# Is MENA's Rural Youth Employment Vulnerable to Climate Change?

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## Abstract

The jobless economic growth that a number of Middle East and North Africa (MENA) countries have been going through, translated into slow rate of job creation in the public and private formal sector pushed the youth to either exit the labor market or to accept more precarious and vulnerable jobs. This paper goes beyond studying the labor market performance by analyzing the unemployed and out of labor force into studying employment vulnerability. The study combines the impact of socioeconomic variables in addition to climate change to understand the determinants of vulnerable employment and economic inactivity among rural youth of the MENA countries. We combine data from the Integrated Labor Market Panel Surveys (ILMPS) and geographically gridded daily measures of climate change. Our results show the persistence of employment vulnerability and economic inactivity among youth with a stronger impact on rural youth. Changes in temperature show a significant impact on labor market inactivity among MENA youth.

*Keywords:* Climate, Temperature, Humidity, Employment vulnerability, Labor market transitions, MENA region, Multinomial logistic regressions.
*JEL Classification:* Q54, N35, J21, C35

## 1. Introduction and motivation

The labor market of the Middle East and North Africa (MENA) countries has been experiencing several challenges ranging from unemployment, informality to inactivity. These challenges are resulting from internal structural challenges but also regional and global shocks. Unemployment is a real defined challenge in the MENA region, not only for having the highest in the world, but also largely considered a youth and educated phenomenon. Unemployment rates in the region have been the highest among the youth and the more particularly the educated, defining what Assaad et al. (2020) referred to as the MENA paradox.

Formal job creation, in the public and the private sector, is considered one of the main challenges facing the region. With the growing size of job seekers, this has created long queues of unemployed waiting for "good" jobs but also pushing others to more precarious jobs. Youth who are employed are suffering from informality, lacking job security and other forms of stability and protection (ILO, 2015). This situation is reinforcing job vulnerability. This vulnerability is emphasizing the intergenerational inequality in outcome and inequality in opportunity especially among the youth and is reinforcing poverty and deprivation (AlAzzawi and Hlasny, 2022).

Other factors are appearing to have a strong impact on these labor market outcomes. The MENA region is considered one that is most vulnerable regions to climate change. Climate change has its impact on labor market outcomes in general, with expected lower productivity for jobs with larger exposure to the impact of the changes of the climate change variables.

Our paper contributes to existing literature by examining the prevalence of employment vulnerability in selected countries of the MENA region during a period where workers productivity is affected by several external factors among which is climate change. Our paper stems from examining the literature which revealed that studies covering countries of the MENA region are scant. Labor market data is obtained from the Integrated Labor Market Panel Survey (ILMPS) for Egypt, Jordan and Tunisia spanning the period from 2006 to 2018. The data allows the dynamic analysis of the employment vulnerability by age, gender, and geographic location. Examining the vulnerability of employment allows for understanding the extent of vulnerability and the role of time sensitive factors in the changing extent of vulnerability in the context of climate change.

The paper proceeds as follows: Section 1 includes introduction, section 2 reviews the literature on climate change and employment vulnerability; section 3 describes the dataset and methodology; section 4 reports the empirical results, and section 5 concludes and draws some policy implications.

## 2. Related literature and country background

### a. Employment vulnerability

The countries of the MENA region have been experiencing highly fluctuating economies since the early 2000s. Economic growth is highly influenced by the size of the workforce but also by the ability of the labor markets to efficiently absorb the growing workforce into the productive sectors of the economy. The increase in the size of the population of the MENA countries is expected to boost economic growth by efficiently employing the growing population into the labor market.

On the other hand, the population of the MENA region has been growing at a rate that is faster than the rate of job creation. Accordingly, participation rates have ranged from 40 to 50 percent across Egypt, Jordan, and Tunisia. The region has been witnessing declining economic participation but also unemployment rates among the active population.

Unemployment rates, especially among the educated, has been increasing recording 16 percent for Jordan and going as high as 30 percent for Tunisia and 20 percent for Egypt in 2019 (ICMPD, 2020). This shows the inability of the labor markets of the MENA countries to absorb the growing educated population.

The public sector has always played a major role in providing "good" jobs to the labor force. The public sector has stopped providing jobs in many countries of the MENA region, leaving this role to the private sector. The private sector has also been facing its own challenges and therefore is not able to create enough jobs for the growing population.

This situation of limited job creation in the public and private formal sector has slowed down any possibility of finding "good" jobs in the local labor market. Jobs landed maybe requiring different skills resulting in a mismatch in the labor market or would push them to more precarious jobs in the informal sector. This has pushed young people into the long queues of unemployed or to join the more precarious informal jobs.

The International labor Organization (ILO) has reported that youth unemployment in Northern Africa is the highest in the World (ILO 2020). In the third quarter of 2017, the overall unemployment rate stood at 11.9 percent, going down to 10 percent by the third quarter of 2018. The rate for the youths is higher, recording approximately 32 percent in 2018. Unemployment among the young, educated youth in the MENA region has reached 20-40 percent of the total unemployment in the region (ICMPD). Azzawi and Hlasny (2021) further showed that unemployment among young women is twice that of young men.

In addition to the high and prevalent unemployment rates, the expansion of informality is having its impact on the quality of life and living standards of the young people of the MENA region. This has created a situation where young people tend to accept jobs that lack job security and stability, paid sick leaves and social and health insurance (WEF, 2012). Azzawi and Hlasny (2021) shows that the share of youth in the informal employment is as high as 85 percent in Arab states and 87 percent in Northern Africa. This indicates the deteriorating quality of jobs in the MENA region driving young people into a vulnerable situation that is affecting their quality of life and leading to multiple deprivations.

Assaad has also referred to the employment vulnerability rising at a time where the rates of employment have been declining, but unemployment has not been increasing (Assaad 2014b). This shows that the performance of the labor market requires alternative measures as emphasized by Assaad and Krafft (Assaad and Krafft 2014). Type of work, prevalence of irregularity, and informality are better measures of the health of the labor market.

**b. Climate changes impacts on employment**

The International Labor Organization (ILO) identified key aspects when addressing climate change impacts of work: the services that the ecosystem provides (as in the case in agriculture or tourism), working conditions in addition to risks and hazards on vulnerable workers (ILO 2018). Due to increased environmental hazards, labor productivity has reportedly decreased globally by 23 million working-life years between 2000 and 2015. Furthermore, it is projected that the total number of work hours will decrease by 1.9 percent by 2030. These impacts will include not only warm countries but also temperate regions (Adam-Poupart et al. 2013). This is especially true for unacclimatized workers that are exposed to increased frequency of heat waves.

Climate change was shown to have differential impacts on workers, based on attributes and type of their work. For example, a study examining the impacts of increasing weather temperatures in three Middle East countries found that work hours of workers were significantly impacted by changing weather temperature. However, workers whose occupations encounter high exposure to climate were more sensitive to the temperature variability than other types of workers (Abou-Ali et al. 2021).

Other comparisons by the work sector revealed a reduction in workers availability in industries characterized by higher exposure to climate such as farming, construction, and other outdoor activities (Antonelli et al. 2020; Shayegh, Manoussi, and Dasgupta 2020). Masuda et. al (2019) show that this lower productivity is expected to affect workers engaged in the agricultural sector. Subsequently, this may have grave impacts on vulnerable workers in Sub-Saharan Africa, where the dominant livelihood is small-scale farming, an outdoor activity practiced in small landholdings (FAO 2012). In another study in Latin America, changing weather conditions and droughts has pushed populations that live-off livestock as a source of livelihood to other sources (Arora et al. 2017).

Unequal opportunities are already disadvantageous to women with limited access to credit, and technology (Krafft and Kettle, 2019). Climate change is exacerbating the difficulties workers are going through and is therefore expected to increase the vulnerability of workers. Climate change and the rise in temperature could drive economic opportunities from one place to another driven by the slowdown in productivity. This is expected to increase employment vulnerability, pushing people more towards informality and irregularity in the labor market. Abou-Ali et al. (2022) examined the impact of changes in climate indicators on labour supply in the Middle East and North Africa (MENA) region. Their results indicate that changes in temperature and humidity have a significant impact on labour working hours, whereas precipitation has no significant effect, and the working hours are impeded by heat and humidity after a specific threshold.

### c. Value added

The previous review of existent literature shows that young people are pushed to a more vulnerable situation of accepting more precarious jobs in the labor market. We can also see that the changing climate is having its impact on employment prospects. In this paper we contribute to the literature by examining the prevalence of employment vulnerability in three countries of the MENA region, Egypt, Jordan, and Tunisia, during a period where labor market outcomes are affected by several external factors among which is climate change.

Our paper stems from examining the literature which revealed that studies covering the MENA countries are scant. Labor market data is obtained from the different rounds of labor market surveys for the three countries at different points in time. The data allows the dynamic analysis of the employment vulnerability through time as well as by age, gender, and geographic location. Examining the vulnerability of employment over time allows for understanding the extent of vulnerability and the role of time sensitive factors in the changing extent of vulnerability in the context of climate change.

## 3. Data and methodology

### 3.1 Data

We rely on linking data from two sources: ILMPS and a globally gridded weather dataset. ILMPS are nationally representative longitudinal survey data collected as a joint effort of the Economic Research Form (ERF) and the governments of Egypt[1], Jordan and Tunisia, where the surveys are fielded (OAMDI, 2019). Eight rounds of labour surveys are incorporated: the Egypt Labour Market Survey (in years 1988, 1998, 2006, 2012, and 2018), two rounds of the Jordan Labour Market Survey (in years 2010 and 2016), and the 2014 Tunisia Labour Market Survey. The studied countries are mapped in Figure 1.

The main questionnaire modules are harmonized and comparable across countries and time. The labor market modules of ILMPS are rich datasets focusing on employment, unemployment, earnings, and work-time indicators; yet it also includes various modules that encompass indicators for parental background, education, housing, access to services, residential mobility, migration and remittances, time use, marriage patterns and costs, fertility, women's decision making and empowerment, job dynamics, savings and borrowing behavior, the operation of household enterprises and farms.

[1] ILMPS data, as found on ERF portal, excludes frontier governorates in Egypt.

Geographically gridded daily measures of climate change variables are matched to the ILMPS data by country. We focus on three variables namely, maximum temperature, precipitation, and relative humidity. Daily maximum temperature is obtained from the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (CPC) Global Daily Temperature. Daily total surface precipitation is acquired from NOAA CPC Global Unified Gauge-Based Analysis of Daily Precipitation. Daily relative humidity is obtained from NASA Prediction of Worldwide Energy Resource (POWER) Project, which is funded through the NASA Applied Sciences Program. The time span of these two datasets starts in 1979 to date. The resolution of these three global datasets is 0.50-degree latitude by 0.50-degree longitude grid.

Using the climate datasets mentioned above, we first calculate the weekly averages of the 7-days preceding the survey dates for the three meteorology variables of interest. The 7-day average was calculated to follow the definition of the dependent variable that recalls a reference period of 7 days in the questionnaire. Afterwards, we match the calculated weekly climate averages with the ILMPS dataset based on the location of the respondent and the visit date of the interview. The second administrative unit (Markaz/Kism in Egypt, locality in Jordan, and sector in Tunisia) is used to identify and match the location of the household without revealing personally identified information of the sample units. This is applied to all the rounds of the survey data where the visit date is present, specifically for Egypt 2006, 2012, and 2018, Jordan 2016, and Tunisia 2014.

We define vulnerable employment as the total of self-employment, unpaid family workers, irregular wage workers and informal private sector workers. Moreover, youth are defined as those between the ages of 15 to 29 in every round of the survey. Fixing this age group would allow us to understand the impact on the employment vulnerability for this defined age group in every round of the survey.

We use multinomial logistic regressions to investigate the individual contributions of workers' circumstances. This method has previously been used by AlAzzawi and Hlasny (2022) to study the static and dynamic nature of vulnerable employment in Egypt Labor Market Survey (in years 1998, 2006, 2012 and 2018), two rounds of the Jordan Labor Market Survey (in years 2010 and 2016), and the 2014 Tunisia Labor Market Survey, Assaad et al. (2014) to study occupational distribution of all workers in Jordan 2010, and by Assaad and Krafft (2014) to study school-to-work transitions in Egypt 2012. The analysis is further extended to include interaction variables between levels of climate change variables and the respondents' individual-level characteristics to identify how respondents' vulnerability based on climatic changes is impacted by the respondent's characteristics such as age range, educational level, and gender. The aim of this paper is not to follow the same group over time, but to see the impact of climate change factors as well as socio-economic indicators on the defined age-group at every survey round.

### 3.2 An overview on vulnerable employment and its determinants

Prior to engaging in the analytic methodology, we start by investigating the data on climate and employment vulnerability. Table 1 reports the summary statistics of the different used variables. Figure 2 shows the youth employment status across the three countries in their respective rounds of the survey: Egypt (2006, 2012 and 2018); Jordan (2010 and 2016) and Tunisia (2014). The results show the steady prevalence of vulnerable employment status over time in the three countries. On the other hand, it shows that nonvulnerable employment levels have been decreasing slowly over time in Egypt and Tunisia. Breaking it down by gender, Figure 3 shows that the majority of females are out of the labor force in the three countries. The figure also shows that for working males, the percentage of workers that belong to nonvulnerable employment is higher than those in vulnerable employment. Looking at the employment variability by household wealth, Figure 4 shows that non-vulnerable employment status increases at higher wealth quintiles while vulnerable employment status increases. Employment vulnerability is more prevalent at the lower wealth groups and more so in Tunisia, which exhibits the lowest rates of vulnerable employment across the five wealth quintiles when compared to Egypt and Jordan.

We exploit the spatial and temporal variation in our observations to capture the impact of changes in our three meteorological indicators on employment vulnerability by respondents per week. Figure 5 shows the employment vulnerability prevalence in each governorate of the studied countries. Figures 6 and 7 depict the weekly average of the maximum temperature and relative humidity, respectively. Figure 8 maps risk zones for MENA countries, where the shaded areas are governorates that exceed the weekly average of maximum temperature, relative humidity, and have employment vulnerability prevalence. This categorizes governorates according to their vulnerability to climate impacts. The figure shows that some Mediterranean coastal governorates—Damietta and Port Said in Egypt; Nabeula, Sousse, and Tunis in Tunisia; and

Madaba in Jordan, which is located by the Dead Sea—are particularly vulnerable and experiencing more risk than other governorates in their respective countries. Some of the potential risks that are expected to be associated with climate change include land loss, reduction in crop yield, population displacement, and job loss (Dell, Jones, and Olken 2014; Abdelfattah, Abou-Ali, and Adams 2018). In addition to risks of sea level rise, labor productivity and health are at risk of thermal discomfort due to heat extremes.

### 3.3 Multinomial logistic models

The study aims at investigating the following research questions: (1) How does climate change (measured by changes in maximum temperature, precipitation, and humidity) impact employment vulnerability in the countries of the MENA region? (2) How does this impact differ between male and female labor groups? (3) How is respondents' vulnerability based on climatic changes impacted by the respondent's characteristics such as age range, educational level, and income?

We use the vulnerable employment variable while controlling socioeconomic and demographic variables such as age, gender, education, wealth, ..., etc. Vulnerable employment variable, dependent variable, is a qualitative variable with three categories. We define vulnerable employment categories as the total of self-employment, unpaid family workers, irregular wage workers and informal private sector workers. The non-vulnerable category is formal employment and employer, and the base category is OLF and unemployed. With longitudinal survey data like ILMPS-climate integrated dataset, it is possible to analyze the transitions of individuals between different employment states using appropriate statistical techniques. For a categorical dependent variable with repeated observations one such model is the generalized linear mixed model (GLMM). The specific GLMM for a dependent variable with three or more categories is the multinomial logit model. This model is very computationally intensive, requiring a large amount of computer processing time that increases with the number of clusters (or individuals) in the data.

Multinomial logistic regressions are adopted to investigate the individual contributions of workers' circumstances. This method has previously been used by Hlasny and AlAzzawi to study the static and dynamic nature of vulnerable employment in Egypt using 1998, 2006 and 2012 waves and Jordan using 2010 and 2016 waves, Assaad et al. to study occupational distribution of all workers in Jordan 2010, and by Assaad and Krafft to study school-to-work transitions in Egypt 2012

(Assaad 2014b; Assaad and Krafft 2014; Hlasny and AlAzzawi, 2018; Hlasny and AlAzzawi, 2022). The analysis is further extended to include interaction variables between climate change variables and the respondents' individual-level characteristics to identify how respondents' vulnerability based on climatic changes is impacted by the respondent's characteristics such as age range, educational level, and gender.

### 3.4 The model

Given the dependent variable, an appropriate model is the multinomial logit model. Suppose that individual *i* has *T* categorical observations and let $Y_{it}$ denote the *t*-the observation for individual *i*, *t = 1,,T*. If there are *J* possible response states then $Pr\ ( Y_{it} = j|X_{it})$, *j = 1,..,J,* is the probability that individual *i* has response *j* at time *t* given $X_{it}$ ,a column vector of explanatory variables for that observation (Cameron and Trivedi, 2005; Greene, 2018)

The multinomial model is expressed as

$$p_{itj} = Pr\ ( Y_{it} = j|X_{it}) = \frac{e^{X_{it}\beta_j}}{\sum_{k=1}^{J} e^{X_{it}\beta_k}}.$$

Since $e^{X_{it}\beta_j} > 0$ these probabilities lie between 0 and 1 and sum over j to one. Because $\sum_{k=1}^{J} p_{itj} = 1$ an equivalent model is obtained by defining $X_{it}$ to be deviations of regressors from the values of alternative one and setting $X_{i1} = 0$.

The coefficients in the multinominal logit models can be given a more direct logit-like interpretation in terms of relative risk. This is because the models can be re-expressed as binary logit models.

The multinomial logit model pairs each response category with an arbitrary baseline category. In our analysis the response has three states (J = 3): OLF/ unemployed (j = 1), vulnerable employment (j = 2) and non-vulnerable employment (j = 3). For identifiability, OLF/ unemployed is set as the reference category so that $\beta_1 = 0$. The multinomial logit model then has the form:

$$log\ (\frac{p_{itj}}{p_{it1}}) = X'_{it}\beta_j$$

In this study it is appropriate to estimate the model where each individual *i* is now considered as a cluster of observations over time *(t = 1,2,3)*.

As previously explained, we rely on matching ILMPS for Egypt, Jordon, and Tunisia and a geographically gridded daily measures of climate. The impact of changes in the aforementioned climate variables in the respondent's location of residence on the vulnerable employment during a given week reported by the respondent is examined. It should be noted that the location applied in the estimation is the second administrative unit (Markaz/Kism in Egypt, Locality in Jordan, and Sector in Tunisia). We exploit the spatial and temporal variation in our observations to identify the causal impact of temperature, humidity, and precipitation changes on labor market vulnerability in our study. We utilize the same econometric framework adopted by Hlasny and AlAzzawi where the respondent vulnerable employment during week t (Hlasny and AlAzzawi, 2022). Our main explanatory variables of interest are climate variables and climate variables square which have several climate variables in the linear and second-degree polynomials. Climate variables are (1) weekly average of the maximum temperature faced by respondent i in week t in location s; (2) average humidity faced by respondent i in week t in location s; (3) average precipitation faced by respondent i in week t in location s. $X_{it}$ is a vector of individual-level characteristics which are controlled for including age minus 15 years, age minus 15 years-squared, gender, household size, female headed household, highest number of years of education in the household, regional distribution, father's employment status and educational level of the individual and the father's. We also control the respondent's wealth score, at the time of the survey which is expected to impact a respondent's willingness to relocate between employment status. We also include round fixed effects to capture the evolution of vulnerable employment over time.

## 4. Results

### 4.1 Workers' circumstances and labor market outcomes: multinomial probability analysis

Table 2 shows the most restrictive model showing strictly the impact of climate change on employment vulnerability among youth aged 15-29 in the three selected countries, combined. The rise in temperature above average raises the odds of being employed in vulnerable jobs, decreasing the odds of being employed in non-vulnerable jobs, as compared to staying out of the labor force. Precipitation on the other hand reduces the odds of being employed in vulnerable or non-vulnerable jobs as opposed to market inactivity. Precipitation is showing a U-shaped effect on the odds of being employed. Where the odds of being in a job, vulnerable or non-vulnerable decrease the odds of being employed at first and eventually the odds of being employed, in vulnerable or non-vulnerable jobs increases.

Given the different nature of climate change in each of the selected countries, it is expected that differences in the impact of change in climate variables would have differing effects on the odds of employment. Table 3 shows the results of the baseline model separately for the three countries under study.

Table 4 controls for other explanatory variables in the attempt to explain the impact of climate change on the odds of vulnerable employment status as opposed to being inactive. The heat stress resulting from an increase in the average temperature, or the average humidity has similar effect on the odds of employment vulnerability for Egypt and Tunisia, with an opposing effect in Jordan. This highlights that the differing climate nature in Jordan is already reflected on its impact on the youth employment outcomes.

Table 4 controls for other explanatory variables in the attempt to explain the impact of climate change on the odds of vulnerable employment status as opposed to being inactive. The first explanatory variable, workers' age is positively affecting the odds of vulnerable or a non-vulnerable employment, as opposed to inactivity for the three countries, combined and separately. With a negative coefficient on the age squared, the effect is diminishing with age. Women have lower odds of any type of employment (vulnerable or a non-vulnerable) as opposed to being inactive.

Education shows a positive effect for the three countries combined, with a varied effect across each country. Egypt shows a positive effect for both type of employments, as opposed to inactivity. While for Tunisia and Morocco, education, at the intermediate, and the university and above shows a negative odd of being in a vulnerable employment, as opposed to being inactive. This confirms the MENA employment paradox where the highly educated would rather stay with no job rather than join an informal or irregular job for Jordan and Tunisia with a more limited impact in Egypt.

The limited jobs available in the formal sector is causing this mismatch in the Egyptian labor market which further suppresses productivity restricting economic growth.

Looking at the gender interaction with education, the positive coefficients on the university education for Tunisia and Jordan highlight that the odds of being employed (in a vulnerable or a non-vulnerable status) is higher for educated women. It is noticed, however, that for Egypt, as well as the overall effects, the odds are negative. Showing that women and the educated of them are still highly found outside the labor force.

Household wealth has a negative effect on workers' odds of becoming employed in a vulnerable job, for the three countries combined and separately. Workers in larger households have slightly higher odds of joining the labor force but in a vulnerable job status, but lower odds of a non-vulnerable one. This finding is supported for the three countries combined and for Egypt and Tunisia separately, but not for Jordan. This suggests that in larger households, individuals are more open to accepting any type of job to support their larger families. The situation in Jordan appears to be different than Egypt and Tunisia. This could highlight the added worker effect where the burden of the family is spread on larger sized household where one would be less likely to accept a non-vulnerable job as the size of the household expands and other household members could provide the support until a "good" job is made available. With the high reservation wages among the Jordanian workforce this result could be better understood.

The highest level of education among household members is associated negatively with the odds of any type of labor market participation (vulnerable and non-vulnerable). Father's education status is also associated negatively but only with the odds of landing a vulnerable job. The father's employment status has significant impact on the transmission of employment vulnerability through generations. Moreover, the vulnerability of employment varies across the different regions for the three countries.

Controlling for the socioeconomic variables, it can be seen that for the MENA countries combined, rise in temperature is associated with the reduced odds for vulnerable jobs as opposed to inactivity. The effect is insignificant for Egypt as opposed to Tunisia and Jordan. This shows that climate change is not only affecting employment vulnerability but is rather pushing the workforce into a state of inactivity.

The model is re-estimated for rural youth to allow for further understanding of the impact of climate change on the youth employment vulnerability in the rural areas of the MENA countries combined, and for Egypt, Jordan, and Tunisia separately (results reported in table 5 below).

The impact of education on employment status is compounded in rural areas. The effect on the odds of employment vulnerability is still positive for the three countries combined, while negative but with a stronger impact for Tunisia and Jordan. The effect is even larger for educated females. Moreover, the rural variables show a strong and positive impact on the odds of employment vulnerability as opposed to being in a non-vulnerable employment or inactive.

Finally, the climate factors are showing less significance for the rural youth when controlling for the socioeconomic factors. This shows that while climate change and particularly the rise in temperature above the maximum reported average significantly affects employment vulnerability among youth in the MENA countries, the labor market conditions, and the socioeconomic status of the youth play a bigger role making the climate change variables less significant.

From Figure 9 to 10 plots the average marginal effect of all employment vulnerability outcomes by the different climate variables, for rural youth and non-rural youth separately. With all the variables showing similar signs and significance, few variables are worth discussing given the magnitude of their impact on employment vulnerability among rural youth. These probabilities are estimated for each individual in the sample, using the observed values of all control variables. Notably, the graphs also clearly depict the worsening employment vulnerability of rural youth over the climate variables values. Figure 9 shows that there is a steeper incline in the vulnerable outcome of the rural youth group compared to non-rural youth as the temperatures rise. While Figure 10 shows a much steeper rise in the vulnerable outcome of the rural youth group compared to non-rural youth as the humidity rise. As for Figure 11, an increase in precipitation will decline in the vulnerable outcome of the rural youth group compared to non-rural youth. The rural youth group is witnessing a rise in OLF/unemployed outcome because of weak infrastructure in urban areas which yields flooding and hindering daily activities as well in urban cities.

## 5. Conclusion and Policy Implications

The general issue in this paper is not the unemployment or inactivity of youth, but rather the informality and insecurity of employment. It is time we look beyond the unemployment rate and inactivity rate to measure the performance of the labor market, where the quality and stability these jobs bring to the youth is of more importance.

The paper discusses this vulnerability in the rural areas of the MENA countries, where formal jobs are scarce. External factors affect the productivity of workers and the overall performance of the sector, which is adding another layer of vulnerability for rural areas residents and with a gendered impact.

Rural sector development programs that are gender sensitive and ensure equitable resource distribution improves the capacity of rural women to adjust to climate change and to overcome the multi-tiered challenges contributing to the multidimensional deprivation and widespread poverty.

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# Tables

Table 1: Descriptive Statistics.

| | Overall | | | 2006 | | | 2012 | | | 2014 | | | 2016 | | | 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. |
| **Employment vulnerability** | | | | | | | | | | | | | | | | | | |
| OLF/Unemployed | 150356 | 0.60 | 0.49 | 29888 | 0.52 | 0.50 | 37992 | 0.57 | 0.50 | 10396 | 0.61 | 0.49 | 25668 | 0.76 | 0.43 | 46412 | 0.58 | 0.49 |
| Vulnerable | 150356 | 0.23 | 0.42 | 29888 | 0.27 | 0.44 | 37992 | 0.24 | 0.43 | 10396 | 0.24 | 0.43 | 25668 | 0.07 | 0.26 | 46412 | 0.28 | 0.45 |
| Non-Vulnerable | 150356 | 0.17 | 0.38 | 29888 | 0.21 | 0.41 | 37992 | 0.18 | 0.39 | 10396 | 0.15 | 0.35 | 25668 | 0.16 | 0.37 | 46412 | 0.14 | 0.34 |
| Age | 197345 | 26.92 | 20.17 | 37140 | 26.64 | 19.42 | 49186 | 26.31 | 19.93 | 16346 | 34.37 | 22.55 | 33450 | 25.35 | 19.42 | 61223 | 26.45 | 20.13 |
| Gender (=1 if female; =0 if male) | 197205 | 0.50 | 0.50 | 37140 | 0.50 | 0.50 | 49186 | 0.50 | 0.50 | 16199 | 0.52 | 0.50 | 33450 | 0.50 | 0.50 | 61230 | 0.50 | 0.50 |
| Household wealth score | 197405 | -0.06 | 0.93 | 37140 | 0.02 | 0.92 | 49186 | -0.05 | 0.92 | 16430 | -0.18 | 0.83 | 33427 | -0.03 | 1.03 | 61222 | -0.09 | 0.91 |
| Household size | 197437 | 5.09 | 2.23 | 37140 | 5.57 | 2.65 | 49186 | 4.98 | 2.20 | 16430 | 4.46 | 1.73 | 33450 | 5.72 | 2.27 | 61231 | 4.73 | 1.90 |
| Female headed | 197437 | 0.13 | 0.33 | 37140 | 0.13 | 0.34 | 49186 | 0.14 | 0.34 | 16430 | 0.12 | 0.33 | 33450 | 0.10 | 0.30 | 61231 | 0.13 | 0.34 |
| Household maximum years of schooling | 196697 | 11.37 | 4.16 | 37140 | 11.45 | 4.01 | 49186 | 11.35 | 3.90 | 15922 | 9.44 | 5.20 | 33389 | 12.47 | 3.83 | 61060 | 11.23 | 4.13 |
| Rural (=1 if rural; =0 if urban) | 197437 | 0.52 | 0.50 | 37140 | 0.47 | 0.50 | 49186 | 0.56 | 0.50 | 16430 | 0.57 | 0.50 | 33450 | 0.25 | 0.44 | 61231 | 0.64 | 0.48 |
| Rural youth | 114990 | 0.25 | 0.43 | 22913 | 0.25 | 0.43 | 28717 | 0.29 | 0.45 | 9751 | 0.21 | 0.41 | 19197 | 0.12 | 0.33 | 34412 | 0.29 | 0.45 |
| **Education Level** | | | | | | | | | | | | | | | | | | |
| Below intermediate | 162977 | 0.65 | 0.48 | 30977.00 | 0.61 | 0.49 | 40632 | 0.61 | 0.49 | 13105 | 0.83 | 0.37 | 27660 | 0.71 | 0.45 | 50603 | 0.62 | 0.49 |
| Intermediate | 162977 | 0.25 | 0.43 | 30977.00 | 0.29 | 0.46 | 40632 | 0.28 | 0.45 | 13105 | 0.13 | 0.34 | 27660 | 0.17 | 0.38 | 50603 | 0.28 | 0.45 |
| University+ | 162977 | 0.10 | 0.30 | 30977.00 | 0.10 | 0.30 | 40632 | 0.11 | 0.32 | 13105 | 0.04 | 0.19 | 27660 | 0.12 | 0.32 | 50603 | 0.11 | 0.31 |
| **Father Education Level** | | | | | | | | | | | | | | | | | | |
| Below intermediate | 163193 | 0.76 | 0.43 | 31501 | 0.79 | 0.41 | 40666 | 0.76 | 0.43 | 12891 | 0.93 | 0.26 | 27366 | 0.77 | 0.42 | 50769 | 0.71 | 0.45 |
| Intermediate | 163193 | 0.16 | 0.37 | 31501 | 0.14 | 0.34 | 40666 | 0.16 | 0.37 | 12891 | 0.06 | 0.24 | 27366 | 0.15 | 0.36 | 50769 | 0.21 | 0.41 |
| University+ | 163193 | 0.07 | 0.26 | 31501 | 0.08 | 0.26 | 40666 | 0.08 | 0.27 | 12891 | 0.01 | 0.11 | 27366 | 0.08 | 0.27 | 50769 | 0.08 | 0.27 |
| **Father Employment Status** | | | | | | | | | | | | | | | | | | |
| Wage worker | 161829 | 0.60 | 0.49 | 31505 | 0.58 | 0.49 | 40661 | 0.63 | 0.48 | 11999 | 0.58 | 0.49 | 27305 | 0.49 | 0.50 | 50359 | 0.67 | 0.47 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Employer | 161829 | 0.15 | 0.36 | 31505 | 0.26 | 0.44 | 40661 | 0.22 | 0.42 | 11999 | 0.06 | 0.24 | 27305 | 0.04 | 0.20 | 50359 | 0.11 | 0.31 |
| Self Employed | 161829 | 0.13 | 0.34 | 31505 | 0.12 | 0.32 | 40661 | 0.11 | 0.32 | 11999 | 0.26 | 0.44 | 27305 | 0.14 | 0.35 | 50359 | 0.12 | 0.33 |
| Unpaid Family Work | 161829 | 0.11 | 0.32 | 31505 | 0.04 | 0.19 | 40661 | 0.04 | 0.20 | 11999 | 0.10 | 0.30 | 27305 | 0.33 | 0.47 | 50359 | 0.10 | 0.31 |
| Weekly Average Maximum Temperature | 184323 | 25.89 | 8.01 | 33999 | 20.30 | 2.90 | 45782 | 25.95 | 4.28 | 12977 | 20.70 | 4.90 | 33435 | 17.58 | 5.18 | 58130 | 35.06 | 3.86 |
| Weekly Average Relative Humidity | 197079 | 48.60 | 16.83 | 37140 | 55.36 | 13.48 | 49186 | 41.69 | 14.35 | 16087 | 68.68 | 9.93 | 33435 | 60.27 | 11.29 | 61231 | 38.42 | 13.78 |
| Weekly Average Precipitation | 196956 | 0.41 | 1.10 | 37140 | 0.29 | 0.75 | 49186 | 0.07 | 0.31 | 15964 | 1.68 | 1.98 | 33435 | 0.96 | 1.61 | 61231 | 0.11 | 0.48 |

Source: Authors’ calculations

Table 2: Multinomial logistic regression for the impact of climate on employment vulnerability.

| | Vulnerable | Non-vulnerable |
|---|---|---|
| Weekly average maximum temperature | 0.02*** | -0.01*** |
| | (0.003) | (0.002) |
| Weekly average relative humidity | -0.001 | 0.003** |
| | (0.001) | (0.002) |
| Weekly average precipitation | -0.156*** | -0.184** |
| | (0.03) | (0.02) |
| Weekly average precipitation squared | 0.016*** | 0.02*** |
| | (0.005) | (0.004) |
| Constant | -1.41 | -1.1*** |
| | (0.119) | (0.13) |
| N | 140712 | 140712 |
| Clusters | 68875 | 68875 |
| Chi-squared | 673 | 673 |
| Pseudo R-Square | 0.0065 | 0.0065 |

Note: robust standard errors clustered at individual level are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ILMPS 2006–2018.

Table 3: Multinomial logistic regression for Egypt, Jordan, and Tunisia for the impact of climate on employment vulnerability.

| | Egypt | | Jordan | | Tunisia | |
|---|---|---|---|---|---|---|
| | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable |
| Weekly average maximum temperature | -0.05*** | -0.02*** | 0.007*** | -0.073** | -0.04*** | 0.03*** |
| | (0.003) | (0.003) | (0.01) | (0.01) | (0.07) | (0.009) |
| Weekly average relative humidity | -0.002 | 0.006*** | 0.007*** | -0.019*** | -0.03*** | 0.02*** |
| | (0.001) | (0.002) | (0.005)** | (0.004) | (0.004) | (0.006) |
| Weekly average precipitation | 0.077** | -0.21*** | -0.05** | 0.02** | 0.01** | 0.09* |
| | (0.053) | (0.032) | (0.05) | (0.038) | (0.05) | (0.06) |
| Weekly average precipitation squared | -0.03*** | 0.034*** | 0.005*** | 0.0017*** | 0.013*** | -0.018*** |
| | (0.014) | (0.006) | (0.007) | (0.005) | (0.008) | (0.01) |
| Constant | -0.534 | -0.799 | -2.82 | 0.811 | 1.8 | -3.8 |
| | (0.125) | (0.182) | (0.47) | (0.423) | (0.33) | (0.477) |
| N | 140712 | 140712 | 25658 | 25658 | 8298 | 8298 |
| Clusters | 68875 | 68875 | 14256 | 14256 | 7617 | 7617 |
| Chi-squared | 673 | 673 | 46.1 | 46.1 | 146.1 | 146.1 |
| Pseudo R-Square | 0.00 | 0.00 | 0.0067 | 0.0067 | 0.01 | 0.01 |

Note: robust standard errors clustered at individual level are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ILMPS 2006–2018.

Table 4: Multinomial logistic regression for the impact of climate as well as the other socio- economic variables on employment vulnerability.

| | Overall | | Egypt | | Jordan | | Tunisia | |
|---|---|---|---|---|---|---|---|---|
| | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable |
| age_min | 0.202*** | 0.342*** | 0.201*** | 0.379*** | 0.226*** | 0.307*** | 0.161*** | 0.297*** |
| | -0.002 | -0.004 | -0.003 | -0.005 | -0.009 | -0.010 | -0.007 | -0.017 |
| age_minsq | -0.004*** | -0.005*** | -0.004*** | -0.006*** | -0.004*** | -0.006*** | -0.003*** | -0.005*** |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Female=1 | -1.798*** | -4.300*** | -1.686*** | -4.675*** | -3.157*** | -3.656*** | -1.871*** | -2.905*** |
| | -0.039 | -0.053 | -0.043 | -0.064 | -0.112 | -0.108 | -0.081 | -0.127 |
| Intermediate | 0.138*** | 0.418*** | 0.306*** | 0.772*** | -0.394*** | 0.022 | -0.801*** | 0.212* |
| | -0.030 | -0.035 | -0.033 | -0.041 | -0.091 | -0.070 | -0.143 | -0.128 |
| University+ | 0.073 | 0.965*** | 0.329*** | 1.463*** | -0.509*** | 0.338*** | -2.060*** | -0.245 |
| | -0.053 | -0.054 | -0.061 | -0.064 | -0.133 | -0.100 | -0.409 | -0.205 |
| Female * Intermediate | -0.325*** | 1.743*** | -0.441*** | 2.034*** | 0.303 | 1.140*** | 0.293 | 1.080*** |
| | -0.043 | -0.063 | -0.048 | -0.073 | -0.196 | -0.133 | -0.237 | -0.214 |
| Female * University+ | -0.275*** | 2.699*** | -0.456*** | 2.950*** | 0.838*** | 2.109*** | 1.555*** | 2.455*** |
| | -0.074 | -0.075 | -0.081 | -0.091 | -0.279 | -0.145 | -0.553 | -0.274 |
| Household wealth score | -0.180*** | 0.164*** | -0.221*** | 0.107*** | -0.021 | 0.305*** | -0.394*** | 0.192*** |
| | -0.017 | -0.020 | -0.016 | -0.019 | -0.050 | -0.047 | -0.062 | -0.057 |
| Household size | 0.010* | -0.063*** | 0.027*** | -0.033*** | -0.091*** | -0.136*** | 0.081*** | -0.082*** |
| | -0.005 | -0.006 | -0.006 | -0.007 | -0.017 | -0.012 | -0.024 | -0.029 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Female headed | -0.046* | -0.040 | -0.047 | 0.022 | -0.045 | -0.149* | 0.153 | -0.166 |
| | -0.027 | -0.035 | -0.029 | -0.041 | -0.114 | -0.089 | -0.107 | -0.154 |
| Edu max yrs in hhd | -0.049*** | 0.005 | -0.054*** | -0.016*** | -0.050*** | 0.038*** | -0.028*** | 0.011 |
| | -0.003 | -0.004 | -0.003 | -0.005 | -0.013 | -0.011 | -0.009 | -0.012 |
| Father Intermediate | -0.457*** | -0.099*** | -0.490*** | -0.074* | -0.047 | -0.195*** | -0.229 | 0.038 |
| | -0.031 | -0.035 | -0.033 | -0.042 | -0.104 | -0.068 | -0.210 | -0.159 |
| Father University+ | -0.685*** | -0.202*** | -0.755*** | -0.061 | -0.071 | -0.608*** | 0.663 | -0.145 |
| | -0.054 | -0.047 | -0.058 | -0.055 | -0.138 | -0.101 | -0.458 | -0.309 |
| Father Employer | 0.417*** | 0.561*** | 0.434*** | 0.626*** | 0.345** | 0.061 | 0.375** | -0.017 |
| | -0.028 | -0.034 | -0.029 | -0.038 | -0.136 | -0.105 | -0.149 | -0.167 |
| Father Self Employed | 0.205*** | -0.116*** | 0.164*** | -0.047 | 0.384*** | -0.148** | 0.432*** | 0.041 |
| | -0.026 | -0.035 | -0.030 | -0.042 | -0.083 | -0.070 | -0.079 | -0.105 |
| Father Unpaid Fam. Wrkr./Non-employed | 0.122*** | 0.004 | 0.360*** | 0.319*** | -0.363*** | -0.200*** | -0.054 | -0.453*** |
| | -0.033 | -0.042 | -0.038 | -0.056 | -0.076 | -0.058 | -0.127 | -0.164 |
| Jordan-North | -0.184** | 0.470*** | | | -0.262*** | 0.224*** | | |
| | -0.094 | -0.105 | | | -0.086 | -0.071 | | |
| Jordan-South | -0.821*** | 0.752*** | | | -0.957*** | 0.438*** | | |
| | -0.114 | -0.097 | | | -0.114 | -0.071 | | |
| Tunisia-North | 0.444*** | 0.744*** | | | | | | |
| | -0.115 | -0.124 | | | | | | |
| Tunisia-North West | 1.620*** | 0.212 | | | | | 0.985*** | -0.554*** |
| | -0.109 | -0.152 | | | | | -0.123 | -0.156 |
| Tunisia-Center East | 1.565*** | 0.934*** | | | | | 1.000*** | 0.058 |
| | -0.117 | -0.145 | | | | | -0.117 | -0.126 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tunisia-Center West | 1.312*** | 0.214 | | | | | 0.667*** | -0.494*** |
| | -0.111 | -0.159 | | | | | -0.135 | -0.176 |
| Tunisia-South East | 1.128*** | 0.407** | | | | | 0.550*** | -0.416** |
| | -0.135 | -0.169 | | | | | -0.165 | -0.190 |
| Tunisia-South West | 1.684*** | 1.217*** | | | | | 0.989*** | 0.256 |
| | -0.153 | -0.188 | | | | | -0.207 | -0.241 |
| Egypt-Gr. Cairo | 1.311*** | 1.119*** | | | | | | |
| | -0.077 | -0.086 | | | | | | |
| ="Egypt-Alx | 1.254*** | 1.442*** | -0.002 | 0.417*** | | | | |
| | -0.095 | -0.094 | -0.075 | -0.078 | | | | |
| Egypt-Urb. Lwr. | 1.672*** | 1.358*** | 0.382*** | 0.304*** | | | | |
| | -0.079 | -0.085 | -0.048 | -0.061 | | | | |
| Egypt-Urb. Upp. | 1.739*** | 1.616*** | 0.431*** | 0.587*** | | | | |
| | -0.083 | -0.087 | -0.051 | -0.061 | | | | |
| Egypt-Rur. Lwr. | 2.270*** | 2.018*** | 0.986*** | 1.029*** | | | | |
| | -0.080 | -0.084 | -0.046 | -0.055 | | | | |
| Egypt-Rur. Upp. | 2.258*** | 1.952*** | 0.928*** | 0.929*** | | | | |
| | -0.082 | -0.089 | -0.049 | -0.060 | | | | |
| Wave of the survey (year)=2012 | -0.329*** | -0.540*** | -0.387*** | -0.706*** | | | | |
| | -0.051 | -0.049 | -0.049 | -0.051 | | | | |
| Wave of the survey (year)=2014 | 0.000 | 0.000 | | | | | 0.000 | 0.000 |
| | (.) | (.) | | | | | (.) | (.) |
| Wave of the survey (year)=2016 | 0.000 | 0.000 | | | 0.000 | 0.000 | | |
| | (.) | (.) | | | (.) | (.) | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Wave of the survey (year)=2018 | 0.043 | -0.673*** | -0.192*** | -1.223*** | | | | |
| | -0.068 | -0.078 | -0.069 | -0.081 | | | | |
| Weekly average maximum temperature | -0.024*** | -0.035*** | -0.005 | 0.002 | -0.043*** | -0.074*** | -0.026*** | -0.018 |
| | -0.005 | -0.006 | -0.006 | -0.006 | -0.014 | -0.010 | -0.010 | -0.013 |
| Weekly average relative humidity | -0.003 | -0.006** | 0.000 | 0.003 | 0.001 | -0.017*** | -0.007 | -0.007 |
| | -0.002 | -0.002 | -0.002 | -0.003 | -0.006 | -0.004 | -0.008 | -0.010 |
| Weekly average precipitation - EG | -0.088*** | -0.048 | -0.031 | -0.206*** | -0.157*** | -0.009 | -0.162** | 0.083 |
| | -0.029 | -0.033 | -0.053 | -0.051 | -0.060 | -0.043 | -0.073 | -0.087 |
| Weekly average precipitation squared | 0.012*** | 0.010** | -0.023 | 0.026** | 0.018** | 0.003 | 0.022** | -0.006 |
| | -0.005 | -0.005 | -0.015 | -0.010 | -0.008 | -0.006 | -0.010 | -0.013 |
| constant | -1.699*** | -3.409*** | -1.114*** | -4.353*** | -0.758 | -0.316 | -1.289* | -2.126** |
| | -0.215 | -0.249 | -0.248 | -0.290 | -0.541 | -0.414 | -0.696 | -0.924 |
| N | 137840.000 | 137840.000 | 105704.000 | 105704.000 | 25189.000 | 25189.000 | 6947.000 | 6947.000 |
| Clusters | 67065 | 67065 | 46629 | 46629 | 14016 | 14016 | 6430 | 6430 |
| Chi-squared | 33252.4 | 33252.4 | 26053.8 | 26053.8 | 4871.4 | 4871.4 | 2010.5 | 2010.5 |
| Pseudo R-Square | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 |

Note: robust standard errors clustered at individual level are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ILMPS 2006–2018.

**Table 5: Multinomial logistic regression for the impact of climate as well as the other socio- economic variables on rural youth employment vulnerability.**

| | All | | Egypt | | Jordan | | Tunisia | |
|---|---|---|---|---|---|---|---|---|
| | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable | Vulnerable | Non-vulnerable |
| age_min | 0.262*** | 0.696*** | 0.696*** | 0.686*** | 0.171 | 0.939*** | 0.270*** | 0.578*** |
| | -0.016 | -0.047 | -0.047 | -0.060 | -0.226 | -0.102 | -0.071 | -0.157 |
| age_minsq | -0.006*** | -0.020*** | -0.020*** | -0.018*** | 0.002 | -0.036*** | -0.009* | -0.023** |
| | -0.001 | -0.002 | -0.002 | -0.003 | -0.013 | -0.006 | -0.005 | -0.009 |
| Female | -1.533*** | -3.484*** | -3.484*** | -4.291*** | -3.062*** | -3.987*** | -1.369*** | -1.077*** |
| | -0.068 | -0.162 | -0.162 | -0.262 | -0.459 | -0.390 | -0.184 | -0.326 |
| Intermediate | -0.195*** | -0.012 | -0.012 | 0.174* | -0.594 | -0.291 | -0.978*** | -0.696 |
| | -0.049 | -0.089 | -0.089 | -0.104 | -0.497 | -0.226 | -0.295 | -0.434 |
| University+ | -0.407*** | 0.157 | 0.157 | 0.593*** | -1.555*** | -0.985*** | -15.377*** | -2.316* |
| | -0.100 | -0.133 | -0.133 | -0.152 | -0.603 | -0.319 | -0.423 | -1.203 |
| Female * Intermediate | 0.015 | 1.075*** | 1.075*** | 1.917*** | 0.593 | 0.999** | -0.830* | -0.512 |
| | -0.074 | -0.191 | -0.191 | -0.283 | -0.936 | -0.507 | -0.497 | -0.658 |
| Female * University+ | 0.009 | 1.952*** | 1.952*** | 2.739*** | 0.971 | 2.161*** | 13.879*** | 2.312* |
| | -0.140 | -0.207 | -0.207 | -0.294 | -1.282 | -0.491 | -1.076 | -1.361 |
| Household wealth score | -0.122*** | 0.349*** | 0.349*** | 0.241*** | -0.267* | 0.568*** | 0.050 | -0.017 |
| | -0.026 | -0.052 | -0.052 | -0.049 | -0.147 | -0.102 | -0.199 | -0.252 |
| Household size | 0.030*** | -0.080*** | -0.080*** | -0.084*** | -0.135** | -0.087** | 0.090 | -0.056 |
| | -0.008 | -0.015 | -0.015 | -0.018 | -0.061 | -0.034 | -0.056 | -0.079 |
| Female headed | 0.028 | -0.060 | -0.060 | -0.015 | -1.128** | -0.437 | 0.401* | -0.026 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -0.051 | -0.086 | -0.086 | -0.093 | -0.479 | -0.307 | -0.221 | -0.387 |
| Edu max yrs in hhd | -0.059*** | 0.002 | 0.002 | -0.015 | -0.003 | 0.034 | -0.058** | 0.074* |
| | -0.006 | -0.012 | -0.012 | -0.013 | -0.056 | -0.039 | -0.027 | -0.040 |
| Father Intermediate | -0.415*** | -0.094 | -0.094 | -0.059 | 0.069 | -0.206 | -0.359 | -0.458 |
| | -0.051 | -0.085 | -0.085 | -0.093 | -0.366 | -0.199 | -0.503 | -0.726 |
| Father University+ | -0.901*** | -0.314** | -0.314** | -0.082 | -0.116 | -1.362*** | -12.376*** | - 14.904*** |
| | -0.104 | -0.127 | -0.127 | -0.127 | -0.469 | -0.366 | -0.752 | -0.917 |
| Father Employer | 0.592*** | 0.468*** | 0.468*** | 0.541*** | 1.224* | -0.100 | 0.410 | -0.215 |
| | -0.045 | -0.081 | -0.081 | -0.087 | -0.643 | -0.608 | -0.421 | -0.737 |
| Father Self Employed | 0.179*** | -0.050 | -0.050 | 0.060 | 0.447 | -0.300 | 0.634*** | -0.852** |
| | -0.059 | -0.108 | -0.108 | -0.117 | -0.369 | -0.280 | -0.190 | -0.422 |
| Father Unpaid Fam. Wrkr./Non-employed | 0.405*** | 0.261** | 0.261** | 0.452*** | -0.181 | -0.231 | -0.778*** | -0.415 |
| | -0.058 | -0.102 | -0.102 | -0.128 | -0.286 | -0.193 | -0.290 | -0.335 |
| Jordan-North | 0.421 | 0.187 | 0.187 | | 0.227 | 0.140 | | |
| | -0.365 | -0.308 | -0.308 | | -0.328 | -0.250 | | |
| Jordan-South | 0.420 | 0.358 | 0.358 | | 0.313 | 0.277 | | |
| | -0.419 | -0.227 | -0.227 | | -0.399 | -0.222 | | |
| Tunisia-North | 1.560*** | 0.672* | 0.672* | | | | | |
| | -0.421 | -0.390 | -0.390 | | | | | |
| Tunisia-North West | 2.380*** | -0.988** | -0.988** | | | | 0.461 | -1.888*** |
| | -0.380 | -0.472 | -0.472 | | | | -0.387 | -0.498 |
| Tunisia-Center East | 2.810*** | 0.858** | 0.858** | | | | 0.886** | -0.355 |
| | -0.388 | -0.399 | -0.399 | | | | -0.377 | -0.398 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tunisia-Center West | 2.342*** | -0.877** | -0.877** | | | | 0.497 | -1.776*** |
| | -0.365 | -0.420 | -0.420 | | | | -0.405 | -0.539 |
| Tunisia-South East | 2.165*** | -0.422 | -0.422 | | | | 0.448 | -1.336** |
| | -0.431 | -0.478 | -0.478 | | | | -0.484 | -0.627 |
| Tunisia-South West | 3.302*** | -0.234 | -0.234 | | | | 1.318** | -0.821 |
| | -0.417 | -0.624 | -0.624 | | | | -0.597 | -0.774 |
| Egypt-Gr. Cairo | 2.048*** | -0.154 | -0.154 | | | | | |
| | -0.565 | -0.490 | -0.490 | | | | | |
| Egypt-Rur. Lower. | 3.366*** | 0.583*** | 0.583*** | 0.930** | | | | |
| | -0.336 | -0.208 | -0.208 | -0.445 | | | | |
| Egypt-Rur. Upper. | 3.328*** | 0.259 | 0.259 | 0.611 | | | | |
| | -0.337 | -0.220 | -0.220 | -0.443 | | | | |
| Wave of the survey (year)=2012 | -0.372*** | -0.676*** | -0.676*** | -0.826*** | | | | |
| | -0.070 | -0.103 | -0.103 | -0.104 | | | | |
| Wave of the survey (year)=2014 | 0.000 | 0.000 | 0.000 | | | | 0.000 | 0.000 |
| | (.) | (.) | (.) | | | | (.) | (.) |
| Wave of the survey (year)=2016 | 0.000 | 0.000 | 0.000 | | 0.000 | 0.000 | | |
| | (.) | (.) | (.) | | (.) | (.) | | |
| Wave of the survey (year)=2018 | -0.117 | -1.114*** | -1.114*** | -1.560*** | | | | |
| | -0.105 | -0.188 | -0.188 | -0.193 | | | | |
| Weekly average maximum temperature | -0.009 | -0.023 | -0.023 | 0.008 | -0.031 | -0.078*** | -0.029 | -0.050 |
| | -0.008 | -0.015 | -0.015 | -0.014 | -0.043 | -0.027 | -0.024 | -0.042 |
| Weekly average relative humidity | 0.001 | -0.004 | -0.004 | 0.004 | -0.008 | -0.021 | -0.004 | -0.005 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -0.003 | -0.006 | -0.006 | -0.006 | -0.020 | -0.013 | -0.022 | -0.030 |
| Weekly average precipitation | -0.248*** | -0.239** | -0.239** | -0.685*** | -0.789* | -0.227 | -0.303 | 0.022 |
| | -0.064 | -0.098 | -0.098 | -0.188 | -0.412 | -0.180 | -0.192 | -0.252 |
| Weekly average precipitation squared | 0.036*** | 0.036* | 0.036* | 0.201*** | 0.103* | 0.017 | 0.048** | -0.001 |
| | -0.012 | -0.018 | -0.018 | -0.052 | -0.054 | -0.030 | -0.024 | -0.036 |
| constant | -3.434*** | -3.803*** | -3.803*** | -5.280*** | -1.323 | -1.965 | -0.832 | -2.209 |
| | -0.461 | -0.606 | -0.606 | -0.813 | -1.556 | -1.232 | -1.824 | -2.831 |
| N | 26110.000 | 26110.000 | 22751.000 | 22751.000 | 2200.000 | 2200.000 | 1159.000 | 1159.000 |
| Clusters | 13849 | 13849 | 11737 | 11737 | 1073 | 1073 | 1039 | 1039 |
| Chi-squared | 6162.3 | 6162.3 | 4752.2 | 4752.2 | 669.3 | 669.3 | 3187.6 | 3187.6 |
| Pseudo R-Square | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.4 | 0.2 | 0.2 |

Note: robust standard errors clustered at individual level are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ILMPS 2006–2018.

# Figures

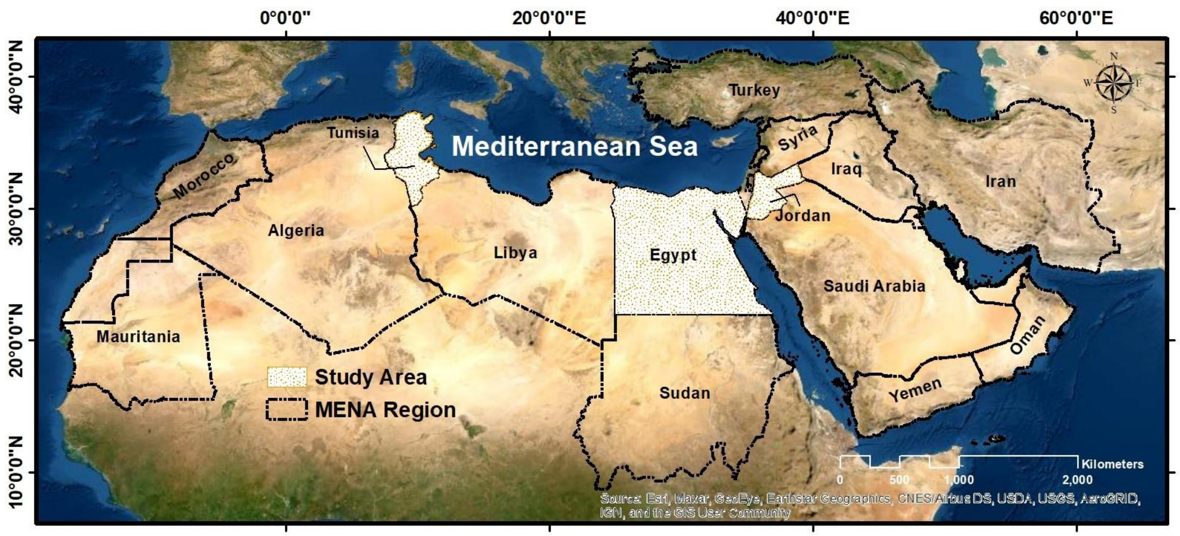


Figure 1: Map of MENA Region Highlighting the Studied Countries

Source: Authors' graph using Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA USGS, AeroGRID, IGN, and the GIS User Community

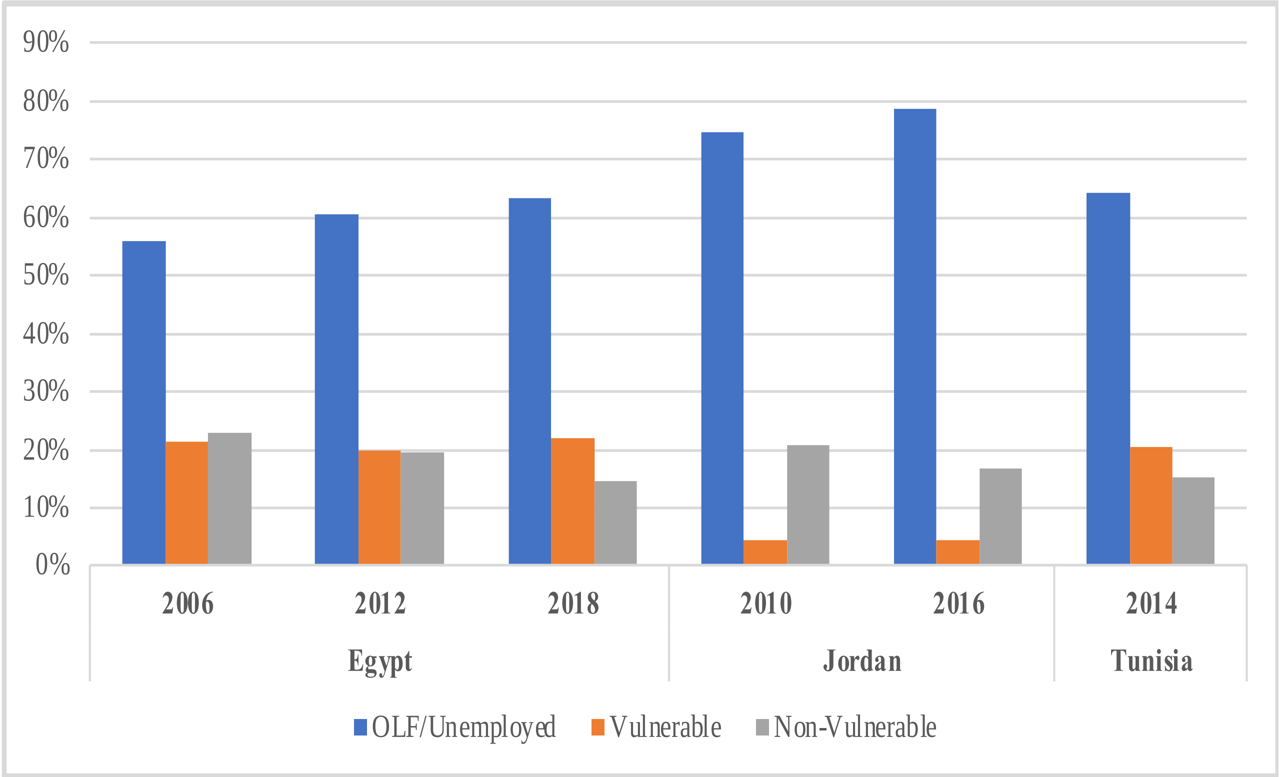


Figure 2: Youth employment status across the rounds of the survey.

Source: Authors' graph.

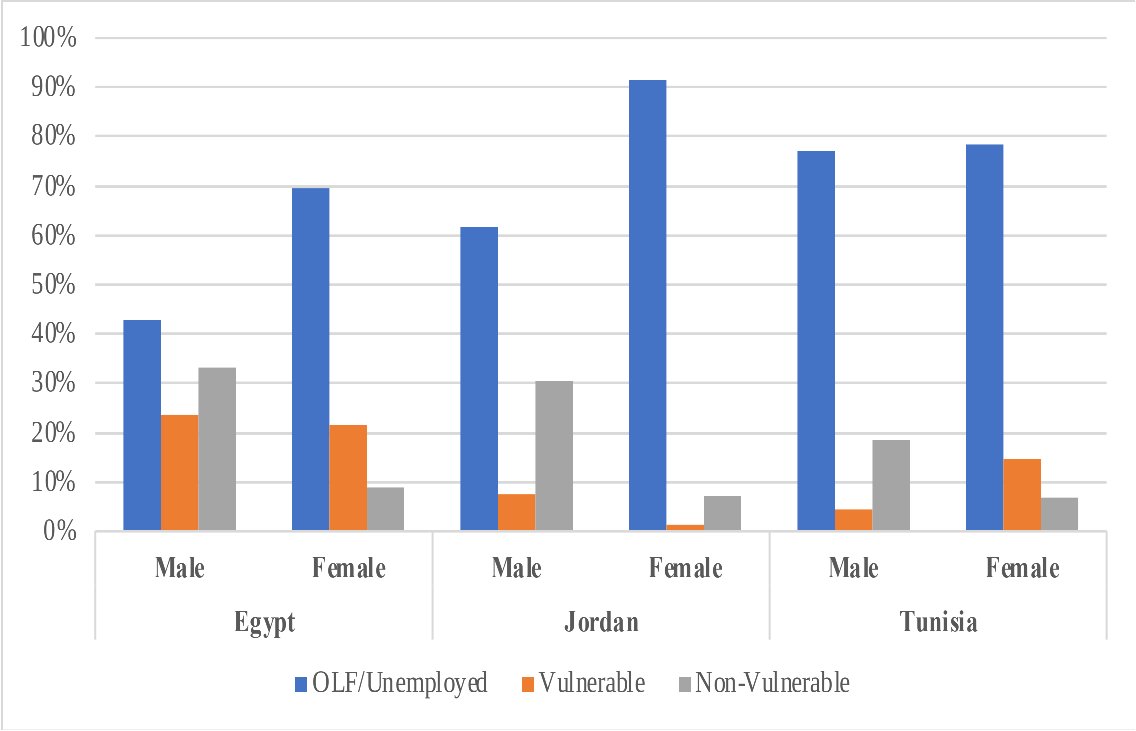


Figure 3: The gender disparities with respect to youth employment.

Source: Authors' graph.

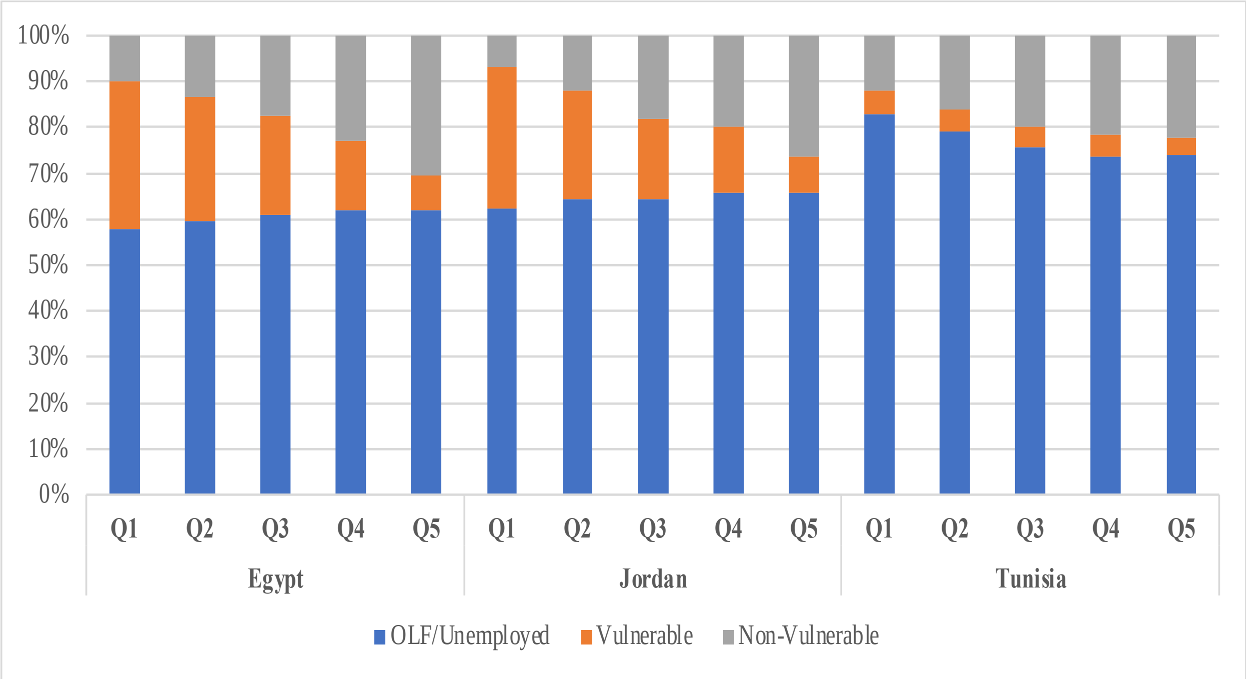


Figure 4: The wealth disparities with respect to employment vulnerability.

Source: Authors' graph.

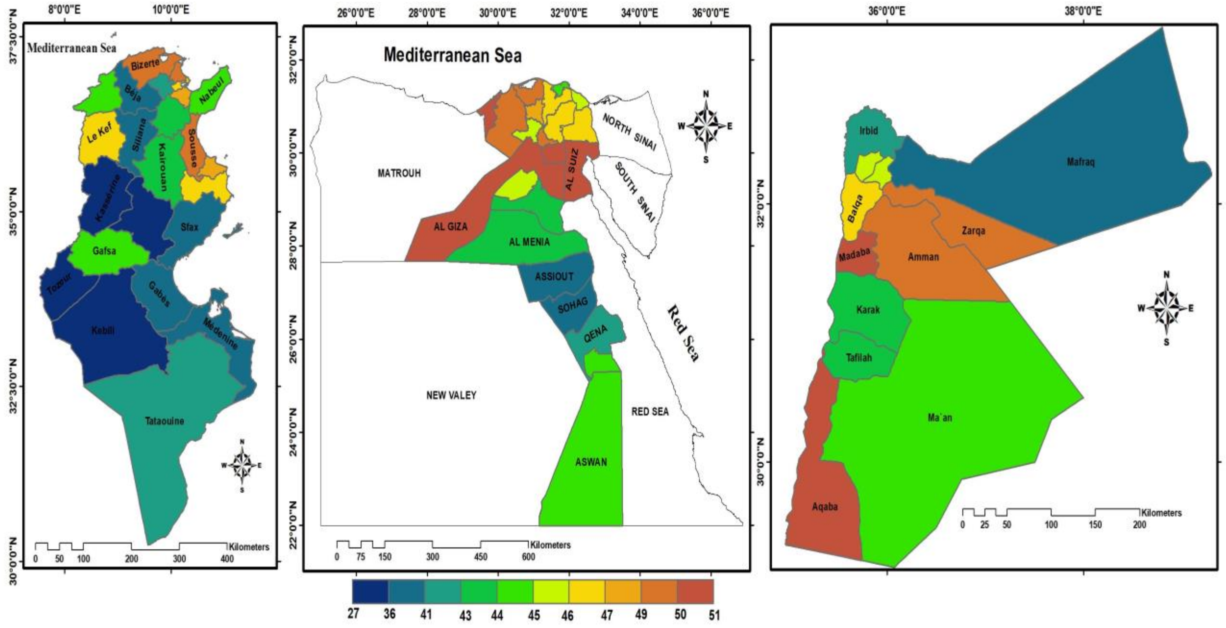


Figure 5: Employment vulnerability prevalence per Governorate

Source: Authors' graph using ILMPS

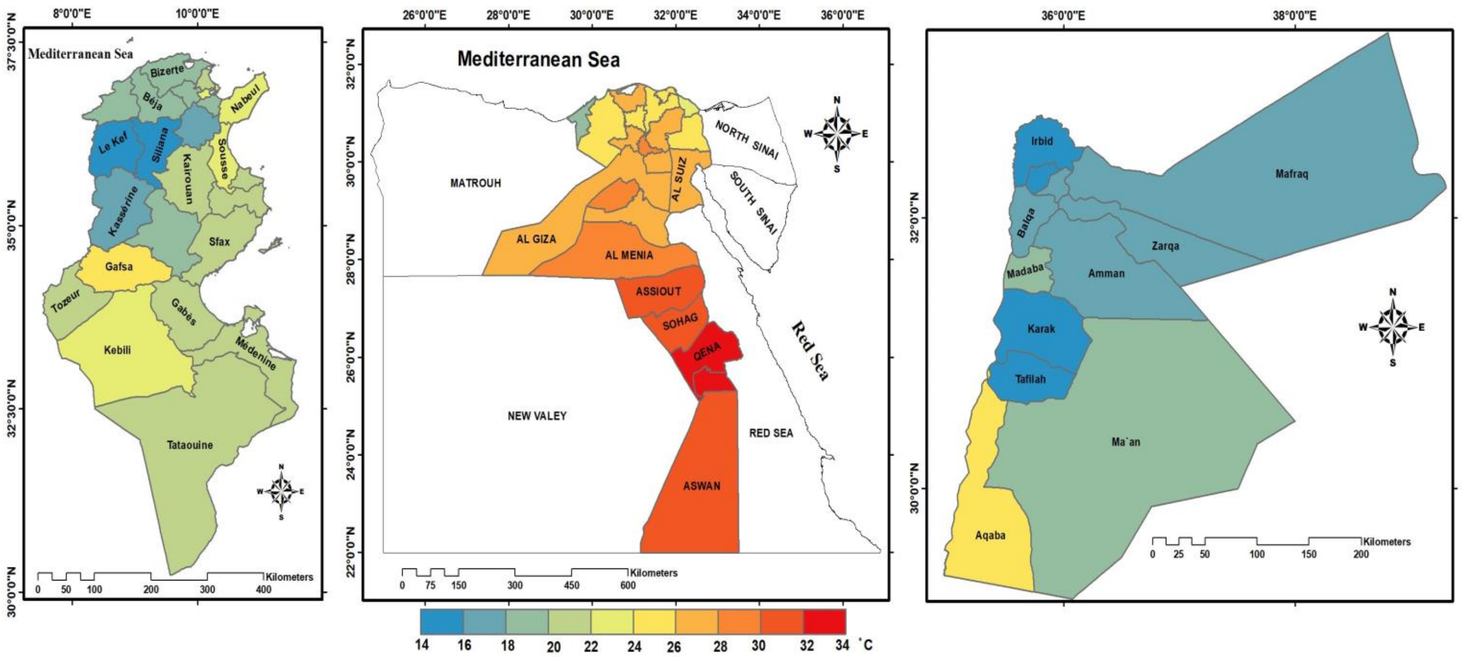


Figure 6: Weekly Average of the Maximum Temperature per Governorate

Source: Authors' graph using NOAA CPC Global and NASA POWER

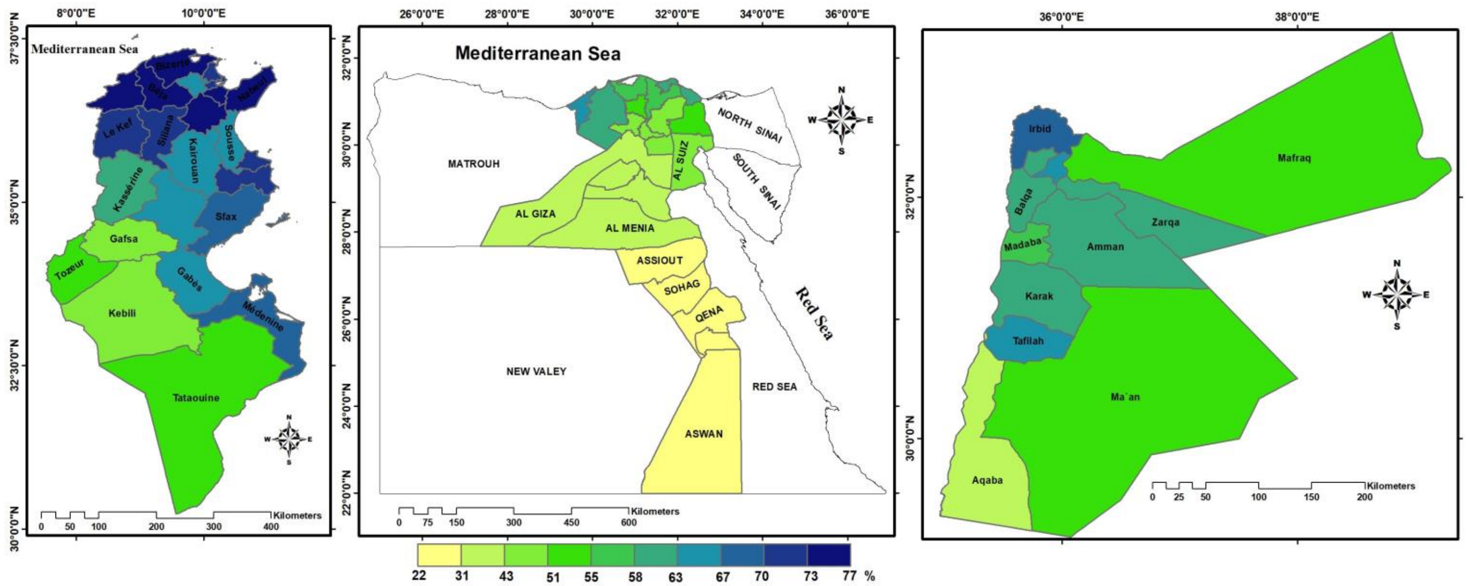


Figure 7: Weekly Average of the Relative Humidity per Governorate

Source: Authors' graph using NOAA CPC Global and NASA POWER

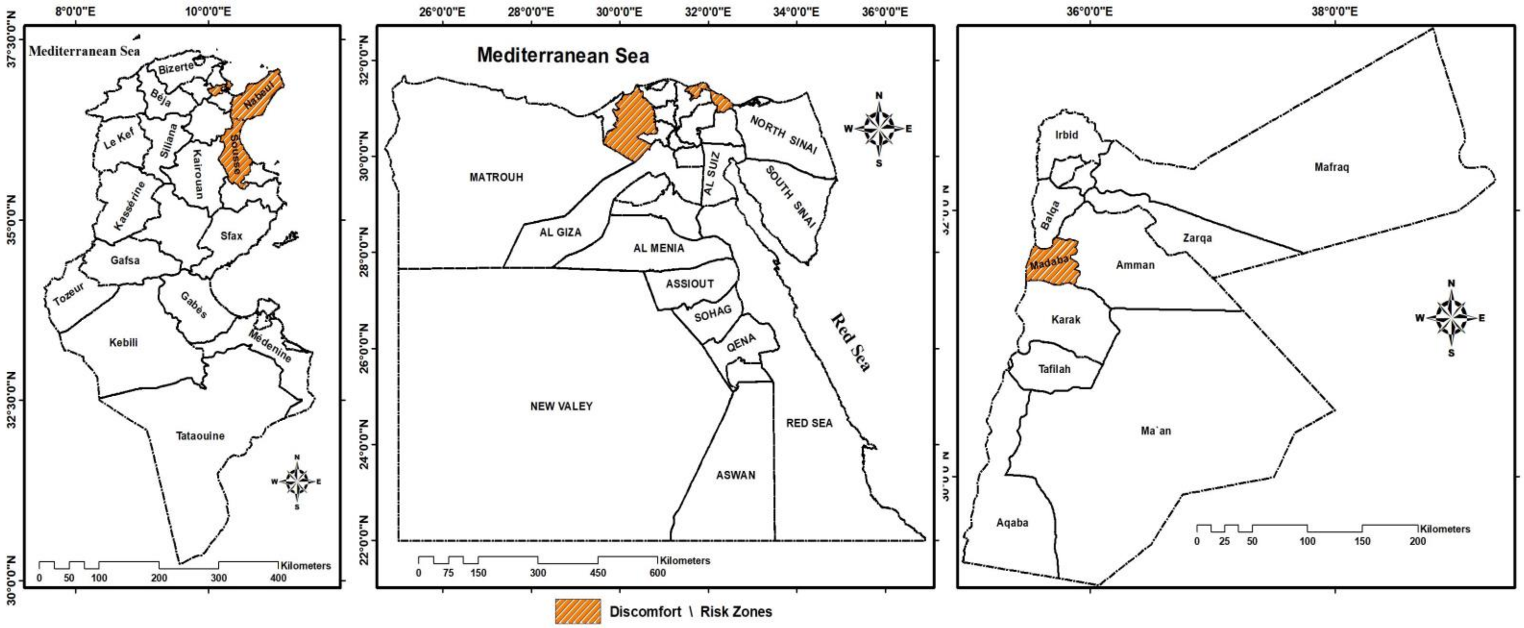


Figure 8: MENA Countries' Risk Zones

Source: Authors' graph using NOAA CPC Global and NASA POWER

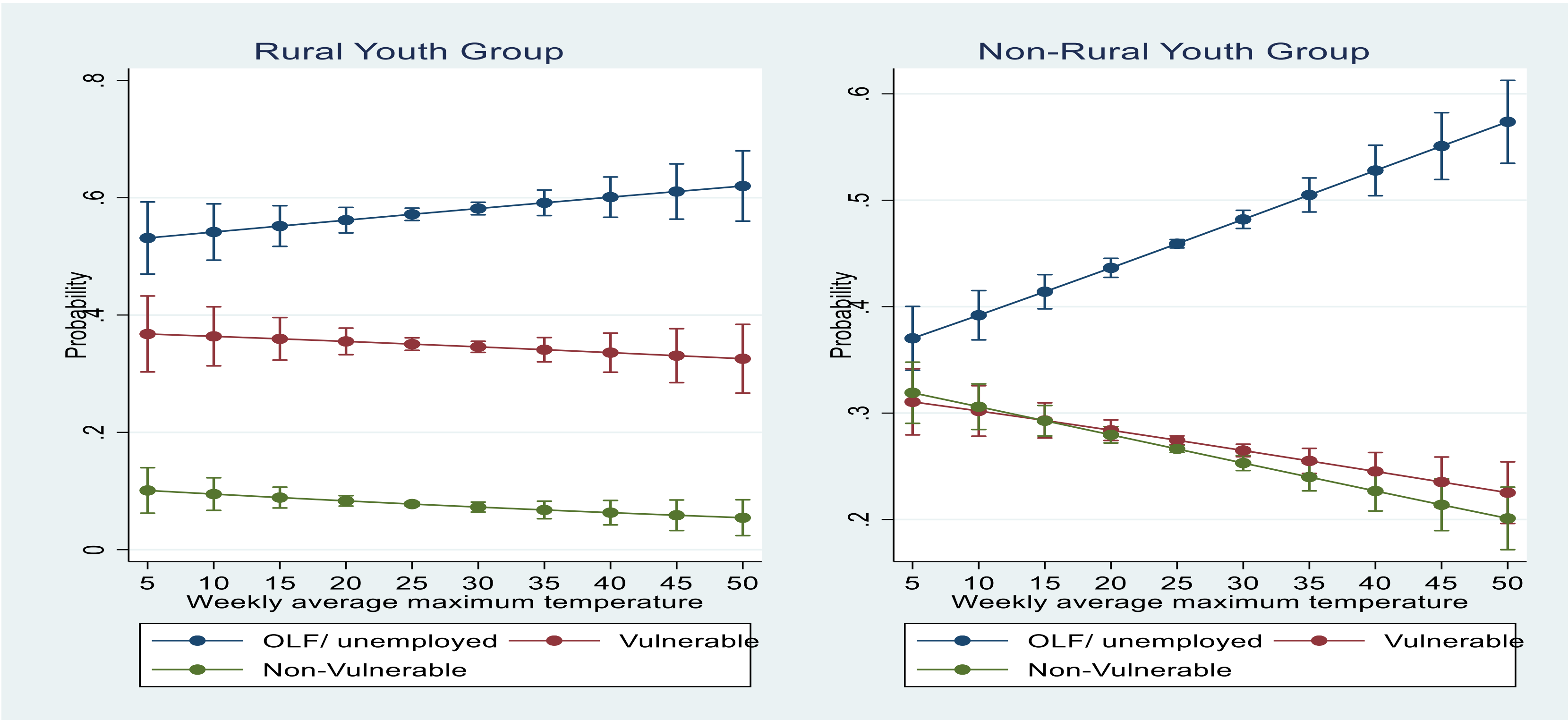


Figure 9: Predicted margins (95% confidence interval)—average maximum temperature and employment vulnerability outcomes.

Source: Authors' graph.

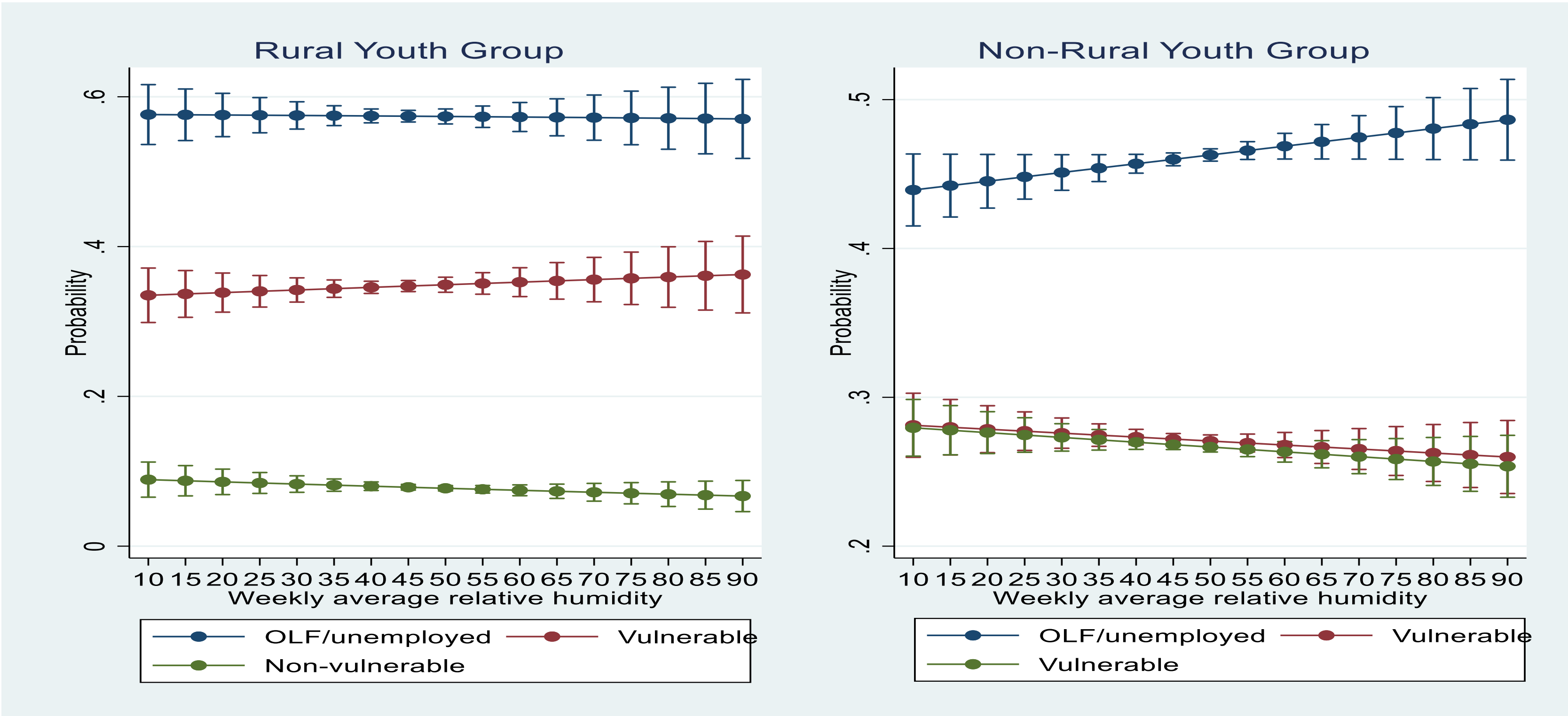


Figure 10: Predicted margins (95% confidence interval)—average relative humidity and employment vulnerability outcomes.

Source: Authors' graph.

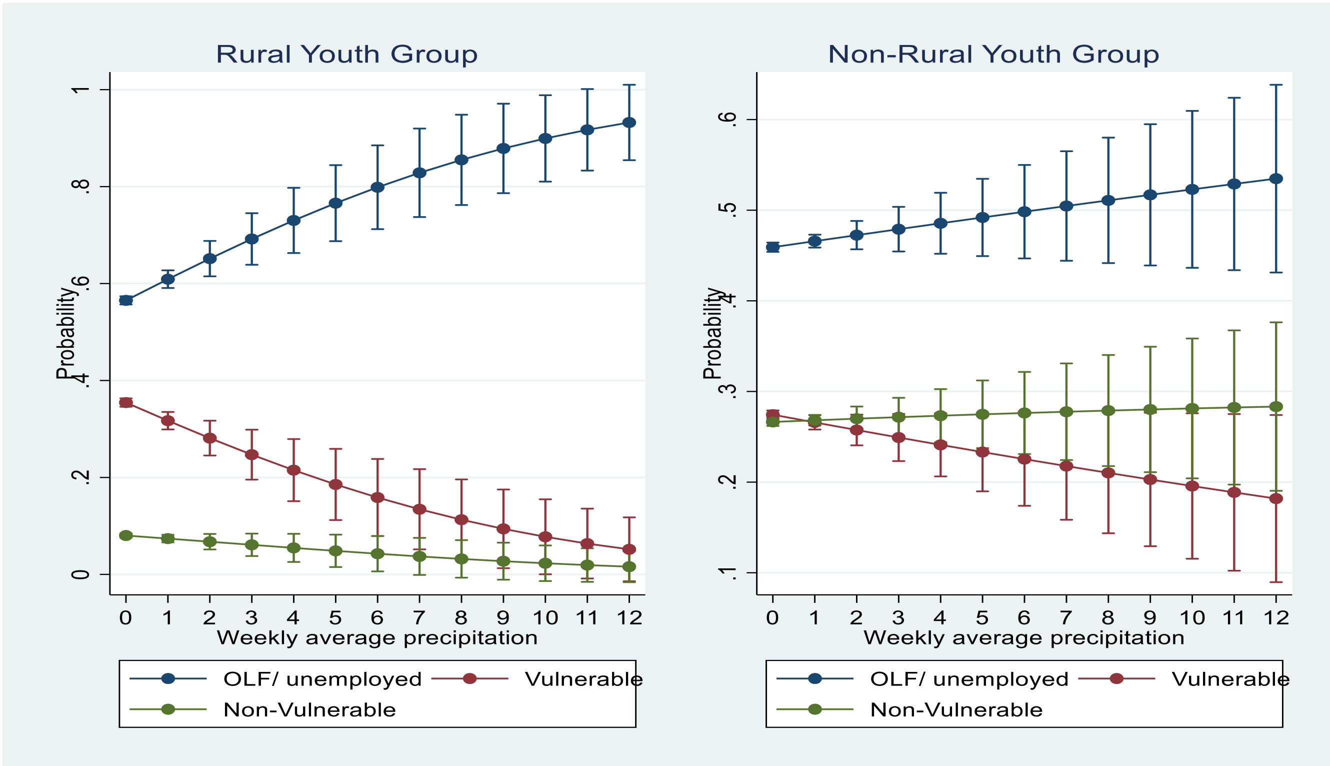


Figure 11: Predicted margins (95% confidence interval)—average precipitation and employment vulnerability outcomes.

Source: Authors' graph.