



# Arab Risk Monitor: Quantifying the drivers of risk of conflict, version 1.0



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# Arab Risk Monitor: Quantifying the drivers of risk of conflict, version 1.0



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United Nations publication issued by ESCWA, United Nations House,  
Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: [www.unescwa.org](http://www.unescwa.org).

23-00083

# Acknowledgements

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This paper was developed by the Governance and Prevention Cluster of United Nations Economic and Social Commission for Western Asia (ESCWA). This is the second of a three-paper series of the Arab Risk Monitor. The first paper introduces an action-oriented conceptual framework to unpack the risk of conflict, crisis, and instability with a focus on the Arab region. The second paper presents the methodology utilized in quantifying risk, explaining different methods to normalize, scale, and weight selected indicators. The third paper is the Arab Risk Monitor. It explores issues shaping conflict, crisis, and instability in the Arab region, measuring vulnerabilities and resilience across

risk pathways of conflict, climate and development.

The three-paper series were implemented under the guidance of Tarik Alami, Cluster Leader, Governance and Conflict Prevention. They were discussed in several iterations involving experts from academia, think tanks and civil service.

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# Key messages

- 
- *Measuring risk requires a series of indicators that can be scaled and weighted to better capture the complexity of the analyzed phenomenon.*
- 
- *Risk is measured by looking at one or more measures, which is expressed as either vulnerability or resilience, for a total of 12 risk measures.*
- 
- *6 indicators look at the risk induced by conflict, climate change and development*
- 
- *Assessing risk vulnerability and risk at indicator and pathway aggregated level is another way of monitoring the risk overtime and in the actual situation*
- 
- *Standardization and weighting of indicators allows comparisons across countries and time to monitor the risk in the Arab region.*
-





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# Abbreviations

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ESCWA United Nations Economic and Social Commission for Western Asia (ESCWA)

FAO Food and Agriculture Organization of the United Nations

GDP gross domestic product

GED Georeferenced Event Dataset

GNI gross national income

HDI Human Development Index

IDMC Internal Displacement Monitoring Centre

ODA official development assistance

OECD Organisation for Economic Co-operation and Development

SDG Sustainable Development Goal

UN DESA United Nations Department of Economic and Social Affairs

WDI World Development Indicators

WPP World Population Prospects



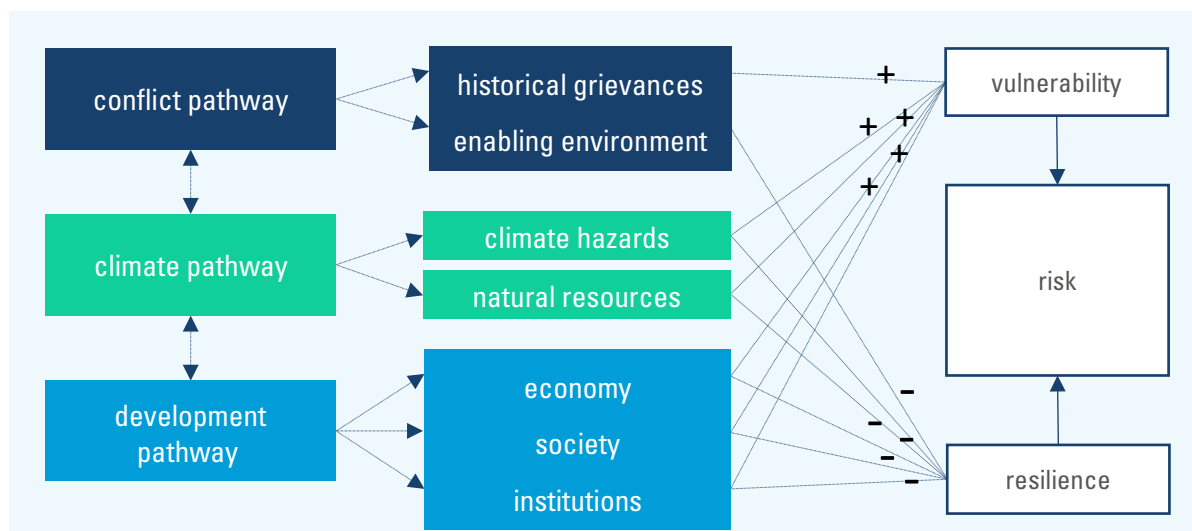
# Introduction

The Arab Risk Monitor report is designed to provide policymakers and development actors with an action-oriented assessment of conflict, crisis and instability in the Arab region. The monitor consists of three risk pathways (conflict, climate and development), each influencing risk through a combination of two elements: vulnerability and resilience (figure 1).<sup>1</sup>

Each risk pathway includes several thematic risk areas. The conflict pathway consists of two areas (historical grievances and enabling environment), the climate pathway two (natural resources and climate hazards) and the

development pathway three (economy, society and institutions). Within each thematic area, the Arab Risk Monitor report provides one or more measures of risk, expressed as either vulnerability or resilience, for a total of 12 risk measures. This paper defines vulnerability in terms of a country's likelihood to experience shocks, and its structural exposure to these, and resilience, and resilience in terms of a country's policy-driven capacity to absorb the negative impacts of shocks.<sup>2</sup> Vulnerability, therefore, provides a measure of structural risk, and resilience provides a measure of non-structural risk.

Figure 1. ESCWA conceptual framework for conflict risk



Source: Authors.

- 1 Pathways of risk have been identified from decades of empirical research on conflict drivers and their relevance to the Arab region, while definitions of risk, vulnerability and resilience are adapted from the literature on economic vulnerability and disaster risk; see Arab Risk Monitor: A Conceptual Framework.
- 2 For discussion on definitions of vulnerability and resilience and their role in shaping structural and non-structural risk, *ibid*.

The 12 measures of risk are divided as follows. The conflict pathway includes two measures of risk (conflict vulnerability and conflict resilience), the climate pathway four measures (natural resource vulnerability, natural resource resilience, climate hazard vulnerability and climate hazard resilience), and the development pathway six measures (economic vulnerability, economic resilience, social vulnerability, social resilience, institutional vulnerability and institutional resilience). An overview is provided in figure 2.

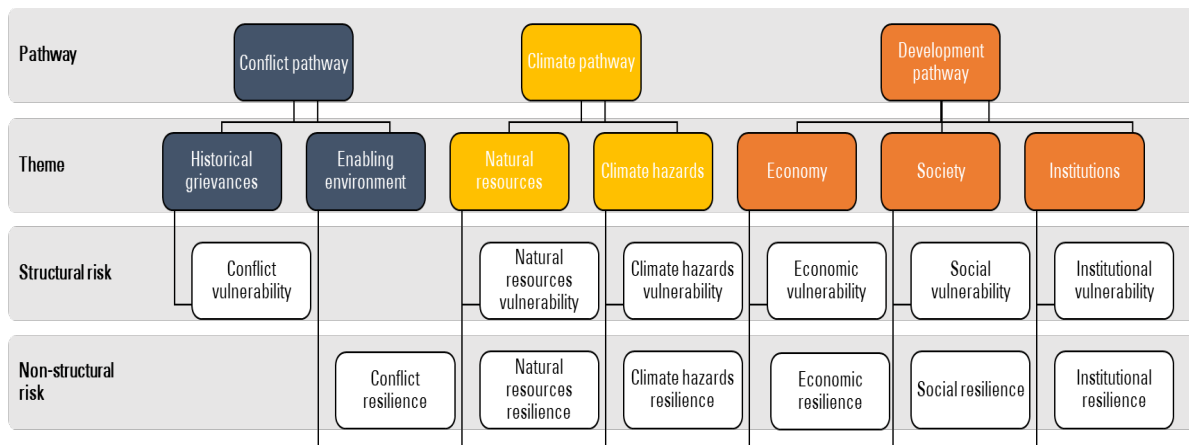
the dataset and statistical output that measure the drivers of risk identified in the Arab Risk Monitor: A Conceptual Framework. And it builds

on previous ESCWA work on developing a conceptual framework for conflict risk.

Section 2 details the imputation, normalization and weighting/aggregation techniques that have been used, sections 3, 4 and 5 list the indicators by pathway, including the number of observations, country coverage, data management system and the normalization/standardization criteria used, and section 6 provides concluding remarks.

The objective of this paper is to present the methodology and indicators for the Arab Risk Monitor report. It focuses on the technical aspects of producing.

Figure 2. Arab Risk Monitor Conceptual Framework structure



Source: Authors.

# 1. Data management

---

## A. Selection criteria

The following criteria were used to select indicators:

- **Relevance:** the indicator should represent the dimension that has been identified or serve as a proxy for the underlying dimension. Should also be relevant to the Arab region.
- **Availability and open access:** free access to credible data, in terms of sources and utilization in scientific literature, is essential. Underlying data should be accessible to policymakers and other stakeholders.
- **Temporal and geographical coverage:** data should cover sufficient countries at global and regional level. Time coverage is another criterion. A larger number of observations allows better coverage for robust correlation analysis.
- **Frequency of data release:** together with time coverage, this will allow a regular and up-to-date analysis of the risk related to the selected indicator, as well as trend analysis.
- Finally, other things being equal, preference is given to the United Nations' Sustainable Development Goals (SDGs) and other internationally agreed datasets – Sendai Framework for Disaster Risk Reduction 2015–2030, Paris Agreement – to consolidate a country's capacity to report SDG-related indicators.

## B. Imputation

Data imputation is a technique used to fill data gaps. A significant portion of the independent variables identified for the Arab Risk Monitor report have missing or incomplete data, stemming from data collection cycles (for example, data collected every five years or on an ad-hoc basis) or challenges in data collection during conflict periods. This is relatively common and unavoidable, particularly for global datasets and for conflict-related data but can introduce bias and compromise the validity of results.

There are several ways to deal with missing data, subject to the attributes of the data, including distribution, size and randomness. The most common approach is listwise deletion, where missing cases (in this case, countries) are dropped from the analysis. This may be feasible for countries missing dependent variables for an overwhelming number of years in the time series.

For independent variables with cyclic or non-cyclic gaps in the times series, the missing data may be imputed using the last observation carried forward method. However, in general, the method should be used sparingly as it may underestimate the variability of the results.

To counter some of the shortfalls for the single imputation methods listed above, this analysis will use multiple imputations where the imputed

values for each of the missing observations are generated resulting in the number of complete data sets.<sup>3</sup> The advantages of multiple imputations include reducing bias and enhancing validity compared with other single, ad-hoc imputations, preserving sample size and producing results that are more readily interpreted.<sup>4</sup> This generalized approach allows for uncertainty about missing data while allowing for valid inference. The specific package and methodology will be presented in a subsequent paper on the analysis and results.

## C. Normalization

This section presents the approach and steps taken in terms of normalization. The main methodologies used in social sciences for normalizations are presented and briefly discussed.

Normalization is a standard procedure in data processing in social sciences. When combining raw data from different sources with varied ranges, normalization results in a rescaling of indicators or features to be consistent – 0 to 1 using min-max scaling, for example – and allows comparability and for each indicator to carry the same weight prior to the purposeful and controlled weighting process. The *ESCWA Development Challenges Index* report utilized min-max methodology.<sup>5</sup> The z-score normalization is commonly utilized in international organizations and research analyses, while the decimal scaling normalization can be relevant for normalized indicators with specific characteristics relating to their distribution.

The three main normalization methodologies are as follows:<sup>a</sup>

### Min-max methodology

Also known as scaling normalization, it provides the minimum and maximum values for every feature, which are transformed to 0 and 1, respectively. Every other value is transformed into a decimal between 0 and 1. This makes it significantly easier to read the difference between the ranging numbers, though it does not handle outliers well.

### Z-score normalization

Also known as standardization or standards-deviation methodology, measures the standard deviations below and above the mean (average), ranging from -3 to +3 standard deviation. Avoiding the outlier issue of mix-max methodology, it is useful when value needs to be compared to the mean.

### Decimal scaling normalization

Converts a number to a decimal point, depending on the maximum absolute value, thereby transforming big numbers into understandable smaller decimal values.

<sup>a</sup> Al Shalabi, Shaaban and Kasasbeh, 2006; Han and Kamber, 2001.

This paper and the subsequent analysis will use min-max methodology as most data do not contain significant outliers and raw data have a large variety of both Gaussian (normal distribution with values that are symmetrically distributed around the mean) and non-Gaussian distributions (that do not have the same characteristics of the normal distribution). Therefore, the methodology is sufficient and

<sup>3</sup> Rubin, 1987.

<sup>4</sup> McCleary, 2002.

<sup>5</sup> Abu-Ismael and others, 2021.



efficient in providing rescaled indicators with identical range. In some cases, in the presence of pre-existing thresholds set out in the literature (as in some natural resources indicators), these are used to set the lower or upper bounds instead of the minimum or maximum value.

## D. Weighting and aggregation

No uniformly agreed methodology exists for weighing individual variables to combine them into a composite indicator. Different weights may be assigned to component series to reflect their significance (collection costs, coverage, reliability and economic reason), statistical adequacy, cyclical conformity, speed of available data, and other things.

Weights usually have an important impact on the composite indicator value, especially when a higher weight is assigned to indicators on which some countries excel or fall behind. Therefore, weighting models need to be made explicit and transparent. At the same time, the weight of all the different dimensions that are included into the variable is the same. This approach has

been implemented to consider the importance of each dimension/variable for the indicator utilized.

The steps for weighting and aggregating are applied as follows:

- **Weighting and aggregation at indicator level:** implies the aggregation of variables in cases where an indicator is composed of more than one variable.
- **Weighting and aggregation at vulnerability/resilience level:** when all indicators are prepared and ready, they are assigned a weight at the risk level.

To implement the weighting of the variables or indicators (steps 1 and 2) we use the following basic formula: the normalized variable or indicator will be assigned a weight of  $1/x$  where  $x$  is the number of variables of the indicator or number of indicators for a risk. In the case shown in table 1, the standardized indicators, rule of law and government effectiveness, will be assigned a weight of 0.5 (1/2). The aggregate weight of both indicators will compose the weight of the institutional resilience indicator.

Table 1. Institutional resilience, indicators

Indicator	Variable	Weight	Example 1	Example 2
Rule of law	Rule of law	0.5	0.8	0.3
Government effectiveness	Governance effectiveness challenge index	0.5	0.6	0.1
Institutional resilience		1.0	0.7	0.2

Source: Authors.

Table 2 is an illustration of where the indicator is defined through a series of variables that complement the potential set of information. A first layer step of weighting and aggregation is needed. For instance, the food security and undernourishment indicators include several dimensions; that is, food imports and more food security-related dimensions. Hence, two

steps of aggregation are applied using the equal weight approach, as per table 2. The formula used here can be summarized as follows:  $1/y$  where  $y$  is the number of components and is also equal to the  $1/x$  for all the components of the indicator (see formula (1)). See the following formula for the economic vulnerability indicator:

$$(1) \text{ EconVul} = \left( \frac{\text{Trade}}{4} \right) + \frac{\left( \left( \frac{\text{Remittances}}{2} \right) + \left( \frac{\text{NetODA}}{2} \right) \right)}{4} \\ + \frac{\left( \left( \frac{\text{CerImp}}{4} \right) + \left( \frac{\text{FoodImp}}{4} \right) + \left( \frac{\text{Undernour}}{4} \right) + \left( \frac{\text{FoodSec}}{(4)} \right) \right)}{4} \\ + \left( \frac{\text{Inequal}}{(4)} \right)$$

Table 2. Economic vulnerability indicators weighting

Indicator	Variable	First level of aggregation/weighting	Second level of aggregation/weighting	Example 1
Trade dependence	Dependence on commodity exports	1	0.25	0.8
Financial dependence	Personal remittances received (percentage of GDP)	0.5	0.25	0.6
	Net ODA received percentage of GNI <sup>a</sup>	0.5		0.6
Food security	Cereal import dependency ratio	0.25	0.25	0.4
	Value of food imports in total merchandise exports (per cent), three-year average	0.25		0.4
	Prevalence of undernourishment (per cent), three-year average, SDG indicator 2.1.1	0.25		0.4
	Prevalence of moderate or severe food insecurity in total population (per cent), three-year average	0.25		0.4
Inequality	Inequality adjusted income index	1	0.25	0.2
Economic vulnerability			1	0.5

Source: Authors.

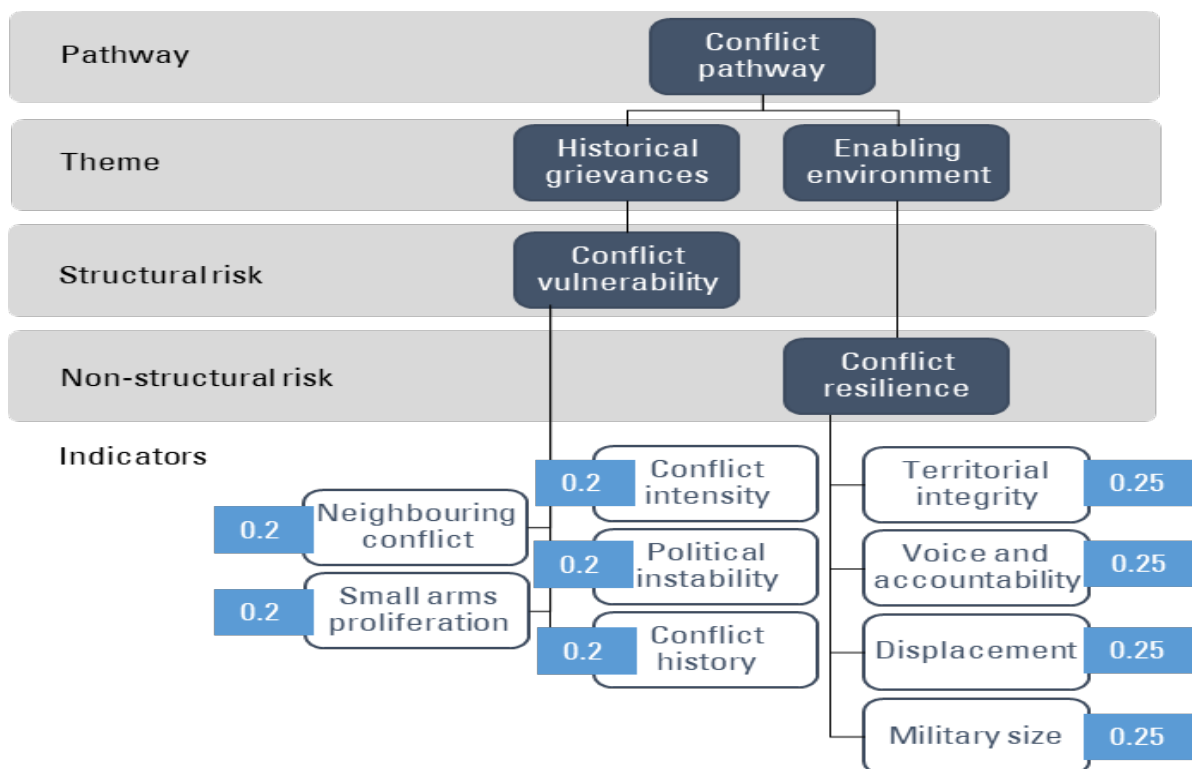
<sup>a</sup> ODA is official development assistance, GNI is gross national income.

After implementing the weighting of indicators, next in the process of aggregation of variables to obtain indicators of risk for the different dimensions considered is the pathway level for vulnerability and resilience. The example in figure 3 shows that the weighting methodology of equal weights, adopted at indicator level, is used at this level, too, the aim being to maintain consistency with implementation of the same methodology. The example provided explains the steps required to aggregate and weight the indicators for conflict vulnerability and conflict resilience. Assigning equal weights of 0.2 to the variables under the indicators row allows us to obtain an indicator for the risk relative to conflict vulnerability. Assigning an equal value of 0.25 to the indicators relative to conflict resilience allows

us to obtain an indicator of the level of risk for conflict resilience. The same approach can be used for all the structural and non-structural risk indicators to complete the analytical setting for the level of risk in the country/region and any other geographical/administration level.

The last step in the aggregation and weighting of the indicators is at structural risk and non-structural risk levels, to get an aggregate score for vulnerability and for resilience per pathway. For this, risk components will be assigned a value  $1/x$ , where  $x$  is the number of risk components per pathway, vulnerability or resilience. After weights are assigned, the components are aggregated at the level of pathway for vulnerability and resilience.

Figure 3. Weighting and aggregation at theme for dimensions of conflict vulnerability and resilience



Source: Authors.

For example, see the following formula for conflict resilience:

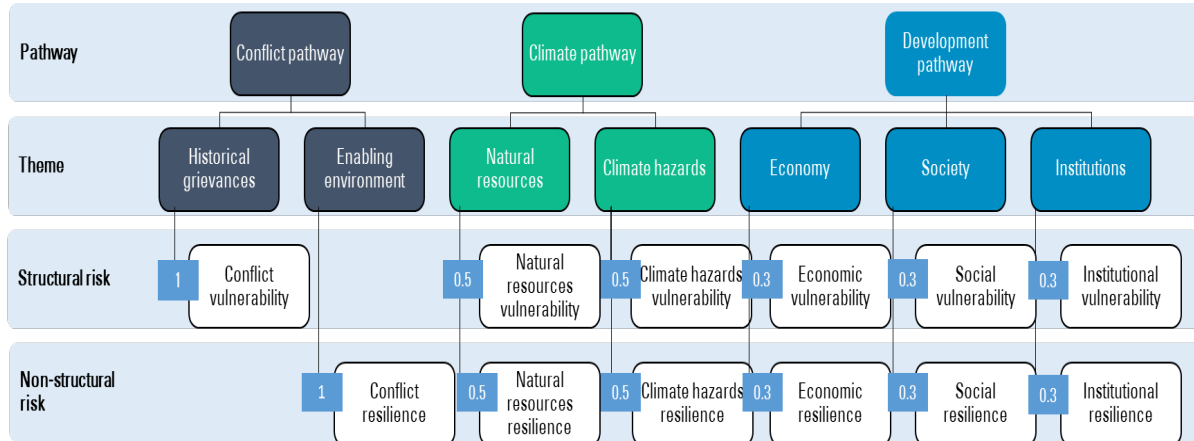
$$(2) \text{ConfRes} = \frac{(\text{TerrInt} + \text{VoiceAcc} + \text{Disp} + \text{Milit})}{4}$$

For the conflict pathway, there is no need for additional calculation, given there is only one vulnerability component and one resilience component. However, for the climate and development pathways, there is more than one vulnerability and one resilience component. Thus, for these pathways, the equal weight methodology is applied. For example, to arrive at the vulnerability score for the climate pathway, the two vulnerability components are assigned equal weight (0.5). The scores for each weighted vulnerability component are then aggregated to arrive at one vulnerability score for the climate pathway. See the following formula for conflict resilience:

$$(3) \text{CIRes} = (\text{NRRes} + \text{CHRes})/2$$

Equal weights are attributed to all indicators included in the Arab Risk Monitor reports, as this is the simplest method to communicate to different audiences. Moreover, statistical advice against non-equal differential weights has been collected for years in constructing indices. Researchers<sup>6</sup> found the best approach in constructing composite indexes is to avoid weighting dimensions using differential weights. There is no gain in efficiency or information when applying weights. Differential weighting with socioeconomic, institutional, historical and environmental dimensions not only ranks them, but also sets a specific numerical value measuring exactly how much more important one dimension is compared with another.

Figure 4. Weighting and aggregation at pathway level for dimensions of vulnerability and resilience for the three pathways



Source: Authors.

6 Hagerty and Land, 2007.

## 2. Conflict pathway (Conf)

The conflict pathway includes the two thematic areas of historical grievances and enabling environment, leading, respectively, to the two risk categories of conflict vulnerability (structural risk) and conflict resilience (non-structural risk).

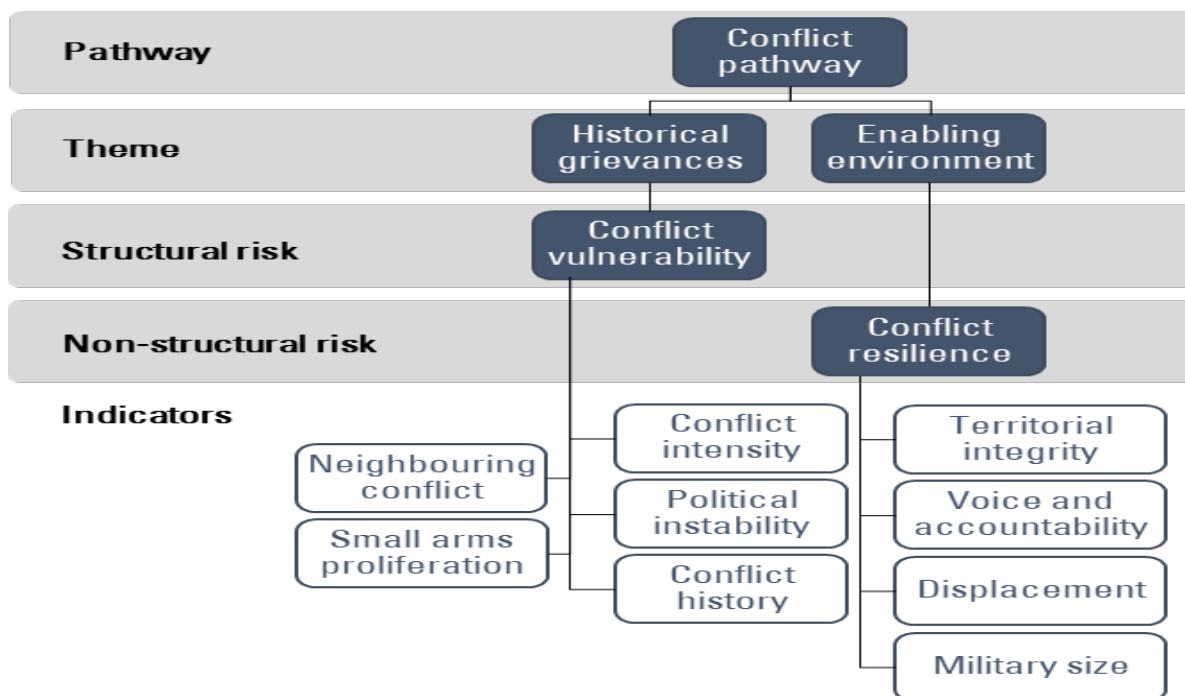
### A. Theme: Historical grievances

The historical grievances thematic area includes one structural risk; that of conflict vulnerability.

### Vulnerability (ConfVul)

The conflict vulnerability category includes four indicators that look at a country's conflict history as a driver of future risk. Countries that have experienced conflict in the past are much more likely to return to conflict than those that have been at peace.<sup>7</sup> Countries in proximity to States experiencing conflict are also more likely to become involved in hostilities, or, at the very least, be affected by the socioeconomic, humanitarian and even security ramifications.

Figure 5. Conflict pathway, structure



Source: Authors.

7 Gates and others, 2016.

Table 3. Conflict vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage <sup>a</sup>
Conflict intensity	Battle-related deaths per 100,000 people	UCDP Georeferenced Event Dataset, UN DESA	2022	123
Political stability	Political stability and absence of violence/terrorism	World Bank Worldwide Governance Indicators	2021	206
Neighbouring conflict	Number of neighbouring countries with at least 25 battle-related deaths	UCDP GED	2022	161
Proliferation of small arms	Civilian firearms holdings per 100 residents	Small Arms Survey	2020	230

**Source:** Authors.

<sup>a</sup> coverage refers to the number of countries at global level with data available for the indicator.

The formula used to calculate conflict vulnerability is as follows:

$$(4) \text{ ConfVul} = ((\text{ConfIntens} + \text{ConflInt1ye} + \text{PolStab} + \text{NeighConf} + \text{SmallArms}))/5$$

#### (a) Indicator: Conflict intensity (ConfIntens, ConflInt1ye)

The **conflict intensity** indicator is expressed as the number of battle-related deaths each year per 100,000 people. For conflict data, the Uppsala Conflict Data Program (UCDP) Georeferenced Event Dataset (GED) Global version 22.1 is used.<sup>8</sup> “GED is UCDP’s most disaggregated dataset, covering individual events of organized violence (phenomena of lethal violence occurring at a given time and place). These events are geocoded down to the level of individual villages, with temporal durations disaggregated to individual days”<sup>9</sup>. From the GED, the variable “best” is used. It provides “the best (most likely) estimates of total fatalities resulting from an event”. For population data, World Population Prospects

(WPP), prepared by the Population Division of the United Nations Department of Economic and Social Affairs (UN DESA), is employed.<sup>10</sup> It presents population estimates from 1950 to the present for 237 countries/areas, underpinned by analyses of historical demographic trends. This indicator is also the SDG indicator 16.1.2.

A lag of one, three, five and 10 years can be used to better reflect the residual effects of conflict in a given country/area. Including this will also allow consideration of different conflict settings embedding the short-, medium- and long-term dimensions of conflict history. The values of the indicators are transformed using natural logarithms to consider the spectrum of situations that are present over time and in different contexts. The distribution presented in annex 3A1 does not consider values of fatalities

8 Davies and others, 2022; Sundberg and Melander, 2013.

9 UCDP. Available at <https://ucdp.uu.se/downloads/>.

10 UN DESA, Population Division, 2022.

equal to 0 and these entries directly assume the lowest value in standardized scale from 0 to 1.<sup>11</sup> The distributions for these indicators, presented in annex 3A1, are overall normal distribution that allows the implementation of the min-max standardization methodology. The normalized variable assumes value 0 for the lowest value of the original variable reflecting low vulnerability and value 1 for the highest values of the original values showing the highest value of vulnerability.

#### (b) Indicator: Political stability (PolStab)

The **political stability** indicator measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. The World Bank 2022 Worldwide Governance Indicators (WGI) project is used as a dataset.<sup>12</sup> The WGI produces aggregate and individual governance indicators for more than 200 countries and territories over the period 1996–2021 for six dimensions of governance. Each of the six aggregate WGI measures is constructed by averaging data from several underlying sources. From the WGI dataset, the aggregate indicator “political stability and absence of violence/terrorism: estimate” is used. The distribution of the political stability indicator by design<sup>13</sup> as reported in annex 3A1 is a normal distribution concentrated around value 0, even though two different distributions can be identified in the figure: first, Organisation for Economic Co-operation and Development (OECD) countries and other high-income countries are concentrated around 1; and second, non-OECD

countries are concentrated in the lower part of the scale, around the value 0.5. This distribution is a classic bimodal distribution, common when looking at socioeconomic and institutional indicators on a global scale. The presence of this bimodal distribution will be treated with the implementation of standardization. That said, the observed distribution allows for the utilization of the min-max approach to standardize the distribution. This will present values ranging from 0 to 1, with 0 representing the highest level of political stability and 1 the lowest level of stability. The higher the value of this standardized variable for a country, the higher the risk and vulnerability, while the lower the value of this indicator, the lower the risk.

#### (c) Indicator: Neighboring conflict (NeighConf)

The **neighbouring conflict** indicator measures how the spillover effects of conflicts happening in neighbouring countries affect domestic risk. The variable is directly proportional to the number of neighbouring countries and the presence of conflicts among them. This is a number that is the share of neighbouring countries in conflict divided by the number of neighbouring countries, therefore ranging from 0 to 1. This is used as a proxy for the risk related to the presence of conflict in neighbouring countries. The dataset used is the GED global version 22.1, which collects the number of battle-related deaths. From the GED, the variable “best” is used. To build the conflict country indicator, a new variable is created where the rule is applied: best values < 25 = 0, and 1 otherwise. A function then adds up the

---

11 In cases of a country reporting data on fatalities with missing values, the values for those years are assumed to be 0. If a country reports no data on fatalities, and is not included in the data used, then it is considered missing. When performing correlation techniques on the dependent variable with the explanatory variables, we consider countries with data on fatalities.

12 World Bank, 2022.

13 Kaufman and others, 2010.

number of countries in conflict among the number of neighbouring countries.

The distribution presented in annex 3A1 does not include the values of countries with 0 per cent of the neighbouring countries in conflict, focusing only on those countries in areas/regions of conflict. The distribution cannot be considered normal. Nevertheless, a concentration around the central value of the distribution can be observed and, given the way the indicator has been created, a concentration near round values is observed. The standardization methodology adopted is min-max and this will create values for the neighbouring conflict indicator ranging from 0 to 1, with 0 representing the lowest level of risk and vulnerability, and 1 the highest level of risk and vulnerability due to the presence of conflict in surrounding countries.

#### (d) Indicator: Small arms proliferation (SmallArms)

The prevalence of civilian-held firearms can hinder the State's ability to enforce security and its monopoly of force over its territory, leading to a greater risk of conflict.<sup>14</sup> The **small arms proliferation** indicator measures how many firearms are in civilian hands in each country, expressed as the number of firearms per 100 residents.

The dataset used is Global Firearms Holdings provided by the Small Arms Survey.<sup>15</sup> The database estimates are calculated based on national firearms registration statistics, general population surveys on firearms ownership, expert estimates of civilian holdings and comparisons based on estimates for similar countries. This variable is transformed in natural logarithms and

the obtained distribution presented in the figure in annex 3A1 relative to this indicator. Despite the limited number of values, the distribution respects the minimum standards of a normal distribution criteria. Other transformations have been implemented but with similar distribution; therefore, we use the natural logarithms. The normalized indicator ranges from 0 to 1; with 0 being the lowest value in the small arms proliferation indicator and 1 the highest value. This standardized variable is directly linked with risk and vulnerability in the country considered for the selected year. The higher the value of the standardized indicator, the higher the risk and vulnerability in the country in the selected year. Countries with a higher number of firearms in civilian hands over the total population face a higher risk of conflict and violence.

## B. Theme: Enabling environment

The enabling environment theme includes one non-structural risk, that of conflict resilience.

### Resilience (ConfRes)

The conflict resilience category includes five variable measuring policy-related factors compounding conflict history, such as the State's ability to provide security, the extent to which it maintains control over its territory, the pressure of forcibly displaced populations, voice and accountability, and the degree of militarization. These indicators present information on four main dimensions of conflict resilience, and, according to the paper Arab Risk Monitor: A Conceptual Framework, cover the dimensions of conflict and security that can be considered at the disposal of the policymakers.

<sup>14</sup> Naudé and others, 2011.

<sup>15</sup> Karp, 2018.



Table 4. Conflict resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Territorial integrity	State authority over territory	Varieties of democracy (V-Dem)	2021	175
Forced displacement	Refugees plus IDPs as a share of population	UN Refugee Agency, Internal Displacement Monitoring Centre (IDMC), UN DESA	2021	170
Voice and accountability	Voice and accountability	WGI	2021	206
Military size	Military expenditure as share of GDP	Stockholm International Peace Research Institute (SIPRI)	2021	165
	Armed forces personnel as share of total labour force	World Development Indicators (WDI)	2021	216

**Source:** Authors.

The formula used to calculate conflict resilience is as follows:

$$(5) \text{ ConfRes} = \left( \text{TerrCon} + \text{ForcedDisp} + \text{VoiceAcc} + \left( (\text{DefenseEx} + \text{ArmyPers}) / 2 \right) \right) / 4$$

#### (a) Indicator: Territorial integrity (TerrCon)

The **territorial integrity** indicator is expressed as the extent of recognition of a State's pre-eminent authority over its territory. A lack of effective territorial control is associated with extensive periods of violence.<sup>16</sup> For the State to provide security to its citizens, it first needs to maintain a monopoly on legitimate violence within different local communities<sup>17</sup> and secure it through its ability to dissuade potential challengers or armed groups.<sup>18</sup> Professional military capabilities with reach into rural and

secluded areas are required to enable a State to project its authority across its territory and enforce order within its jurisdiction.<sup>19</sup>

For this indicator, Varieties of Democracy (V-Dem) version 12 is used as a dataset.<sup>20</sup> V-Dem is a multidimensional disaggregated dataset relying on expert survey data, with the variable "State authority over territory (C) (v2svstterr)" used. It provides an estimate of the size of the territory that a State effectively controls as a percentage of the total territory that is officially part of the country. The indicator can be

16 De la Calle and Sánchez-Cuenca, 2015.

17 Naudé, Santos-Paulino and McGillivray, 2011.

18 Collier and Hoeffler, 2004.

19 Herbst, 2004.

20 V-Dem, n.d.

controversial for several reasons, including: militarization and securitization of areas of the country, which can increase tensions and risk; imposition of decisions not in line with local needs; and areas inhabited by groups seeking more decision-making power over these territories that do not align with national-level plans. However, it is also assumed that the larger the share of territory under the control of State authorities, the lower the risk of conflict and violence. Outliers that are equal to 0 are not considered in the distribution. The distribution of the indicator presented in annex 3A2 cannot be considered as a normal distribution, so an alternative approach to normalization can be utilized. Being a percentage value, we can consider the indicator ranging from 0 to 1, with 0 meaning no State control over the territory and 1 full control. Values from 60 per cent and less assume the value 0 of the indicator. The standardized value ranges from 0 to 1, with 0 representing the lowest level of territorial integrity and resilience, and 1 the highest value of territorial integrity and highest resilience to risk.

#### (b) Indicator: Forced displacement (ForcedDisp)

The **forced displacement** indicator is expressed as the size of refugees and internally displaced persons (IDPs) as a share of a country's population. People flee conflicts and disasters in search of safety. Sudden population increases, particularly in crowded urban areas, can have a negative effect on a State's stability due to economic, environmental and security-related stresses, and the increased strain on basic resources and services.<sup>21</sup> Population growth in urban or rural settings can lead to

resource competition, which may increase tensions between and within communities.<sup>22</sup>

For refugee data, the UN Refugee Agency's statistics dataset is employed,<sup>23</sup> and for IDP data, the Internal Displacement Monitoring Centre (IDMC),<sup>24</sup> using "conflict stock displacement" variable as per the definition in the dataset. The UN DESA WPP is utilized for population data. Given the characteristics of the analysed phenomenon and of the distribution of values, it is transformed using natural logarithms. The values that are equal to 0 in the selected indicator are assigned the lowest values. The overall distribution of transformed variables shows a distribution that we can consider as normal; therefore, the standardization methodology that is adopted is the min-max. The standardized variables will assume values between 0 and 1. This variable can also be considered used as a lagged variable to estimate the impact of the presence of the IDP population on the risk of violence. The temporal dimension of this relation and correlation requires consideration. The population of those displaced through violence and conflict are a proxy for the intensity of conflict in previous years but their presence negatively impacts the risk of violence in the current year by several channels. A higher value of this indicator corresponds to a higher risk in the country in the year considered. On the other hand, the lower level of this transformed variable is considered a lower level of risk and, therefore, higher resilience for the country in the year considered, given this less affects the general level of insecurity derived from conflict and violence that caused the displacement. Therefore, the value 0 of the standardized

21 SIPRI, 2017.

22 Young and others, 2014.

23 UNHCR, 2022.

24 IDMC, 2021.

indicator refers to the highest values of the original values and the lowest level of resilience, while the value 1 of the standardized indicator indicates the highest values of resilience and the minimum values of the original values.

#### (c) Indicator: Voice and accountability (VoiceAcc)

The **voice and accountability** indicator measures perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association and a free media. The World Bank 2022 Worldwide Governance Indicators (WGI) project is used as a dataset. From the WGI dataset, the aggregate indicator "voice and accountability, estimates" is used.

This variable presents a distribution that is trimodal, even if it is normally distributed by design. This can be dealt with by adopting the standardization methodology. The distribution reflects the main groups of countries characterized by different types of political regimes that can have a lower or higher level of risk. The standardized indicator ranges between 0 and 1. The higher the value of the indicator, the higher the country's resilience to risk, as having institutions where people can voice their grievances and have their voices heard can make confrontations more likely to be non-violent. The lower the value of the standardized indicator, the lower the level of the country's resilience to risk.

#### (d) Indicator: Military size in budget and personnel (DefenceEx, ArmyPers)

The two **military size** indicators provide measures of a country's security environment. A State security sector ensures its monopoly over violence.<sup>25</sup> Poorly managed or ineffective security systems can result in instability and insecurity.<sup>26</sup> Armed forces that are untrained and undisciplined can facilitate the escalation of violence.<sup>27</sup> A professional security force that upholds human rights, international conventions and the rule of law in its security operations can help prevent the risk of insurgency by more militant groups or the proliferation of violence.<sup>28</sup>

The first variable measures the military budget as a share of gross domestic product (GDP). The SIPRI Military Expenditure Database is used, which contains consistent time series on countries' military spending for the period 1949–2021.<sup>29</sup> The second variable measures armed forces personnel as a share of the total labour force. The World Bank collects data for the variable from *The Military Balance*, an annual assessment of global military capabilities by the International Institute for Strategic Studies (IISS).<sup>30</sup> Armed forces personnel are defined as active-duty military personnel, including paramilitary forces, if their training, organization, equipment and control suggest they may be used to support or replace regular forces. The labour force comprises all people who meet the International Labour Organization (ILO) definition of the economically active population.

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25 Collier, Hoeffler and Rohner, 2009.

26 Hegre and Sambanis, 2006.

27 Humphreys and Weinstein, 2006.

28 Fearon, 2011.

29 SIPRI, 2023.

30 World Bank, n.d.

The military expenditure variable has a normal distribution that is skewed to the upper side of the tail of distribution by default. This allows us to implement a min-max standardization. The value of the indicator ranges from 0 to 1, where 0 represents a lower level of resilience for the country, and 1 a higher level of resilience.

The second variable used for conflict resilience presents a distribution that is concentrated on the lower values of the distribution. This serves as a proxy for the level of control over the

population and of tensions in society. Like the previous indicator, the value of the indicator ranges from 0 to 1, where 0 represents a lower level of resilience for the country (low number of armed forces personnel), and 1 a higher level of resilience (high number of military forces).

Both indicators can show that a high level of military control is linked to low risk and high resilience to risk. A lower level of both indicators represents high tension, and consequently higher risk and low resilience.

### 3. Climate pathway (Climate)

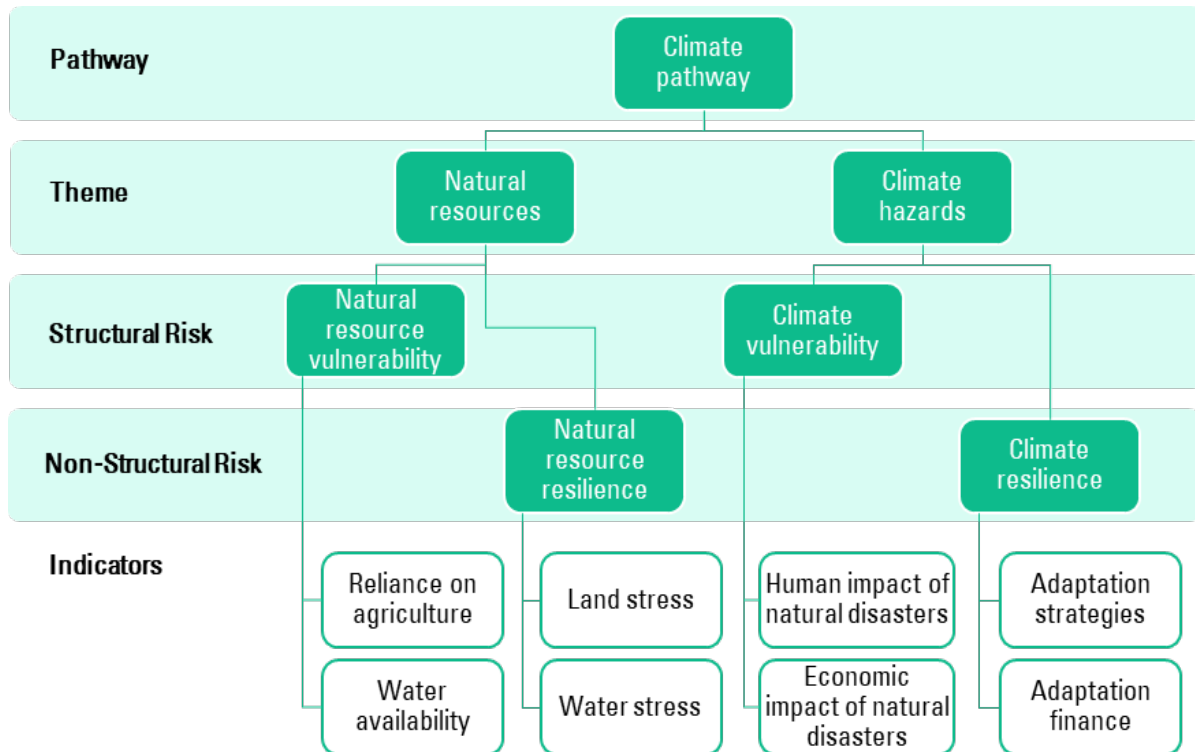
The climate pathway includes two overarching themes, namely climate hazards and natural resources. These can be divided into four risk categories. These are climate vulnerability and natural resource vulnerability, which indicate structural risk, and climate resilience and natural resource resilience, which relate to risks that can be influenced to a larger degree by policy choices.

To calculate the vulnerability and resilience dimensions of the climate pathway, the formula is as follows:

$$(6) \text{ CliVul} = (\text{NRVul} + \text{CHVul})/2$$

$$(7) \text{ CliRes} = (\text{NRRes} + \text{CHRes})/2$$

Figure 6. Climate pathway, structure



Source: Authors.

## A. Theme: Natural resources (NR)

The natural resources theme includes one structural risk (natural resource vulnerability), and one non-structural risk (natural resource resilience).

### 1. Vulnerability (NRVul)

The natural resource vulnerability category includes two indicators that look at a country's resource availability, specifically, fresh water, a scarce resource in the region, and reliance on agriculture, a sector particularly vulnerable to climate impacts.

The formula used to calculate natural resources vulnerability is as follows:

$$(8) \text{NRVul} = (\text{RelianceAgr} + \text{WatAvail})/2$$

#### (a) Indicator: Reliance on agriculture (RelianceAgr)

The **reliance on agriculture** indicator is based on a World Bank variable that measures the value added of agriculture, forestry and fishing as a share of GDP.<sup>31</sup> Given agriculture is among the sectors more exposed to climate change, reliance on agriculture can indicate higher vulnerability to adverse climate impacts. Indeed, climate change has already been found to reduce growth in agricultural productivity.<sup>32</sup> At the same time,

agriculture provides significant livelihoods in many Arab countries.<sup>33</sup> Agriculture, forestry and fishing correspond to UN DESA ISIC divisions 1 to 3 (an international classification where economic activities are arranged so entities can be classified according to the activity they carry out), which include forestry, hunting and fishing, as well as cultivation of crops and livestock production. The value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without deductions for depreciation of fabricated assets or depletion and degradation of natural resources.

This variable measures the importance of agriculture in the national economy. This might provide indications as to a country's exposure to agriculture and land-related vulnerabilities.<sup>34</sup> The observed distribution is multimodal. It has multiple centres on values representing the level of reliance on agriculture for different groups of countries. Nevertheless, a min-max approach is implemented to standardize the value, with the minimum set to the minimum value of the distribution, 0, and the maximum to 40 per cent, used here as upper threshold.<sup>35</sup> Higher values in the normalized indicators correspond to higher values in the non-normalized indicator and to higher vulnerability of the country to different climate shocks. The lower the value of the normalized indicator, the lower the vulnerability.

31 Ibid.

32 Duenwald and others, 2022; IPCC, 2022.

33 ESCWA and others, 2017.

34 More information is available in the Arab Risk Monitor: A Conceptual Framework, forthcoming.

35 Threshold based on data that shows that less than 5 per cent of the data are higher than 40 per cent, which justifies selection of this threshold.

Table 5. Natural resource vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage
Reliance on agriculture	Agriculture, forestry and fishing, value added (percentage of GDP)	WDI	2021	217
Water availability	Renewable internal freshwater resources per capita (m <sup>3</sup> )	FAO AQUASTAT	2018	200

Source: Authors.

#### (b) Indicator: Water availability (WatAvail)

Water scarcity is a significant challenge in the Arab region, which is considered one of the most water-scarce regions in the world.<sup>36</sup> Climate change could put further strain on this resource and contribute to increased competition and, potentially, enhanced risk. The **water availability variable** measures renewable internal freshwater resources per capita in cubic metres. The data are extracted from AQUASTAT, the Food and Agriculture Organization of the United Nations (FAO) global water information system, and provided in five-year intervals.<sup>37</sup> In this case, the lack of timely data releases (as per selection of indicators presented in section 1A) is not considered a sufficient reason to not use the indicator, given its relevance within the region. Further, it is assumed that water availability does not necessarily change significantly year on year. Renewable internal freshwater resource flows refer to internal renewable resources (internal river flows and groundwater from rainfall). It should be noted that as the variable refers to per capita availability, this does not consider the relative water

availability for economic sectors such as agriculture. However, by looking at water stress in section 3.1.2, this aspect will be covered, as agriculture, in particular, is responsible for the largest withdrawals in most countries.

The selected variable is transformed using natural logarithms. The graph for water availability in annex 3B1. shows a normal distribution, which allows the normalization methodology within set thresholds. Less than 500 m<sup>3</sup> per capita is considered indicative of absolute water scarcity.<sup>38</sup> All countries below this level face significant vulnerabilities in availability. To capture this, absolute water scarcity will be used as the lower bound for this indicator. The upper bound is set by the threshold for water stress – 1700 m<sup>3</sup> per capita – as countries with availability beyond this are not deemed to face water availability challenges. The values are then transformed to a 0–1 scale. Considering that lower water availability means a higher risk of competition over fresh water, and potentially the risk of conflict, the data are scaled so that 0 indicates the highest water availability and low vulnerability, and 1 the lowest water availability

36 ESCWA, 2019.

37 FAO, n.d.

38 WWAP, 2012.

and high vulnerability. The caveat to this approach is that differences between countries below or above the thresholds will not be visible in the rescaled data, and neither will improvements or deteriorations if they remain outside the set minimum and maximum of the scale. Within the water-scarce Arab region, this can mask differences in severity and changes year on year. However, the advantage is that it ensures any country facing absolute water scarcity receives the highest vulnerability score, which otherwise may not be the case.

## 2. Resilience (NRRResilience)

The natural resource resilience category includes two indicators that look at a country's level of stress on water and land resources, specifically freshwater withdrawals as a share of available resources and land use change.

The formula used to calculate natural resources resilience is as follows:

$$(9) \text{NRRes} = (\text{WaterStress} + \text{LandStress})/2$$

### (a) Indicator: Water stress (WaterStress)

The **water stress** indicator measures freshwater withdrawal as a proportion of available freshwater resources, thereby providing an indication of the pressure on water resources by human activities. The variable used is "freshwater withdrawal as percentage of total renewable water resources", the SDG indicator 6.4.2 extracted from AQUASTAT. It is provided in five-year intervals by FAO but annual data are available in the United Nation's SDG Global Database.<sup>39</sup> This provides the ratio between total fresh water withdrawn by all major economic sectors and total renewable freshwater resources, after accounting for environmental requirements. Water stress can contribute to competition and increasing tensions among different stakeholders. If not managed properly, this has the capacity to increase risk.

Table 6. Natural resource resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Water stress	Freshwater withdrawal as percentage of available freshwater resources, SDG indicator 6.4.2	FAO's AQUASTAT	2019	246
Land stress	Change in share of agricultural land within total land area	FAOSTAT	2021	218

Source: Authors.

39 FAO, n.d.



The distribution of the variable transformed into natural logarithm can be considered as normal, allowing a min-max transformation to be implemented with the use of the natural thresholds presented as follows. Since low levels of water stress are thought to be associated with higher resilience and lower risk, such values could be assigned a rescaled value of 1, and maximum levels of water stress a value of 0. There are, however, established thresholds for what constitutes water stress. Any use below 25 per cent is considered to not lead to stress, with higher withdrawal rates classified as low (25–50 per cent), medium (50–75 per cent), high (75–100 per cent) and critical when above 100 per cent.<sup>40</sup> Using these thresholds to rescale the indicator has the advantage of reflecting the amount of stress experienced. Considering most Arab countries have a withdrawal rate above 100 per cent and are arid or semi-arid, most would then be assigned the min value (0) and there would be no differentiation between degrees of critical water stress. Like the approach taken for the water availability indicator (see section 3.0.1.2), the caveat is that it hides values beyond the set scale, and hence, does not differentiate between two countries at different levels of water stress but both above the set threshold. Given the level of this indicator in the Arab region, this could hide important differences in water stress. Nevertheless, the advantage remains that such a scale corresponds to generally agreed thresholds regarding water stress. The standardized indicator's values range from 0 to 1, with 0 representing more water-stressed countries and 1 more resilient and less water-stressed countries.

## (b) Indicator: Land stress (LandStress)

The **land stress** indicator examines the change in the share of agricultural land within the total land area of a country. Agricultural land is defined as the land area that is arable, under permanent crops or under permanent pasture. The data for agricultural land availability is extracted from the FAO database FAOSTAT.<sup>41</sup> This variable considers the change in the share of agricultural land over a country's total land area compared with the average of the last 10 years. Changes in the use of land area are considered here as a proxy for the stress of human activities, specifically, agricultural activities on available land resources. It may, therefore, provide indications as to the demand for the resource, and potential competition.

The distribution of this variable (presented in annex 3B2) is normal, centred on values close to 0, allowing for the min-max normalization method to be applied. To ensure that 0 indicates lowest resilience and 1 highest resilience, the highest values of stress on land resources will be rescaled to 0, and the lowest assigned the value of 1.

## B. Theme: Climate hazards (CH)

### 1. Vulnerability (CHVul)

The climate hazards vulnerability category includes two indicators that examine the effects of such hazards by looking at the human impact of natural disasters and the economic cost relative to GDP.

40 FAO and UN Water, 2021.

41 FAO, 2023.

Table 7. Climate hazards vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage
Human impact of natural disasters	Share of population affected by natural disasters (per cent)	EM-DAT, UN DESA	2021	225
	Disaster-induced internal displacement (new displacement)	IDMC	2021	203
Economic impact of natural disasters	Total estimated disaster damages (percentage of GDP)	EM-DAT, WDI	2021	225

Source: Authors.

The formula used to calculate climate hazards vulnerability is as follows:

$$(10) CHVuln = \left( \left( (ShAffPop + C \lim IDPs) / 2 \right) + TotDamCl \right) / 2$$

(a) Indicator: Human impact of natural disasters (CHHumImp)

Two different variables make up the indicator on the human impact of natural disasters. The **people affected by natural disasters** variable measures the share of population affected by natural disasters. This can include a variety of natural disasters and ways of being impacted, such as people affected by food insecurity due to drought, which can contribute to increased risk.<sup>42</sup> The data has been filtered to include only natural disasters that may be considered climate hazards or whose increased intensity, duration or frequency may be caused by climate change, such as droughts, extreme temperatures, floods, insect infestations, landslides, storms and wildfires. The data on the

number of people affected by natural disasters is retrieved from EM-DAT, the Centre for Research on the Epidemiology of Disasters (CRED) emergency events database,<sup>43</sup> and the population data from UN DESA.<sup>44</sup>

The distribution of the transformed variable is normal and, therefore, the min-max normalization method has been applied.<sup>45</sup> Value 0 in the original variable is assigned with value 0 – minimum values – in the standardized variable. The share of people affected by natural disasters is expected to have a positive relationship with vulnerability. Therefore, value 0 of the normalized variable indicates the lowest share of people affected and value 1 the highest share of people affected and consequently higher risk.

42 More information is available in the Arab Risk Monitor: A Conceptual Framework.

43 CRED, n.d.

44 UN DESA, Population Division, 2022.

45 The variable has been multiplied by 1 000 to be able to transform it into logarithms.

The human impact of natural disasters can also be seen by looking at the number of people displaced.<sup>46</sup> The **disaster displacement** variable measures the number of disaster-induced new internal displacements. This refers to the number of new cases or incidents of displacement because of natural disasters. It differs from the “stock” displacement included in section 2.2, and may include individuals who have been displaced more than once. The data are retrieved from IDMC, with the “new disaster internal displacements” associated with sudden onset natural hazard-related disasters variable used to present data relative to the flow of IDPs during the reporting year.<sup>47</sup>

The distribution reported in annex 3B3 is normal and, therefore, the min-max normalization method has been applied.<sup>48</sup> Due to the assumption that higher internal displacement contributes to higher vulnerability and higher risk, value 0 of the normalized indicator is assigned when zero displacement has been recorded and value 1 to the highest incidence of displacement.

#### (b) Indicator: Cost of natural disasters (TotDamCI)

The **cost of natural disasters** indicator measures the total estimated damages caused by natural disasters as a share of current GDP. It is considered a proxy of the impact of climate hazards and natural disasters on

national economic systems (including private economic entities) and State finances, and the related ability to provide public services. The data on estimated total damages is retrieved from EM-DAT,<sup>49</sup> and GDP data from the World Bank World Development Indicators (WDI).<sup>50</sup> The natural disaster data from EM-DAT has been filtered to include only natural disasters that may be considered climate hazards or whose increased intensity, duration or frequency may be caused by climate change (droughts, extreme temperatures, floods, insect infestations, landslides, storms and wildfires).

It is also worth noting that countries for which data are missing or not available are assigned value 0.<sup>51</sup> The distribution of the transformed variable is normal and, therefore, the min-max normalization method is applied, resulting in a scale of 0–1 for the different values. Considering that higher cost relates to higher vulnerability, value 0 of the normalized indicator corresponds to no cost incurred and value 1 is assigned to the highest cost as a share of GDP.

## 2. Resilience (CHResilience)

The climate hazards resilience category includes two indicators that provide indications of a country’s adaptation strategies, specifically, the level of adoption and implementation of disaster risk reduction strategies and the adaptation finance received.

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46 Ginnetti and Ponserre, 2019.

47 IDMC, 2021.

48 The disaster displacement variable is multiplied by 1 000 to be able to transform it into natural logarithms.

49 CRED, n.d.

50 World Bank, n.d.

51 The variable is multiplied by 1 000 to be able to transform it into natural logarithms.

Table 8. Climate hazards resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Adaptation strategies	Score of adoption and implementation of national DRR strategies in line with the Sendai Framework, SDG indicator 1.5.3	UN DESA, Statistics Division	2020	129
Adaptation finance	Climate adaptation-related development finance, as a share of GDP	OECD, World Bank	2020	149

Source: Authors.

The formula used to calculate climate hazards resilience is as follows:

$$(11) CHRes = (AdapStrat + AdaptFin)/2$$

#### (a) Indicator: Adaptation strategies (AdapStrat)

Adequate response and implementation of adaptation capacities to prevent and mitigate the effects of extreme climate and weather events is part of the overall strategy of national, regional and local governments and authorities.

The **adaptation strategies** indicator measures the score of adoption and implementation of national Disaster Risk Reduction (DRR) strategies in line with the Sendai Framework. This variable is included in the list of SDG indicators, specifically 1.5.3 and 13.1.2. The score is the sum of self-assessment scores for 10 key elements, equally weighted, which are scored on a range from 0 to 1 (where 1 = best).<sup>52</sup> The data are retrieved from United Nations SDG Tracker.<sup>53</sup> While data for this

variable are scarce in terms of geographical and time coverage, it nevertheless represents the best available indicator/proxy to capture the degree of policy progress in addressing climate hazards and disasters.

While the distribution presented in the annex 3B4 is trimodal, the data are already provided on a 0–1 scale, and, as such, does not need to be normalized for the purposes of the risk monitor. Countries where data are missing are assumed to have no relevant strategies adopted or implemented and are assigned value 0. The lower the value, the lower the associated resilience and the higher the risk, while the higher the value, the higher the resilience and the lower risk.

#### (b) Adaptation finance (AdaptFin)

Investing in adaptation can help reduce the impact of climate and weather events, and the potential associated risks. As such, the availability of finance can be considered a good proxy for resilience to climate hazards. The

52 UNDRR, 2017.

53 SDG Tracker, 2022.

**adaptation finance** indicator measures climate adaptation-related development finance, relative to a country's GDP. The data on adaptation finance flows is retrieved from the OECD and includes multilateral and bilateral official development finance targeting climate adaptation.<sup>54</sup> To capture the significance of these flows to the receiving country, OECD data are divided by the GDP in current US\$, retrieved from the World Bank. One caveat, however, is that the OECD data capture only official development assistance (ODA) flows, not all adaptation finance and investment. Higher income countries may not, therefore, be included in the data as recipients, which does not necessarily indicate there is no adaptation finance available to them, but rather, that this may come from other channels.

This variable is multiplied to allow the transformation into natural logarithms. The distribution of the transformed indicator has a distribution that is normal even if skewed on the right, thereby allowing the min-max approach to set the normalized scale to be used. The lower the value of the transformed variable, the lower the capacity of the country to adapt to climate change and the lower its resilience. The lower the value of the normalized variable, the higher the value of the non-standardized variable. The higher the value of the adaptation finance variable, the higher the resilience to climate hazards. To address the challenge regarding non-ODA recipients, they will be assigned the max value to indicate their potential for accessing or mobilizing the finance needed for implementing climate adaptation.

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54 OECD, n.d.



## 4. Development pathway (Dev)

The development pathway includes three overarching themes (economy, society, and institutions) leading to six risk categories. Three of these indicate structural risk (economic vulnerability, social vulnerability and institutional vulnerability) and three indicate

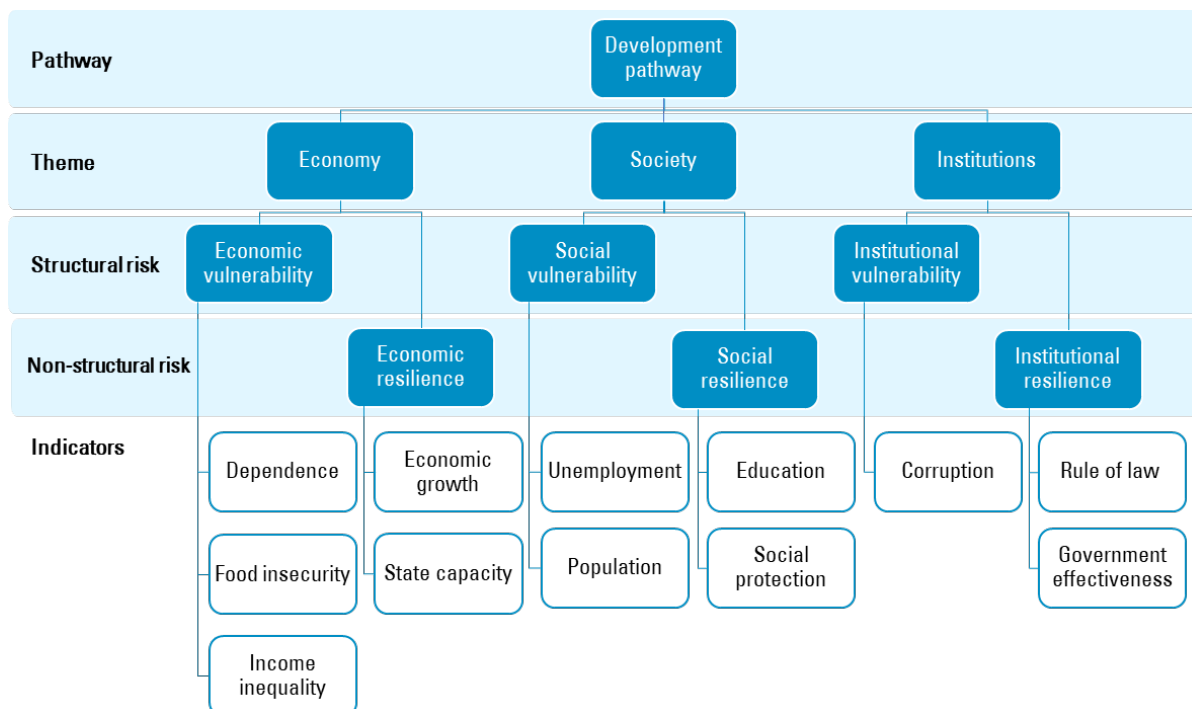
non-structural risk (economic resilience, social resilience and institutional resilience).

The formulas to calculate vulnerability and resilience, respectively, of the development pathway are as follows:

$$(12) \text{DevelopmentVul} = (\text{EconVuln} + \text{SocVuln} + \text{InstVul})/3$$

$$(13) \text{DevelopmentRes} = (\text{EconRes} + \text{SocRes} + \text{InstRes})/3$$

Figure 7. Development pathway, structure



Source: Authors.

## A. Theme: Economy

The economy theme includes one structural risk (economic vulnerability) and one non-structural risk (economic resilience).

### 1. Vulnerability (EconVul)

The economic vulnerability category includes four indicators that look at a country's trade and financial dependence, and food security and inequality.

The formula used to calculate economic vulnerability is as follows:

$$(14) \text{EconVul} = \left( \frac{\text{DepAllCom} + (\text{CerealImp} + \text{FoodImp} + \text{FoodSec} + \text{Undernour})}{4 + \text{NetODA} + \text{Inequal}} \right) / 4$$

Table 9. Economic vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage
Trade dependence	Dependence on commodity exports	UNCTAD	2019	194
Financial dependence	Personal remittances received (percentage of GDP)	WDI	2020	194
	Net ODA received (percentage of GNI)	WDI	2020	194
Food security	Cereal import dependency ratio	FAOSTAT	2021	151
	Value of food imports in total merchandise exports (per cent), three-year average	FAOSTAT	2020	186
	Prevalence of undernourishment (per cent), three-year average, SDG indicator 2.1.1	FAOSTAT	2021	134
	Prevalence of moderate or severe food insecurity in total population (per cent), three-year average	FAOSTAT	2021	149
Inequality	Inequality adjusted income index	ESCWA	2021	170

Source: Authors.



### (a) Indicator: Trade dependence (Trade)

Overreliance on energy resources that are traded on international markets can increase vulnerability to supply shocks caused by external and environmental factors.<sup>55</sup> In many commodity-dependent countries, civil wars are related to disputes over non-renewable natural resources.<sup>56</sup>

The **trade dependence** variable captures a country's dependence on commodities (agriculture, energy and mining) exports as a share of total merchandise exports. The data are retrieved from United Nations Conference on Trade and Development (UNCTAD).<sup>57</sup>

The distribution of the variable presented in annex 3C1 shows two different distributions that characterize two different kinds of economic systems: integrated but less dependent economies, less subject to shocks, at least for the supply of items considered in the indicator's basket, and highly dependent economies that are affected by shocks in the regional and local markets. Even though it is difficult to consider a unimodal distribution for the use of the normalization model, here we assume that the higher the value of the non-normalized variable, the higher the risk of facing negative consequences of endogenous or exogenous shocks. Moreover, this is strongly related to the country and economic system's vulnerability to shocks in international markets. Therefore, the variable is standardized using the min-max methodologies. Zero means less

dependency, and less risk and vulnerability, while higher values of the standardized variable are relative to a higher level of risk and vulnerability.

The variable of dependency from mining has a distribution closer to the normal distribution, even if with higher frequency towards the lower values, given mining resources are concentrated in a small group of countries. The higher the value of this indicator, the higher the risk and vulnerability of the economic system. The normalization implemented – min-max – generates the indicator in the same directionality as the original variable. The value 0 of the standardized indicator means lower risk and vulnerability, and the value 1 of the same indicator means higher risk and vulnerability.

### (b) Indicator: Financial dependence (FinDep)

The two **financial dependence** indicators measure a country's reliance on external capital. Dependence on international capital, such as remittances, can leave the receiving country vulnerable to foreign shocks, including economic crises in countries of origin, and global shocks such as commodity price fluctuations, climate change and pandemics.<sup>58</sup>

The first variable measures personal remittances received by a country as a share of GDP. Personal remittances comprise personal transfers and employee compensation. Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or

55 Dube and Vargas, 2013; Collier and Hoeffler, 1998.

56 Collier, 1999; Humphreys and others, 2007.

57 UNCTAD, 2021.

58 Bettin and others, 2014.

from non-resident households. The data are retrieved from the World Bank WDI.<sup>59</sup>

The distribution of the transformed variable is normal but concentrated around lower values. This allows us to implement a standardization to better analyse the variable. The indicator is standardized by using a min-max distribution. Values exceeding 30 per cent in the original values are assigned the higher values in the transformed variable. This indicator is a proxy for the vulnerability of the economic system to economic shocks; therefore, the assumption is that the higher the value of this variable, the more vulnerable it is to external and internal shocks. Negative shocks in foreign aid have been associated with outbreaks of violence, as potential rebels gain bargaining strength vis-à-vis the government when the latter is unable to provide resource transfers.<sup>60</sup>

The second indicator measures the net official development assistance (ODA) received as a share of gross national income (GNI). Net ODA consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of OECD Development Assistance Committee (DAC) members, multilateral institutions and non-DAC countries to promote economic development and welfare in countries and territories on the DAC list of ODA recipients. The data are retrieved from the World Bank WDI.<sup>61</sup>

The distribution of this variable is largely concentrated into the lower bound of the range;

not surprising given the diversity of countries and the somewhat long time period considered in this analysis. The fact countries receiving ODA are considered is already narrowing the analysis to receiving countries that count due to their capacity to provide basic services and implement other activities. The higher the share of ODA over GNI, the higher the vulnerability, and the lower the value of the same indicator, the lower the level of vulnerability faced by the country in the year considered. Despite the concentration of the distribution towards the lower values, and the unbalanced normal distribution towards the right side of the distribution, this distribution allows us to implement a min-max distribution. Thus, values closer to 0 are at lower level of risk, and countries with higher values are at a higher level of risk and vulnerability, as they are more dependent on external sources to sustain their finances.

### (c) Indicator: Food security (FoodSecurity)

Four **food security** indicators are included, with the data retrieved from FAOSTAT.<sup>62</sup> Food is one of the most basic resources for survival and securing it can lead to great hostility.<sup>63</sup> Overreliance on food resources traded on international markets can increase vulnerability to price shocks caused by environmental factors.<sup>64</sup> Demonstrations, riots and civil conflict are more likely to occur when international and domestic food prices rise.<sup>65</sup> The first indicator measures a country's dependence on cereal imports, expressing how much of the available

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59 World Bank, n.d.

60 Nielsen and others, 2011.

61 World Bank, n.d.

62 FAO, 2023.

63 Koren and Bagozzi, 2016.

64 Dube and Vargas, 2013.

65 Koren and Bagozzi, 2017.

domestic cereal supply has been imported and how much comes from the country's own production. Negative values indicate that the country is a net exporter of cereals. The second indicator measures a country's food imports (excluding fish) as a share of total merchandise exports and is provided as a three-year average.

The distribution of the transformed variable – through logarithmic transformation – is concentrated towards the higher value side of the distribution. It allows us to standardize the variable using the min-max approach and assumes 0 for countries with lower values of the variables that correspond to lower levels of risk. Higher reliance on food imports – value 1 or closer to 1 in the standardized indicator – is a proxy for higher risk and vulnerability for the year considered.

Food insecurity can lead to outbreaks of social unrest and, therefore, increases the likelihood of conflict.<sup>66</sup> Conflict can also bring about food insecurity, whereby competition arises over aspects of food production, such as land and water, as well as the contamination of arable land used for agriculture.<sup>67</sup> The third food security variable examines the prevalence of undernourishment in a country and is provided as a three-year average. This indicator is included in the list of SDG indicators, specifically 2.1.1. It measures the percentage of a country's population whose habitual food consumption is insufficient to provide dietary energy levels required to maintain a normal active and healthy life. The fourth variable assesses the prevalence of moderate or severe food insecurity in the total population of a country and is described as a three-year

average. Specifically, this represents the percentage of the population who live in households classified as moderately or severely food insecure.

The distributions presented below are relative to the transformed variables of undernourishment, food security and food import that can all be classified as proxy for the level of food security in a given country each year and directly related to the risk of conflict. The distributions relative to undernourishment and food security have a bimodal trend that can be explained by the fact we consider countries at different income group level and that can be absorbed with the implementation of imputation models. The standardized values of the variables assume value 0 when at the lowest level of the standardized variable, and 1 at the highest value, with the higher level of risk and vulnerability. Lower levels of risk and vulnerability correspond to the lower level of these standardized indicators.

#### (d) Indicator: Inequality (Inequal)

Income inequality exacerbates overall poverty in the general population and impedes long-term economic growth, particularly in fragile settings.<sup>68</sup> It can also cause or exacerbate underlying tensions and group differences to the detriment of social cohesion, leading to State fragility, the erosion of trust and increased risk of conflict.<sup>69</sup>

The **inequality** indicator measures income inequality. This variable is obtained by multiplying the Human Development Index (HDI) income index by the income inequality

66 Koren and Bagozzi, 2016.

67 Bora and others, 2010.

68 Stewart, 2008; Jones, 2013.

69 Muller, 1985; Cederman and others, 2011.

adjustment factor. Produced by the United Nations Development Programme (UNDP), the index is based on GNI per capita (constant 2017 US dollars adjusted for purchasing power parity). The data are retrieved from ESCWA.<sup>70</sup>

This value of the income inequality represents the distribution of income among individuals in a country. It is important to consider measuring the level of social cohesion associated with the different distribution of income situations. Income distribution can be also associated with the income level as an inverted U-shaped curve, while at the same time having structural characteristics inherent in the country's social and economic systems. For this reason, it is considered a structural condition and a proxy for the vulnerability of the economic system to the risk of conflict, and also an indicator of national socioeconomic cohesion. We now report the distribution of the

indicator before and after the transformation in logarithmic values. The distribution of the transformed indicator shows a normal trend but skewed towards higher values; therefore, the min-max methodology will be utilized. The higher level of the indicator is associated with higher risk and vulnerability, and lower values with lower risk and vulnerability, representing a higher level of economic and social cohesion. The transformed and standardized variable is 0 for the lower level of income inequality and 1 for the higher one.

## 2. Resilience (EconRes)

The economic resilience category includes three indicators that look at a country's economic development and growth, and State capacity.

The formula used to calculate economic resilience is as follows:

$$(15) \text{EconRes} = (\text{EconDev} + \text{EconGrow} + \text{TaxRev})/4$$

Table 10. Economic resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Economic development	GDP per capita (current US\$)	WDI	2021	212
Economic growth	GDP growth (annual per cent)	WDI	2021	212
State capacity	Tax revenue (percentage of GDP)	WDI	2020	158

Source: Authors.

70 ESCWA, 2022.

#### (a) Indicator: Economic development (EconDev)

Economic development is an important factor in explaining shifting trends in conflict, both between and within countries.<sup>71</sup> Per capita income, in particular, can help determine a country's development status. Per capita income is negatively correlated with conflict and highly correlated with institutional quality.<sup>72</sup> Thus, increasing development and wealth can increase the opportunity cost of conflict, and strengthen institutions, which may, in turn, be better equipped to mitigate the drivers of conflict.<sup>73</sup>

The **economic development** indicator measures a country's GDP per capita in current US\$. GDP per capita is GDP divided by mid-year population. GDP is the sum of gross value added by all resident producers in the economy, plus any product taxes and minus any subsidies not included in the value of the products. The data are retrieved from the World Bank WDI.<sup>74</sup>

The variable is transformed using natural logarithms and the distribution of the transformed values is close to the normal distribution; therefore, a min-max normalization is implemented to obtain values between 0 and 1. This variable will assume values 0 for lowest and 1 for the highest GDP per capita value. The higher the value of the indicator, the higher the risk and the resilience capacity of the country in the year considered.

Additionally, lagged variables for one, five and 10 years are also considered for the current

year. The observed distributions as reported in annex 3C2 are normal, and are normalized using the min-max approach. The indicators for the lag variables assume a value of 0 for the lowest level of the indicator and 1 for the highest level.

#### (b) Indicator: Economic growth (EconGrowth)

Economic growth increases the relative value of capital and decreases the value of land, reducing incentives for land acquisition through conquest.<sup>75</sup> But economic growth can provide a State with the capacity to project power and engage in conflict, which it previously lacked.<sup>76</sup> The **economic growth** indicator measures a country's annual percentage growth rate of GDP at market prices based on constant local currency. The data are retrieved from the World Bank WDI.<sup>77</sup>

Compared with the variable of economic development, this indicator looks at annual dimension as a potential indication of vulnerability of the economic system that is a proxy for the well-being of a country's population in the considered year. The indicator is used as provided and is standardized using the min-max methodologies, and considered negatively correlated to the risk of conflict. Based on the data, downward and upward thresholds are used (-/+20 per cent), as outliers in this distribution represent less than 5 per cent of the total observation. Outlier values are assigned minimum and maximum values depending on whether they are lower or higher than the indicated thresholds. The higher the

71 Gilpin, 1981; Gleditsch and others, 2005.

72 Collier and Hoeffler, 1998 and 2004; Fearon and Laitin, 2003; Hegre and Sambanis, 2006; IMF, 2003.

73 Ibid.

74 World Bank, n.d.

75 Gartzke, 2007; Rosecrance, 1986.

76 Boehmer, 2010.

77 World Bank, n.d.

value of the standardized indicator, the lower the risk and the vulnerability of the country and its economic system.

### (c) Indicator: State capacity (TaxRev)

Higher tax revenue can provide governments with the income to finance expenditures that reduce fragility.<sup>78</sup> It can provide indications as to the social contract between the national authority and its people, and the ability of the authority to provide services and infrastructure. The **State capacity** indicator/proxy measures tax revenue as a share of GDP. Tax revenue refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers, such as fines, penalties and most social security contributions, are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue. The distribution for this variable – 0–40 per cent – can be considered as a normal distribution, with values above the upper range assigned the max value, and therefore, a min-max standardization can be

implemented. The data are retrieved from the World Bank WDI.<sup>79</sup>

The distribution is close to normal, with only a limited number of outliers (not included here as they are higher than 100). These outliers have been assigned the max value 1 before proceeding with the normalization between 0 and 1. For this indicator, the min-max normalization is used after having assigned the value 1 to the outlier values in the upper side of the distribution. The higher the value of the standardized indicator, the higher the resilience to conflict, and vice versa.

## B. Theme: Society (Soc)

The society theme includes one structural risk (social vulnerability), and one non-structural risk (social resilience).

### 1. Vulnerability (SocialVul)

The social vulnerability category includes three indicators that look at unemployment, youth bulge and infant mortality (table 11).

Table 11. Social vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage
Unemployment	Unemployment, total (percentage of total labour force), modelled ILO estimate	ILOSTAT	2021	217
Youth bulge	Share of youth in total adult population	UN DESA	2021	217
Infant mortality	Mortality rate, under 5 years (per 1 000 live births)	WDI	2020	193

Source: Authors.

78 IMF, 2022.

79 World Bank, n.d.

The formula used to calculate social vulnerability is as follows:

$$(16) \text{ SocialVul} = (\text{Unempl} + \text{Youth} + \text{ChildMort})/3$$

#### (a) Indicator: Unemployment (Unempl)

High levels of unemployment have been linked to a higher probability of conflict, as opportunity costs decrease and the likelihood of joining rebel groups and engaging in illicit activities increases.<sup>80</sup> Unemployment plays an important role in activating mechanisms interlinked with factors that can have an impact on the risk of conflict, given certain economic, social and political circumstances.

The variable used to proxy the level of unemployment in the country is “unemployment, total (per cent of labour force) (modelled ILO estimate)”, extracted from the ILO website.<sup>81</sup> This variable represents a proxy for the level of vulnerability to domestic or international shocks and reflects the socioeconomic situation in the country.

The employment variable ranges from 0 to 40 per cent of the country’s total labour force. The distribution of the unemployment variable is close to a normal distribution, and therefore, the min-max standardization can be implemented. Values above 30 per cent are assigned the maximum value of the standardized indicator. The higher the value of the standardized variable the higher the risk. The lowest value of

the indicator – 0 – is associated with lowest risk and vulnerability.

#### (b) Indicator: Youth bulge (Youth)

Youth bulges, or large young male population segments, are also linked to a higher likelihood of conflict.<sup>82</sup> If individuals are unemployed and/or face economic difficulties, the opportunity costs of rebellion decrease. They, thus, have less to lose in joining rebel groups.<sup>83</sup>

The **youth bulge** indicator measures the share of youth in the total adult population. It is calculated by dividing the population aged 15–24 years by the total population aged 25+. Population data are retrieved from UN DESA World Population Prospects (WPP).<sup>84</sup>

The distribution of the youth bulge is clearly bimodal, representing countries that have experienced a demographic transition and countries that have not. The lower share of the age bracket is associated with a lower level of risk. The min-max standardization is utilized, and imputation (see section 2.2) will solve the issue related to the variable’s distribution. The lower the value of the standardized variable, the lower the risk and vulnerability related to this social and demographic dimension, and vice versa.

#### (c) Indicator: Infant mortality (ChildMort)

Infant mortality rates are often utilized to compare socioeconomic development. They

80 Collier, Hoeffler and Rohner, 2006; Goldstone, 2002; Moeller, 1968; Cincotta, Engelman and Anastasion, 2003; Choucri, 1974; Braungart, 1984.

81 ILO, n.d.

82 Urdal, 2002.

83 Braungart, 1984.

84 UN DESA, Population Division, 2022.

are, therefore, frequently used to identify vulnerable populations, as data on the prevalence and incidence of disease are limited.<sup>85</sup> Infant mortality is often used as an indicator of the overall health of a society, given it is correlated with factors that can influence population status, such as living conditions, quality and access to health care, economic development and public health expenditure.<sup>86</sup>

The **infant mortality** indicator captures the mortality rate in a country for those under 5 years of age. It is expressed as the probability per 1,000 that a newborn baby will die before reaching age 5. The data are retrieved from the World Bank WDI.<sup>87</sup> The values have been transformed using the natural logarithm.

The distribution of this variable as reported in annex 3C3 of this variable is normal; therefore, min-max distribution is used. In the standardization, lower values of the original variable will be assigned to higher values of the standardized indicator, and vice versa. Lower levels of this standardized indicator – using min-max standardization – are associated with a higher level of institutional and public infrastructural development and, other things being equal, to lower vulnerability and risk. Conversely, the higher the indicator, the higher the level of risk.

## 2. Resilience (SocRes)

The social resilience category includes two indicators that look at education and social protection in a country.

Table 12. Social resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Education	Quality adjusted HDI education index	ESCWA	2020	189
Social protection	Share of population covered by social protection schemes/systems, SDG indicator 1.3.1	ILOSTAT	2020	176

Source: Authors.

85 Mazen and others, 2011; Wagstaff, 2000.

86 Rahman, Alam and Khanam, 2022.

87 World Bank, n.d.



The formula used to calculate social resilience is as follows:

$$(17) SocRes = (Educ + Soc Prot)/2$$

#### (a) Indicator: Education (Educ)

Level of education is associated with a society's capacity to cope with challenges. Good literacy rates can reduce fragility by offering larger pools of individuals the possibility of participating in the labour force and improving their living standards.<sup>88</sup> A rise in education levels has also been shown to improve economic growth.<sup>89</sup> Investments in education can reduce the likelihood of conflict by providing support to the poor strata.<sup>90</sup>

The **education** variable used here measures the level and quality of education in a country. The data are retrieved from ESCWA, which calculates it based on expected and mean years of schooling and harmonized test scores.<sup>91</sup>

The level of education is associated with a society's capacity to cope with short-, medium- and long-term challenges. The distribution of the non-standardized variable is normal except for the frequency at the lower values. The standardized variable is inversely related to the original variable; therefore, the standardized variable assumes value 0 or close to 0 for the highest values, and 0 or close to 0 for the lowest values of the non-standardized variable. The higher the value of this indicator, the higher the

resilience of the society to cope with risk. The lower the value of this indicator, the lower the resilience and higher the risk.

#### (b) Indicator: Social protection (SP)

Providing social services can help offset the effects of inequality and poverty in society, thereby reducing grievances.<sup>92</sup> Spending on welfare can contribute to sustaining peace.<sup>93</sup>

The **social protection** indicator measures the share of population covered by social protection schemes/system. The variable is included in the list of SDG indicators, specifically 1.3.1. It reflects the share of the population effectively covered by a social protection system, including social protection schemes. This includes, in particular, child and maternity benefits, and support for people without a job, those with disabilities, victims of work injuries and older people. The data are retrieved from ILOSTAT.<sup>94</sup>

The distribution of the social protection variable/proxy is bimodal. The first part of the distribution contains countries at lower income group level, and the second part, generally, countries at higher income group level. The standardization implemented with the use of min-max methodology associates the highest values of the indicator non-standardized with the higher values of the standardized variable, and vice versa. The higher the value of the indicator, the higher the resilience to risk of the socioeconomic system.

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88 Hanushek, 2016.

89 Gyimah-Brempong and others, 2006.

90 Taydas and Peksen, 2012.

91 ESCWA, 2022.

92 Burgoon, 2006.

93 Taydas and Peksen, 2012.

94 ILO, n.d.

## C. Theme: Institutions (Inst)

The institutions theme includes one structural risk (institutional vulnerability), and one non-structural risk (institutional resilience).

### 1. Vulnerability (InstVuln)

The institutional vulnerability category includes one indicator that looks at corruption in a country.

The formula used to calculate institutional vulnerability is as follows:

$$(18) \text{InstVul} = \text{Corruption}$$

#### Indicator: Corruption (Corruption)

Government inability to provide necessary services and security leads to grievances and creates space for non-State actors to grow and recruit.<sup>95</sup>

The **corruption** indicator measures perceived levels of corrupt practices in a country. It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as State capture by elites and private interests. The data are retrieved from the World Bank WGI, with the aggregate indicator “control of corruption, estimates” utilized.<sup>96</sup>

The distribution of the variable of control of corruption is normal by design and can be standardized by using the min-max standardization methodology. The standardization implies the rescaling of this variable with value 0 for the highest perceived control of corruption and value 1 for the lowest. This means that the higher the value of the indicator, the higher the vulnerability and risk.

### 2. Institutional resilience (InstRes)

The institutional resilience category includes two indicators that look at rule of law and government effectiveness in a country.

Table 13. Institutional vulnerability, indicators

Indicator	Variable	Data source	Latest year	Coverage
Corruption	Control of corruption	WGI	2021	204

Source: Authors.

Table 14. Institutional resilience, indicators

Indicator	Variable	Data source	Latest year	Coverage
Rule of law	Rule of law	WGI	2021	217
Government effectiveness	Governance effectiveness challenge index	ESCWA	2020	204

Source: Authors.

<sup>95</sup> Collier and Hoeffler, 2004; Buhaug, 2006.

<sup>96</sup> World Bank, 2022.

The formula used to calculate institutional vulnerability is as follows:

$$(19) \text{InstRes} = (\text{RuleofLaw} + \text{GovEf})/2$$

(a) Indicator: Rule of law (RuleofLaw)

Strong rule of law is vital to secure stable peace.<sup>97</sup> It prohibits the accumulation of oligarchic and autocratic power, holds all parties accountable for their actions and constrains the power of all parties in government, as well as providing the means for non-violent dispute resolution.<sup>98</sup> The variable presented below can be considered a proxy for the capacity of States to cope with risk factors.

The **rule of law** indicator measures perceptions of confidence in and compliance with the rules of society. It captures, among other things, the quality of the police and courts, and the likelihood of crime and violence. The data are retrieved from the World Bank WGI, and the aggregate indicator “rule of law, estimates” is used.<sup>99</sup>

The original variable ranges from -2.5 (weak rule of law) to +2.5 (strong rule of law). The distribution of the variable of rule of law is normal by design and can be standardized by using the min-max standardization methodology. The standardization implies the rescaling of this

variable with value 0 for the weakest perceived rule of law and value 1 for the strongest. This means that the higher the value of the indicator, the higher the resilience and lower the risk.

(b) Indicator: Government effectiveness (GovEf)

Poorly governed States lack the institutional capacity and security services to prevent violence. Protracted violent events continue to exist when crucial issues of governance remain unsettled.<sup>100</sup>

The **government effectiveness** indicator measures performance by capturing government effectiveness and the quality of infrastructure and public service delivery. The data are retrieved from ESCWA.<sup>101</sup>

As can be observed in the figure in annex 3C6, the distribution of the variable of government effectiveness is almost perfectly normal and can, therefore, be standardized by using the min-max standardization methodology. As for the other variables of governance and institutions, the standardization implies that this variable assumes value 1 for the highest value of government effectiveness and value 0 for the lowest values. This means that the higher the value of the indicator, the lower the vulnerability and risk that the institutional and social system must deal with.

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97 Fearon, 2011; Buhaug, 2006.

98 Kritz, 2007.

99 World Bank, 2022.

100 Collier and Hoeffler, 2004; Sambanis, 2004.

101 ESCWA, 2022.



## 5. Conclusions

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This paper describes the phases of establishing an approach to measure the risk of conflict for the dimensions presented in the Arab Risk Monitor: A Conceptual Framework, from the selection of variables and application of the standardization methodology, to weighting and aggregation at different levels.

The key points are:

- Measuring risk requires a series of indicators that can be scaled and weighted to better

capture the complexity of the analysed phenomenon.

- Risk vulnerability and risk are/should be assessed at indicator and pathway aggregated level.
- Standardization and weighting of indicators allows comparisons across countries and time.

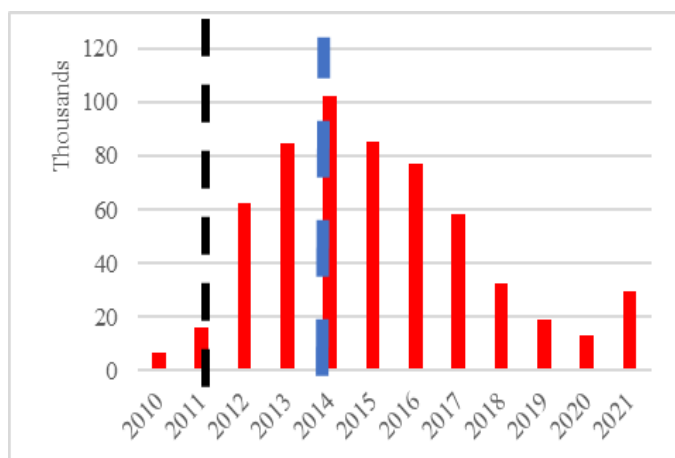
This paper aims to bridge the theory provided in the Arab Risk Monitor: A Conceptual Framework with the analysis of regional trends and the actual situation presented in the Arab Risk Monitor report.



## Annex 1. The methodology applied

An increase in the number of countries in conflict can be seen at the beginning of the 2010s, demonstrating the persistence of conflict in the region. Figure A1.1 shows the number of fatalities as a proxy for the intensity of conflict. An upward trend is observed with the outbreak of conflict in some Arab countries, with the biennium 2014–2015 representing the peak of violence in the region. This period is followed by a downward trend until the end of the decade. A slight rise in the number of fatalities is recorded for 2021. In this regard, 2010 will be considered the first point in time, followed by the peak of violence in 2014 and 2015, which corresponds to the declaration of the 2030 Agenda for Sustainable Development, and then 2021, the reference point for implementation of the Arab Risk Monitor report.

Figure A1.1 Fatalities in the Arab region by type of violence, 2010–2021



**Source:** UCDP, “Georeferenced Event Dataset (GED) Global version 22.1”, UCDP Dataset Download Centre. Available at <https://ucdp.uu.se/downloads/> (accessed on 30 November 2022).

**Notes:** No data available for State of Palestine; black dotted line refers to 2011 as initial phase of conflict, blue dotted line to 2014 as peak of violence and fatalities.

The aim of the analysis is to identify gaps in the 12 identified areas – six for the vulnerability and six for the resilience dimensions – and to monitor trends and developments in the values of these indicators. The broader picture is also given with the assessment of the three pathways: conflict, climate and development. In both cases, we use the same representation for the vulnerability and development dimensions. For the vulnerability, we have for values below 0.4, a ‘very low’ and ‘low’ level of vulnerability and risk, for values between 0.4 and 0.6, a ‘moderate’ level of vulnerability and risk, and for values above 0.6 and 1, a ‘high’ or ‘very high’ level of vulnerability and risk. Conversely, for the resilience dimension, we have for values below 0.4, a ‘very low’ and ‘low’ level of resilience, for values between 0.4 and 0.6, a ‘moderate’ level, and for values above 0.6 and 1, a ‘high’ or ‘very

high' level, and, therefore, a lower level of risk. This opposite directionality is typical of the dichotomy between vulnerability and resilience.

In the following parts of this section, we will provide examples of how the methodology developed here will be applied in the Arab Risk Monitor for some of the selected indicators and over the considered period. At the end of the section, an analysis relative to the vulnerability and resilience at pathway level will be provided.

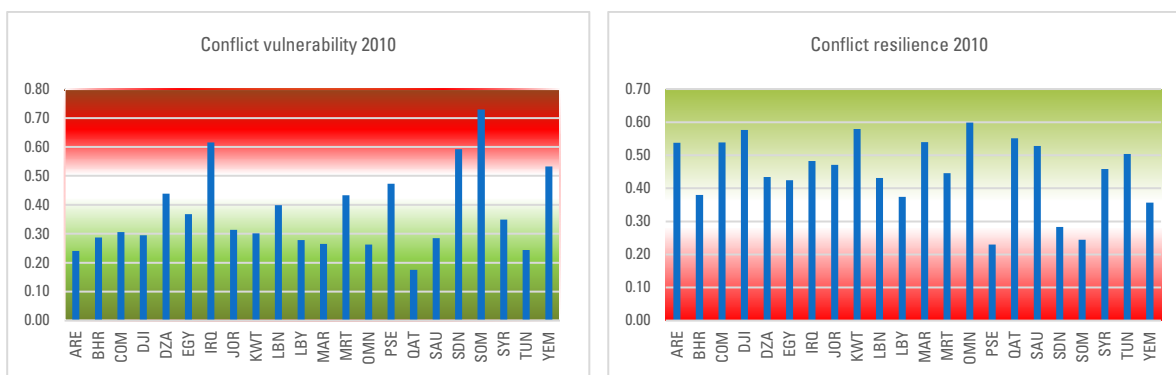
Table A1.1 Levels of vulnerability and resilience for the Arab Risk Monitor

Level of vulnerability	Score	Colours	Level of resilience	Score	Colours
Very high	0.8–1.0		Very high	0.8–1.0	
High	0.6–0.8		High	0.6–0.8	
Moderate	0.4–0.6		Moderate	0.4–0.6	
Low	0.2–0.4		Low	0.2–0.4	
Very low	0.0–0.2		Very low	0.0–0.2	

**Source:** Authors.

Looking at the three pathways, and the indicators provided in sections 3, 4 and 5, two examples are presented in this annex to show the value-added of the approach used in the Arab Risk Monitor report.

Figure A.1.2 Conflict vulnerability and resilience in 2010, 2015 and 2021







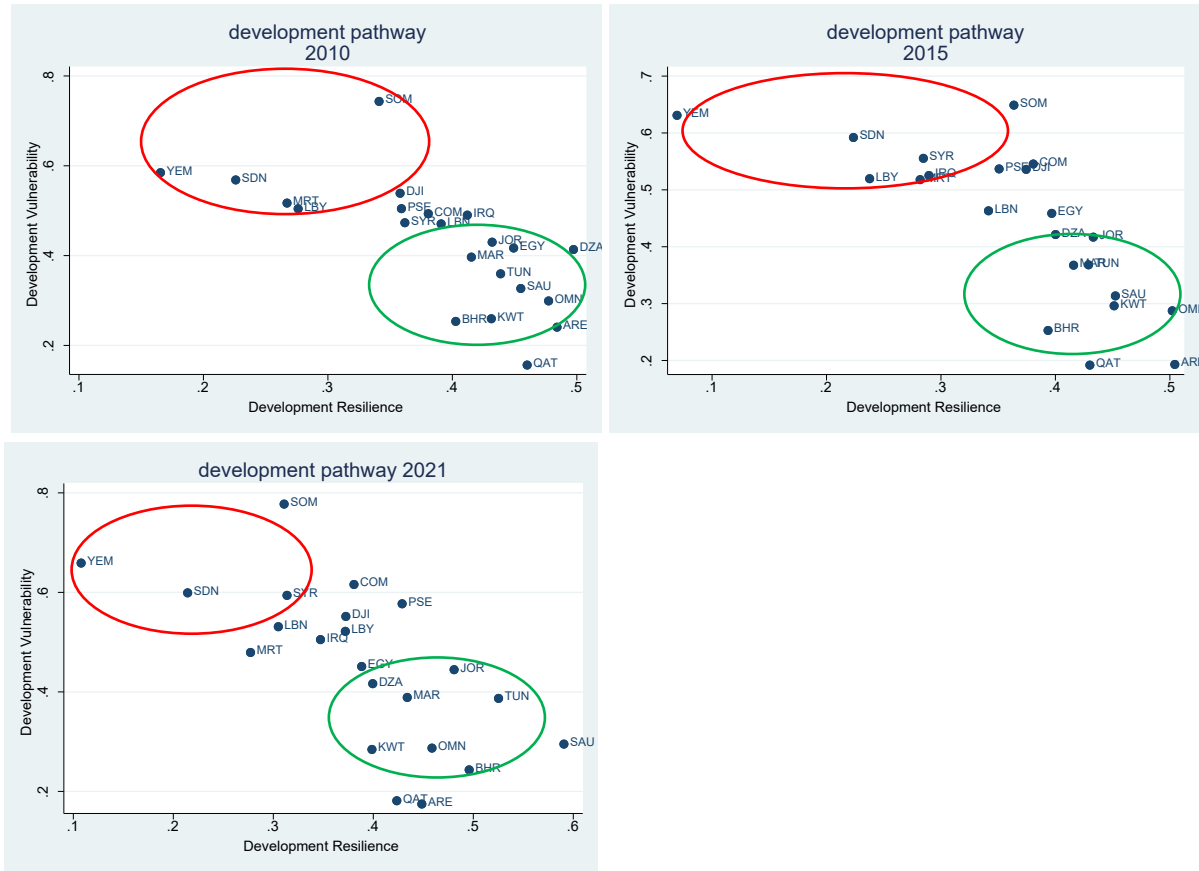
**Source:** Authors.

**Notes:** country names are: ARE (United Arab Emirates), BHR (Bahrain), COM (Comoros), DJI ( Djibouti), DZA (Algeria), EGY (Egypt), IRQ (Iraq), JOR (Jordan), KWT (Kuwait), LBN (Lebanon), LBY (Libya), MAR (Morocco), OMN (Oman), PSE (State of Palestine), QAT (Qatar), SAU (Saudi Arabia), SDN (Sudan), SOM (Somalia), SYR (Syrian Arab Republic), TUN (Tunisia), YEM (Yemen).

The conflict vulnerability graphs show the progressive increase in the number of countries vulnerable due to conflict drivers, as presented in section 3. In 2010, three countries were vulnerable for reasons related to conflict dimensions, while this number increased to seven in 2015 and to six in 2021. Looking at the same time at the conflict resilience graphs above, six countries had very low or low values of resilience to conflict factors, and this increases for the deterioration of conflict-related dimensions in the region. In 2021, the number remained the same even though changes in this group of countries, as well those classified as moderately resilient, reflect the changes at regional and national levels.

Reporting on the vulnerability and resilience dimensions at pathway level, an example is presented in figure A1.3. The scatter plots illustrate the development vulnerability and resilience of Arab countries, as calculated by the formula presented in section 5 for the three points in time considered in this annex. This allows us to allocate the observed geographical unit in the considered time in the graphs, where it is referred to as the level of vulnerability on the vertical axis and resilience on the horizontal axis. This can be replicated for the conflict and climate pathways. The graphs show the movement of countries from one point to another over time because of different factors, including the outbreak of conflict and/or its intensification or cessation.

Figure A1.3 Scatterplot of development pathway vulnerability and resilience, 2010, 2015 and 2021



Source: Authors.

Notes: Red circle means high level of vulnerability and low level of resilience, green circle low level of vulnerability and high level of resilience.



Table A.2.1 Correlation matrix: conflict pathway

	Conflict intensity	Neighbouring conflict	Civilians/small arms	Political stability	Conflict intensity one year lag	Conflict IDPs	Territorial control	Voice and accountability	Army personnel
Conflict intensity	nan	nan	nan	nan	nan	nan	nan	nan	nan
Neighbouring conflict	0.01	nan	nan	nan	nan	nan	nan	nan	nan
Civilians/small arms	-0.04	-0.01	nan	nan	nan	nan	nan	nan	nan
Political stability	-0.29	0.02	0.12	nan	nan	nan	nan	nan	nan
Conflict intensity one year lag	0.03	0.01	0.02	-0.21	nan	nan	nan	nan	nan
Conflict IDPs	0.04	0.06	0.04	-0.17	0.03	nan	nan	nan	nan
Territorial control	-0.03	0.04	0.03	0.41	-0.03	0	nan	nan	nan
Voice and accountability	-0.18	-0.02	0.25	0.69	-0.14	-0.13	0.29	nan	nan
Army personnel	0.02	-0.07	nan	-0.21	0.03	0.16	0.07	-0.36	nan

Source: Authors.

Table A2.2 Correlation matrix: climate pathway

	Conflict intensity	Water availability	Water stress	Climate change affected population	IDPs from climate	Adaptation finance	Adaptation strategy	Total damage climate events	Resilience on Agriculture
Conflict intensity	nan	nan	nan	nan	nan	nan	nan	nan	nan
Water availability	-0.02	nan	nan	nan	nan	nan	nan	nan	nan
Water stress	-0.01	0.28	nan	nan	nan	nan	nan	nan	nan
Climate change affected population	0.02	-0.05	-0.05	nan	nan	nan	nan	nan	nan
IDPs from climate	0	-0.04	-0.03	0.05	nan	nan	nan	nan	nan
Adaptation finance	-0.04	0.01	-0.01	0.03	0.04	nan	nan	nan	nan
Adaptation strategy	-0.04	0.13	0.08	-0.09	-0.06	0.13	nan	nan	nan
Total damage climate events	0.03	-0.03	-0.03	0.36	0	0.01	-0.04	nan	nan
Reliance on agriculture	0.04	-0.13	-0.2	0.07	0.06	0.01	-0.29	0.16	0.16

Source: Authors.

Table A2.3 Correlation matrix: development pathway A

	Conflict intensity	Income inequality	Food insecurity	Cereal import	Undernourishment	Food import	Net ODA	Remittances	Dependency on energy	Dependency on mining
Conflict intensity	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan
Income inequality	0.07	nan	nan	nan	nan	nan	nan	nan	nan	nan
Food insecurity	-0.05	0.27	nan	nan	nan	nan	nan	nan	nan	nan
Cereal import	0.02	0.14	0.05	nan	nan	nan	nan	nan	nan	nan
Undernourishment	0.03	0.46	0.34	0.14	nan	nan	nan	nan	nan	nan
Food import	0.13	0.06	0	0.13	0.09	nan	nan	nan	nan	nan
Net ODA	0.19	-0.01	-0.02	-0.03	0.15	0.32	nan	nan	nan	nan
Remittances	-0.01	0.02	0.06	0.11	0.1	0.18	0.16	nan	nan	nan
Dependency on energy	0.01	-0.07	-0.08	nan	-0.01	nan	-0.24	-0.27	nan	nan
Dependency on mining	-0.07	0.16	0.2	nan	0.21	nan	0	0.03	-0.18	nan

Source: Authors .

Table A2.4 Correlation matrix: development pathway B

	Conflict intensity	Tax revenue	GDP per capita	Child mortality	Youth bulge	Unemployment	Education	Social protection	Control of corruption	Government efficiency
Tax revenue	-0.16	nan	nan	nan	nan	nan	nan	nan	nan	nan
GDP per capita	-0.02	0.24	nan	nan	nan	nan	nan	nan	nan	nan
Child mortality	0.09	-0.29	-0.37	nan	nan	nan	nan	nan	nan	nan
Youth bulge	0.03	-0.3	-0.58	0.53	nan	nan	nan	nan	nan	nan
Unemployment	-0.01	0.2	-0.13	-0.12	-0.03	nan	nan	nan	nan	nan
Education	0.09	-0.37	-0.74	nan	0.86	0.09	nan	nan	nan	nan
Social protection	-0.05	0.11	0.16	-0.24	-0.28	-0.01	-0.01	nan	nan	nan
Control of corruption	-0.15	0.36	0.7	-0.56	-0.63	-0.04	-0.73	0.26	nan	nan
Government efficiency	0.15	-0.35	-0.77	nan	0.72	0.2	0.82	-0.07	-0.91	nan

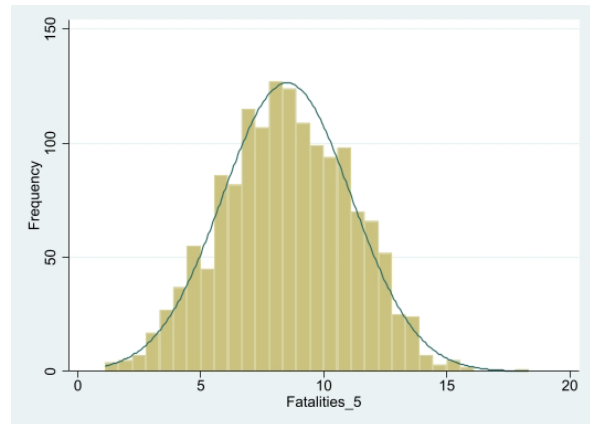
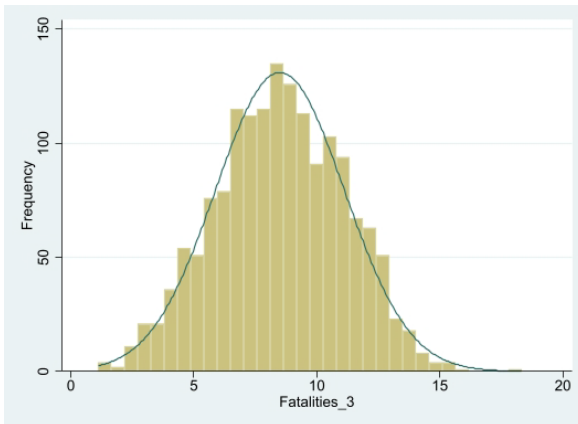
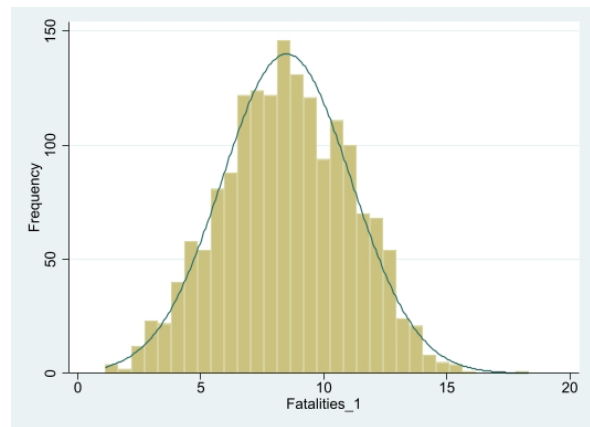
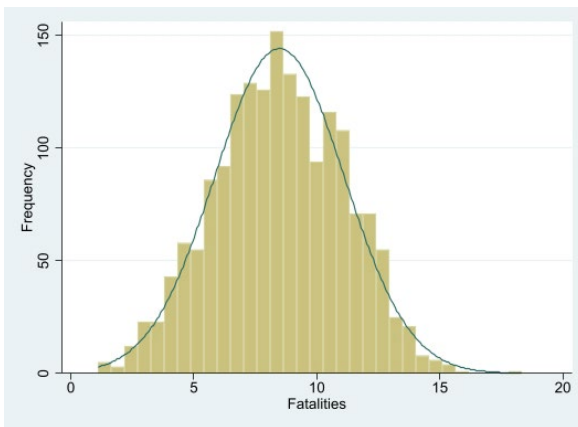
Source: Authors.

## Annex 3. Distribution of data

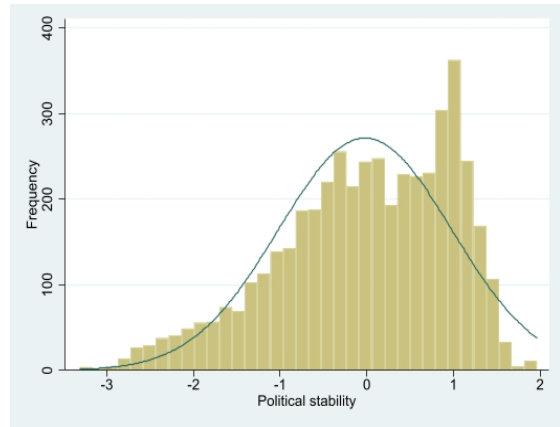
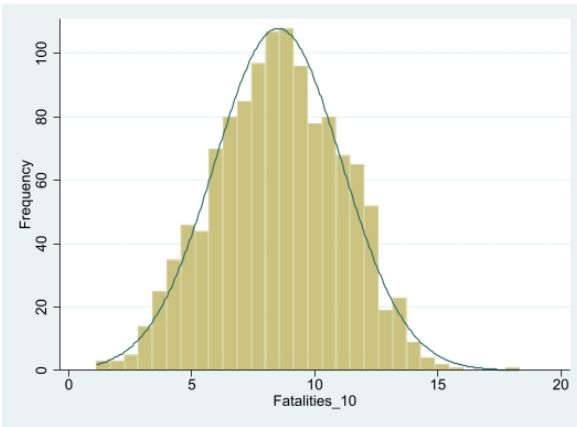
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### A. Conflict pathway

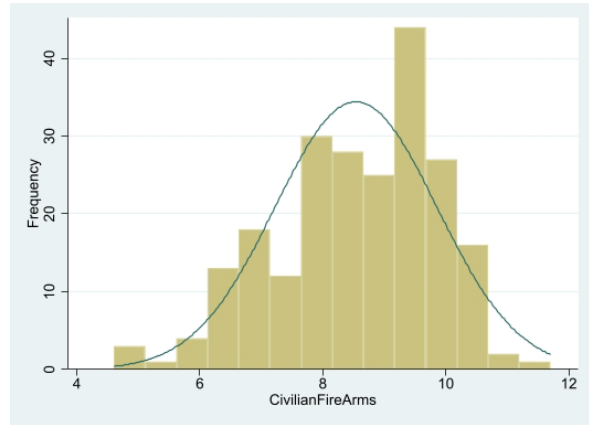
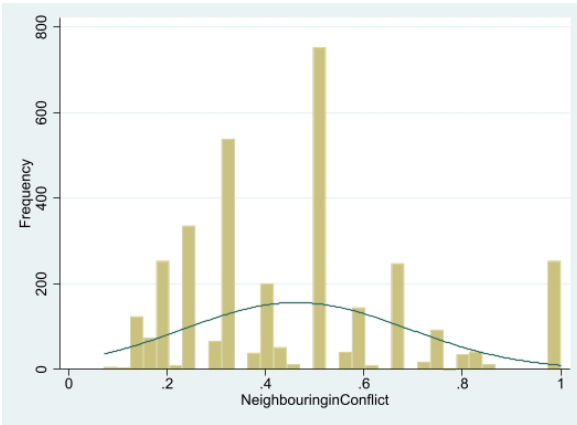
#### 1. Conflict vulnerability



**Source:** Authors. Elaboration based on UCDP, DESA.

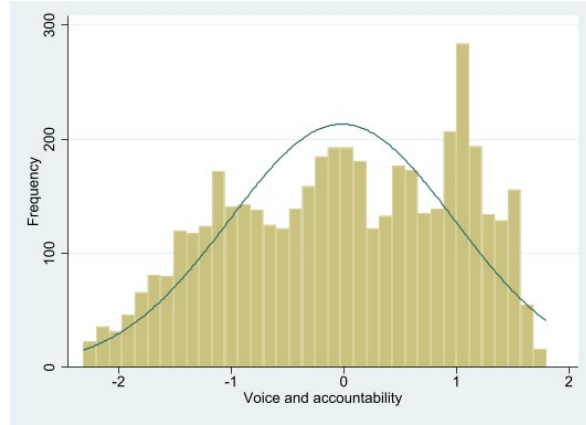
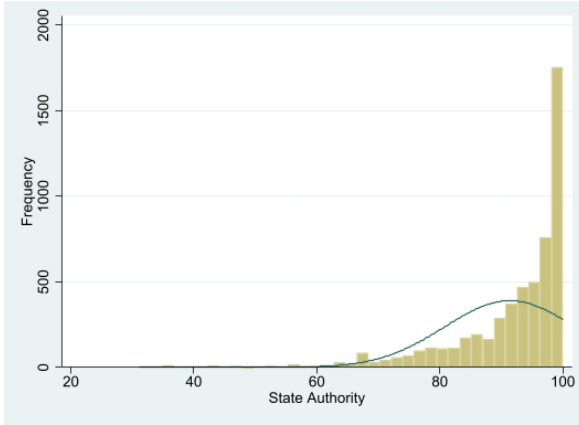


**Source:** Authors. Elaboration based on UCDP, Geodata source and WGI.

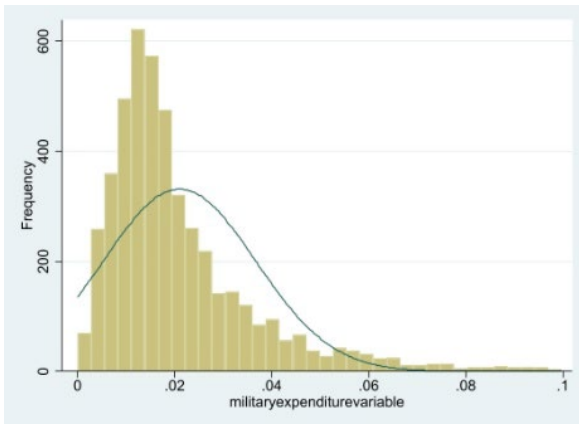
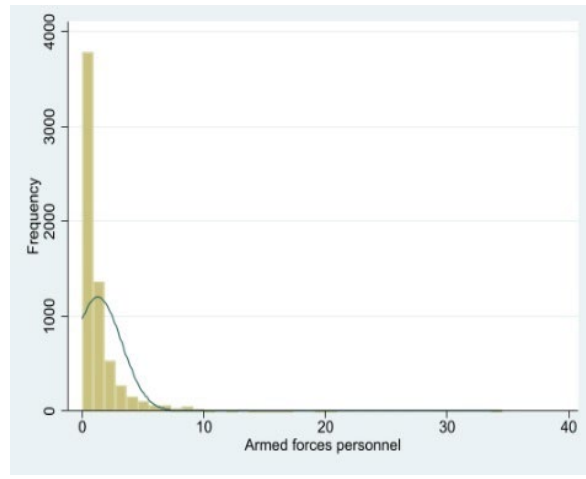
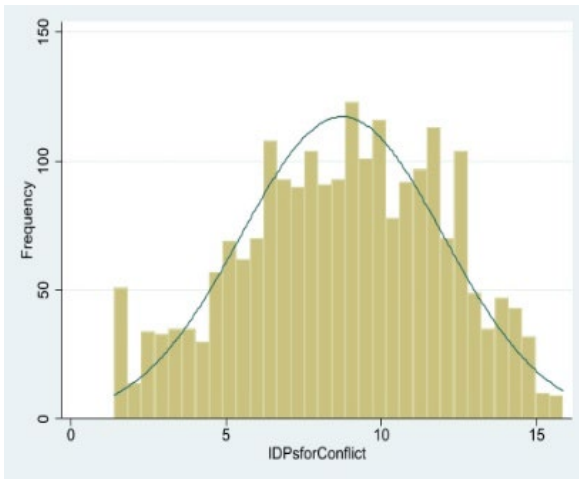


**Source:** Authors. Elaboration based on UCDP, Geodata source and Small Arms Survey.

## 2. Conflict resilience



**Source:** Authors. Elaboration based on V-DEM and WGI.

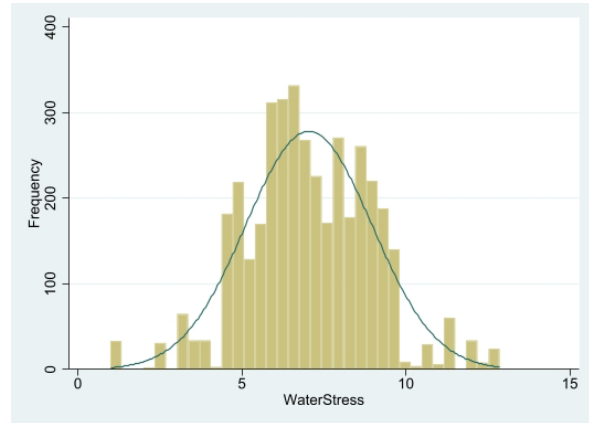
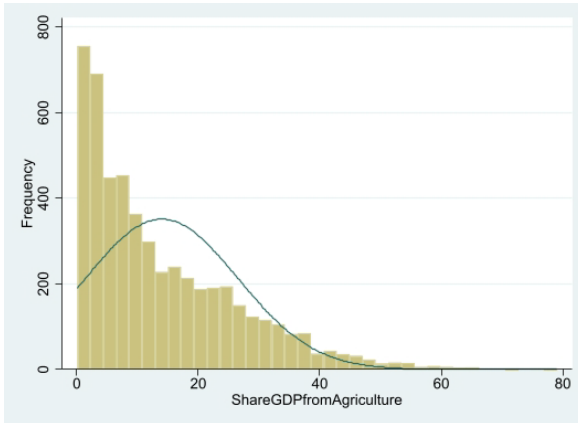


**Source:** Authors. Elaboration based on UNHCR, IDMC, DESA and SIPRI.



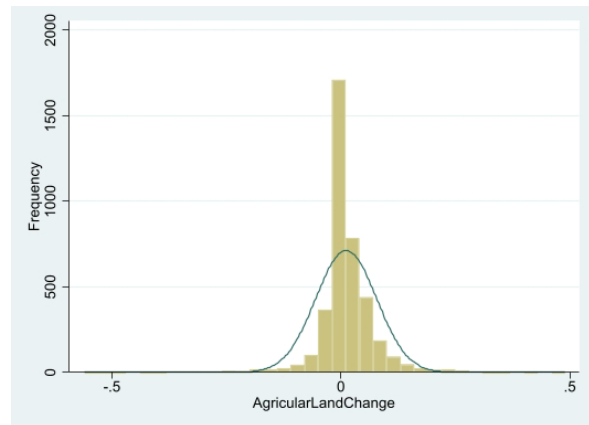
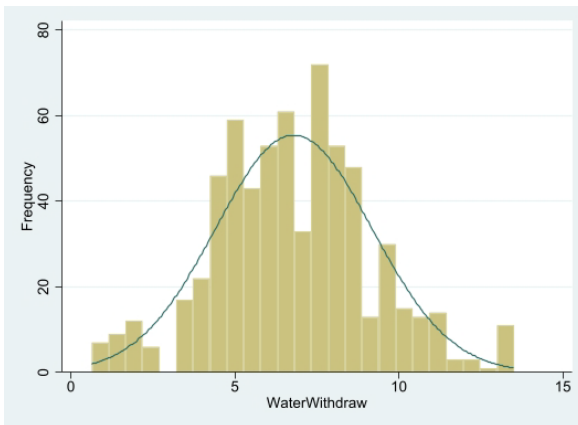
## B. Climate pathway

### 1. Natural resources vulnerability



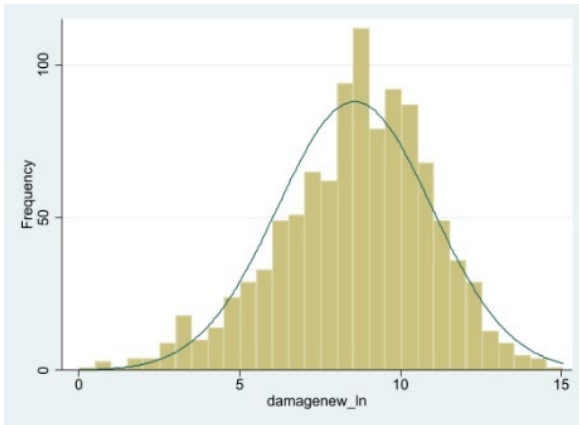
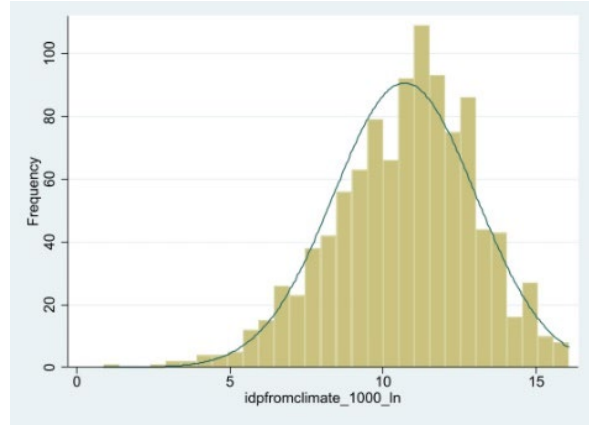
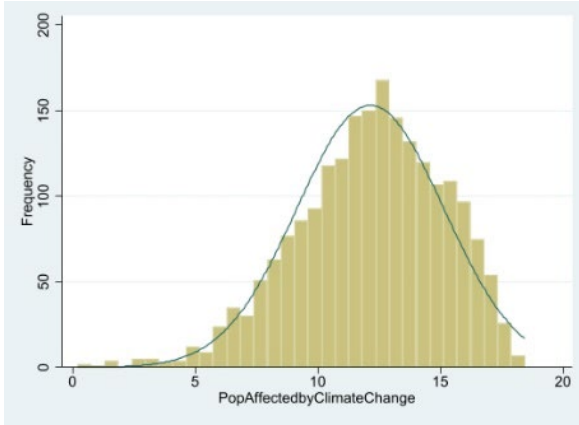
**Source:** Authors. Elaboration based on FAO AQUASTAT and FAOSTAT.

### 2. Natural resources resilience



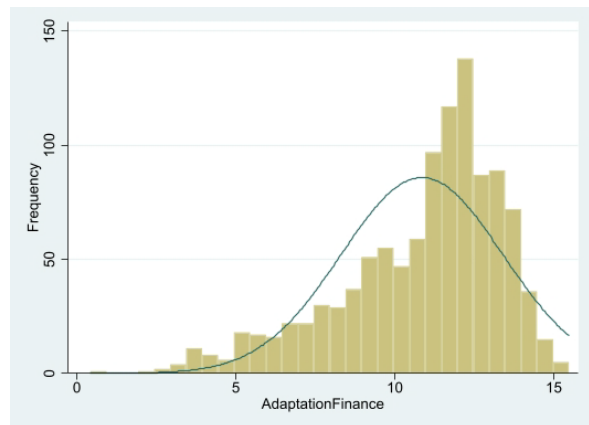
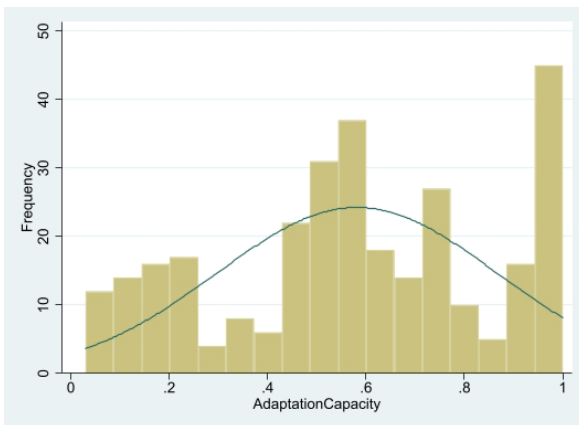
**Source:** Authors. Elaboration based on FAOSTAT and WDI.

### 3. Climate hazards vulnerability



**Source:** Authors. Elaboration based on EM-DAT, UNDESA and IDMC.

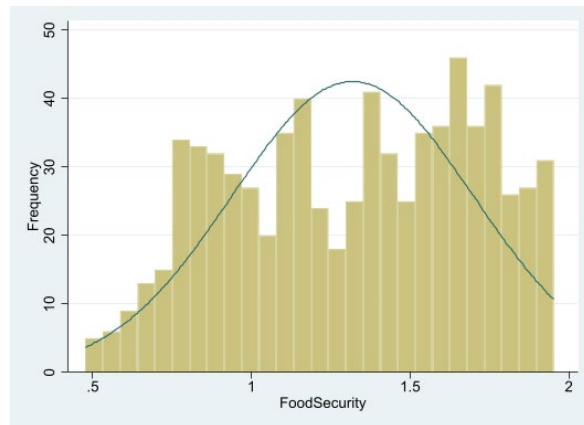
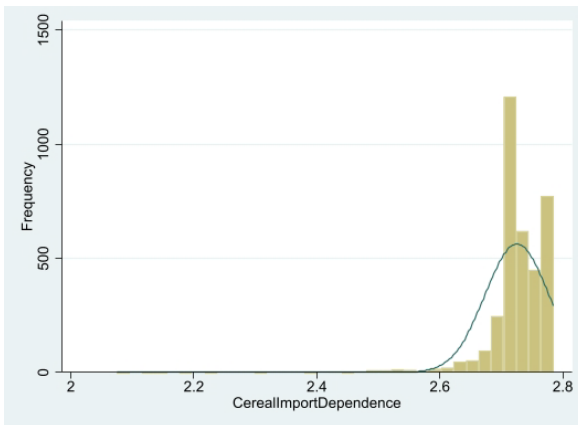
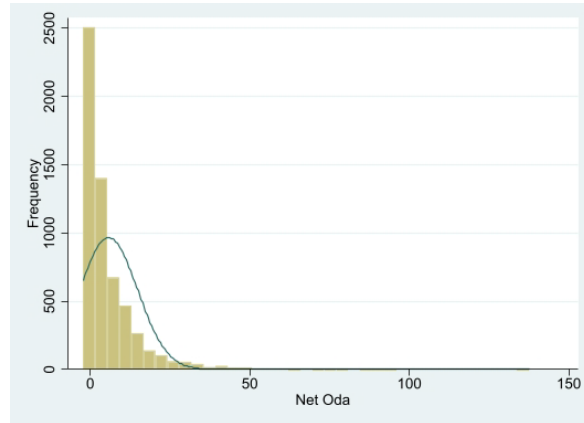
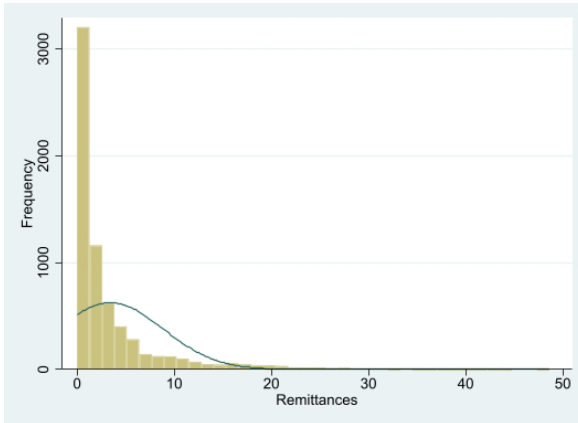
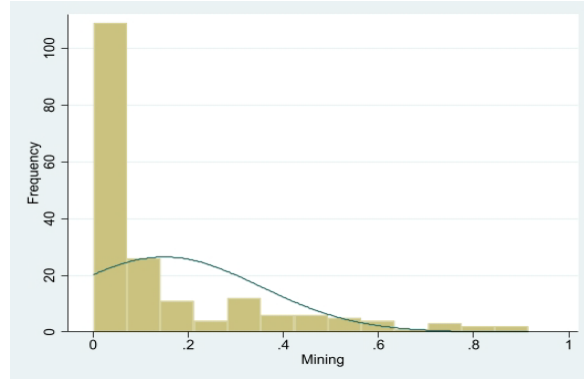
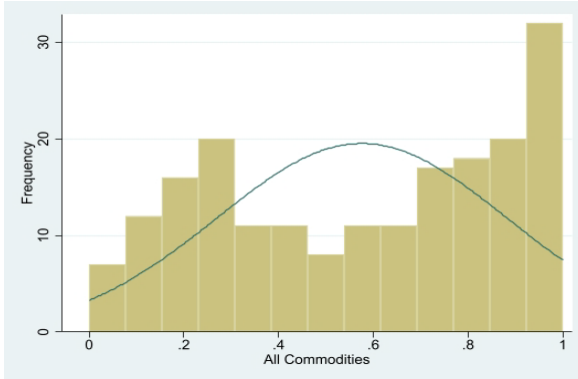
### 4. Climate hazards resilience

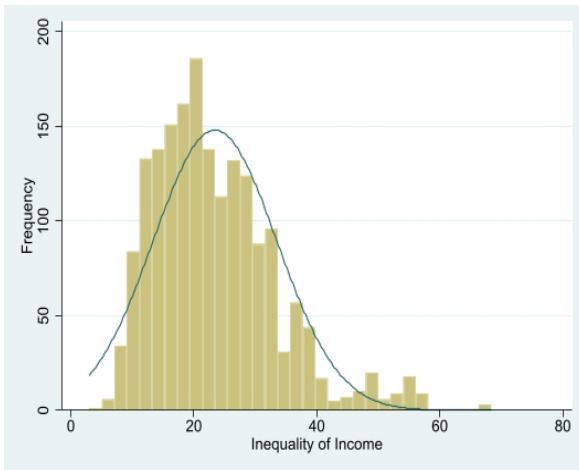
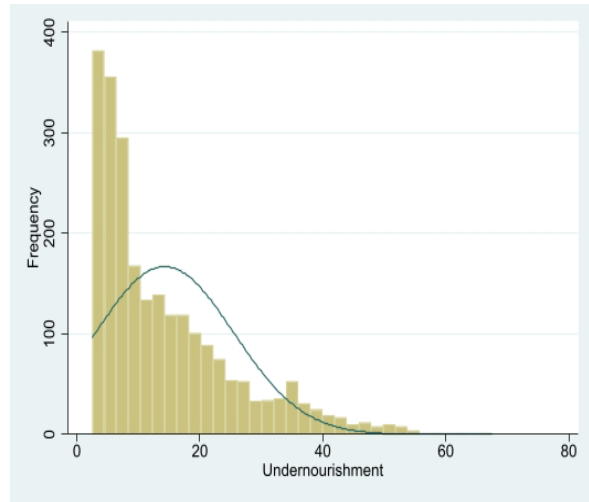
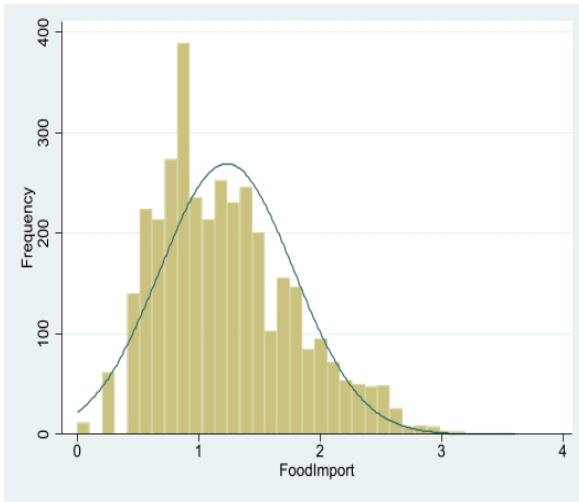


**Source:** Authors. Elaboration based on UNSTAT and OECD & World Bank.

## C. Development pathway

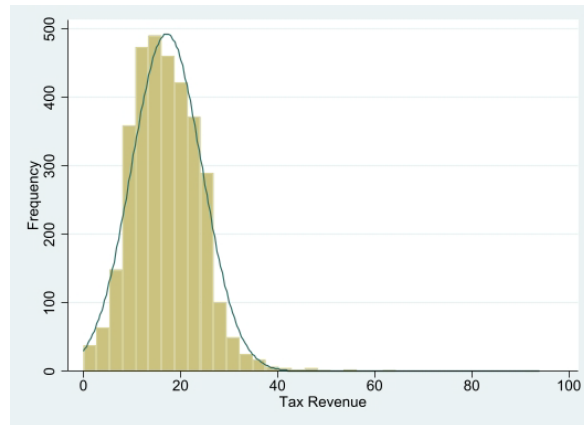
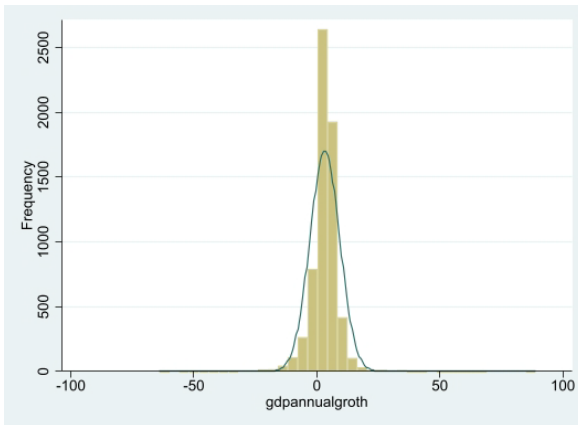
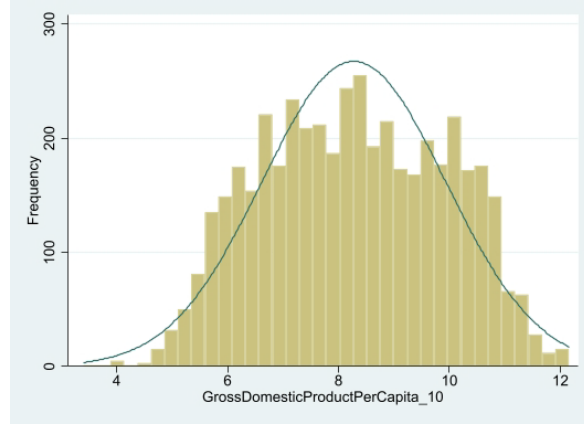
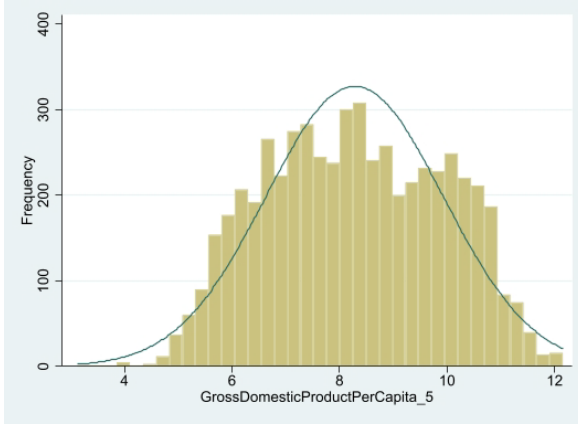
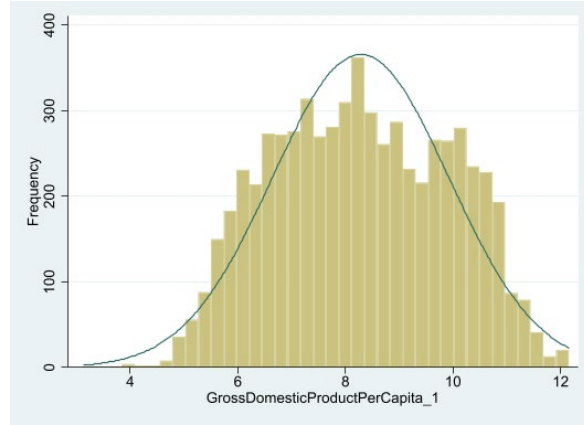
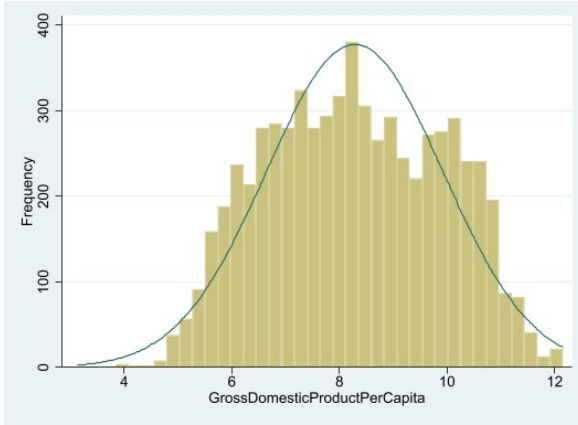
### 1. Economic vulnerability





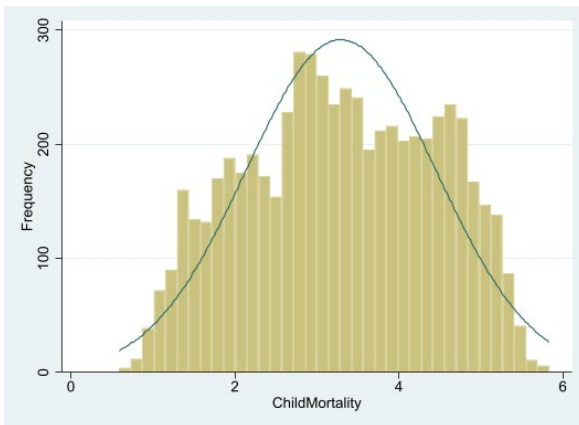
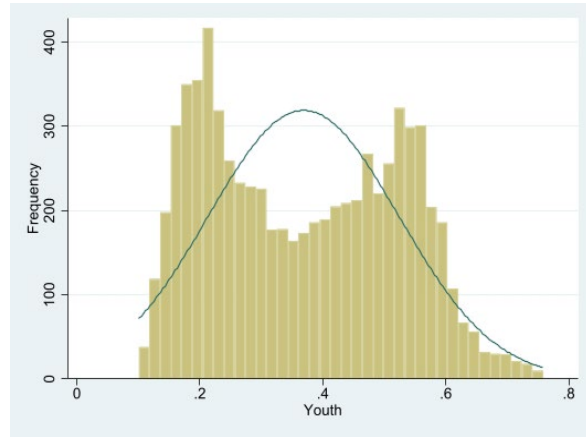
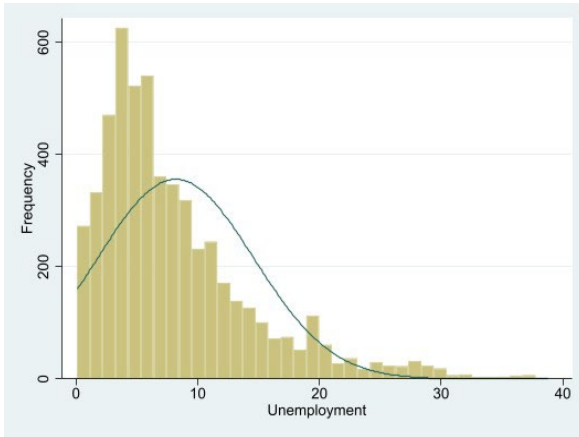
**Source:** Elaboration based on WDI, UNCTAD, FAOSTAT and ESCWA.

## 2. Economic resilience



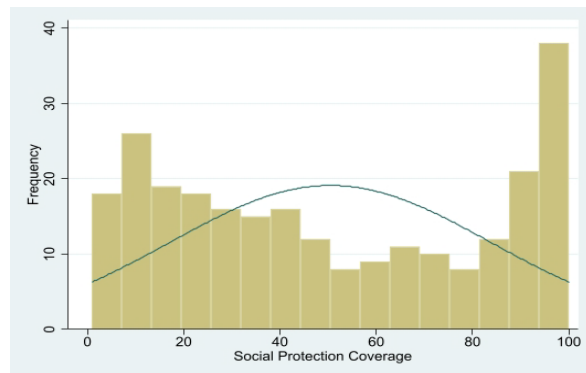
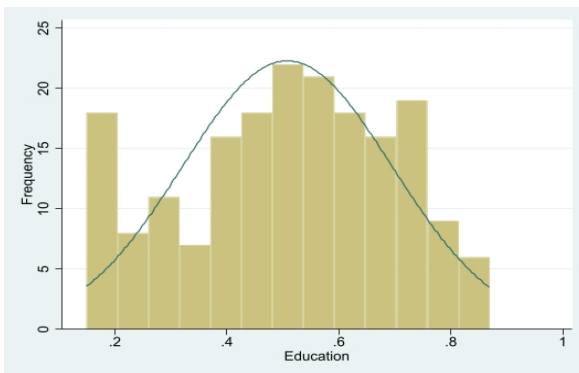
**Source:** Authors. Elaboration based on WDI.

### 3. Social vulnerability



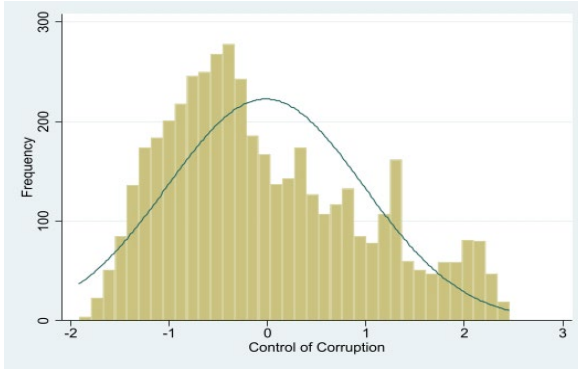
**Source:** Authors. Elaboration based on ILOSTAT, UNDESA and WDI.

### 4. Social resilience



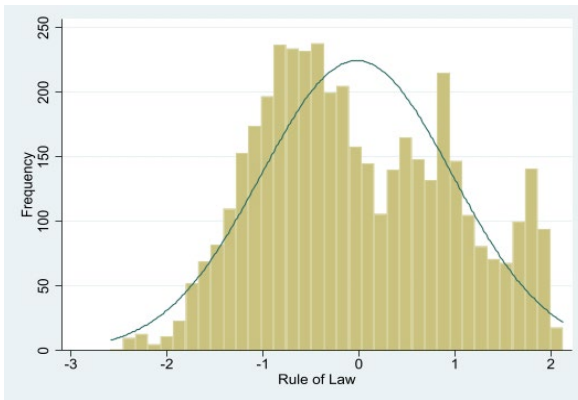
**Source:** Authors. Elaborations based on ESCWA and ILOSTAT.

## 5. Institutional vulnerability

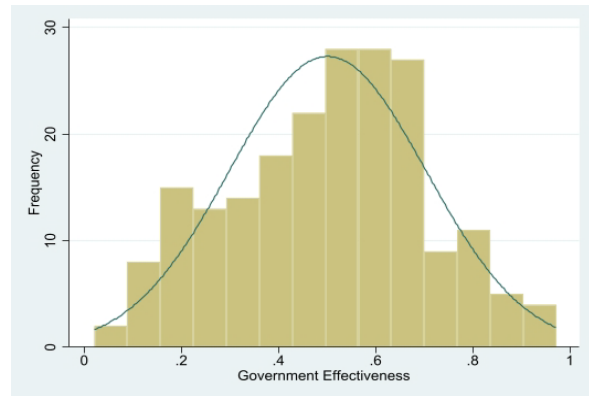


**Source:** Authors. Elaborations based on WDI.

## 6. Institutional resilience



**Source:** Authors. Elaborations based on WDI and ESCWA.



## Annex 4. List of Indicators

This section presents the complete list of indicators, including their pathway, theme, measure of risk, variable, data sources, latest year, and coverage.

Pathway	Theme	Measure of Risk	Indicator	Variable	Data Source	Latest year	Coverage
Conflict Pathway	Historical Grievances	Vulnerability	Conflict intensity	Battle-related deaths per 100,000 people	UCDP, DESA	2022	123
			Political stability	Political Stability and Absence of Violence/Terrorism	WGI	2021	206
			Neighboring conflict	Number of neighboring countries with at least 25 battle-related deaths	UCDP, Geodata source	2022	161
			Proliferation of small arms	Civilian Firearms Holdings per 100 residents	Small Arms Survey	2020	230
	Enabling Environment	Resilience	Territorial integrity	State authority over territory	V-DEM	2021	175
			Forced displacement	Refugees + IDPs as a share of population	UNHCR, IDMC, DESA	2021	170
			Voice and accountability	Voice and accountability	WGI	TBD	206
			Military size	Military expenditure as share of GDP	SIPRI	TBD	165
Armed forces personnel as share of total labor force	WDI	TBD		216			
Climate Pathway	Natural Resources	Vulnerability	Reliance on agriculture	Agriculture, forestry, and fishing, value added (percentage of GDP)	WDI	2021	217
			Water availability	Renewable internal freshwater resources per capita (m <sup>3</sup> )	FAO AQUASTAT	2018	200



Pathway	Theme	Measure of Risk	Indicator	Variable	Data Source	Latest year	Coverage
		Resilience	Water stress	Freshwater Withdrawal as % of Available Freshwater Resources (SDG 6.4.2)	FAO AQUASTAT	2019	246
			Land Stress	Change in share of agricultural land within total land area	FAOSTAT	2021	21
	Climate Hazards	Vulnerability	Human impact of natural disasters	Share of population affected by natural disasters (per cent)	EM-DAT, UNDESA	2021	225
				Disaster-induced Internal Displacement (New Displacement)	IDMC	2021	203
			Economic impact of natural disasters	Total estimated disaster damages (percentage of GDP)	EM-DAT, WDI	2021	225
		Resilience	Adaptation strategies	Score of adoption and implementation of national DRR strategies in line with the Sendai Framework (SDG 1.5.3)	UNSTAT	2020	129
			Adaptation finance	Climate adaptation-related development finance, as a share of GDP	OECD & World Bank	2020	149
		Development Pathway	Economy	Vulnerability	Trade dependence	Dependence on commodity exports	UNCTAD
Financial dependence	Personal remittances received (percentage of GDP)				WDI	2020	194
	Net ODA received (percentage of GNI)				WDI	2020	194
Food security	Cereal import dependency ratio				FAOSTAT	2021	151
	Value of food imports in total merchandise exports (per cent) (3-year average)				FAOSTAT	2020	186

Pathway	Theme	Measure of Risk	Indicator	Variable	Data Source	Latest year	Coverage	
				Prevalence of undernourishment (per cent) (3-year average) (SDG 2.1.1)	FAOSTAT	2021	134	
				Prevalence of moderate or severe food insecurity in total population (per cent) (3-year average)	FAOSTAT	2021	149	
			Inequality	Inequality-adjusted income index	ESCWA	2021	170	
		Resilience	Economic development	GDP per capita (current US\$)	WDI	2021	212	
			Economic growth	GDP growth (annual per cent)	WDI	2021	212	
			State capacity	Tax revenue (percentage of GDP)	WDI	2020	158	
	Society	Vulnerability		Unemployment	Unemployment, total (percentage of total labor force) (modeled ILO estimate)	ILOSTAT	2021	217
				Youth bulge	Share of youth in total adult population	UNDESA	2021	217
				Infant mortality	Mortality rate, under 5 (per 1,000 live births)	WDI	2020	193
		Resilience	Education	Quality-adjusted HDI education index	ESCWA	2020	189	
			Social Protection	Share of population covered by social protection schemes/systems (SDG indicator 1.3.1)	ILOSTAT	2020	176	
	Institutions	Vulnerability	Corruption	Control of corruption	WGI	2021	204	
		Resilience	Rule of Law	Rule of law	WGI	2021	217	
			Government effectiveness	Governance effectiveness challenge index	ESCWA	2020	204	

**Notes:** Coverage refers to the number of countries at global level with data for the available.

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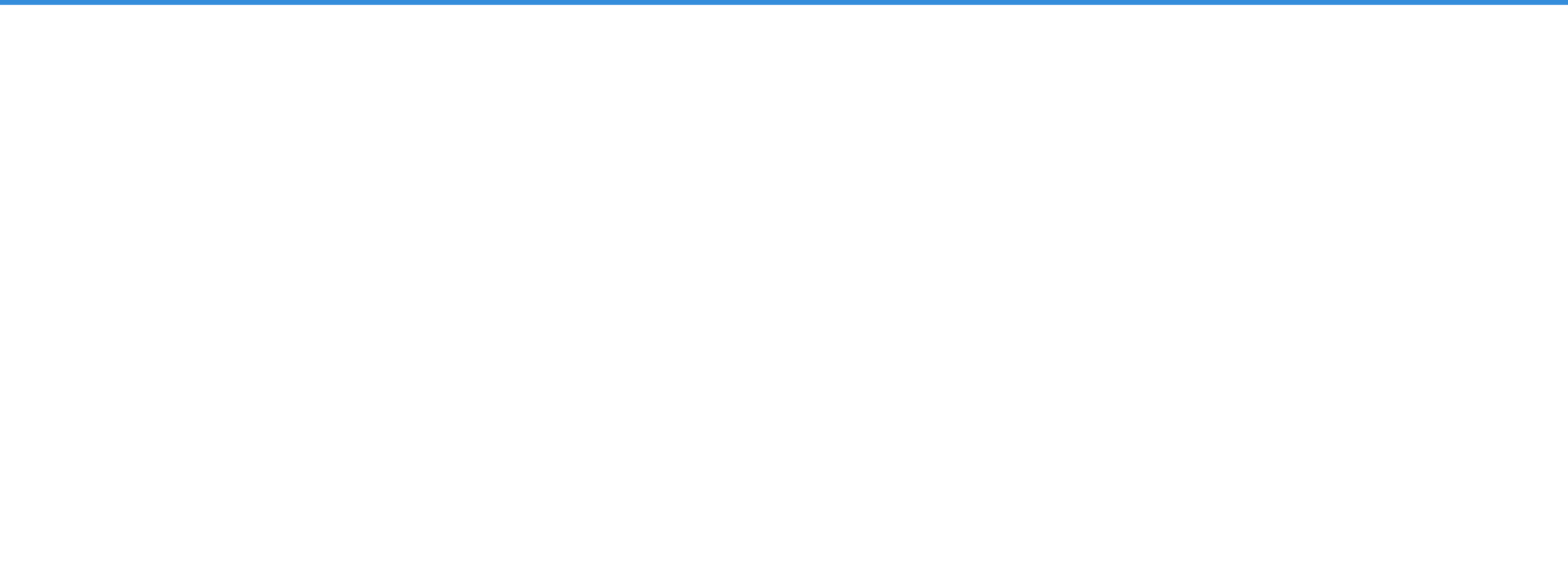
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The objective of this technical paper is to present the methodology and indicators for the Arab Risk Monitor report, focusing on the technical aspects of producing the dataset and statistical output that serve to measure the different drivers of risk identified in the paper Arab Risk Monitor: A Conceptual Framework. The conceptual framework of the Arab Risk Monitor identifies several pathways to risk having to do with conflict, climate change and development.

Each risk pathway includes several thematic risk areas. The conflict pathway consists of two areas (historical grievances and enabling environment), the climate pathway two areas (natural resources and climate hazards) and the development pathway three areas (economy, society, and institutions). Within each thematic area, the Arab Risk Monitor provides one or more measures of risk, expressed as either vulnerability or resilience, for a total of 12 risk measures. This paper defines vulnerability in terms of a country's likelihood to experience shocks, and its structural exposure to these, and resilience in terms of a country's policy-driven capacity to absorb the negative impacts of risks. Vulnerability, therefore, provides a measure of structural risk, and resilience provides a measure of non-structural risk.

The 12 measures of risk are divided as follows. The conflict pathway includes two measures of risk (conflict vulnerability and conflict resilience), the climate pathway four measures (natural resource vulnerability, natural resource resilience, climate hazard vulnerability and climate hazard resilience), and the development pathway six measures (economic vulnerability, economic resilience, social vulnerability, social resilience, institutional vulnerability and institutional resilience).

The structure of the paper is as follows. After an introduction, Section 1 details the imputation, normalization and weighting/aggregation techniques that have been used. Sections 2, 3, and 4 present the list of indicators by pathway, including the number of observations, country coverage, data management system, and the normalization/standardization criteria used. Section 5 is the conclusion.

