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Abstract

What are the perceptions of households in the Middle East and North Africa Region regarding changes in the climate of the areas where they live? To what extent are households affected by extreme weather events such as droughts or floods? And who tends to suffer the most from such events when they occur? This chapter suggests answers to these questions on the basis of new household survey data collected in 2011 in Algeria, Egypt, Morocco, Syria, and Yemen. The household surveys were implemented in two climate affected areas in each country. Overall, households in these areas do perceive important changes in the climate, for example with droughts becoming more frequent. While many households declare being affected by extreme weather events, with resulting losses in income, crops, livestock, or fish catchment, this is especially the case of the poor who appear to suffer the most from extreme weather events.

1. Introduction

Climate change is expected to result in an increase in global temperatures by 3°C to 5°C in this century, as well as in a reduction in rainfall and greater seasonal temperature and rainfall variability in many areas. Higher sea levels are also a threat to many areas, including in the MENA region where a large share of its population is located in low lying areas. With agriculture remaining essential for livelihood in the region, and existing conditions in terms of water scarcity being already precarious in many areas, climate change represents a significant concern for households (Verner, 2012; see also World Bank, 2010 and Foresight, 2011). Expectations are that extreme weather events such as floods and droughts are likely to become more frequent, which has implications for coping and adaptation mechanisms, as well as internal and international migration (e.g., UNDP 2009; World Bank, 2011; IPCC, 2012; Elasha, 2010; McSweeney, New, and Lizcano, 2009). For a brief review of the literature which informs this chapter, see the introduction of chapter 2 by Wodon et al. (2014) and chapter 3 on the five countries of focus for this work by Burger et al. (2014a), both in this study.

This chapter focuses on household perceptions regarding climate change, the impact of extreme weather events, and the ways through which households cope with such events. More specifically, the chapter looks at four main questions: (1) What are the perceptions of households in the Middle East and North Africa Region regarding changes in the climate of the areas where they live?; (2) To what extent are households affected by extreme weather events such as droughts or floods and who tends to suffer the most from such events when they occur?; and (3) How do households cope with extreme weather events? The chapter suggests answers to these questions on the basis of new household survey data collected in 2011 in Algeria, Egypt, Morocco, Syria, and Yemen (see Burger et al., 2014a, 2014b). The household surveys were implemented in two climate affected areas in each country with only slight modifications in the survey instrument based on country-specific context. The survey took approximately two hours to administer and it was designed to elicit household perceptions of climate change and environmental degradation, self-assessed economic loss, and coping strategies, among others.

Overall, households do perceive important negative changes in the climate, for example with droughts becoming more frequent, or rainfall more erratic. While many households declare being affected by extreme weather events, with resulting losses in income, crops, livestock, or fish catchment, this is especially the case of the poor who appear to suffer the most. As far as coping mechanisms are concerned, again the poor ten do have fewer options than better off households. While none of the findings are unexpected, they do confirm that the poor tend to be most affected by extreme weather events that are likely to become more frequent with climate change, while they also have fewer means to cope with such events. It must however be emphasized that the household survey results are not meant to be representative of the five countries in which the work was carried, since only a few areas were surveyed in each country. It must also be recognized that it is difficult to distinguish the separate effects of climate change, environmental change, and weather shocks on households, and to separate short-term versus long-term household responses. This is especially the case when working with cross-sectional household surveys given that shorter-term events may be consistent with, but need not necessarily be reflective of longer-term climate change.

These caveats being stated, the chapter is organized as follows. Section 2 introduces the data used for the analysis. Section 3 discusses household perceptions about climate change and extreme weather events. Section 4 provides evidence on the impact of changes in weather patterns and the environment. A brief conclusion follows.

2. Data

This chapter relies on data from five household surveys implemented in Algeria, Egypt, Morocco, Syria, and Yemen. The same household survey instrument was used in all countries with minor adjustments for country context. In each country, 800 households were interviewed. The survey questionnaire was designed by a World Bank team, and the surveys were implemented in the five countries by Rand in collaboration with local partners.

In Algeria, the survey was implemented in the prefectures of Djelfa and M'sila. D'jelfa is in the north-central part of Algeria, while M'Sila is in the northern part. The sites were selected based on reported high sensitivity to desertification and with input from the Algerian government. For example, according to the Ministry of Agriculture and National Center for Spatial Techniques, 62 percent of M'Sila province is classified as "sensitive" or "very sensitive" to desertification. The sample size of 800 families was equally split across the two prefectures.

In Egypt, we selected two Governorates: Dhakhlia and Sharqia. Dhakhlia is north-east of Cairo, while Sharqia is in the northern part of the country. The total sample of 800 interviews was distributed equally across the two governorates. Within each governorate, the selection of villages was dictated by the Egyptian government authority that was approving the survey work (Egyptian Environmental Affairs Agency). There were nine villages selected in Dhakhlia, and 16 villages in Sharquia. A total of 400 interviews were conducted in each governorate.

In Morocco, two regions (al-Gharb, Chichaoua) were selected based on the extent of environmental degradation either due to recent disasters or longer term processes. Within each region, 10 areas or strata were constructed across the entire region. We considered each area (town) selected as its own stratum, and the 10 strata to be overall representative of the region. There were 40 household interviews completed per stratum, under an equal allocation design.

In Syria we selected the governorates of Alhasaka in the northeast and Deir Ezzor in the east. Within Alhasaka, six areas/provinces and 20 villages were selected from two of the four districts. Some areas in Alhasaka were not eligible for inclusion due to safety concerns, no relevant climate/weather impacts, and language issues for areas that bordered Iraq. In Deir Ezzor, 10 areas/provinces and 16 villages were selected. These areas/provinces represented all three districts in Deir Ezzor. Interviews were divided equally between the two governorates.

In Yemen, we selected the governorates of Taiz in the south and Hudayda in the western region. The governorates were chosen because of their exposure to environmental degradation and high rates of migration due to environmental reasons. The sample of 800 interviews was allocated according to population size (58 percent in Taiz and 42 percent in Hudayda. The interviews were completed in 15 villages within Taiz and 11 villages within Hudayda.

The survey questionnaire included a total of 17 sections. This chapter focuses on part of the data collected in section 5 on perceptions related to extreme weather events and climate change, and in section 8 on adverse events. Specifically, the analysis focuses on household answers to four questions (data from the other sections are used for the regression analysis).

First, households were first asked: *"Compared to 5 years ago, have you noticed any changes in the weather patterns in the following way?"* For each of a dozen types of potential changes in weather patterns, households could answer "*yes*", "*no*", or "*don't know*" (two additional codes capture refusal to respond or feedback from the households that the condition is not applicable, but these cases were rare). The potential changes in weather patterns identified in the questionnaire were: *"Rainfall is more erratic; Less rain; More rain; More frequent draught; More frequent floods; More frequent rain storms; More frequent sand storms; Rainy season is*

shorter; The start of the rainy season is later; The end of the rainy season is earlier; The temperature is hotter; and finally The temperature is colder."

Second, household were asked: *"Compared to 5 years ago, have you noticed any of the following changes in the environment?"* Again for each of a dozen options, households could answer "*yes*", "*no*", or "*don't know*". The types of changes in the environment listed were: *"Deforestation and less trees; More frequent livestock loss; More frequent crop failure; Less fish in rivers, lakes or sea; More air pollution; More water pollution in rivers, lakes, sea or streams; Less water in boreholes, rivers, lakes or streams; Land is dryer; Less fertile land; More soil erosion; More insects and pests in crops; More diseases in animals and livestock; Towns and urban areas are more crowded; People have migrated out to other places."* Note that the last two types of changes in the environment result from human responses through migration to changes in weather patterns and the environment. While migration itself may bring changes in the environment, those last two changes will not be included in the analysis of this chapter, which focuses more directly on changes in weather patterns and how they affect households.

The third important question in the section of the questionnaire in climate change used in this chapter relates to the impact of weather and environmental patterns. Specifically, households were asked the following question: *"In the past 5 years, have you or your household experienced the following events as a result of weather and environmental patterns?"* As before, households could respond "*yes*", "*no*", or "*don't know*", this time for four different types of losses: *"Loss of crops; Loss of income; Loss of livestock or cattle; and Less fish caught."*

Finally, in section 8 of the questionnaire, households were asked the following question: *"I am now going to read a list of adverse events that may have occurred over the last 5 years. By shocks, I mean severe weather that has affected your household's welfare. Thinking of adverse events over the last 5 years that have had an impact on your household, please tell me which one adverse event impacted your household the most?"* The potential answers for that question were the following: "*Drought; Flood; Storms; Mudslides; Excessive heat; Excessive rain; Pest infestation; and Crops and livestock diseases.*" Given these four questions, the objective of the chapter is very simple: it is to document household perceptions regarding changes in weather patterns and their environment as well as adverse events, and whether these changes and events lead to various types of losses for households, depending on the households' characteristics.

3. Perceptions of Climate Change

Do households believe that changes in weather patterns and their environment are taking place in the five countries? Before answering that question, it is important to mention a caveat to the analysis. Perceptions of changes in weather patterns need not mean that weather patterns are actually changing or that climate change is actually occurring. In addition, while the questions were asked over the last five years, it could be that household responses reflect perceptions that have matured over a longer period of time. The reason why the questions were asked about the last five years is that household recall of weather patterns is likely to be more accurate over that period than over longer periods of time. As to the reliance on data on perceptions, even if they may not always reflect reality very well (the issue of recall adds to that), they are still an important entry point in trying to understand how changes in weather patterns of the environment affect household livelihoods, and how households respond to such events. In fact, at least to so some extent, one might argue that decisions on how to cope with and adapt to changes in weather patterns and the environment may be influenced as much by how households and individuals perceive those changes than by the events themselves. Thus the information is valuable.

Household perceptions about changes in weather patterns and the environment have been ranked in table 1 according to the share of households sharing these perceptions (that is, answering "*yes*") in the five-country sample. More than three fourths of households in the combined sample (77.5 percent) declare that rain has become more erratic, and almost three quarters (72.4 percent) declares that temperatures have increased. Between half and two thirds of households declare that there is less rain today than five years ago, that the land is dryer or less fertile, that the rainy season starts later, is shorter, or ends earlier, and that droughts are more frequent. Households also believe that the diseases are increasing for animals and livestock, that there are more insects and pets in crops, less water in boreholes, rivers, lakes or streams, more air pollution, more frequent crop failures and livestock loss, and more soil erosion.

A few of the extreme weather events often associated with climate change, such as rain storms and floods, are however not perceived as more frequent by a majority of households, but even for those events, almost half of respondents mention that they have increased in frequency (these events tend to be more localized, so it is to be expected that a smaller share of the sample would report them, which does not necessarily mean that they are less frequent). Some households do suggest that temperatures are becoming cooler (this is the case for almost half of the sample), and that there is actually more rain, but this is often the case only for a minority of households, and the overall picture that emerges is that of negative perceptions of changes in weather patterns and the environment, generally towards a dryer climate.

Table 1: Perceptions of Climate Change and Environmental Conditions (%)

	Country					Assets Quintiles					
	Algeria	Egypt	Morocco	Syria	Yemen	Q1	Q2	Q3	Q4	Q5	All
Changes reported by a majority of households											
Rain more erratic	81.7	43.6	91.1	99.6	71.6	76.8	74.4	78.0	79.8	78.6	77.5
Temperature is hotter	82.9	40.6	69.8	100.0	68.5	66.6	68.5	67.5	79.1	79.7	72.4
Less Rain	81.8	20.5	48.9	100.0	81.6	62.3	57.8	61.6	72.8	77.7	66.6
Land is dryer	64.5	13.8	73.0	98.3	74.6	63.4	65.5	65.1	65.0	65.2	64.8
Less fertile land	53.0	12.4	79.7	94.6	71.5	67.8	64.3	60.0	60.2	59.0	62.2
Rainy season starts later	51.9	12.1	71.4	100.0	67.2	46.4	58.6	62.3	66.0	69.1	60.5
Rain season is shorter	55.5	13.3	64.6	100.0	67.8	47.4	53.5	60.2	68.2	71.4	60.2
More frequent droughts	56.2	16.5	59.3	100.0	63.4	62.7	63.8	63.1	53.8	52.6	59.1
More diseases in animal and livestock	52.2	23.4	58.9	91.8	61.1	63.7	63.3	55.3	55.7	49.3	57.5
More insects and pets in crops	38.5	18.5	71.4	92.4	60.8	52.1	54.5	55.0	61.9	57.8	56.3
Less water in boreholes, rivers, lakes or streams	50.1	11.4	64.6	90.0	64.4	47.5	52.5	59.3	62.9	58.3	56.1
More air pollution	36.1	23.3	71.2	83.0	64.4	55.8	57.0	57.2	51.9	56.2	55.6
More frequent crop failure	41.7	21.0	65.9	87.0	61.2	62.8	59.2	59.9	50.6	44.9	55.4
Rainy season end earlier	39.2	15.1	54.3	99.8	61.6	47.8	51.3	62.2	55.1	53.8	54.0
More frequent livestock loss	47.6	17.5	56.1	88.1	53.0	63.3	55.7	53.9	49.8	40.1	52.5
More soil erosion	29.6	12.6	75.3	91.1	53.5	48.8	53.9	58.8	51.5	49.5	52.4
Changes reported by a minority of households											
More frequent sand storms	50.7	10.3	36.7	99.5	45.8	51.2	51.0	54.5	44.7	42.0	48.6
Temperature is colder	54.1	27.8	34.5	73.8	42.8	40.9	44.4	42.5	52.7	52.0	46.6
More water pollution in rivers, lakes, sea or steams	20.1	18.8	65.5	47.0	41.7	34.4	41.2	48.0	38.0	32.0	38.6
Deforestation and less trees	39.6	13.0	37.3	68.6	34.3	52.0	45.2	41.2	29.6	25.4	38.6
Less fish is rivers, lakes or sea	1.2	12.4	38.5	36.0	35.1	24.2	26.0	27.2	26.0	20.0	24.7
More frequent rain storms	21.2	9.8	59.4	0.1	16.9	25.8	28.3	25.2	16.6	12.0	21.5
More rain	15.1	20.8	52.0	0.0	17.5	23.6	27.5	28.5	15.3	11.1	21.1
More frequent floods	17.8	3.5	58.2	0.0	7.6	21.1	22.4	23.6	12.1	8.5	17.4

Source: Authors' estimation.

Basic statistics are also provided in table 1 on perceptions by country, and according to the welfare level of households. The welfare quintiles are based on an index of wealth estimated through factorial analysis, as often done in the absence of data on consumption. The quintiles are based on an index of wealth estimated through factorial analysis, as often done in the absence of good data on consumption. There are clear differences between countries in perceptions, as expected. In Syria, virtually all households declare that most of the changed in weather patterns and in the environment are occurring. In Egypt by contrast, none of the changes is reported by a majority of households, with the most frequent change reported being that of rain being more erratic by 43.6 percent of households. The other three countries fall somewhere in between, with some changes reported more in some countries and others in others. Of course, these data are not representative of the countries as a whole, but only of the two areas sampled in each of the countries. Still, there is clear evidence that in most areas – with the exception of Egypt, households do perceive negative changes in weather patterns and the environment to take place. By contrast, differences in perceptions by quintiles of well-being are smaller, also as expected given that within areas all households should broadly notice the same changes in climate and the environment, even if the impact of these changes may not be the same for all households.

While table 1 provides detailed data on various dimensions of autonomy identified in the screening card, it is also useful to come up with summary measures or indices of autonomy. These are obtained through multiple correspondence analysis (MCA), a technique used for analyzing the relationship between variables taking categorical values. This type of analysis is often used to uncover the main underlying factors that capture the variance in a data set, typically with visualization along two or three dimensions. Here, we are using the techniques to obtain aggregate indices of the changes in perceptions regarding changes in weather patterns and the environment. By construction the indices constructed through the MCA are defined in such a way that they explain a share of the variance in the underlying variables as large possible. In implementing the MCA, we relied on the subset of variables related to the perceptions of weather patterns and the environment for which at least five percent of the sample responded in the affirmative, so as to reduce potential noise in the data. Given that for most changes in weather patterns and the environment more than five percent of household declare that these changes are actually occurring, this procedure does not affect the results too much.

The results for the first two factors of the MCA are presented in tables 2 and 3. In each table, the original variables are ranked according to their contribution to each of the two factors, by descending order of contribution. For example in table 2 the three variables contributing the most to the first factor are “Land is dryer-No” and “Less Fertile Land –No”, and “Rainy season starts later-No”. By contrast, in table 3, the variables contributing the most to the second factor are “More Rain-Yes”, “More frequent floods-Yes” and More frequent rain storms-Yes”. The first factor explains a very large share (88.3 percent) of the inertia or variance in the data included in the MCA, with the second factor explaining an additional 6.0 percent of the inertia. Given that these two factors explain most of the inertia in the original variables, we will use only these two factors in the subsequent analysis.

Consider first table 2. In order to understand intuitively what the first factor represents, it is necessary to look at both the contribution of each variable and modality to the factor, and the sign and value of the coordinates for the variables. The first twelve largest contributors are all indicators of good climatic conditions in that there is no deterioration in these variables - Land is not dryer nor is it less fertile; the rainy season does not start later, nor is it shorter; draughts are not more frequent, and insects and pests in crops are not increasing, and so on. The coordinates

for all those variables are positive, so that when these modalities are observed in the data, the first factor takes on a larger value. The next set of contributors include many variables that take a positive value – yes, there is more soil erosion and livestock losses, as well as more insects and pests in crops. There is also less water in boreholes, the rain is more erratic, the land is less fertile, draughts are more frequent, and so on. For these modalities, the coordinates are negative, suggesting that these modalities reduce the value assigned to the first factor. Overall, a higher value for the first factor thus suggests good weather conditions especially in terms of rainfall and its implications for land fertility, while a lower value suggests that negative structural changes are occurring, with less rain, more draughts, and thereby poorer agricultural conditions.

Consider next table 3. The variables and modalities with the largest contributions to that factor are very different. More rain, as well as more frequent floods and rain storms are the first three contributors, and they have positive coordinates. Negative answers to questions about the frequency of rain storms and floods as well as the amount of rain are also important contributors, but with negative coordinates. This second factor seems to capture the presence of excess water, especially through floods and rain storms, which tend to be sudden events, as opposed to more structural conditions. While a larger positive value for the first factor denotes good conditions, a larger positive value for the second factor is associated with excess water, which is a negative.

In order to facilitate the interpretation of the econometric analysis in section 4, we will use the two factors of the MCA, but with two transformations. First, we will consider the negative value of the first factor as our first summary climate variable. This means that a larger positive value for the first factor will denote worse structural conditions in terms of climate (higher temperatures, reduced land fertility, more draughts and erratic rainfall, etc.). With that first transformation, larger positive values for both factors will denote worsening climate and environmental conditions. Second, we will normalize the two factors so that they both take a value between zero and one (this is done by redefining each factor as its value minus the minimum value, and dividing the result by the difference between the maximum and minimum values). Thus, a value close to zero will imply that the conditions are among the best in the sample, while a value close to one will denote some of the worst conditions in the sample. For ease of interpretation, and even though this does not capture all of what the two factors represent, we will denote the two factors as respectively “Dryer/Warmer Weather” and “Excess Rain”. The question will be whether these two factors are closely associated with losses for households.

Table 2: Results from Multiple Correspondence Analysis – First Factor

Categories	Mass	Quality	% inertia	Coordinate	Sq. corr. coefficient	Contribution
Land is dryer-No	0.014	0.959	0.039	1.714	0.954	0.043
Less Fertile Land –No	0.016	0.959	0.036	1.58	0.959	0.039
Rainy season starts later-No	0.016	0.942	0.033	1.44	0.92	0.034
More Insect & Pets in crops-No	0.019	0.951	0.032	1.355	0.942	0.034
More frequent draught-No	0.017	0.963	0.03	1.389	0.96	0.033
Rain season is shorter-No	0.017	0.93	0.033	1.407	0.881	0.033
More Soil Erosion-No	0.02	0.958	0.031	1.303	0.946	0.033
Less water in boreholes, rivers, etc.-No	0.019	0.96	0.029	1.309	0.96	0.032
More diseases in animal/livestock-No	0.018	0.949	0.03	1.327	0.942	0.032
More frequent livestock loss-No	0.02	0.936	0.029	1.246	0.921	0.031
More frequent crop failure-No	0.018	0.955	0.028	1.274	0.928	0.03
More air pollution-No	0.018	0.969	0.028	1.28	0.955	0.03
More Soil Erosion-Yes	0.022	0.958	0.028	-1.159	0.946	0.03
More frequent livestock loss-Yes	0.022	0.936	0.026	-1.123	0.921	0.028
Rainy season end earlier-No	0.019	0.971	0.025	1.172	0.956	0.027
More Insect & Pets in crops-Yes	0.023	0.951	0.026	-1.089	0.942	0.027
Less water in boreholes, etc.-Yes	0.023	0.96	0.023	-1.051	0.96	0.026
Temperature is hotter-No	0.012	0.966	0.024	1.467	0.912	0.025
Rain More Erratic-No	0.01	0.954	0.023	1.601	0.953	0.024
Less Rain-No	0.014	0.91	0.03	1.309	0.729	0.024
Less Fertile Land –Yes	0.026	0.959	0.022	-0.968	0.959	0.024
More diseases in animal/livestock-Yes	0.024	0.949	0.022	-1.001	0.942	0.024
More frequent draught-Yes	0.025	0.963	0.021	-0.959	0.96	0.023
More frequent sand storms-Yes	0.02	0.969	0.021	-1.069	0.962	0.023
Rainy season end earlier-Yes	0.022	0.971	0.021	-1.014	0.956	0.023
More frequent crop failure-Yes	0.023	0.955	0.022	-0.998	0.928	0.023
More air pollution-Yes	0.023	0.969	0.022	-1.003	0.955	0.023
Land is dryer-Yes	0.027	0.959	0.021	-0.913	0.954	0.023
More frequent sand storms-No	0.021	0.969	0.02	1.018	0.962	0.022
Rain season is shorter-Yes	0.025	0.93	0.022	-0.938	0.881	0.022
Rainy season starts later-Yes	0.025	0.942	0.021	-0.933	0.92	0.022
Deforestation and less trees-Yes	0.016	0.938	0.02	-1.135	0.925	0.021
More water pollution in rivers, etc.-Yes	0.016	0.929	0.023	-1.141	0.819	0.021
Less fish is rivers, lakes or sea-Yes	0.01	0.941	0.02	-1.348	0.835	0.019
Less Rain-Yes	0.027	0.91	0.015	-0.68	0.729	0.013
Deforestation and less trees-No	0.025	0.938	0.013	0.725	0.925	0.013
More water pollution in rivers, etc.-No	0.026	0.929	0.014	0.721	0.819	0.013
Temperature is hotter-Yes	0.03	0.966	0.009	-0.566	0.912	0.01
Rain More Erratic-Yes	0.032	0.954	0.007	-0.473	0.953	0.007
Less fish is rivers, lakes or sea-No	0.031	0.941	0.006	0.442	0.835	0.006
Temperature is colder-No	0.023	0.899	0.004	0.41	0.898	0.004
Temperature is colder-Yes	0.019	0.899	0.004	-0.483	0.898	0.004
More Rain-Yes	0.009	0.766	0.014	0.375	0.078	0.001
More frequent rain storms-Yes	0.009	0.787	0.011	-0.323	0.076	0.001
More Rain-No	0.033	0.766	0.004	-0.103	0.078	0
More frequent floods-No	0.034	0.778	0.002	0.032	0.013	0
More frequent floods-Yes	0.008	0.778	0.011	-0.147	0.013	0
More frequent rain storms-No	0.033	0.787	0.003	0.091	0.076	0

Source: Authors' estimation.

Table 3: Results from Multiple Correspondence Analysis – Second Factor

Categories	Mass	Quality	% inertia	Coordinate	Sq. corr. coefficient	Contribution
More Rain-Yes	0.009	0.766	0.014	4.272	0.688	0.164
More frequent floods-Yes	0.008	0.778	0.011	4.317	0.765	0.141
More frequent rain storms-Yes	0.009	0.787	0.011	3.785	0.71	0.131
Less Rain-No	0.014	0.91	0.03	2.51	0.181	0.09
Less Rain-Yes	0.027	0.91	0.015	-1.302	0.181	0.047
More Rain-No	0.033	0.766	0.004	-1.172	0.688	0.045
More water pollution in rivers, etc.-Yes	0.016	0.929	0.023	1.607	0.11	0.042
More frequent rain storms-No	0.033	0.787	0.003	-1.066	0.71	0.037
Less fish is rivers, lakes or sea-Yes	0.01	0.941	0.02	1.843	0.106	0.035
More frequent floods-No	0.034	0.778	0.002	-0.956	0.765	0.031
Rain season is shorter-No	0.017	0.93	0.033	1.268	0.048	0.027
More water pollution in rivers, etc.-No	0.026	0.929	0.014	-1.016	0.11	0.026
Temperature is hotter-No	0.012	0.966	0.024	1.375	0.054	0.022
Rain season is shorter-Yes	0.025	0.93	0.022	-0.845	0.048	0.018
More frequent crop failure-No	0.018	0.955	0.028	-0.832	0.027	0.013
Rainy season starts later-No	0.016	0.942	0.033	0.845	0.021	0.012
Less fish is rivers, lakes or sea-No	0.031	0.941	0.006	-0.605	0.106	0.011
More frequent crop failure-Yes	0.023	0.955	0.022	0.652	0.027	0.01
Rainy season starts later-Yes	0.025	0.942	0.021	-0.547	0.021	0.008
Temperature is hotter-Yes	0.03	0.966	0.009	-0.531	0.054	0.008
More frequent livestock loss-No	0.02	0.936	0.029	-0.615	0.015	0.007
More frequent livestock loss-Yes	0.022	0.936	0.026	0.555	0.015	0.007
Rainy season end earlier-No	0.019	0.971	0.025	0.565	0.015	0.006
More air pollution-No	0.018	0.969	0.028	-0.592	0.014	0.006
More Soil Erosion-No	0.02	0.958	0.031	-0.571	0.012	0.006
More Soil Erosion-Yes	0.022	0.958	0.028	0.508	0.012	0.006
Rainy season end earlier-Yes	0.022	0.971	0.021	-0.488	0.015	0.005
Deforestation and less trees-Yes	0.016	0.938	0.02	0.528	0.014	0.005
More air pollution-Yes	0.023	0.969	0.022	0.464	0.014	0.005
More Insect & Pets in crops-No	0.019	0.951	0.032	-0.511	0.009	0.005
More Insect & Pets in crops-Yes	0.023	0.951	0.026	0.411	0.009	0.004
More diseases in animal/livestock-No	0.018	0.949	0.03	-0.453	0.007	0.004
Deforestation and less trees-No	0.025	0.938	0.013	-0.338	0.014	0.003
Land is dryer-No	0.014	0.959	0.039	0.46	0.005	0.003
More diseases in animal/livestock-Yes	0.024	0.949	0.022	0.341	0.007	0.003
More frequent sand storms-No	0.021	0.969	0.02	0.313	0.006	0.002
More frequent sand storms-Yes	0.02	0.969	0.021	-0.329	0.006	0.002
Land is dryer-Yes	0.027	0.959	0.021	-0.245	0.005	0.002
More frequent draught-No	0.017	0.963	0.03	0.286	0.003	0.001
More frequent draught-Yes	0.025	0.963	0.021	-0.197	0.003	0.001
Rain More Erratic-No	0.01	0.954	0.023	0.119	0	0
Rain More Erratic-Yes	0.032	0.954	0.007	-0.035	0	0
Temperature is colder-No	0.023	0.899	0.004	0.054	0.001	0
Temperature is colder-Yes	0.019	0.899	0.004	-0.064	0.001	0
Less water in boreholes, rivers, etc.-No	0.019	0.96	0.029	-0.013	0	0
Less water in boreholes, rivers, etc.-Yes	0.023	0.96	0.023	0.011	0	0
Less Fertile Land –No	0.016	0.959	0.036	0.061	0	0
Less Fertile Land –Yes	0.026	0.959	0.022	-0.037	0	0

Source: Authors' estimation.

4. Impact on Households

Having described the perceptions of households about changing weather patterns and their environment, we now turn to the question of whether households declare having been affected by specific extreme weather events, and in that case which events had the largest impact on them. The data can also be used to assess whether households suffered from specific losses due to such events. As shown in table 4, when asked if they have been affected by a weather-related disaster in the last five years, almost all households say that this is indeed the case, except in the case of Egypt where the proportion is smaller, but still high at 70.75 percent.

When asked which adverse event had the largest negative consequences for them, households cited draughts first (30.9 percent of the overall sample), followed by excessive heat (which can be associated with draughts) and floods, both affecting about eight percent of households. These two factors – draughts and excessive heat on the one hand, and floods on the other hand, are closely related to the two factors that were obtained from the MCA in the previous section, although the MCA factors tend to capture a broader range of phenomena, including some of the consequences of changes in weather patterns, for example in terms of land fertility. Note that there are differences between countries in table 4. In Syria, all households declare having been affected by draughts, which are also considered as the most damaging adverse event. In Morocco by contrast, floods were the main adverse event affecting households. There are also some differences between households according to their quintile of wealth, but these are less pronounced. For example, the data suggest that households in the poorer quintiles are more likely to identify the adverse events that affected them the most, probably because they are more vulnerable to such events.

Table 4: Reported Incidence of Extreme Weather Events and their Impact (%)

	Country					All
	Algeria	**Egypt**	**Morocco**	**Syria**	**Yemen**	
Affected by disaster						
No	0.13	29.25	-	-	0.62	5.99
Yes	99.87	70.75	100.00	100.00	99.38	94.01
Adverse event with largest impact						
Drought	10.92	2.38	14.30	99.00	27.89	30.90
Flood	1.60	0.13	34.56	-	1.38	7.54
Storms	1.72	0.25	-	-	0.38	0.47
Mudslides	8.46	-	-	-	0.25	1.74
Excessive Heat	12.67	8.88	13.21	0.75	5.28	8.16
Excessive Rain	4.56	5.63	4.19	-	2.64	3.40
Pest Infestation	10.73	0.25	-	0.13	0.25	2.27
Crops And Livestock Diseases	7.40	5.38	0.53	0.13	1.26	2.94
No Adverse Impact	41.93	77.13	33.21	-	60.68	42.57
	Quintiles					**All**
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	
Affected by disaster						
No	7.37	5.92	4.92	5.22	6.53	5.99
Yes	92.63	94.08	95.08	94.78	93.47	94.01
Adverse event with largest impact						
Drought	27.16	30.67	37.37	32.04	27.53	30.90
Flood	10.93	11.74	10.03	4.11	1.23	7.54
Storms	0.00	0.78	1.32	0.17	0.12	0.47
Mudslides	1.06	5.21	2.46	-	0.12	1.74
Excessive Heat	8.54	8.26	7.69	7.21	9.10	8.16
Excessive Rain	4.60	4.13	4.41	1.92	2.06	3.40
Pest Infestation	7.08	3.22	0.89	-	0.25	2.27
Crops And Livestock Diseases	3.33	3.40	4.32	2.01	1.75	2.94
No Adverse Impact	37.31	32.61	31.52	52.54	57.84	42.57

Source: Authors' estimation.

The fact that the poor are more likely to suffer from changes in weather patterns and the environment is confirmed by households' responses to the other question about the effect of these changes on them. As mentioned in section 2, households were asked whether in the last five years they suffered from lost income, lost crops, lost livestock or cattle, or less fish caught as a result of weather and environment patterns (the surveys do not provide data on the magnitude of the losses; they only inform us as to whether losses occurred). Table 5 summarizes the responses. More than half of all respondents said that changes in weather patterns and the environment led to a loss of crops, and more than a third reported a loss of income. About a fourth reported a loss of livestock or cattle, and 8.6 percent said that they caught less fish (this would be observed only for those households whose livelihood depend on fishing). The results differ again between the countries, with especially high frequencies of losses of crops in Syria (remember that virtually all households in the areas surveyed reported suffering from a drought), and lower frequencies in Egypt. Yet as expected, households belonging to lower quintiles of well-being were more likely than better off households to declare having suffered from the various types of losses.

Table 5: Economic Impacts of Environmental Change (%)

	Country					All
	Algeria	Egypt	Morocco	Syria	Yemen	
Lost income	58.11	8.25	44.90	19.50	52.11	36.59
Lost crops	58.48	28.63	38.00	87.00	60.95	54.62
Lost livestock or cattle	31.21	3.75	26.92	17.00	38.18	23.43
Less fish caught	0.00	0.88	14.77	1.50	25.75	8.60
	Quintiles					**All**
	Q1	Q2	Q3	Q4	Q5	
Lost income	46.37	44.14	43.21	29.25	20.72	36.59
Lost crops	58.12	61.96	62.13	49.42	42.10	54.62
Lost livestock or cattle	23.81	25.19	30.11	23.17	15.23	23.43
Less fish caught	9.51	10.27	8.90	9.65	4.69	8.60

Source: Authors' estimation.

Do these results on the differentiated impact of adverse weather events on households depending on their welfare level still hold when conducting multiple regression analysis? The answer to this question is provided in table 6 which displays the results of standard probit regressions on whether households declare having lost income, crops, livestock/cattle, or caught less fish. The marginal effects estimated at the mean of the sample are displayed, and the levels of statistical significance are based on robust standard errors. Many of the variables included in the regression have statistically significant impacts on the probability of losses. There are differences between countries in the likelihood of losses as well as the types of losses incurred, which is not surprising given the differences in the local economies in the various areas. For example, losses in crops are most likely in Yemen, which is also the country with the largest share of GDP accounted for by agriculture, while losses in income are most likely in Syria, which is the country in which more households reported adverse events.

As expected, the two climatic conditions factors have statistically significant impacts on the likelihood of losses. The impacts are large. Recalling that the climatic factors are normalized to take a value between zero and one, going from the best conditions (value of zero) to the worst conditions (value of one) in the sample for the first factor related mostly to draughts as well as dryer and warmer weather increases the probability of losses by 42.4 percent for crops, 45.8 percent for income, 31.0 percent for livestock or cattle, and 10.8 percent for fishing. For the second factor which is related mostly to floods and excess water, the impacts of going from best to worst conditions are of a similar order of magnitude, at 42.7 percent for crops (the same order of magnitude as that observed for the first factor), 27.6 percent for income, 34.3 percent for livestock or cattle, and 15.1 percent for fishing. Thus, even if the occurrence of adverse events and environmental conditions related to the first factor are more frequent than those related to the second factor, once those conditions come into play, both types of changes in weather patterns and environmental conditions have large negative effects on the livelihoods of households.

Also as expected, the probability of a loss is higher in many cases for poorer households. This is clear for crop and income losses, where in both cases households in the bottom three quintiles of wealth tend to have an increase in the probability of a loss of about ten percentage points as compared to households in the top quintile of wealth. On the other hand, losses in livestock and cattle as well as in fishing are highest in the fourth quintile of well-being, possibly because those households are more likely to be involved in these activities which tend to require more assets, while households in the top quintile tend not to be working much in agriculture. It could of course be that part of the relationship between welfare levels and losses associated with

adverse weather events is due to an endogeneity issue, in that the lower level of wealth observed for the households who suffered from a loss may reflect the loss itself. Yet because of the way the questions are asked over a five year period, and because welfare is measured through assets as opposed to income, it is likely that the correlations also reflect simply a higher propensity of low income households to be more exposed to such losses due to their occupations.

The relationship between occupation and losses actually comes out strongly as well in the regression. First, households who own land (and probably cultivate it), and to some extent households who are land tenants, both tend to have a higher probability of losses related to adverse weather events. A similar pattern is observed in terms of the types of occupation of the household head, with the highest marginal impact on the likelihood of losses for crops and incomes observed among the self-employed in agriculture, in comparison to the reference category of the salaried. Those households who have better jobs as salaried worker, as well as households whose heads have higher levels of education tend to be the least likely to suffer from crop, income, livestock/cattle, or fishing losses related to adverse weather events.

All of these results make sense, and the regressions simply display basic facts that are somewhat obvious – namely that households who tend to be poorer as well as those who rely on agriculture and livestock as well as fishing for their livelihoods are the most exposed to losses related to changes in weather patterns and environmental conditions. The other variables in the regressions – such as the household size and the gender of the household head, do not have statistically significant impacts on the likelihood of losses. But two more variables display statistically significant correlations. First, in several instances households with younger household heads tend to be less affected by adverse weather shocks, perhaps because they tend to be less employed in traditional agricultural activities than households with older heads, with these effects being only partially controlled for in the regression through the other independent variables. At the same time however, those who are single are more likely to suffer an income or livestock loss, perhaps at least in the first case because they are also more likely to be involved in casual labor that is less required when crops are destroyed by draughts or floods.

Table 6: Correlates of Probability of Various Losses Due to Adverse Events (dF/dX)

	Loss of crops	Loss of income	Loss of livestock or cattle	Less fish caught
Country (ref.=Syria)				
Algeria	0.293***	-0.344***	0.171***	-
Egypt	0.119*	-0.344***	0.021	0.070
Morocco	0.138***	-0.549***	0.104***	0.134***
Yemen	0.482***	-0.143***	0.445***	0.473***
Climatic conditions				
Factor 1: Dryer/Warmer Weather	0.428***	0.458***	0.310***	0.108***
Factor 2: Excess Water	0.427***	0.276***	0.343***	0.151***
Quintiles (ref.=Q5)				
Q1	0.104**	0.069*	-0.035	0.022
Q2	0.088**	0.118***	-0.022	0.009
Q3	0.134***	0.110***	0.049	0.011
Q4	0.041	0.059	0.053*	0.046**
Household size (ref.=Less than four)				
From 5 to 8	0.013	-0.000	-0.000	0.001
More than 8	0.029	-0.009	0.112***	-0.017*
Land status (ref.=Other)				
Land owners	0.424***	0.218***	0.167***	0.080***
Land tenants	0.347***	0.070	0.059	0.051*
Head age (ref.=50+)				
Below 30	-0.105**	-0.133***	-0.052	-0.024***
30-39	-0.037	-0.122***	0.060**	-0.017**
40-49	-0.017	-0.111***	0.029	-0.014**
Head gender (ref.=Female)				
Male	0.110	-0.077	-0.060	-0.072
Head marital Status (ref.= Other)				
Single	0.147	0.221**	0.279**	0.098
Married	0.090	0.108	0.059	0.020*
Head education (ref. =Below primary)				
Primary	0.058*	0.014	0.037	0.006
Preparatory	-0.046	-0.059	-0.005	0.019
Secondary	-0.091**	-0.112***	-0.043	-0.015*
Above Secondary	-0.053	-0.134**	-0.056*	-0.010
Head public employee (ref.=no)				
Head is public employee	0.038	0.035	-0.007	0.008
Head occupation (ref.=Salaried)				
Self-Employed Farmer	0.224***	0.251***	0.045	-0.024***
Non-Agric Self Employed	-0.048	0.064	0.004	-0.008
Other Employer	0.111**	0.206***	0.022	0.009
Servant/Unqualified	0.034	0.136***	0.048	0.013
Other	-0.014	0.123**	0.044	0.028
Agriculture/Fisheries/Pastoral activities	0.075	0.182***	0.155***	0.006
Number of observations	3,009	3,009	3,009	2,302

Source: Authors' estimation. Robust standard errors in parentheses.
Note: Levels of statistical significance *** p<0.01, ** p<0.05, * p<0.1.

5. Conclusion

The goal of this chapter was to contribute to a better understanding of perceptions of climate change and environmental degradation, as well as extreme weather events and their impact on households in the MENA region. The analysis was based on household surveys implemented in five countries, with a focus in each country on two areas more susceptible to be affected by adverse weather shocks. The data suggest that a substantial majority of households do perceive important changes in the climate and their environment. Some of the most commonly reported changes include more erratic rain, higher temperatures, less rain, dryer and less fertile land, and more frequent droughts. In some areas by contrast, excess rain is the issue, especially when it leads to floods. As expected, these household perceptions of changes in weather patterns and the environment are strongly correlated with the likelihood that households declare having suffered from various types of losses in livelihood due to adverse climatic events.

Also as expected, the data suggest that households involved in agriculture, and especially the poor as measured through indices of wealth, are most likely to suffer from losses in crops and income, the two most frequently cited types of losses associated with adverse weather events. By contrast, households who tend to be more protected through a better education and salaried employment are much less likely to suffer from the negative effects of perceived climate change and adverse weather shocks. While none of those results are in themselves surprising, they help to set the stage for subsequent chapters devoted to an analysis of how households cope with these changes, first through migration, and then through other coping and adaptation mechanisms.

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Annex Table 1: Distribution of Perceptions by Quintiles of the MCA's First Factor (%)

		Quntiles for First factor				
		1	**2**	**3**	**4**	**5**
Rain More Erratic	No	58.10	28.18	17.27	5.47	4.89
	Yes	41.90	71.82	82.73	94.53	95.11
Less Rain	No	80.92	34.54	30.04	19.65	5.52
	Yes	19.08	65.46	69.96	80.35	94.48
More Rain	No	75.31	75.19	70.96	78.36	92.60
	Yes	24.69	24.81	29.04	21.64	7.40
More frequent draught	No	88.03	63.34	35.29	11.07	6.27
	Yes	11.97	36.66	64.71	88.93	93.73
More frequent floods	No	92.52	77.56	73.34	74.63	91.34
	Yes	7.48	22.44	26.66	25.37	8.66
More frequent rain storms	No	92.52	77.68	67.08	69.40	83.44
	Yes	7.48	22.32	32.92	30.60	16.56
More frequent sand storms	No	91.90	69.20	57.70	26.62	10.54
	Yes	8.10	30.80	42.30	73.38	89.46
Rain season is shorter	No	91.52	45.76	42.30	16.17	4.02
	Yes	8.48	54.24	57.70	83.83	95.98
Rainy season starts later	No	92.27	46.01	35.17	17.41	5.52
	Yes	7.73	53.99	64.83	82.59	94.48
Rainy season end earlier	No	89.90	59.60	46.93	28.48	6.78
	Yes	10.10	40.40	53.07	71.52	93.22
Temperature is hotter	No	68.70	29.80	24.41	13.31	2.89
	Yes	31.30	70.20	75.59	86.69	97.11
Temperature is colder	No	74.19	53.87	55.19	53.36	33.75
	Yes	25.81	46.13	44.81	46.64	66.25
Deforestation and less trees	No	95.76	83.54	60.70	46.02	18.82
	Yes	4.24	16.46	39.30	53.98	81.18
More frequent livestock loss	No	96.13	74.44	47.18	13.93	5.14
	Yes	3.87	25.56	52.82	86.07	94.86
More frequent crop failure	No	90.27	65.71	41.55	19.65	2.26
	Yes	9.73	34.29	58.45	80.35	97.74
Less fish is rivers, lakes or sea	No	97.88	88.53	77.10	71.02	41.78
	Yes	2.12	11.47	22.90	28.98	58.22
More air pollution	No	94.26	57.86	42.05	19.40	5.90
	Yes	5.74	42.14	57.95	80.60	94.10
More water pollution in rivers, lakes, sea or steams	No	97.26	77.68	57.07	58.08	15.93
	Yes	2.74	22.32	42.93	41.92	84.07
Less water in boreholes, rivers, lakes or streams	No	94.14	62.34	37.17	26.00	2.76
	Yes	5.86	37.66	62.83	74.00	97.24
Land is dryer	No	93.27	51.00	20.03	8.58	0.75
	Yes	6.73	49.00	79.97	91.42	99.25
Less Fertile Land	No	97.01	52.99	26.16	12.06	1.51
	Yes	2.99	47.01	73.84	87.94	98.49
More Soil Erosion	No	97.88	69.70	43.18	21.02	3.39
	Yes	2.12	30.30	56.82	78.98	96.61
More Insect & Pets in crops	No	95.76	64.84	36.42	21.89	3.64
	Yes	4.24	35.16	63.58	78.11	96.36
More diseases in animal and livestock	No	92.39	66.46	34.04	14.80	7.03
	Yes	7.61	33.54	65.96	85.20	92.97

Source: Authors' estimation.