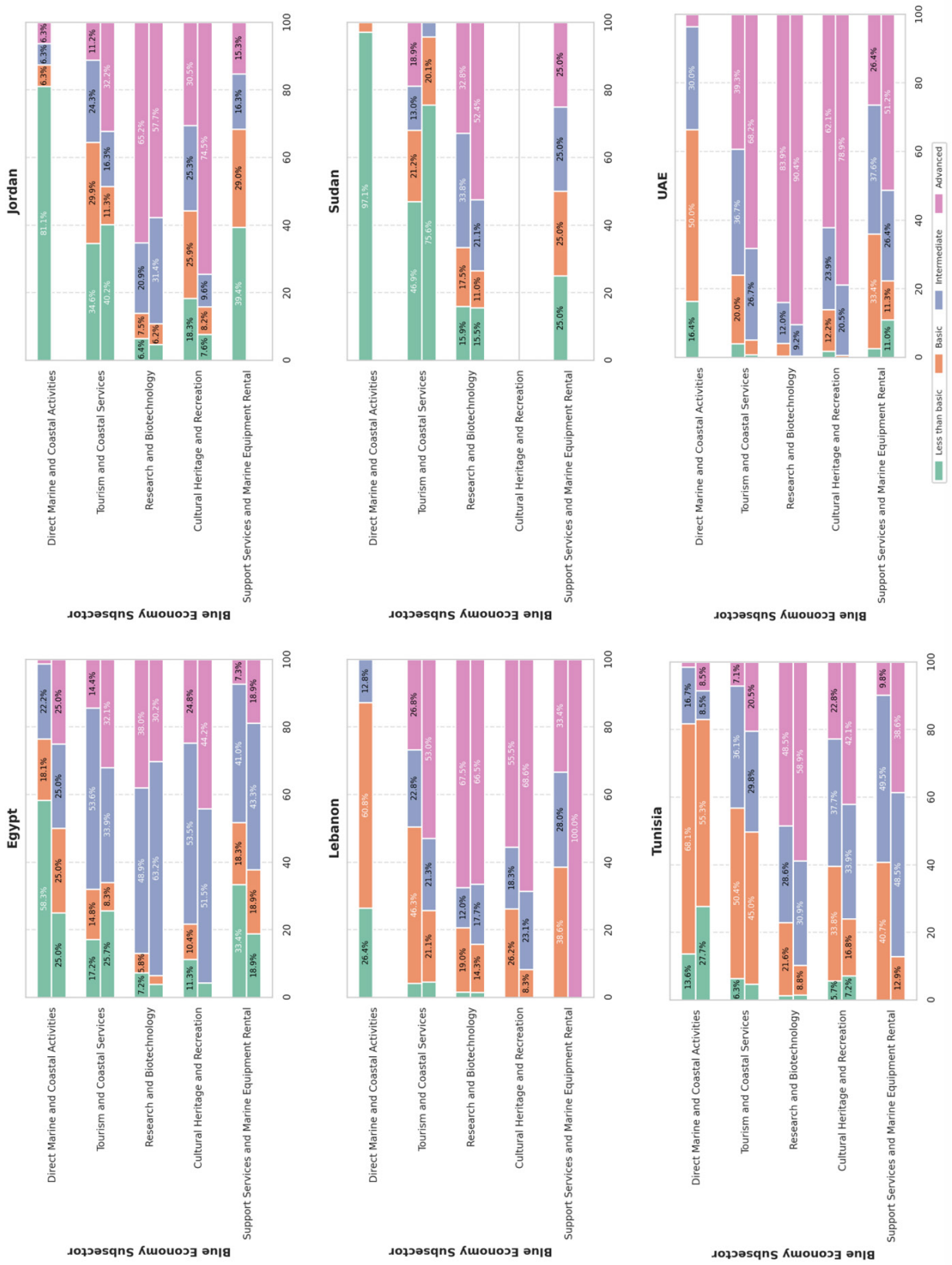
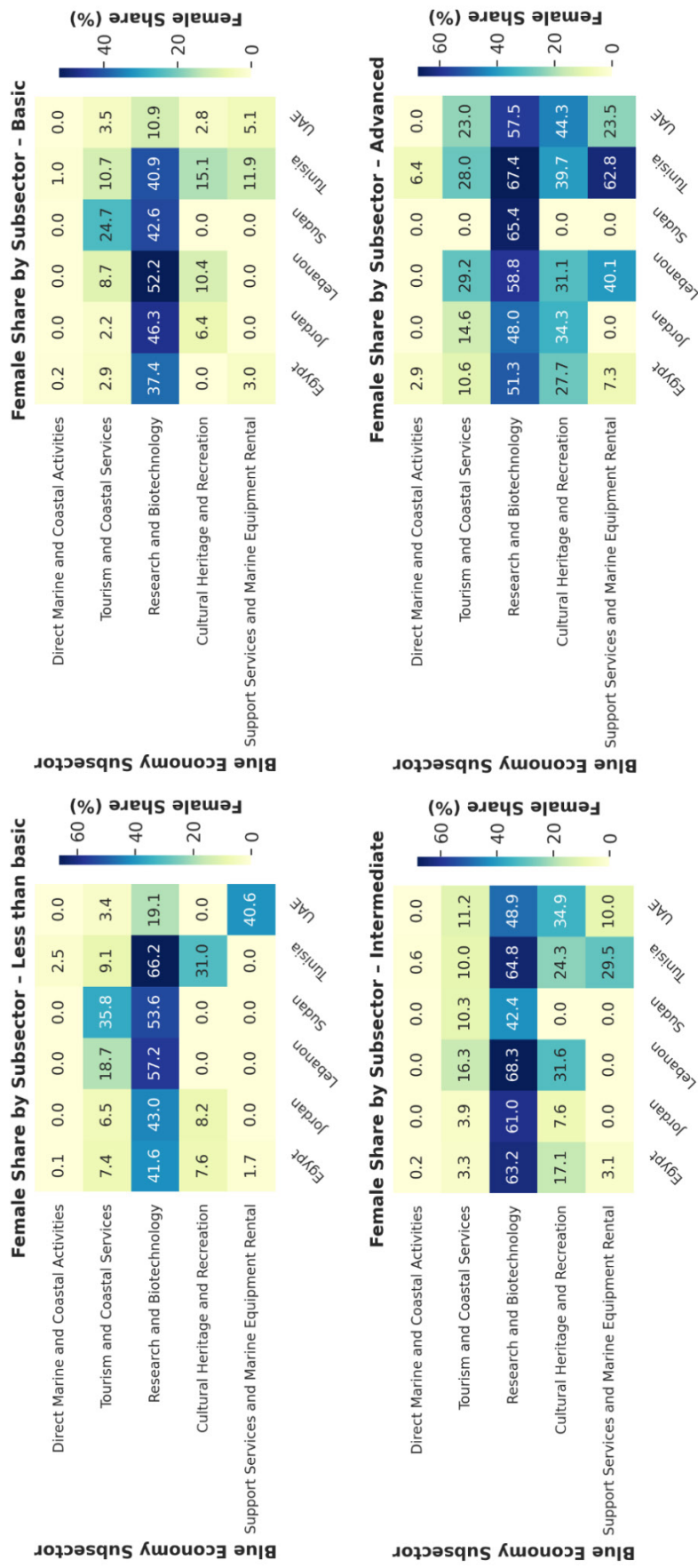


Figure 2c. Heatmap of female employment shares by education level in blue economy subsectors across selected Arab countries



participation. This underscores persistent occupational segregation, likely influenced by demand-side barriers such as employer preferences and sector-specific skill requirements, as well as supply-side constraints including social expectations and caregiving responsibilities (Mangubhai et al., 2022; Williams, 2023).

### *4.3. Skill-level distribution and occupational segregation*

#### *4.3.1. Annual trends in skill-level distribution by gender*

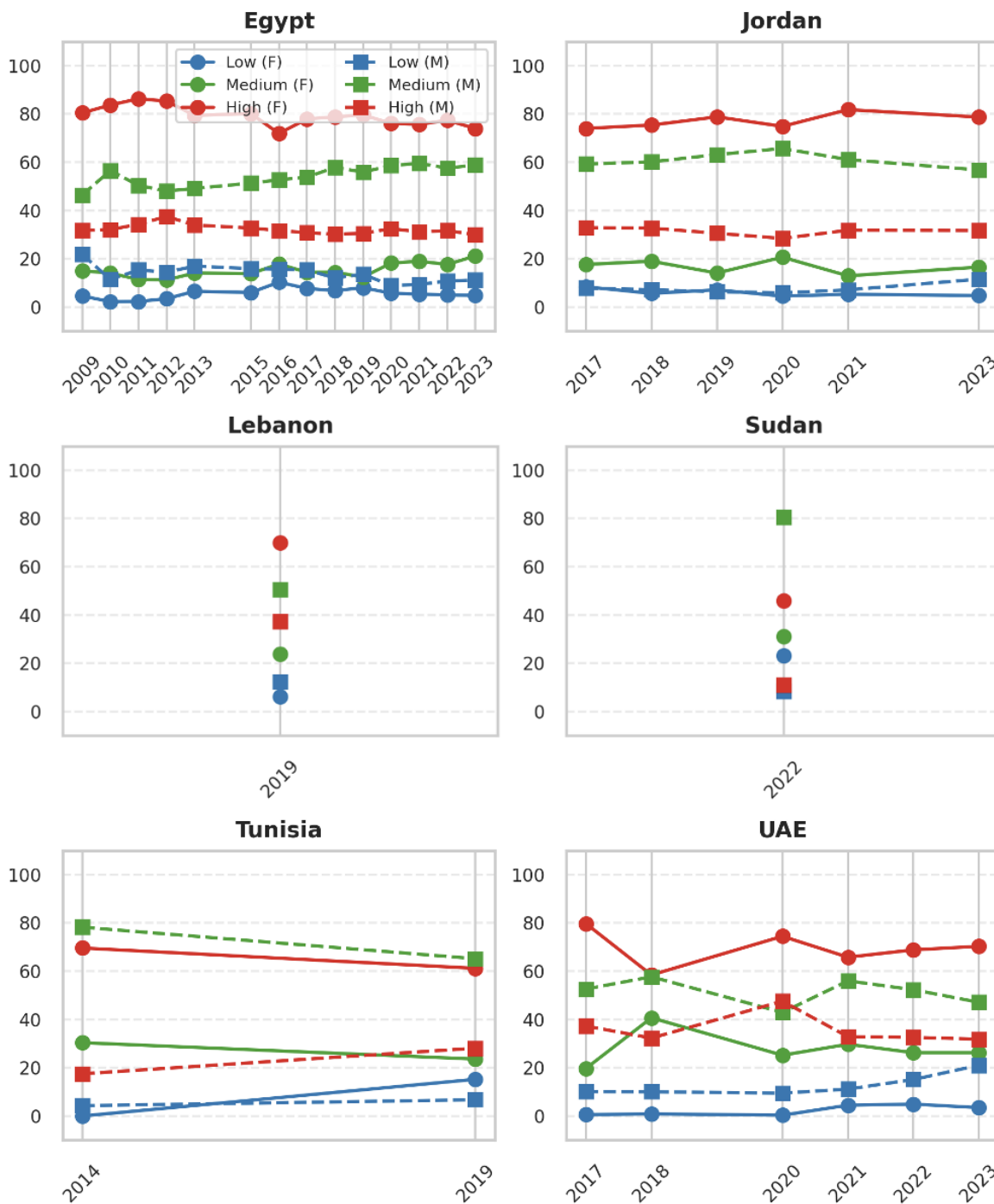
Analyzing employment data from 2009 to 2023 reveals significant and consistent gender disparities in skill-level distribution across Arab blue economy sectors (Figure 3a). Throughout this period, women in Egypt have predominantly occupied high-skilled positions, consistently exceeding 80% from 2009 to 2015 and reaching a peak of 86.3% in 2011. Although there was a gradual decline, thereafter, reaching 73.95% in 2023, women's employment remained predominantly high-skilled. This contrasts with male employment, which was dominated by medium-skilled positions, accounting for over 50% annually. These findings reveal significant occupational segregation, with women concentrated in specialized roles and men primarily in mid-skilled positions. Similar patterns emerged in Jordan, where women consistently held high-skilled positions ranging from 74% in 2017 to approximately 82% in 2021, with a slight decline to 78.7% by 2023. However, men remained predominantly in medium-skilled roles, averaging around 60%.

Employment data from the UAE reveals significant fluctuations in the skill levels of female employees. High-skilled female employment varied from nearly 80% in 2017 to approximately 58.5% in 2018 before rising to 70.3% in 2023. Conversely, men's employment remained stable, with medium-skilled roles comprising around 50% to 60%. These fluctuations suggest that women's employment in high-skilled sectors, such as biotechnology and marine research, is sensitive to economic and subsector-specific conditions. Snapshot data from Lebanon and Tunisia further emphasize these disparities. In Lebanon, approximately 70% of employed women in 2019 held high-skilled positions, in stark contrast to men, who were predominantly medium-skilled at around 50.5%. Tunisia exhibited a noticeable decrease in high-skilled female employment, from nearly 70% in 2014 to around 61% in 2019, indicating emerging barriers to women's access to skilled employment. In 2022, Sudan presented a different dynamic, showing a relatively balanced female skill distribution across medium-skilled (31.1%) and high-skilled (45.8%) roles. Meanwhile, men were concentrated primarily in medium-skilled positions, at around 80.6%.

#### *4.3.2. Skill-level distribution by subsector and gender*

A detailed examination of the distribution of skills by subsector confirms the pronounced occupational segregation across the blue economy (see Figures 3b and 3c in the Appendix). In Egypt, subsectors associated with manual labor, such as direct marine and coastal activities, have minimal female participation, below 1% (figure 3b). Conversely, women dominate high-skilled positions in knowledge-intensive subsectors. Notably, they comprise 61.3% of high skilled employment in research and biotechnology, and 84% of women employed in research and biotechnology hold high-skilled positions. Similarly, women account for 18.76% of high skilled employment in cultural heritage and recreation. Jordan mirrors this trend, with substantial female employment in high-skilled employment

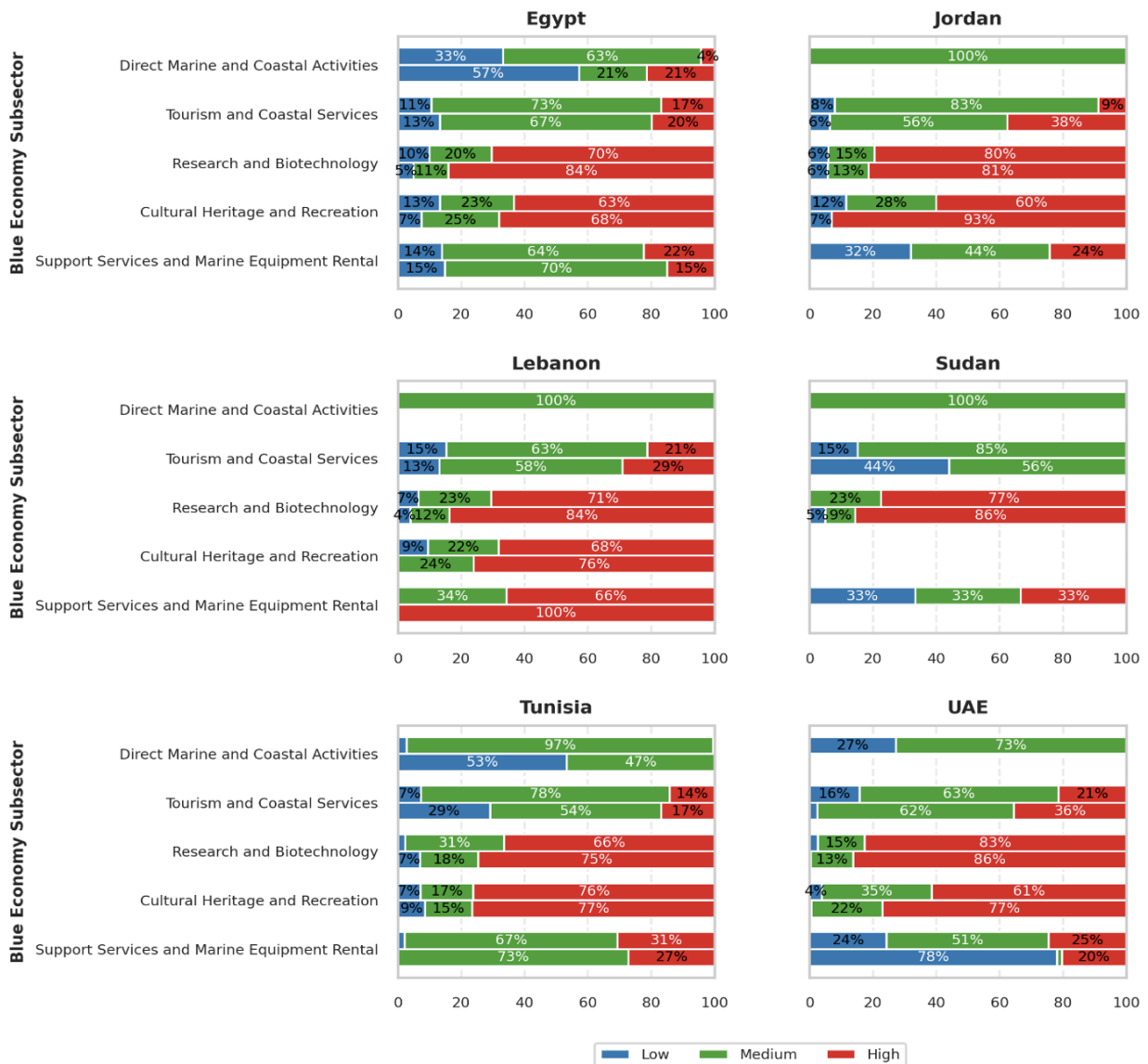
Figure 3a. Annual trends in skill-level distribution by gender (Egypt, Jordan, Lebanon, Sudan, Tunisia, UAE)



in the research and biotechnology subsector (51.59%) and and with women in this sector predominantly concentrated in high skilled roles (81.34%). However, subsectors requiring less specialized skills, such as support services and marine equipment rental, remain male-dominated and predominantly comprise medium-skilled workers.

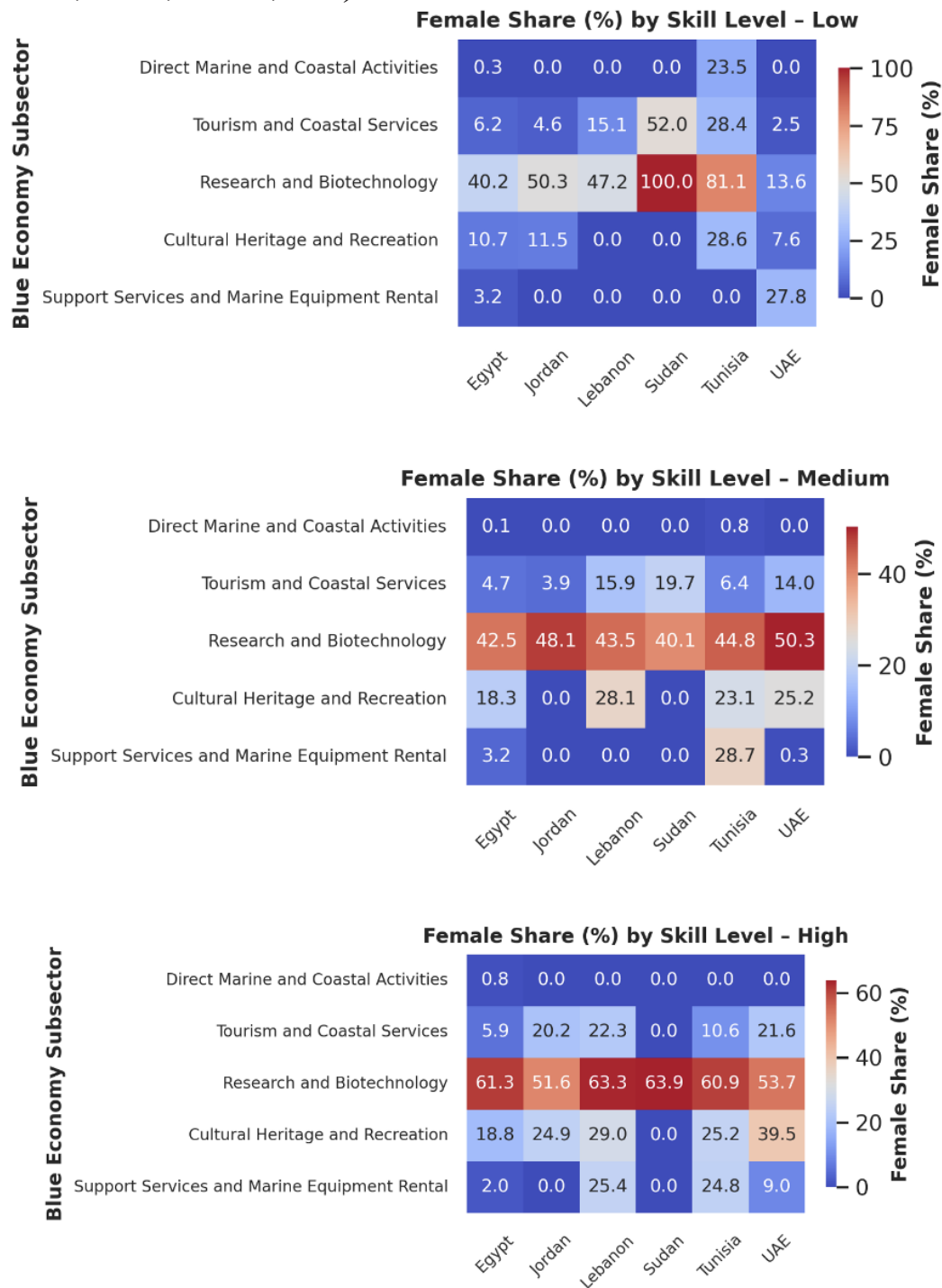
These gendered subsector dynamics are consistently reflected in patterns in Lebanon, Tunisia, and the UAE. Lebanese women represent 63.27% of high-skilled employment in research and biotechnology, while lower-skilled subsectors are predominantly male. Tunisia also features significant female employment in high-skilled roles in research and biotechnology (74.63%) and cultural heritage and recreation (76.53%), while lower-skilled sectors remain male-dominated. The UAE exhibits similar patterns, with women primarily occupying high-skilled roles, notably in research and biotechnology (86.25%) and cultural heritage and recreation (77.02%). A comprehensive regional heatmap analysis (Figure 3c) highlights the strong correlation between subsector skill requirements and female employment. Women dominate high-skilled subsectors such as research and biotechnology, with

**Figure 3b. Cumulative skill-level distribution by gender across blue economy subsectors (Egypt, Jordan, Lebanon, Sudan, Tunisia, UAE)**



Note: upper bar for each subsector = female share; lower bar = male share.  
 Source: National Labor Force Surveys (LFS), processed by authors.

Figure 3c. Female employment shares by skill-level across blue economy subsectors (Egypt, Jordan, Lebanon, Sudan, Tunisia, UAE)



Source: National Labor Force Surveys (LFS), processed by authors.

employment shares of 61.27% in Egypt, 63.87% in Sudan, and 60.85% in Tunisia. In contrast, direct marine and coastal activities across all countries exhibit negligible female participation below 1%, emphasizing enduring cultural and occupational barriers.

These distributions clearly reflect deep-rooted occupational segregation by gender across blue economy subsectors, highlighting distinct, sector-specific barriers to women's participation.

#### *4.4. Employment stability and establishment size*

##### *4.4.1. Gendered employment dynamics by firm size in the blue economy compared to the total economy*

An analysis of data from 2009 to 2023 from Egypt, Jordan, Lebanon, Sudan, Tunisia, and the UAE shows that women's employment stability in the blue economy varies greatly by firm size. Notably, there is higher volatility in micro-sized firms (one to four employees) than in medium-sized firms (five to 49 employees) and large enterprises (50 employees or more) (Figure 4a). In Egypt, for example, women's employment in microenterprises within the blue economy fluctuated significantly. It increased sharply from 8.93% in 2010 to a peak of 28.62% in 2017 before dropping to 15.98% in 2023. Conversely, larger firms showed a consistent upward trend, rising steadily from 36.46% in 2009 to 49.47% in 2023. There was less pronounced volatility in women's employment in micro-enterprises in Egypt's general economy. Women's employment in microenterprises rose moderately from 9.19% in 2009 to 21.51% in 2017 before decreasing to 13.67% in 2023.

Similar patterns were observed in Jordan, where women's employment in micro-enterprises within the blue economy was notably unstable, peaking at 28.22% in 2018 and dropping to 17.06% in 2019. Larger establishments, however, provided relatively stable employment, consistently maintaining female employment shares between 30% and 38%. This stability within larger enterprises highlights their capacity to provide sustainable employment conditions compared to micro-sized firms. This pattern is more pronounced in the blue economy than in the general economy.

Similar dynamics were observed in Lebanon's 2019 data: female employment in micro-enterprises was higher in the blue economy (29.37%) than in the broader economy (22.70%). However, larger blue economy enterprises exhibited even greater stability in female employment at 53.36%, surpassing the broader economy's 50.24%. In Sudan, employment patterns from 2011 to 2022 were particularly contrasting. Female employment in micro-enterprises increased significantly, rising from 21.97% to 29.49%. However, it declined sharply in medium-sized enterprises, dropping from 44.48% in 2011 to 24.90% in 2022. This suggests increased vulnerability within mid-sized businesses, likely due to economic disruptions.

Tunisia's employment dynamics showed distinct progress between 2014 and 2019. Initially minimal, female employment in micro and medium-sized blue economy enterprises grew significantly, reaching 17.83% and 29.46%, respectively, by 2019. Large enterprises in Tunisia consistently offered greater stability, maintaining female employment between 44% and 48%. There is a clear relationship between firm size and women's employment stability, with notably higher instability and vulnerability concentrated in smaller enterprises within the blue economy.

Figure 4a: Annual gendered employment dynamics by firm size: blue economy vs. total economy (Egypt, Jordan, Lebanon, Sudan, Tunisia)

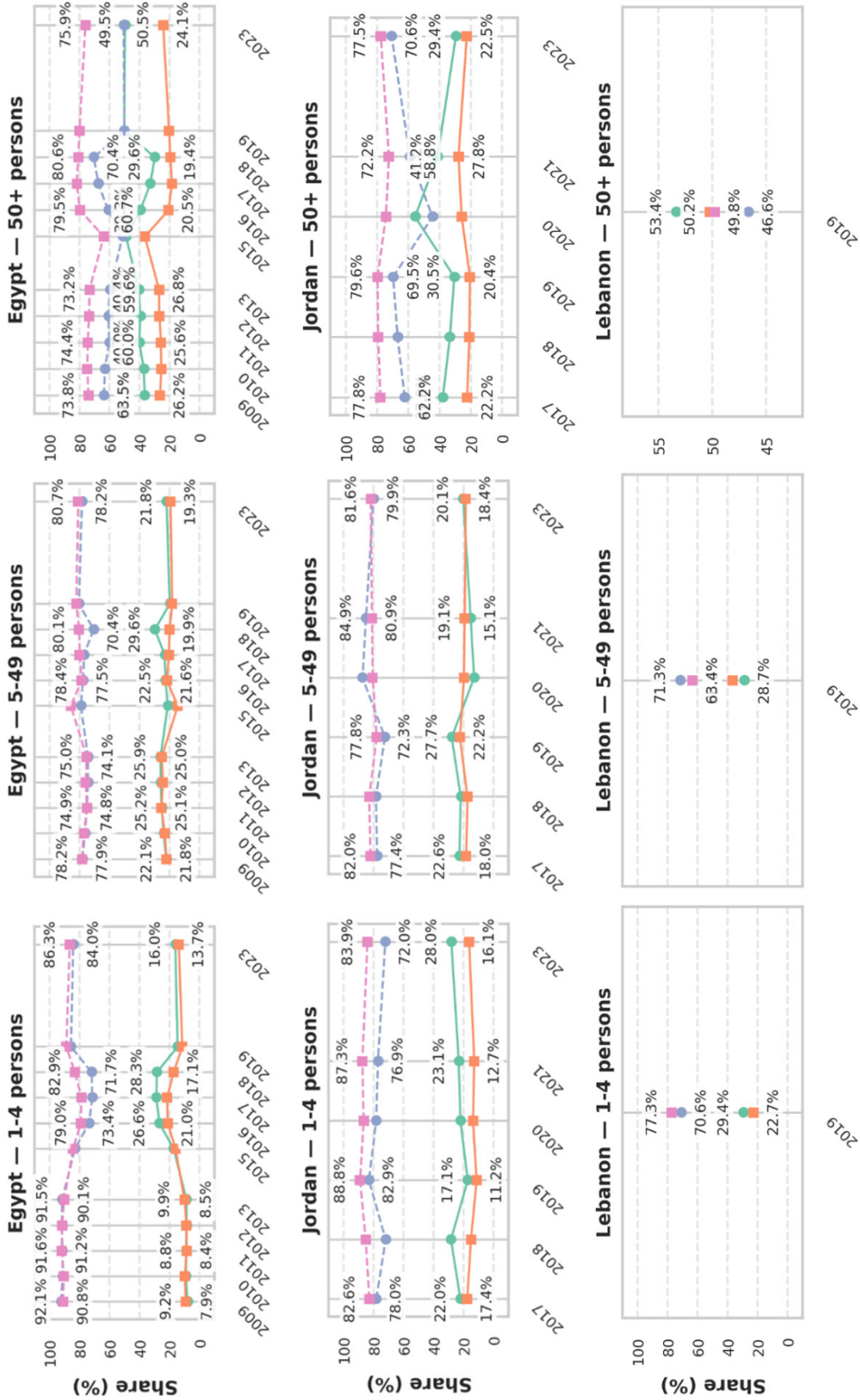
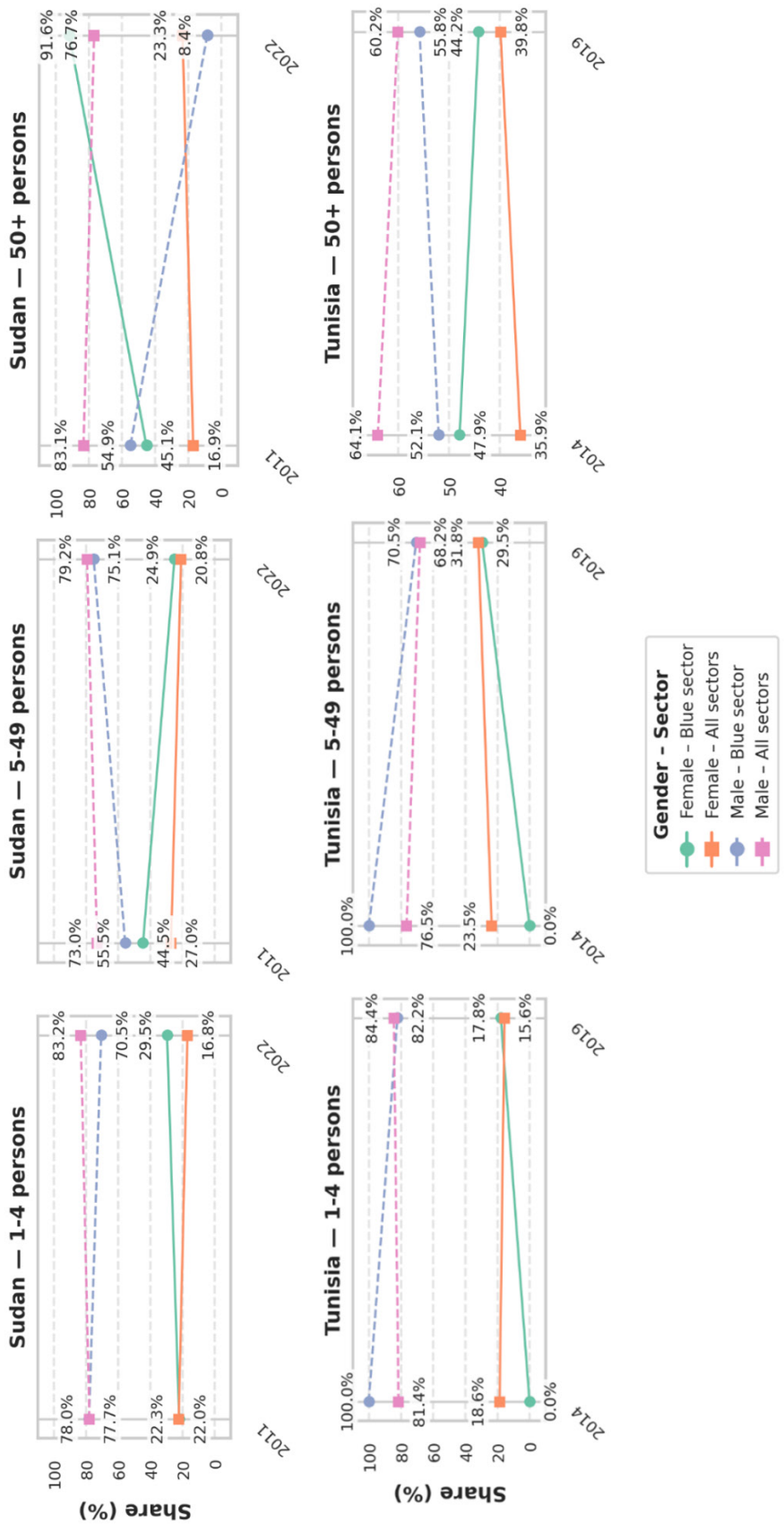


Figure 4a: Annual gendered employment dynamics by firm size: blue economy vs. total economy (Egypt, Jordan, Lebanon, Sudan, Tunisia) (Continued)



#### *4.4.2. Gender and firm size-based employment patterns across blue economy subsectors*

Further examination of employment patterns by gender, firm size, and blue economy subsector highlights the impact of enterprise size on employment stability and gender disparities (see Figure 4b). In Egypt, gender disparities within subsectors dominated by smaller firms are pronounced. Micro-sized firms (1–4 employees) engaged in direct marine and coastal activities are predominantly male-occupied, and male representation in those enterprises comprises 55.0% of male employment; while female representation remains substantially lower, at 33.3%. A similar gender dynamic is evident in the tourism and coastal services subsector. Male employment in microenterprises is about 45.8%, while female employment accounts for about 47.1% of total male and female employment in the subsector respectively. In contrast, in knowledge-intensive sectors such as research and biotechnology, have more balanced gender distributions. Women constitute approximately 54.3% of the total workforce in this sub-sector (Figure 4C).

Jordan exhibits similar patterns. Large enterprises in the research and biotechnology subsector employ a significant proportion of women working in the sub-sector, accounting for approximately 40.4% of the workforce. In contrast, micro-enterprises engaged in direct marine activities, marine equipment rental, and support services are predominantly male-dominated, effectively excluding women from these sectors. Tunisia presents a nuanced employment landscape. In research-intensive sectors such as biotechnology, female employment is heavily concentrated in large enterprises, accounting for 68.2% of female employment in the sector. However, significant female participation in tourism and coastal services was observed in micro-enterprises (29.9%), indicating potential economic vulnerabilities related to smaller firm size.

While this study did not primarily focus on detailed sectoral comparisons outside the blue economy, existing literature supports the general conclusion that firm size significantly influences employment quality and gender disparities in sectors beyond marine-related activities (World Bank, 2022; ILO, 2024a).

#### *4.5. Employment status and gender dynamics*

##### *4.5.1. Gendered employment distributions: Employees versus self-employed in the blue economy*

Analyzing the employment distribution of women and men in the blue economy compared to the total economy reveals distinct patterns (Figure 5a). In Egypt's blue economy, employees account for the great majority of jobs for both genders: over 2009–2022 male employees represent about 57–63% of total employment and female employees about 23–28%, while male self-employment declines from roughly 17% to about 10% and female self-employment remains below 2%. This implies that almost all working women in Egypt's blue economy are employees rather than self-employed. In the total economy, employees also dominate but female self-employment is higher (around 4–9% of total jobs), so women outside the blue economy are more often in own-account or family work than those in blue sectors.

**Figure 4b. Cumulative gendered employment patterns by firm size across blue economy subsectors (Egypt, Jordan, Lebanon, Sudan, Tunisia) upper bar male, lower female**

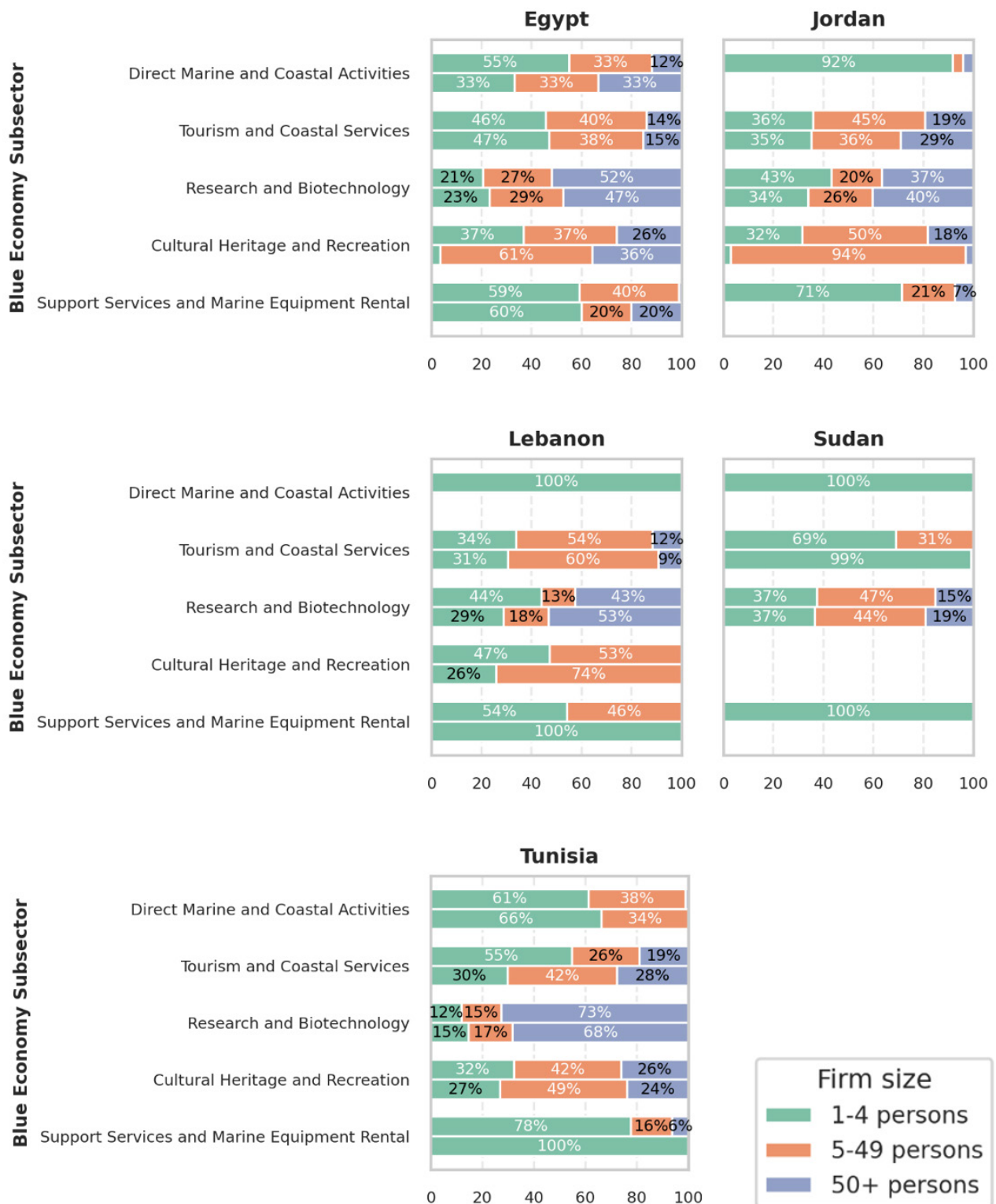
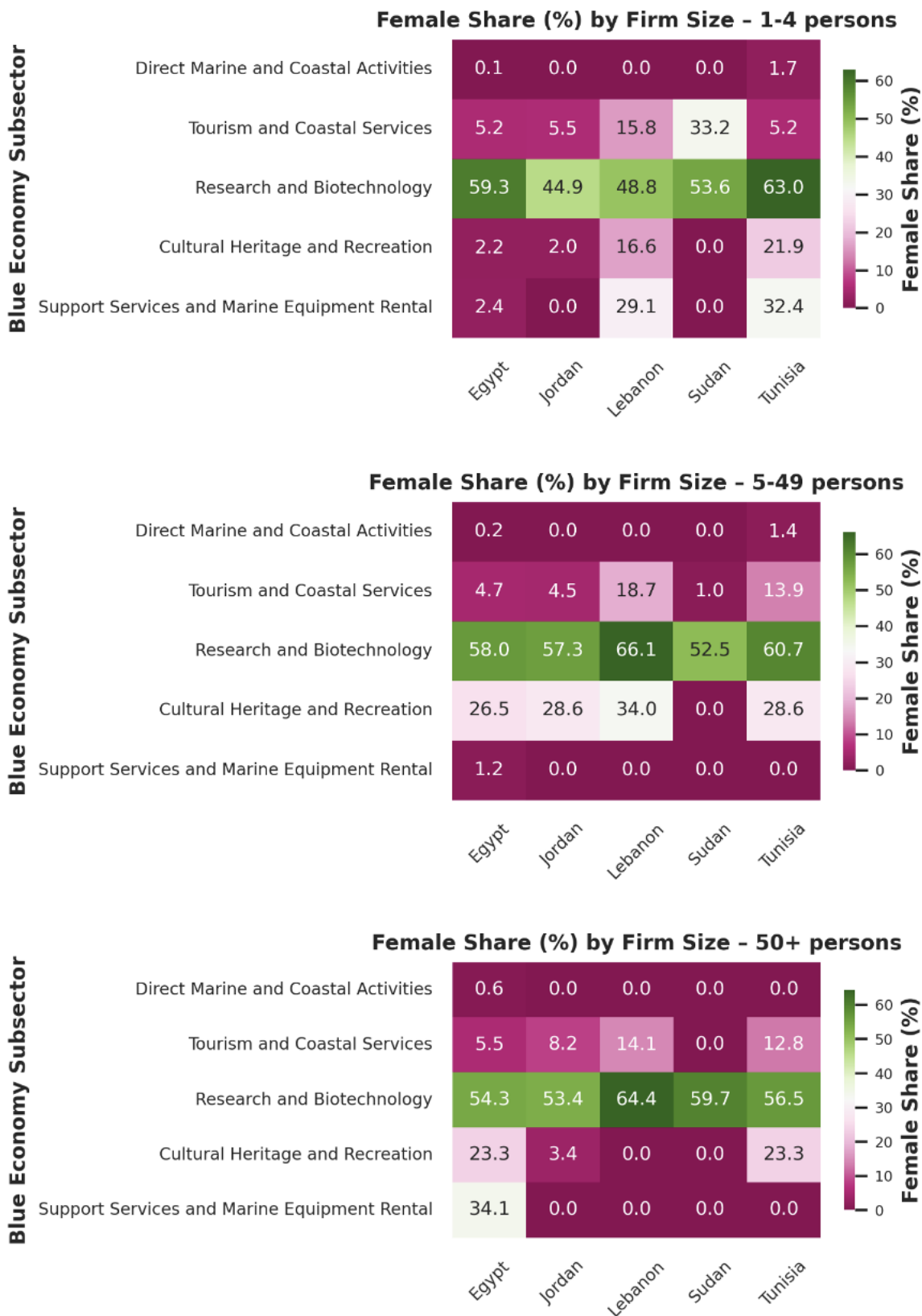


Figure 4c. Female employment shares by firm size across blue economy subsectors (Egypt, Jordan, Lebanon, Sudan, Tunisia)



In Jordan's blue economy (2017–2023), a similar structure is observed: male employees consistently account for about 65–69% of jobs and female employees for roughly 24–26%, while male self-employment remains around 6–8% and female self-employment around 1%. The total economy is likewise employee-based, although male self-employment is slightly higher than in the blue economy. For Lebanon in 2019, employees clearly dominate blue-economy jobs: male employees represent 49.0% of total employment and female employees 31.9%, compared with 15.8% male and 3.3% female self-employment.

In Sudan's blue economy, the picture is more mixed. Between 2012 and 2022 the share of male employees falls from 45.8% to 36.0%, while male self-employment rises from 19.4% to 33.5%. Female employees remain close to one quarter of total employment and female self-employment around 6%. In Tunisia's blue economy (2014–2019), employees remain the dominant status, but male employees decline from 71.3% to 56.5% while female employees increase from 16.6% to 26.6%. Self-employment is largely male (about 12–14% of total jobs), with female self-employment rising from 0% to 2.7%.

Finally, in the UAE's blue economy (2017–2023), employment is almost entirely salaried: male employees fall moderately from 83.2% to 67.7%, while female employees rise from 15.7% to 26.3%. Self-employment for both genders remains very low, generally between 1% and 4% of total jobs. These patterns show that across the Arab blue economy women are overwhelmingly concentrated in employee positions, with very limited participation in self-employment, while men are more likely than women to appear in self-employed roles, especially in Sudan and, to a lesser extent, Egypt and Tunisia.

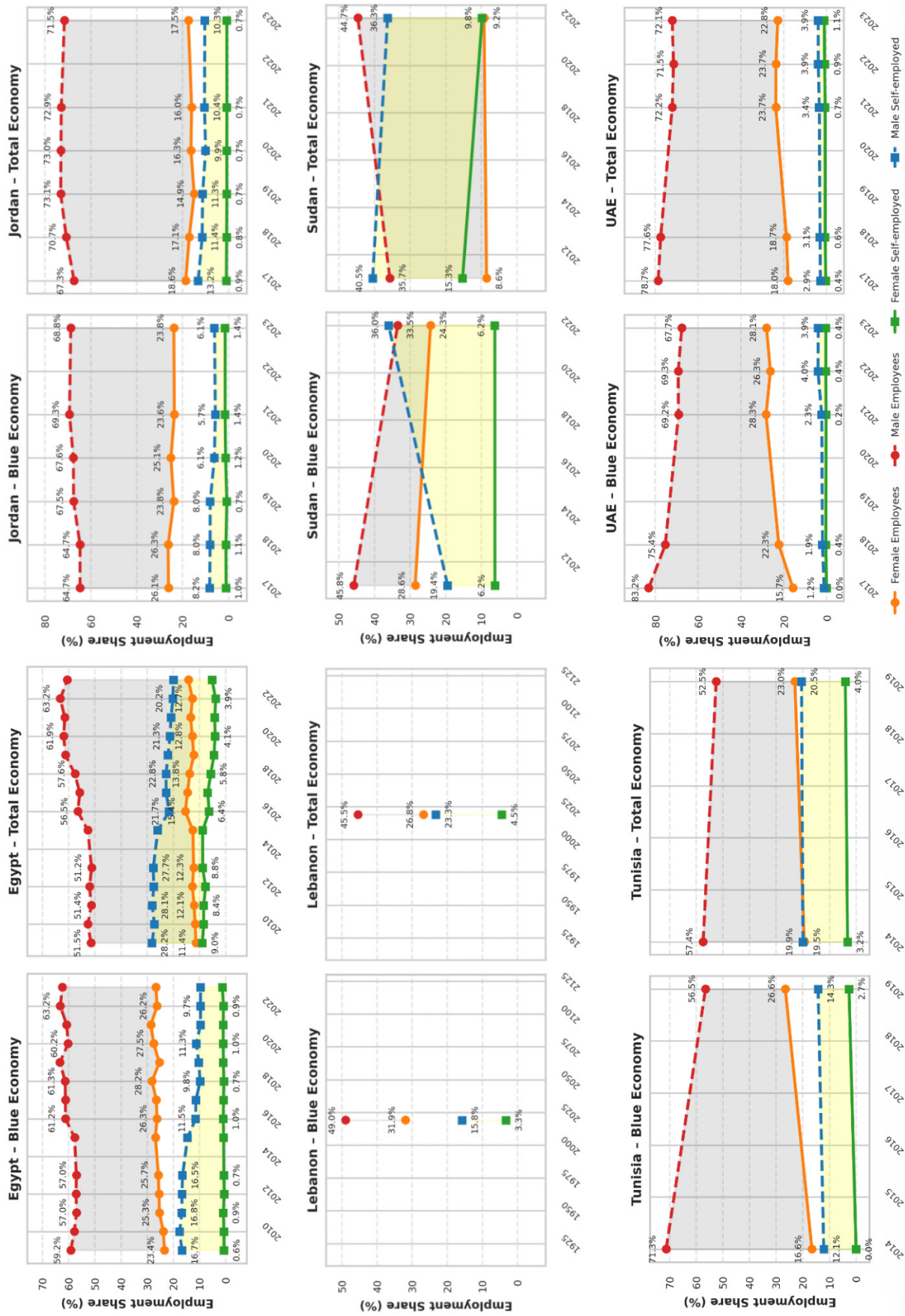
#### *4.5.2. Subsector variations and gender employment status disparities*

Analyzing the employment status of women and men within blue economy subsectors reveals distinct patterns that reflect the characteristics of the subsectors and gender dynamics (Figure 5b). In Egypt, for example, women predominantly occupy structured, salaried roles in knowledge-intensive subsectors, such as research and biotechnology. Nearly 99% of women in these sectors are salaried employees. Similarly, female employment in cultural heritage and recreation is entirely salaried. Conversely, men frequently engage in self-employment in labor-intensive subsectors, such as direct marine and coastal activities, which represent approximately half (50.3%) of male employment. These findings highlight clear occupational and entrepreneurial divides along gender lines.

Lebanon displays a comparable pattern. Women overwhelmingly occupy salaried positions in research and biotechnology (92.7%), suggesting that fewer entrepreneurial opportunities are available to them. Conversely, Lebanese men have substantially higher self-employment rates, particularly in direct marine and coastal activities, with about 73.3% being self-employed. Jordan reinforces this trend, with nearly all female employment in research and biotechnology being salaried positions (97%), while nearly 90% of men are self-employed in direct marine and coastal activities. This pronounced gender-based entrepreneurial division highlights sector-specific occupational segregation.

Tunisia has a more balanced distribution of workers across specific subsectors. Notably, both women and men are engaged in self-employment within the support services and marine equipment rental subsectors, accounting for approximately 59% and 59.8%, respectively. This observation potentially

Figure 5a. Annual gendered employment distributions: Employees vs. Self-employed (Egypt, Jordan, Lebanon, Sudan, Tunisia, UAE)



**Figure 5b. Cumulative gendered employment status distribution by subsector (Egypt, Jordan, Lebanon, Sudan, Tunisia, UAE) (upper male, lower bar female)**



reflects entrepreneurial incentives, economic necessity, or structural constraints impacting women and men similarly. This is consistent with prior evidence showing that certain structural factors, such as limited access to formal jobs or market-driven conditions, can affect both genders similarly in specific economic contexts (ILO, 2024a; Williams, 2023).

However, the UAE provides a contrasting scenario, with high levels of salaried employment across blue economy subsectors. The proportion of salaried employment positions often exceeds 94% for both genders and sometimes reaches 100%.

#### *4.6. Job formality and women's employment dynamics*

##### *4.6.1. Comparative analysis of employment formality by gender*

Analyzing formal and informal employment dynamics within the blue economy and comparing them with broader economic contexts reveals significant gender disparities shaped by national regulatory frameworks and sector-specific characteristics (Figure 6a). The previously noted high rates of salaried employment among women in Egypt correspond closely with consistently high formal employment levels in blue economy sectors, peaking at 88.09% in 2009 and declining slightly to around 74.74% by 2023. This strong formalization contrasts with broader economic conditions where women's informality often exceeds 50%. Conversely, men in Egypt remain largely in informal jobs, particularly in artisanal fisheries. Informality reached approximately 66.25% in 2023, highlighting regulatory gaps (World Bank, 2022).

Jordan also shows similar patterns between salaried employment status and formal employment rates. By 2023, formal employment for women in blue economy sectors had reached 88.88%, which is significantly higher than the general economy's rate of 63.10%. Men also benefited, with formal employment rates in marine sectors reaching 66.74% by 2023. In contrast, Sudan experiences extensive informality for both genders. Informal employment rates were approximately 91.8% for women and 92.8% for men in 2022, particularly in artisanal fisheries and informal coastal services (World Bank, 2022; Williams, 2023).

In line with its predominance of salaried employment for women, Tunisia presents relatively higher formal employment rates. In 2019, formal employment reached 80.35% in the blue economy, surpassing the broader economy's rate of 56.17%. Men experienced a similarly high rate of formal employment, at approximately 70.62%, suggesting effective regulatory implementation, particularly in the tourism and biotechnology sectors (World Bank, 2022). The UAE sets a regional benchmark with nearly total formality, closely matching its salaried employment structure at approximately 99% for women and 96% for men. This highlights stringent labor standards and effective governance frameworks (World Bank, 2022; ILO, 2024a).

##### *4.6.2. Sector-specific analysis of job formality distribution by gender*

Further analysis by sector underscores the interplay between employment status (employees versus self-employed), job formality, and gender in Arab countries (Figure 6b). In Egypt, women predominate in formal roles, which aligns with their salaried employment status in research and biotechnology (86.17%) and cultural heritage (78.2%). Meanwhile, men have higher informality rates, especially

**Figure 6a. Annual gendered employment formality: blue economy vs. total economy (Egypt, Jordan, Lebanon, Sudan, Tunisia)**

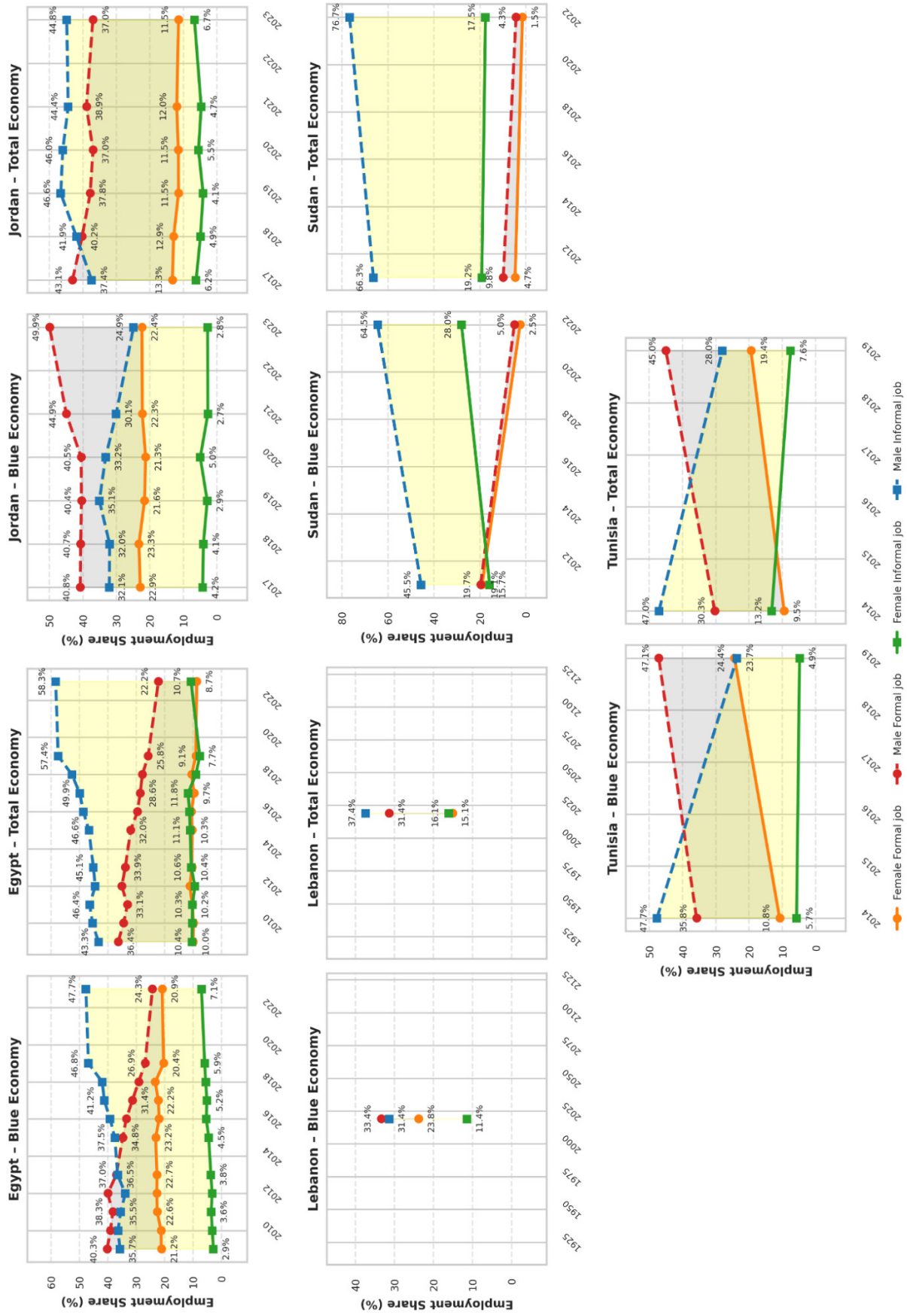
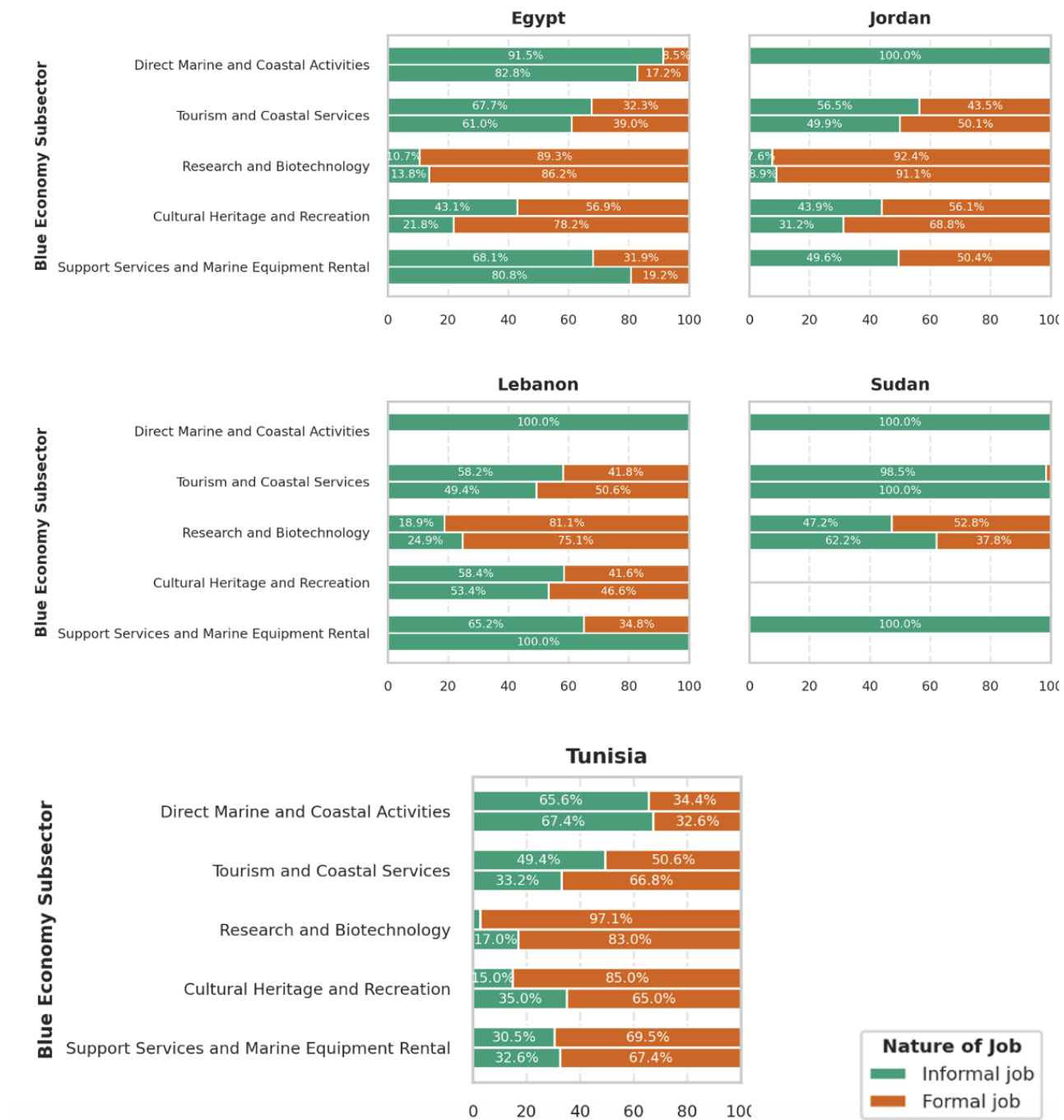


Figure 6b. Cumulative gendered job formality distribution by subsector (Egypt, Jordan, Lebanon, Sudan, Tunisia) (upper man, lower bar woman)



in direct marine activities (91.46%) and support services (68.13%), reflecting their greater tendency toward self-employment and less regulated occupational structures. Jordan exhibits similar yet more pronounced gender disparities. Women are predominantly employed in formal roles in research and biotechnology (91.08%), while significant informality persists in the cultural heritage (31.18%) and tourism sectors. Men in direct marine activities, who are predominantly self-employed, face total informality, highlighting specific regulatory shortcomings.

In Lebanon, women have a high level of formal employment in research and biotechnology (75.13%), yet substantial informality remains prevalent in tourism services (49.38%) and cultural heritage (53.37%). Men's informality is notably high in direct marine activities, reaching 100%, reflecting their predominant self-employment and broader regulatory deficiencies. Sudan experiences pervasive informality across all subsectors for both women and men, highlighting severe institutional weaknesses and regulatory inadequacies (World Bank, 2022; Williams, 2023). Tunisia shows mixed regulatory effectiveness: high formal employment among women in research and biotechnology (83.01%), support services (67.37%), tourism services (66.77%), and cultural heritage (65.02%). However, direct marine activities remain predominantly informal. In contrast, the UAE demonstrates comprehensive regulatory effectiveness, achieving near-total formal employment in research and biotechnology (98.84%), tourism (98.44%), and cultural heritage (100%) due to its salaried employment structure. Similarly, men's formal employment remains high, even in typically informal sectors such as direct marine activities (90.94%), reflecting robust institutional governance and regulatory frameworks (World Bank, 2022; ILO, 2024a).

These sector-specific comparisons illustrate the interconnections between regulatory frameworks, employment status, sectoral characteristics, and job formality in shaping gender dynamics in the Arab blue economy.

## 5. Discussion

The descriptive patterns observed in this study reveal several associations between women's employment in the Arab blue economy and three key dimensions highlighted in the literature: educational attainment, job formality and firm size. These associations resonate with comparative and multi-dimensional approaches to labour-market analysis (Chatfield, 2003; Hantrais, 1995; Ragin, 2014) and reflect institutional and sectoral characteristics specific to the six analysed countries. While noting the low representation of women in the blue economy across the board, patterns across Egypt, Jordan, Lebanon, Sudan, Tunisia and the United Arab Emirates, show that those employed in this sector are disproportionately concentrated in knowledge-intensive subsectors, particularly research and biotechnology, where higher educational thresholds and standardised recruitment processes create more structured entry points. As shown in the skill compositions and subsectoral distributions (Figures 2c and 3c), female employment is limited in absolute terms but relatively stronger in these high-skill areas compared with traditional blue-economy activities. This pattern aligns with previous empirical work suggesting that education facilitates access to higher-quality jobs for women even when broader structural constraints persist (ILO, 2013; ILO, 2015; OECD/ILO/UNDP, 2024).

Formality patterns similarly reflect institutional diversity across the region with notable differences between countries or between certain sub-sectors. For example, the United Arab Emirates displays near-universal formality for both women and men, while Sudan shows extensive informality across subsectors (Figures 6a and 6b). These contrasts mirror differences in the structures of both economies. The findings also show that certain sub-sectors are dominated by informality such as marine and coastal activities. These are consistent with previous analyses showing that informality is particularly

common in artisanal fisheries, coastal services and micro-scale marine activities, while knowledge-intensive sectors, such as research and bio-technology tend to operate under more formal institutional arrangements (ILO, 2013; ILO, 2015; ILO, 2024b; ILO, 2024c; World Bank, 2022).

Firm size constitutes a third important dimension associated with women's integration in the blue economy. In all countries where detailed information is available, medium and large firms in the blue economy, which generally have more structured employment relationships than micro and small firms, exhibit a more balanced gender composition than micro and small enterprises. These observations echo comparative studies in developing and emerging economies, which find that women tend to be overrepresented in firms that provide more stable contracts and standardised job classifications (ILO, 2015; OECD/ILO/UNDP, 2024; United Nations Economic and Social Commission for Western Asia & UN Women, 2025).

Occupational segregation remains a defining feature of women's employment in the blue economy. Across the six countries, women are disproportionately represented in administrative, research, scientific and service-related occupations and underrepresented in seafaring, fisheries, port operations and other physically demanding or traditionally male-dominated roles (Figures 1b, 3b and 3c). These patterns are consistent with longstanding sociocultural norms and gendered career expectations documented in regional and international analyses of the blue economy (Bennett et al., 2022; UN Women and ICSF, 2020; Jenkins and Brown, 2023; Matovu et al., 2025a). They also align with global evidence on horizontal segregation across marine, coastal and environmental sectors (UNCTAD, 2023; Saggese, 2023; Yuan et al., 2024).

Employment status interacts with these dimensions in a specific way. Across the Arab blue economy, women are overwhelmingly concentrated in salaried positions, whereas men are more likely to appear in self-employment, particularly in direct marine and coastal activities in countries such as Sudan, Egypt and Tunisia (Figures 5a and 5b). This pattern suggests that the combination of formality, firm size and subsectoral specialisation channels women into more structured, employee-based roles while leaving self-employment in riskier and more informal segments largely male-dominated (World Bank, 2022; Williams, 2023).

The descriptive findings point to an employment landscape shaped by educational attainment, firm-level characteristics, employment status and the degree of formality in blue-economy activities. They also reflect structural factors related to institutional heterogeneity within the blue economy and the coexistence of traditional marine sectors with emerging knowledge-based blue-economy domains (Sieghart et al., 2019; FAO, 2024). These interpretations remain descriptive and grounded in harmonised labour-force survey tabulations rather than microdata, which means that individual causal effects cannot be inferred. Nonetheless, the patterns observed across countries and subsectors offer meaningful insights into the mechanisms associated with women's labour-market participation in blue-economy activities.

## 6. Recommendations

The results point to a set of very specific levers that governments, port authorities, sectoral regulators and development partners can use to improve women's access to stable, decent jobs in the Arab blue economy. A first priority is to extend the "Tunisia–UAE model" of formal, high-skill employment beyond a few enclaves such as biotechnology and research. In practical terms, ministries of labour, maritime affairs and tourism could require all publicly regulated blue-economy operators (maritime research institutes, port authorities, marine parks, coastal tourism concessions) to adopt time-bound gender targets for new hires and promotions, supported by wage-subsidy schemes or reduced social-security contributions for firms that recruit women into first formal jobs. In Tunisia and Jordan, where women already form a large share of high-skill employment in research and biotechnology, these incentives could be explicitly linked to expanding women's access to supervisory and technical positions in coastal tourism, cultural heritage and support services.

A second recommendation is to organise very concrete "blue skills pipelines" that connect existing female education advantages to actual jobs. The data show that women in the blue economy are on average more educated than women in the total economy, yet they remain almost absent from direct marine and coastal activities. To achieve higher inclusivity of all women, ministries of education and TVET agencies could therefore establish dedicated blue-economy tracks in coastal universities and technical institutes (for example, marine safety, coastal engineering, port logistics, boat maintenance, eco-tourism management), with reserved places and scholarships for women from coastal governorates. These programmes should be designed jointly with employers and should systematically include paid internships in ports, research centres and tourism companies. In the UAE, where education-to-employment linkages are already strong in biotechnology, similar co-designed internships could be extended to marine transport and ocean-energy projects; Egypt and Sudan could focus on formal segments of fisheries value chains and coastal-tourism operators that commit to hiring graduates.

Third, the very high levels of informality in Sudan, Egypt, Lebanon and parts of Jordan call for targeted formalisation programmes that are explicitly tailored to women workers and micro-entrepreneurs. Rather than relying only on legal reforms, governments could roll out simplified registration one-stop shops in coastal municipalities, offering a "blue micro-enterprise package" that combines a light-touch business licence, access to social-security schemes on a reduced-contribution basis, and priority access to municipal infrastructure (market stalls, landing sites, tourist kiosks) for registered women-led businesses. Cooperative models can be used as an entry point: in Lebanese and Sudanese coastal tourism, women's informal groups providing catering, handicrafts or guest-house services could be supported to form registered cooperatives that receive collective training, small matching grants and marketing support, as suggested by recent ILO work on cooperatives. Development partners already active in coastal development projects (FAO, UNDP, GIZ, UN Women) could be mandated to embed such formalisation components in all new blue-economy programmes.

A fourth axis concerns financial inclusion and entrepreneurship. The descriptive evidence shows that women are overwhelmingly employees and rarely self-employed, even where men display high rates

of self-employment (for example, in Sudan and Tunisia). Central banks and public development banks in the six countries could create dedicated “blue women’s windows” within existing SME credit lines, with simple eligibility criteria (for instance, female ownership above a minimum threshold and activity in a recognised blue subsector) and partial risk guarantees to encourage commercial banks to lend. To ensure that such lines do not remain under-utilised, they should be coupled with basic business-development services delivered through coastal business incubators and municipal women’s centres, including assistance in preparing business plans for eco-tourism, boat services, marine equipment rental or cultural-heritage activities.

Finally, governance and data systems need to be adjusted in very concrete ways if gender equality is to become an operational objective in the Arab blue economy. Line ministries responsible for fisheries, environment, tourism and transport should be required to report annually on gender-disaggregated employment in the subsectors they regulate, using the type of indicators developed in this paper (shares of women by subsector, by skill level, by formality and by firm size). National blue-economy strategies and coastal-zone plans should include explicit gender-responsive budgeting lines, for example earmarking a fixed percentage of new public investments in ports, coastal promenades or marine-research infrastructure for facilities that enable women’s employment (safe transport to worksites, childcare services near large coastal employers, sanitary facilities in landing sites). Establishing cross-ministerial gender and blue-economy working groups, anchored in existing national gender machineries and planning ministries, would provide an institutional space to monitor progress against these indicators, adjust programmes and ensure that external finance for the blue economy is systematically aligned with national gender-equality targets.

## 7. Future research

The analysis in this paper is based on harmonised, aggregated LFS tabulations and therefore cannot capture the full complexity of women’s trajectories in the Arab blue economy. Future work would benefit from access to individual-level microdata, which would allow researchers to disentangle compositional effects, estimate the probability that women with given characteristics enter specific blue subsectors, and quantify the separate contributions of education, household structure and local labour-market conditions to observed employment patterns.

A second avenue for research concerns qualitative and mixed-method approaches. In-depth interviews, focus groups and case studies with women employed in, or excluded from, blue-economy jobs in coastal communities would make it possible to document lived experiences of discrimination, mobility constraints, unpaid care responsibilities and perceptions of risk in self-employment. Combining such qualitative evidence with survey data would provide a more nuanced understanding of how norms and institutions shape the choices of women, employers and local authorities.

Third, longitudinal analyses of policy reforms are needed to assess which instruments are most effective in expanding women’s access to formal, high-quality jobs. Panel studies following regulatory changes

in fisheries, coastal tourism, marine conservation or port governance could examine whether specific interventions – such as quota schemes, cooperative support, social-protection extensions or targeted TVET programmes – translate into measurable improvements in women’s employment and earnings over time. Comparative work across the six countries, and with non-Arab coastal regions that have adopted different regulatory models, would be particularly informative.

Finally, future research should explore new forms of work and technological change in the blue economy. The growing use of digital platforms, remote monitoring and data-driven marine services may create opportunities for women who are constrained by geography or mobility, but may also reproduce existing inequalities. Rigorous evaluation of pilot projects using digital tools, remote work arrangements or blended green–blue initiatives could clarify under which conditions these innovations genuinely widen access for women rather than reinforcing existing patterns of exclusion.

## References

- Alharthi, M., & Hanif, I. (2020). Impact of blue economy factors on economic growth in the SAARC countries. *Maritime Business Review*, 5(3), 253–269. <https://doi.org/10.1108/mabr-01-2020-0006>
- Behera, A. (2024). *Examining the perception of women's role in India's blue economy: A systematic literature review*. Asian Development Bank Institute. <https://doi.org/10.56506/bekd9215>
- Bennett, N. J., Villasante, S., Espinosa-Romero, M. J., Lopes, P. F. M., Selim, S. A., & Allison, E. H. (2022). Social sustainability and equity in the blue economy. *One Earth*, 5(9), 964–968. <https://doi.org/10.1016/j.oneear.2022.08.004>
- Caroline, O. (2024). Does women's economic empowerment drive value creation in the blue economy? *International Journal of Research and Innovation in Social Science*, VIII(IX), 2518–2530. <https://doi.org/10.47772/ijriss.2024.8090209>
- Chatfield, C. (2003). *The analysis of time series*. Chapman and Hall/CRC. <https://doi.org/10.4324/9780203491683>
- Das, J. (2023). Blue economy, blue growth, social equity and small-scale fisheries: A global and national level review. *Studies in Social Science Research*, 4(1), 38. <https://doi.org/10.22158/sssr.v4n1p38>
- Doolittle Llanos, S., Garteizgogeoasca, M., & Gonzales, I. E. (2025). A gendered blue economy? Critical perspectives through women's participation in Peru. *Ocean and Society*, 2, Article 9167. <https://doi.org/10.17645/oas.9167>
- FAO – General Fisheries Commission for the Mediterranean. (2024). *Women in fisheries in the Mediterranean and Black Sea region: Roles, challenges and opportunities (GFCM Publication)*. FAO.
- GIZ. (2021). *Green jobs for women in Africa: Opportunities and policy interventions*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Retrieved from [https://www.giz.de/fachexpertise/downloads/06\\_5.3\\_ENG\\_Green%20Jobs%20for%20Women%20in%20Africa%20Opportunities%20and%20Policy%20Interventions.pdf](https://www.giz.de/fachexpertise/downloads/06_5.3_ENG_Green%20Jobs%20for%20Women%20in%20Africa%20Opportunities%20and%20Policy%20Interventions.pdf)
- Gomes, D. B., Kolovich, L., Malta, V., Newiak, M., Ouedraogo, R., & Priano, S. (2024). Closing education gaps and promoting inclusive development: Lessons from West Africa. In *Gender equality and economic development in Sub-Saharan Africa* (pp. 147–162).
- Hantrais, L. (1995). Comparative research methods. *Social Research Update*, 13, 1–4.
- International Labour Organization (ILO). (2025). *Measuring informal employment and new insights on women's economic participation*. Retrieved from [https://www.ilo.org/sites/default/files/2025-01/WESO25\\_Trends\\_Report\\_EN.pdf](https://www.ilo.org/sites/default/files/2025-01/WESO25_Trends_Report_EN.pdf)
- International Labour Organization (ILO). (2024a). *Arab States employment and social outlook – Trends 2024*. ILO.
- International Labour Organization (ILO). (2024b). *Cooperatives provide a pathway to inclusion for informal workers*. Retrieved from <https://www.ilo.org/resource/news/cooperatives-provide-pathway-inclusion-informal-workers>
- International Labour Organization (ILO). (2024c). *Women and men in the informal economy: A statistical picture*. Retrieved from [https://www.ilo.org/sites/default/files/2024-04/Women\\_men\\_informal\\_economy\\_statistical\\_picture.pdf](https://www.ilo.org/sites/default/files/2024-04/Women_men_informal_economy_statistical_picture.pdf)
- International Labour Organization (ILO). (2015). *Recommendation R204: Transition from the informal to the formal economy*. Retrieved from [https://normlex.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100\\_ILO\\_CODE:R204](https://normlex.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R204)
- International Labour Organization (ILO). (2013). *Measuring informality: A statistical manual on the informal sector and informal employment*. Retrieved from [https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms\\_222979.pdf](https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_222979.pdf)
- Issifu, I., Dahmouni, I., Deffor, E. W., & Sumaila, U. R. (2023). Diversity, equity, and inclusion in the Blue Economy: Why they matter and how do we achieve them? *Frontiers in Political Science*, 5, Article 1067481. <https://doi.org/10.3389/fpos.2022.1067481>

- Ivanova, A., Serrano, R., & Torres, A. (2024). Blue economy in APEC: Pathway towards sustainability, climate action, and inclusion. *Modern Economy*, 15(5), 547–565. <https://doi.org/10.4236/me.2024.155028>
- Jenkins, O., & Brown, G. (2023). *Women's economic empowerment in the blue economy in Small Island Developing States* (WOW Helpdesk Query No. 73). Work and Opportunities for Women (WOW)/UK FCDO.
- Mangubhai, S., Lawless, S., Cowley, A., Mangubhai, J. P., & Williams, M. J. (2022). Progressing gender equality in fisheries by building strategic partnerships with development organisations. *World Development*, 158, Article 105975.
- Matovu, B., Bleischwitz, R., Lukambagire, I., Alkoyak-Yildiz, M., Tarek, R., Etta, L. A., ... Hsieh, Y.-L. (2025a). Examining the perceptions and attitudes toward women's employment and leadership in the blue economy: A case study of India. *Social Sciences & Humanities Open*, 11, Article 101537. <https://doi.org/10.1016/j.ssaho.2025.101537>
- Matovu, B., Bleischwitz, R., Lukambagire, I., Etta, L. A., Alkoyak-Yildiz, M., Tarek, R., ... Suresh, A. S. (2025b). Linking the blue economy to women's empowerment to create avenues for the realization of ocean sustainability targets in the global south. *Ocean & Coastal Management*, 230, Article 107582. <https://doi.org/10.1016/j.ocecoaman.2025.107582>
- Mwakyambiki, S. E. (2024). *Navigating gender challenges in advancing the blue economy: Insights from Zanzibar*.
- OECD/ILO/UNDP. (2024). *Informality and structural transformation in Egypt, Iraq and Jordan: A framework for assessing policy responses in the MENA region*. OECD Publishing. Retrieved from <https://www.ilo.org/sites/default/files/2024-06/ILO-OECD-UNDP%20Informality%202024-en.pdf>
- Ragin, C. C. (2014). *The comparative method: Moving beyond qualitative and quantitative strategies*. University of California Press.
- Rahaman, Md. S., Dana, L. P., & Anjum, N. (2024). Empowering women in building a sustainable blue economy. In *Handbook of Sustainable Blue Economy* (pp. 1–20). Springer. [https://doi.org/10.1007/978-3-031-32671-4\\_6-1](https://doi.org/10.1007/978-3-031-32671-4_6-1)
- Rizky, M. C., Anwar, Y., & Ardian, N. (2025). The gendered dynamics of the blue economy: Women's contribution to sustainable development in coastal communities. *International Review of Management and Marketing*, 15(3), 150–163. <https://doi.org/10.32479/irmm.18167>
- Sabotinova, D. (2019). The challenges women face in the blue economy. In *Jubilee International Conference Contemporary Management Practices X: Connectivity and Regional Partnership* (pp. 101–110). Burgas Free University.
- Saggese, A. (2023). Sustainable fishing and women's labour in the blue economy. *International Growth Centre Blog*. Retrieved from <https://www.theigc.org/blogs/sustainable-fishing-and-womens-labour-blue-economy>
- Sieghart, L. C., Mizener, J. A., & Gibson, J. (2019). *Capturing opportunities for integrated coastal zone management and the blue economy in MENA* (MENA Knowledge and Learning: Quick Notes Series No. 172).
- UN Women & ICSF. (2020). *Women's economic empowerment in fisheries in the blue economy of the Indian Ocean Rim: A baseline report*. UN Women.
- UNCTAD. (2023). *Empowering waves: An ocean of opportunities for women in the blue economy* (Event brief, WTO Public Forum 2023). United Nations Conference on Trade and Development.
- United Nations Development Programme (UNDP). (2023). *Digital transformation and inclusive employment in Arab states*. UNDP Regional Hub for Arab States. Retrieved from <https://www.undp.org/arab-states/stories/driving-digital-transformation-arab-region>
- United Nations Economic and Social Commission for Western Asia & UN Women. (2025). *Women in the blue and green economies*. Retrieved from [https://www.unescwa.org/sites/default/files/event/materials/Green%20and%20Blue%20Economies\\_UN%20Women\\_SS.pdf](https://www.unescwa.org/sites/default/files/event/materials/Green%20and%20Blue%20Economies_UN%20Women_SS.pdf)
- Williams, M. (2023). *Financing the blue economy: Impacts and implications for gender equality and women's empowerment in the Global South* (DAWN Discussion Paper, 48). Retrieved from <https://dawnnet.org/wp-content/uploads/2023/01/20230127-Financing-the-Blue-Economy-Discussion-Paper-48.pdf>

World Bank. (2017). *The potential of the blue economy*. World Bank Group.

World Bank. (2022). *Gender integration in the blue economy portfolio: Review of experiences and future opportunities*. World Bank Group.

Yuan, H., Choukroune, L., & Failler, P. (2024). Centering justice for labor in the new blue economy: Principles for applying emerging evidence and theoretical critiques to policy and practice. *Marine Policy*, 168, Article 106327. <https://doi.org/10.1016/j.marpol.2024.106327>