

Climate Change within Arid Environments: A Case Study of Local Perceptions in Jordan's Badia

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Abstract A year-long survey (2021-2022) was conducted among 165 Bedouin households in Jordan's arid Badia region to assess local opinions on climate change. The study adopted both quantitative and qualitative approaches to assessing how residents perceive climate change, their observations of its physical effects, and its most significant economic and social impacts on their lives. The study concluded that overall locals were highly concerned with climate change and its immediate effects on the Badia. Moreover, the study reviewed a generational gap in climate change awareness and understanding, while older generations' awareness is based on their own experiences and oral traditions to interpret environmental changes. In this sense, their responses to climate challenges are more focused on practical, physical alterations to the local environment. The younger generations, on the other hand, had more academic and media-based awareness of climate change, as a result, their solutions were more intangible and focused predominantly on awareness raising and education. The study also found several clear signs of climate change, including decreased rainfall, delayed rainy seasons, increased temperatures, and frequent waves of drought, with occasional sudden floods caused by soil destabilization and heavy rainfall. In conclusion, it is crucial to engage the views of the elderly, youth, and decision-makers, combining education, modern media, traditional knowledge, and practical experiences of local generations, to make sound decisions and identify important strategies that help mitigate the effects of climate change and enhance agricultural and livestock production.

Keywords Climate Change, Awareness, Local Knowledge, Environment and Sustainability, Bedouin, Arid Land

1. Introduction

'Badia' is an Arabic word that refers to the arid and semi-arid regions of the Middle East where annual rainfall is typically below 200 mm [1-4]. The Badia covers a significant portion of the region's countries, making up around 80% of Jordan, 75% of Iraq, 90% of Saudi Arabia, and 55% of Syria [5,6].

The Badia is divided into two main zones: the steppe and the desert, classified based on rainfall and vegetation. The steppe, with annual rainfall between 100 mm and 200 mm, supports vegetation suitable for grazing, while the desert receives less than 100 mm of rain each year and has fewer grazing resources. In Jordan, the Badia is further categorized into three regions: northern, southern, and middle. The inhabitants, known as Badu or Bedouin, were traditionally nomadic, though those remaining today are largely semi-nomadic [1,2]. Jordan now faces critical decisions about managing these arid lands, as the traditional pastoral lifestyle of the Bedouin has largely collapsed without an effective replacement [2,7].

In the past century, desertification and growing aridity have emerged as two tandem challenges for ecosystems on the edge of barren lands. According to a 2009 United

Nations report, over 20% of the Middle East and North Africa (MENA) was at risk of desertification [8]. More recent findings from the Intergovernmental Panel on Climate Change suggest that this percentage could be even higher, with up to 70% of the region possibly facing desertification due to climate change and the overuse of drylands [9].

Climate change represents a major environmental challenge to development, especially in areas suffering from water scarcity. In the coming years, evaporation is expected to increase due to rising temperatures, which will affect agricultural areas and semi-arid areas [10]. Studies indicate that rising temperatures, global warming, and drought will increase in the coming years [11]. This requires actually confronting these challenges and finding immediate and future solutions.

It is estimated that by 2025, 90 million Middle Easterners will encounter water stress in one form or another, and as lands become uninhabitable and incomes disappear, climate refugees will become more prevalent [12]. The first to be affected by this are those currently living in rural arid and semi-arid environments, namely the Bedouin. This group is the focus of this paper; their innate knowledge of the spaces they have inhabited for generations provides a unique view into the changing climate, the techniques they have used to adapt themselves, and the trends they have noticed [13]. The Bedouins, like many other groups of indigenous peoples, have depended predominantly on the local biological diversity that exists on the margins of human habitation. Collectively indigenous people “utilize 22 percent of the world’s land surface. In doing so, they maintain 80 percent of the planet’s biodiversity”; additionally, this land “contain[s] hundreds of gigatons of carbon” [14]. The Intergovernmental Panel on Climate Change (IPCC) recognized the need for indigenous knowledge, as a means of combating climate change, saying their understanding “may prove useful for ... adaptation strategies that are cost-effective, participatory and sustainable” [10].

2. Background & Literature Review

2.1. Education

In 2016, Jordan presented its first National Determined Contribution (or NDC) to the United Nations Framework Convention on Climate Change (UNFCCC). They did so, in an effort to reduce greenhouse gasses and spur climate education within schools [15]. Yet despite this, there is, as of yet, no national mandate to ensure the teaching of climate science in schools, only the suggestion that it should “reach all levels” [15]. Additionally, Jordan’s NDC does not put forth any stipulations regarding the enhancement of teacher’s training on climate topics; and, without this proper training, there leaves room for the unintended circulation of misinformation surrounding

climate change and its effects. Climate change may lead to a rise in temperature and a decrease in rainfall levels [5]. Admittedly, Jordan’s NDC scores among the highest regionally, in terms of national efforts to combat climate change and circulate climate education, though it certainly could be bolstered. And, according to the World Bank, Jordan would benefit greatly from “international cooperation to support national efforts to deliver climate change education” [15].

2.2. Media

For years, Jordanians have been engaging with climate dialogue via local and international networks. Social media, according to a UNICEF report, has become one of the primary channels for Jordanian youth to raise their concerns and fears about the urgency and social responsibility of policy makers [16]. This form of modern media allows for a discursive interchange between urban and rural communities, allowing for a more personalistic side of climate change. Youth are more exposed than ever to the loss of human life during extreme weather events, including hurricanes, tropical hurricanes, heatwaves, cold snaps, and heavy precipitation. Though social media acts as a global-climate news source and has incentivized political action, it can also lead to dissolution and exhaustion. According to the Shorenstein Center on Media, Politics, and Public Policy, the “repetition of a narrow narrative that focuses exclusively on the impacts of climate change leaves the public with an overall sense of powerlessness” [17]. Hence, as Liyu Woldemichael, a climate researcher from Duke University, argues, it becomes necessary for media to present positive solutions along with frequent coverage of the issue, finding examples like indigenous people practicing “sustainable living” to inspire youth through online platforms [18]. Similarly, the Jordanian government produced a National Climate Change Policy Document (NCCP) for the period 2013-2020. It is considered the first official document to include climate change [19]. Jordan also published its second National Climate Change Plan (2022-2050), which aims to build a low-carbon society [20].

2.3. Oral Tradition and Lived Experience

Melody Hunter-Pillion, a historian and journalist at Duke University, makes the case that “oral histories provide customized tools for resilience in communities with distinct ecosystems, threatened by global climate change” and that ultimately this type of knowledge should be “shared and used by communities, scientists, resource managers, and historians” to combat the climate crisis [21]. These knowledge systems can include reading nature’s signs, weather prediction, and also stories of flora and fauna that may have disappeared in the region as a result of the changing environment [21]. The researcher conducted a study of oral history and lived experience in rural communities in Fiji finding that communities had

witnessed an increase in extreme weather events and village relocations as a result of the deteriorating environment [22]. Another study, conducted by Cruikshank [23], an anthropologist at the University of British Columbia, analyzed the ways in which indigenous Alaskans used oral tradition to track the ablation of glaciers. She found that consistently indigenous knowledge was sidelined for more empirical data-driven analysis [23].

2.4. Observed Phenomenon

Extreme weather events have been on the rise, especially within the MENA region, where both temperatures and droughts have hit record highs [24]. Cyprus also recorded its highest temperature ever recorded in September 2020, at approximately 46.2 °C [25]. In addition, various parts of the Middle East, including Jordan, Syria, and Lebanon, experienced significant temperature increases during an exceptional heat wave [26]. The Maghreb region in particular has experienced severe droughts with increasing frequency over the last five decades, recording droughts in “1992–1995, 1998–2001, 2005, 2007, and 2015–2016”, all of which required emergency government plans in order to combat their effects [27]. Areas of Western Asia have experienced severe drought and agricultural drought, as indicated by the Intergovernmental Panel on Climate Change [28]. History also records the greatest droughts that occurred between 1951 and 2016, especially in the Middle East and the Eastern Mediterranean regions [29]. Due in large part to these droughts, Mauritania has seen a 50% decrease in agricultural and livestock production over the last 50 years [30]. Morocco has measured a negative trend in rainfall, with spring levels declining over 40% since 1960 [27]. Over the last two decades, Oman and Yemen have been subject to extreme cyclone activity resulting in billions in damages, and Cyclone Gonu alone resulted in \$4 billion in damages and fifty deaths [31]. At the same time, heavy rainfall can lead to floods, which can cause significant losses and damage to agricultural land [32]. What’s more, Jordanian climate models suggest that there will be a “20 percent decrease in freshwater availability by 2100” [30]. This is only made worse by the fact that over the last 70 years water levels have dropped from “3600 sq. m. per person/yearly ... to 50 sq. m. per person/yearly today” [30].

Cumulatively these effects can be felt throughout the Middle East and North Africa but nowhere is it more severe than in rural environments where there is limited infrastructure and shelter from floods, cyclones, and the effects of drought. This is indicative of the fact that, according to UNHCR, “some 90% of the world’s refugees originate from territories which are classified as extremely climate vulnerable” [30]. Examining the localities in Jordan and Syria paints a more specific picture of the observed phenomenon contributing to this crisis, and one particular study out of Deir El Kahf, in the governorate of Mafraq, found that historical and archeological records

show that the area, once occupied by the Romans, had been an agrarian region, when water levels had been higher; this was indicated by the furrows and manmade ponds that have been discovered using aerial photography [33]. This same study interviewed residents of Deir Al Kahf and found numerous accounts of a rapidly changing environment: “5 years ago, rain used to fall in January, February, and March. Now everything changes. The rain is late. The Winter and the Summer have changed their timing” [33]. Other residents expressed their deep concerns for the continued drought saying, “We used to have 100 olive trees now we only have 15”, what’s more “there are no green pastures for livestock anymore”, so herds are being reduced and sold off at a rapid rate [33].

Due to Jordan’s position as a lower riparian country, Israel and Syria have been able to limit Jordan’s water supply by damming and redirecting portions of the Yarmouk and Jordan rivers, and despite the 1994 Peace Treaty between Jordan and Israel, which included assurances to Jordan’s fair share of the water, Jordan has yet to receive the yearly amount stipulated in the Treaty [5]. To complicate matters, desalination efforts of the Red Sea have stalled due to costs and disagreements between Jordan and Israel. Cumulatively, this means Jordan’s water security and susceptibility to drought will be further exacerbated, exposing it to undue climate stress, devastating ecosystems, watersheds, and economic insecurity [5].

2.5. Economic & Social Factors

MENA has already begun to experience the economic effects of climate change; as even in the mid-1990s, droughts were beginning to cause devastating effects, especially in North Africa, where Morocco saw an “estimated GDP loss of 7.6%” due to decreased agricultural and livestock output” (IPCC 2019). In real numbers, this translated into a loss of “\$900 million US dollars” and “more than one million hectares of cultivated land” (IPCC 2019). Within a contemporary lens, it is projected that in the next few decades GDP loss could be anywhere from a conservative 0.4% to upwards of 13% in MENA, depending on the implementation of “mitigation and adaptation measures” [34]. Other estimates project that as little as a “1°C rise in temperature” could “lead to a decrease in GDP per capita by 8.5%” globally [35]. Drought directly affected Africa more than other continents, at a rate of 44% [36]. Statistics also showed some droughts in both Asia and Europe, the latter of which showed 45 droughts, equivalent to \$27.8 billion in economic losses [36]. There are indications of an increase in the rate of drought over the coming years [37]. These effects will be predominately felt in the land-use and tourism sectors. Agriculture and grazing, according to the Economic Science Institute’s Euro-Mediterranean Forum, will see a “significant loss in crop yields and an increase in salinization due to the erosion and pollution of soil” [34].

It is further projected that socioeconomic factors in MENA will account for 78% of water shortages in the next decade [30]. Already, 50% of the global population live in urban areas, and it is likely that many of the negative economic impacts of climate change will be worsened by an increase in urban living [38].

Mainly due to the water shortages and desertification of arable land, the Middle East and North Africa will likely see “an increased reliance on food imports, making the region particularly sensitive to fluctuations in global food supply chains and markets” [39]. This is evident by the current food shortages affecting Yemen, Libya, and Egypt, three major importers of Russian and Ukrainian wheat, constituting 22, 43, and 85 percent of each respective country’s wheat imports as of 2020 [39]. Without adequate protections from supply chain variability: famine, social unrest, and rioting are all feasible outcomes. Forty years ago, the region saw bread riots in Egypt and Tunisia during similar scarcity conditions [39].

3. Materials and Methods

The study focused on the desert region in Jordan, which was chosen based on its being considered an arid region with scarce rainfall, i.e., less than 200 mm annually. The study was conducted during 2021 and 2022. The study focused on the farmers as a target group for this study and for the purpose of achieving its objectives. The study relied on a field survey of the opinions of randomly selected farmers, the number of which reached 165 in the Jordanian desert. The purpose of this work was explained to the participants, and their consent was sought for participation. They were also given the right to withdraw if necessary. No names of participants were included. The demographic of participants is shown in Table 1.

The researchers designed a research tool, a questionnaire with dual nature interview questions. The questionnaire consisted of 27. The first question in the questionnaire comprised four demographic questions: age, gender, education level, and occupation. The second question related to water resources consisted of 11 paragraphs. The third question related to climate change consisted of 6 paragraphs. The fourth question, about cooperation and conflict across borders, consisted of 9 paragraphs. The answers to these questions included the option "yes," "no," and the option "I don't know" for some questions. Many questions allowed participants to add additional comments if they wished.

In addition, an open question was asked about the policies and strategies that should be implemented to reduce and alleviate water scarcity and the problems caused by climate change which enhanced the study's results. The quantitative data was coded after completing all questionnaires to continue the data analysis.

The questionnaire was presented to experts and

specialists to ensure its validity and reliability. After that, the researchers modified, deleted, and added items to the questionnaire as recommended by experts. Finally, the questionnaire was presented in its final form to the participants.

The data were analyzed and modeled in Excel to generate percentages and other useful metrics.

Table 1. Demographic characteristics of participants

Characteristics	Number	Ratio %
Gender		
Male	116	70
female	49	30
Total	165	100
Age		
18 ≤ 30 Years	55	33
30 ≤ 60	55	33
< 60	55	33
Total	165	100
Education		
Primary	53	32
Secondary	54	33
Bachelor	53	32
Master	5	3
Total	165	100
Occupation		
government job	30	18
private job	27	17
retired	29	18
unemployed	37	22
farmer	12	7
school	30	18
Total	165	100

4. Results & Discussion

This section is mainly structured around the answers given on the quantitative survey, which respondents filled out as a method of understanding local perceptions of climate change. The first four questions on the survey gathered demographic data and the proceeding ten questions sought to understand local knowledge and opinions. The following section compares the knowledge and opinion questions from the second half of the survey with the demographic data from the first half.

4.1. Awareness of Climate Change

The research found that by and large respondents had high levels of awareness surrounding climate change

phenomena, with some 73% of total subjects responding in the affirmative. There was no discernable difference between awareness in men as compared to women, nor was there any significant difference between age groups; however, when looking at education there was a slight peak in awareness amongst those who had completed secondary school, as compared to those who had only finished primary school, this being 83% and 68% respectively. The two groups with the highest climate awareness were the unemployed, superseded only by the farmers, of which, all responded that they had awareness of climate change. This is likely because the unemployed and the farmers are the first to be affected by water shortages, drought, and heightened temperatures, as their livelihoods or former livelihoods may have depended on these exact variables. This is consistent with the study that farmers are most vulnerable to climate change and food insecurity [40]. It is worth noting that, when looking at those who responded in the negative, the highest amount came from those currently at university, with 33% asserting they had no awareness of climate change. This suggests a significant lapse in teaching on environmental change and climate readiness.

4.2. Sources of Climate Knowledge

When considering where the surveyed subjects had mostly heard about or seen climate change, across the five categories: television, community, school, awareness programs, and live observation, the highest number of respondents, 33.5%, said Television. The next highest came from awareness programs, which averaged 23% across all groups. Interestingly, women were a quarter time more likely to have heard about climate change through television than men. Men, on the other hand, were more divided amongst live observation, television, and awareness programs. When analyzing age groups, youth also trended toward television and media, and perhaps surprisingly, none of them responded with having had lived experience of climate change. Figure 1 shows that youth primarily hear about climate change through TV (41.8%), followed by school (23.6%), awareness programs (21.8%), and community sources (12.7%). This highlights the significant role of television in disseminating information, the importance of educational institutions in raising awareness, and the contributions of awareness programs and community efforts. This seems consistent with UNICEF's report, which suggested that upwards of half of Jordanian youth were engaging in climate change dialogue via modern media, including television and social media. This demonstrates a stark contrast to the elders and farmers groups, who both overwhelmingly said they saw climate change through lived experience, with 47% and 58% attesting to this. As one elderly resident of Safawi, in the northern Badia, said, "Many plants that we used to rely on for food and health, such as Artemisa, Saffron, and wild

thyme, are no longer available; in the past, we could collect them anywhere; now, you must travel to remote areas and wadis to find them." These results are consistent with both Hunter-Pillion's observations of elderly groups in North Carolina and Janet et al.'s observations of tribal elders in Fiji, who both maintained memory of former environmental conditions within their localities and lifetimes. These groups then used these memories to produce oral tradition and safeguard this memory in generational knowledge.

Oddly enough, awareness from school programs scored the lowest across all groups, though this may be due to the fact that 66% of the surveyed group were over the age of 30 and likely would not have been taught about climate change in school at the time of their education. And, across education groups, we can see this by the disparity between those with a primary, a secondary, and a university level education. Those with only the first two said school played little part in their awareness of climate change, while those with a degree were nearly 20 times more adamant that they had learned about it in school. This is likely due to the fact that elders and adults are more likely to have only completed primary and secondary schools than contemporary youth, and as such may not have been taught about these phenomena at the time of their education. As one student from Mansoura, the northern Badia, said "we were born in a very dry environment, but through schools, we were informed about climate change, even though our parents were unaware of it and used to say it was the end of the world."

Amongst youth and those currently in university, awareness from schooling was far more robust, being at 23% and 33%. This is an interesting contrast to earlier results that showed that nearly a third of respondents currently at university had no awareness of climate change. This may be a result of specialization, meaning certain fields may receive more substantive lessons on the climate's impact on their relevant field of study. For example, one student from Mawaqer, the middle Badia, said "I didn't know anything about climate change until I was taught about it at my university and attended a workshop there." This is particularly important, as it suggests that much of the investment that UNICEF and the Jordanian government has put into bolstering climate education, has not been uniformly effective, especially, it would appear, in rural communities. UNICEF's heavy investment in schools and green NGOs may not be reaching all levels evenly, according to these results.

As climate change realistically affects all sectors of the economy, it is something that should merit greater investment, especially in line with Jordans NDC to the Paris Climate Accord, which despite being the most comprehensive of the MENA region, fails to ensure the compulsory teaching of climate-minded practices and readiness in all levels of the education system [15].

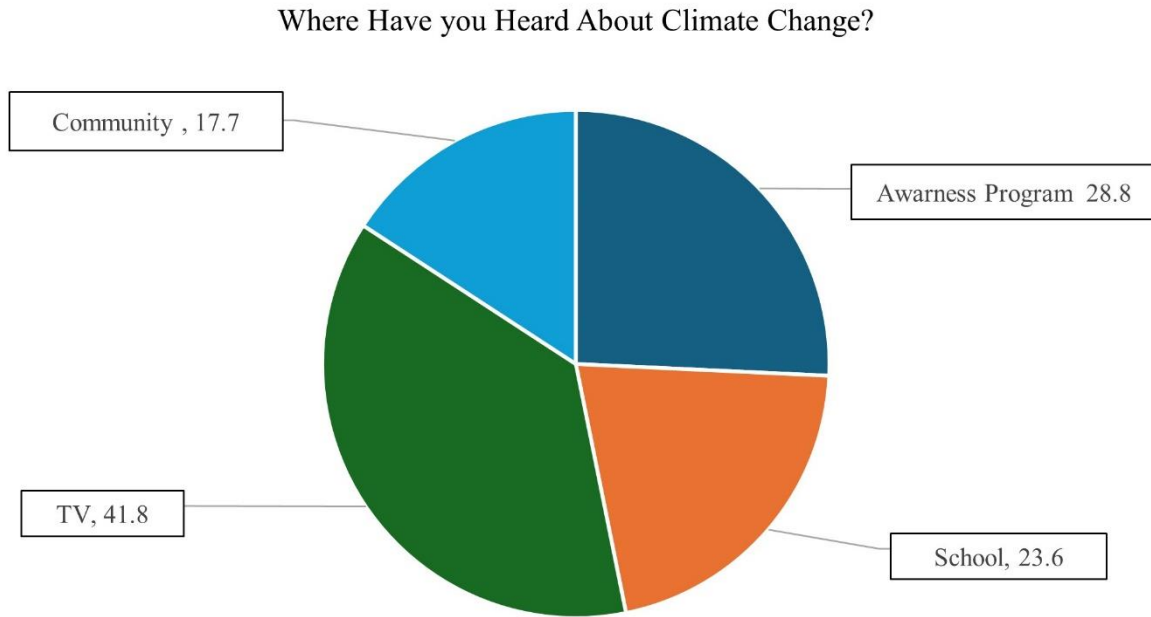


Figure 1. 'Where Have you Heard About Climate Change': Youth Category

4.3. Definitions of Climate Change

The next major component of the study was aimed at uncovering how locals defined climate change within their lives and within their environment. From the main categorical definitions: drought, desertification, changing life, hot weather, more carbon in the atmosphere, and unknown, the most agreed upon answer was drought, at 20% of responses, followed closely by hot weather. What is significant is how high the percentage of youth and university students was, who were unable to define climate change. Youth averaged almost 31% in this category, while those currently in university averaged almost 27%. This is in line with some of the studies that indicated that education has not been linked to the manifestations and causes of climate change sometimes because of the learning materials themselves [41], which suggests universities are inadequately preparing students for the realities of climate change and the immediacy of its effects on their lives. One former student from southern Badia said, "I recall my secondary-school science teacher discussing climate change, but I didn't pay attention to the extent to which it would now be significantly affecting our lives."

Amongst elders and the unemployed responses were mostly concentrated around 'drought', with 38% and 29% for each. Though the second most common response from elders was 'life is changing', as was also the case for those with a primary and a secondary school education levels. This brings us back to Hunter-Pillion and Janif [21,22] who both suggested that their elderly subjects were not entirely certain what was causing climate change, or even if it was happening globally, but who were certain that their life, as they knew it, was no longer the same. As one 78-year-old

man from Sabha, the northern Badia said, "We don't know what you call it, but we call it life changing, drought invading us, and resources running out." This same level of uncertainty pervaded many subjects, another elderly man, this time from Al Faisaliyah, the southern Badia said, "I believe something is attacking us; we have been experiencing drought for many years, and our land has become desertified."

4.4. Local Changes as a Result of Climate Change

When asked whether the climate was changing in the place they lived, respondents overwhelmingly answered yes, with 91% in agreement. Interestingly, women were more certain of the climate's regional change than men were, by a rather significant 11%. It is difficult to determine what factors may have caused this, as looking at the results of Question #5 on the survey, 'Have you heard of the climate change phenomenon?', men actually scored higher in terms of awareness, at almost 76% compared to women's 71%. It would seem that despite being aware of climate change, men tend to be more resistant to believing it is affecting their everyday lives and local environment; albeit, only by a small margin. On the other side of things, Farmers and elders were, again, in full agreement that the climate had changed; here, both groups were 100% in affirmation. As one farmer, from Wadi Rum, put it "Water table decline, drought, and global warming have all contributed to environmental climate change, which has caused us, as farmers, to suffer and struggle to manage our farms, while also causing significant increases in production costs."

Perhaps surprisingly, those with a university degree had the highest levels of dissent, with almost 19% saying ‘no, the climate had not changed locally’; this was followed by the adults group, who were closer to 18% in the dissent.

Table 2. Survey Question #8, ‘Do you think the Climate is changing in the Place you Live at the moment?’ 2020

Q8 Do you think the climate is changing in the place you live at the moment	Yes	No
Male	86.2	13.8
Female	95.9	4.1
Youth	85.5	14.5
Adult	81.8	18.2
Elder	100.0	0.0
Primary	94.3	5.7
Secondary	90.7	9.3
University	81.1	18.9
Unemployed	89.2	10.8
School	90.0	10.0
Farmer	100.0	0.0

4.5. Locally Observed Changes

The next question sought to characterize the climate phenomenon which had impacted the region. The categories included: sudden floods, drought, decreased water table, sandstorms, desertification, disappearance of wildlife, extinction of plants, heat waves, and late rain. Here, ‘drought’ received the most acknowledgement, with almost 77% of respondents. The second most frequent response was ‘extinction of plants’ followed by ‘rain has started later’, with 29% and 28% respectively. These results coincide with the United Nations Development Program’s (UNDP) study of Deir Al Kahf, which found that drought hindered the agricultural environment, resulting in the extinction of certain species of plants as well as the pastoral lifestyle as a whole. This is because the herds were predominantly sustained upon the aforementioned flora.

Comparing across genders, results were more or less similar; however, women had an 8% greater leniency toward the option, ‘rains have started later’. When looking at education level, there was no statistically significant disparity between respondents. Amongst respondents only 2% mentioned sudden floods, none of whom were farmers or elders. Additionally, the options for sandstorms and decreased water table saw some of the lowest numbers of respondents, with the exception of Farmers, of whom 83% responded that the water table had decreased and 41% responded that sandstorms had increased. For a point of comparison, no university students (0%) stated that the water table item has decreased and only 16% said

sandstorms increased. This notable disparity between groups is likely informed by the farmers’ intimate knowledge of the land and the effects of desertification. And in corroboration of this, according to the Carnegie Endowment for International Peace, as the water table decreases, top soil becomes looser, resulting in a higher frequency of airborne particulates during high winds [12].

4.6. Concern for Climate Change

The next question sought to understand the extent to which respondents were concerned about climate change, ranking their concern on a scale of 1 through 10, 1 being ‘not concerned at all’ and 10 being ‘extremely concerned.’ One of the most notable findings is that no respondents gave a number under a 7. This seems slightly incongruent with the results of question #5, which asked “have you heard of the climate change phenomenon”; there, as much as 26% responded that they had not. It seems fairly peculiar that of that 26%, all of them were at least fairly concerned with a phenomenon they had never heard of. The majority of respondents were extremely concerned, with 44% listing a value of 10. Unsurprisingly, the unemployed group gave the highest number of 10s on average, over all other groups. As one 45-year-old man from Maghaier, the middle Badia, said, “I used to cultivate my land and raise my small flock, but due to climate change and drought, I was forced to sell the flock, losing this income opportunity and becoming impoverished, relying on aid from Jordan's National Aid Fund.”

4.7. Causes of Climate Change

Gauging local beliefs on the causes of climate change, the most common rationales were 'industry' and 'energy production.' Data show that both genders equally identify "industry" as a major factor, with 28% of both males and females choosing it. "Producing Energy" is the most popular choice among females (31%), as well as males (24%). "Political Reason" is another significant factor, cited by 24% of males and 31% of females. Men were twice as likely as women to believe that changes in lifestyle had caused climate change, with 12% versus 6%, respectively (Figure 2). Youth and students, on the other hand, were the least convinced that a change in lifestyle had brought about climate change, with none of the young people or students (rate of 0%) admitting to this option. The unemployed were the most adamant, of any group, that climate change was caused by political reasons, capturing around 24% of the group's responses. Interestingly, as previously mentioned in the analysis of question #10, the 26% of the total, who had not heard of climate change, did not hesitate to define its causes. And, only 2% of respondents said they had no awareness of what had caused climate change. This may be a product of having alternative methods of defining climate change, or a product of survey bias.

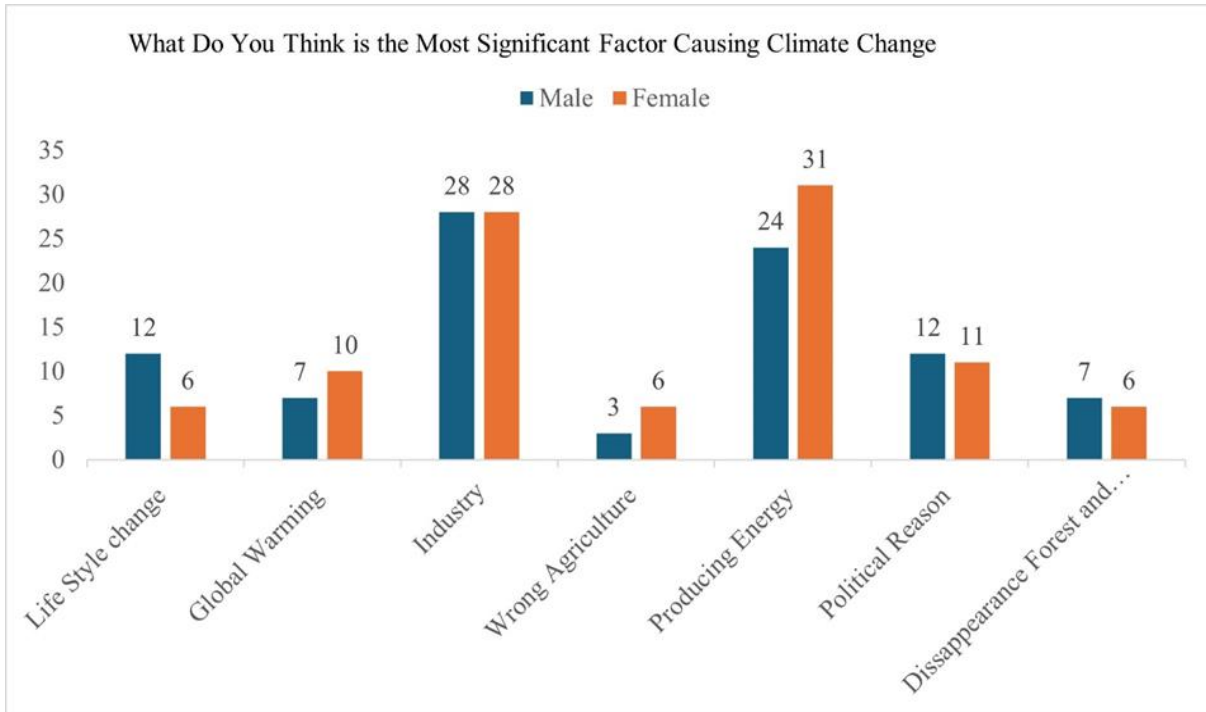


Figure 2. What Do You Think is the Most Significant Factor Causing Climate Change

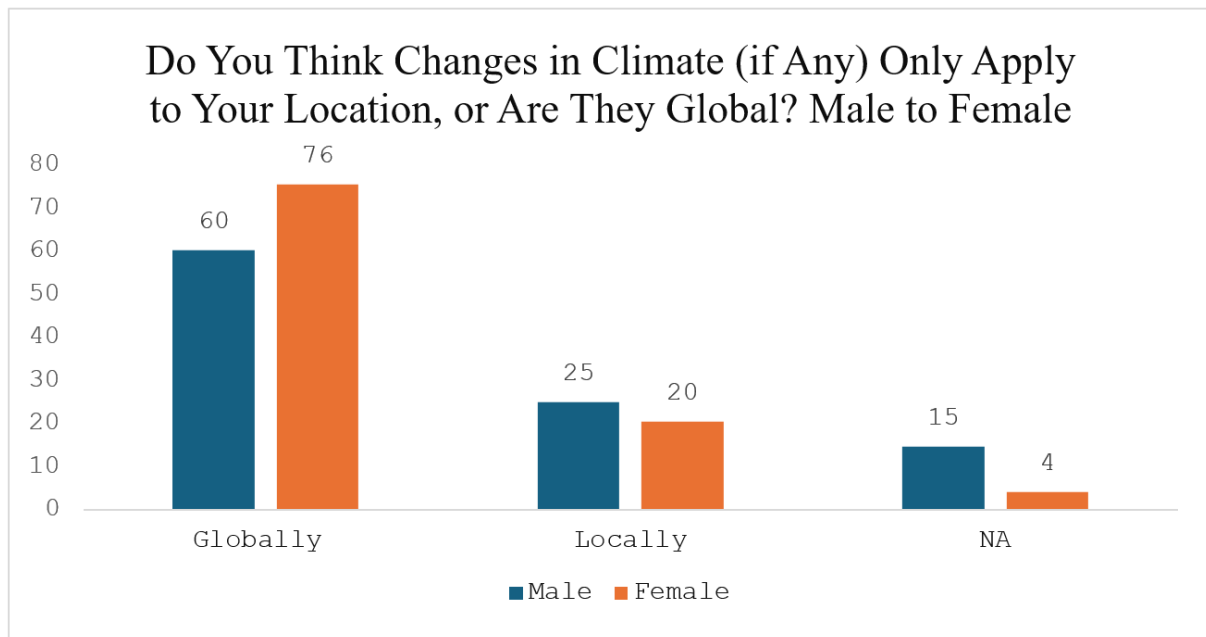


Figure 3. Do You Think Changes in Climate (if Any) Only Apply to Your Location, or Are They Global? Male to Female

4.8. Climate Change as a Local or Global Phenomenon

Regardless of cause, most respondents were convinced climate change was a global phenomenon rather than solely a local problem, and this was noted with over 70% agreement across groups. The data suggests that both males and females predominantly perceive climate changes as a global phenomenon, with a higher number of females holding this view compared to males. The number of

respondents who believe climate changes are local or did not express an opinion is significantly lower (Figure 3).

Women and farmers were both the highest proponents of a global viewpoint on climate change, with women at 75%. There were no significant differences between employment, gender, or education level, and results were more or less uniform across categories. However, elders were the outliers, and 23% of them said it was only a locally occurring phenomenon. University students, interestingly,

gave the most N/A responses, with almost 23% unsure if the phenomenon was local or global. Another indicator is that schools could do more to bolster their climate education programs.

4.9. Climate Impacts on the Community

When asking respondents to categorize the impacts of climate change on their locality, of the choices: water scarcity, poverty, destroyed ecosystem, loss of livelihood / farming / livestock, unemployment, and overgrazing / rangeland depletion, 37% identified water scarcity as the primary impact. Men were 10% more inclined to give this response than women, and surprisingly, the unemployed favored this answer over the choice for 'unemployment', by almost 30%. There were few to no discrepancies between or in the demographic categories of education level and gender, though age groups and employment did differ in response. Roughly 44% of youth identified poverty and a destroyed ecosystem, as significant effects of climate change. One man from Al Mukaifteh in the northern Badia said, "I used to keep bees and produce honey, but due to climate change and loss of vegetation cover, it is no longer feasible, and my hives are dying and I am losing income opportunities." Oddly enough, elders and farmers agreed that there was a loss of livelihood, at 54% and 58% from each group. Still, neither group (0%) indicated that unemployment was an effect of climate change. This is an interesting result, as it implicates an alternative definition for unemployment; realistically, many Bedouins sustain themselves off of a series of micro-economy projects, as was noted with the beekeeper. These micro-projects and additional income streams are forms of jobs that are in danger of being lost, or have already been lost, and as such they constitute an element of unemployment. For example, because of climate change there is now limited vegetation cover and as feed prices increase, local women can no longer afford to raise small flocks of goats for milk and cheese production, further restricting their income. Statistics prove this and report that Eastern Europe and the Mediterranean regions are the most vulnerable to drought [37]. Globally, arid areas will increase by (10.3%) and the non-arid regions by (9.9%) [42].

4.10. Methods of Combating Climate Change Locally

The question sought to identify a workable solution to climate change from the perspective of the locals, the options for this question included: awareness programs, global cooperation, water harvesting projects, new agricultural technology, a move toward sustainability, stopping the political game, diversifying income, rangeland rehabilitation / planting, and N/A. Almost 43% of respondents chose N/A, of which the majority were women, who had 13% higher chance of choosing this option than men. Though the highest individual group to choose this

category were the unemployed, at 54.1%. This suggests a general uncertainty about how climate change should be combatted, as is indicated by the fact that this question received the highest number of N/A responses over any of the previous questions. Another possibility is that, as mentioned by the Shorenstein Center on Media, Politics, and Public Policy, the media's consistent presentation of the disastrous impacts of climate change can instill a general sense of powerlessness in viewers; and, may be a contributing factor to this high figure of N/A responses.

Further analyzing gender differences, men were 8% more likely to choose global cooperation and land rehabilitation / planting, than women, at 16% to 8% and 14% to 6% respectively. Then when looking at age, the second and third highest choices for youth, after N/A, were awareness programs and global cooperation, but they constituted some of the lowest numbers of responses for water harvesting projects, new agricultural technology, rangeland rehabilitation and planting, and diversified income. It would appear that youth prioritized a more theoretical approach to climate change, rather than a concrete actionable approach. Conversely, adults and elders made up the largest pool of respondents who were in favor of these four aforementioned actionable approaches. Farmers were the largest percentage of respondents to call for water harvesting projects and new agricultural technology, split evenly at 50% for each. The category that received the least attention was 'stop the political game' with only 4% of respondents cumulatively.

5. Conclusions

In conclusion, and based on our results, it is clear that climate change affects the lives of Badia people in significant ways, most notably water scarcity and drought. The study also showed some other challenges farmers face due to climate change, including desertification, sandstorms, lack of vegetation cover, and loss of pastures and livestock. All of these challenges have led to the destruction of livelihoods, which has contributed to increased unemployment and poverty and has led to the migration of young people from these rural areas in search of greater economic opportunities in the surrounding urban environment. The results also showed that the population is primarily convinced of the impact of climate change on their lives and its global nature. However, there was a difference between the opinions of the elderly and the youth, who viewed climate change from different perspectives. This led to two different approaches to climate change solutions, as the elderly suggested implementing implementable environmental measures and strategies. At the same time, the youth had a different perspective that focused on awareness and education programs. The study highlighted the need to improve climate education to ensure the participation of rural people in climate dialogues. This will enable them to connect with

their urban peers and government officials and encourage using modern technology and strategies that help address water crises, boost agricultural production, conserve vegetation, and protect livelihoods.

Conflict of Interest

The authors declare no conflict of interest.

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