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# Environmental Management of Mediterranean Farmers: Perceptions on Climate Change and Its Impacts on Agriculture

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Abstract

Climate change has become a global hot topic of discussion in both academic communities and across all industrial sectors of the world. Climate change continues to be one of the most critical challenges facing the world, and countless efforts are being made to mitigate the process of climate change and limit its impacts on the world. One of the industrial sectors most impacted by this phenomenon is the agricultural sector, the agricultural sector is not just vulnerable to climate change but it has also been reported as one of the significant contributors of the occurrence of climate change. Processes of climate change mitigation have been closely associated with adequate perceptions and awareness of the phenomenon. This study is investigative research on the perceptions of climate change among farmers in North Cyprus and Libya, countries bordering the Mediterranean. The study is designed to collect primary survey data from farmers in North Cyprus and Libya to carry out an analysis of the two countries with regard to their perceptions of climate change, their perceived environmental problems, and the main causes of climate change. Analysis of collected data has shown there is a similarity between farmers from North Cyprus and Libya with regard to their perceptions of climate change, its effects, and the main causes of the phenomenon.

**Keywords:** agriculture, climate change, environmental management, Libya

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## 1. Introduction

There is a critical dependency of the global economy on the agricultural industrial sector [1]. There has been a recent rising concern in the observed and reported global environmental degradation, and this has been associated with a need for significant contributions by all industries and sectors of the global economy towards sustainable development including the agricultural sector [2]. The long habit of human development techniques of using unsustainable human practices such as cases of non-renewable energy usage., the agricultural industry has been identified by studies as one of such industries using mainly unsustainable methods of industrial development which impacts and shapes the environment negatively [1]. The agricultural industry deals with direct environmental shaping practices due to intensive direct natural resources use in the process of industrial development. Agricultural processes that are commercially driven are processes that involve the use of significant industrial mechanization and chemical usage for pest and yield control of farm produce to ensure optimal profit for the companies and individuals involved in the process, this practice has a significant impact on the environment, biodiversity, and global climate change phenomenon. The agricultural industry and its conventional production practices have a severe impact on the environment and that leads to severe degradation, such as the conventional practices of animal husbandry which have been associated with significant emission of greenhouse gasses such as phosphorus, and nitrogen, such gasses if not properly managed can lead to severe environmental and climate degradation [3]. Agricultural impact on the environment is subjective to the kinds of production practices that are used in the industry as farming methods, greenhouse gasses, in general, have been estimated to be emitted at 18% contribution from the global agricultural industry [4]. As much as the agricultural industry contributes to the challenges of environmental degradation and climate change, the agricultural industry is also one of the most significantly impacted by the phenomenon of global climate change, these challenges are imposed on the agricultural industry through landscape pollution, water pollution, air pollution, and atmospheric pollution [5]. Agricultural activities are significantly dependent on natural and environmental conditions such as soil quality and climate stability for all their processes. One of the most important adept of climate change mitigation besides the carrying out of mitigation practices as well as the implementation of adequate environmental protection

policies is having the proper awareness regarding the subject of climate because only then can we know how critical it is and what the necessary measures for mitigating it are [6].

***Research Objectives***

This study is aimed at investigating the environmental awareness among farmers in Libya and North Cyprus, which are Mediterranean countries where climate change is felt strongly. The findings in this study are potentially a great scientific contribution to the ongoing environmental protection and climate change mitigation efforts carried out by both academic and scientific communities around the world. The perceptions of farmers on the current trends of climate change and how it directly affects them is a useful indicator of the efforts being made globally towards climate change and environmental sustainability. Both Libya and North Cyprus being developing countries have a high risk associated with them with regard to adequate efforts and awareness of climate change and environmental protection.

***Problem Statement***

There have been several studies carried out across the world on the investigation of the perception and awareness of farmers on climate change, however, there is limited literature with respect to this on Libyan and Cypriot farmers. This study is an attempt to contribute to the body of literature by answering the following research questions:

- What is the perception and awareness of Libyan and Cypriot farmers on climate change?
- What is the opinion of the Libyan and Cypriot farmers with regard to the effects and impacts of climate change globally and in their country?
- What kind of information do Libyan and Cypriot farmers have with regard to climate change and the policies made in their respective countries?

## 2. Literature Review

***Climate change and agriculture***

Climate change as a phenomenon is considered to be one of the most critical global challenges facing the entire human race and the planet [7]. Climate change is defined as the significant and critical change in meteorological elements' values; meteorological elements in this context include temperature and precipitation [8]. In the past decades, climate change has come to the limelight of global concern due to the significant rise in meteorological element values due to unsustainable human development practices around the world. These unsustainable human development processes alter and change the global atmosphere [9]. Climate change leads to the increase and release of greenhouse gasses such as carbon dioxide, methane, and nitrous oxide, the concentration of these elements have risen by 40%, 150%, and 20% since 1970 [10]. The global average temperature has been on a steady increase at an average temperature range of 0.15 °C to 0.20 °C every 10 years.

While global climate change and temperature rise are contributed to due to natural phenomena, the significant contributor to this phenomenon in recent times has been attributed to unsustainable development practices around the world [11]. Increased concentration of greenhouse gasses in the atmosphere contributes to undesirable changes such as an increase in atmospheric carbon content, a negative impact on soil microbial activities, and undesirable water contaminations, among other such occurrences [12]. One of the largest contributing industrial sectors of climate change is the agricultural industry, the global agricultural industry is estimated to contribute about 15% of global greenhouse gas emissions, and the main greenhouse gasses emitted by the agricultural sector are nitrous oxide and methane [2]. These already high emissions are projected to even be higher in coming years due to the high agricultural produce demand and the use of unsustainable agricultural practices to meet these demands [6].

***Impact of climate change on agriculture***

The agricultural sector is not only one of the major contributors to climate change, but it is also one of the most vulnerable sectors to the challenges of climate change [11]. Climate change impacts the agricultural sector due to the high sensitivity and dependency of the entire sector to climatic and weather factors and parameters, hence causing a significant subsequent impact on the world's economy [1]. Agricultural yield is impacted by changes in factors such as rainfall and temperature. Changes in temperature and rainfall lead to undesirable variations in precipitation and carbon dioxide concentrations among other elements required for agricultural yields. There have been studies that have reported significant agricultural yield reduction because of the variety of these factors due to climate change, these include the impact of fertilization in Iran's agricultural sector [13], a decrease in precipitation, and the impact on agricultural revenue in Cameroon [9], the impact of low agricultural yield in Mexico's coffee fields and national revenue impact [14].

***Environmental perception of farmers***

According to a study by Alotaibi et al. (2019)[15], environmental protection and climate change mitigation can be significantly achieved through adequate awareness among farmers because of their contributions to the sustenance or degradation of the environment. Farmers are positioned in very critical positions of both being able to carry out direct environmentally sustainable practices and also influence the policies of their society regarding environmental sustenance and climate change. The perception of farmers on the state of the environment and the criticality of the phenomenon of climate change has a direct impact on environmental sustainability [16]. The environmental and climate change perception of farmers has a significant impact on environmental sustainability, the adequate awareness of environmental degradation, climate change, and sustainability practices increases the chances of farmers adopting sustainable practices of agriculture to help in the fight against global climate change. Farmers' engagement in climate change mitigation and environmental sustainability is not only a process of protecting the

environment but is also a way for the farmers to ensure their long-term sustenance in the agricultural industry. According to Piwowar (2020)[17], the correlation between Polish farmers and their level of education on environmental sustainability has a high impact on the environmental protection practices of the farmer and the agricultural industry they practice in. Another study by Okumah et al. (2018)[18] reported empirical evidence from a study carried out on farmers in the UK where environmental protection is seen in farmers with adequate awareness of environmental degradation and global change challenges.

## 3. Methodology

This research has been designed to utilize both qualitative and quantitative techniques of research. The research is based on an extensive literature review to enable establishing an adequate theoretical framework to base the quantitative technique of primary data collection for analysis on the respective case studies; Libya and North Cyprus. The views of the farmers in Libya and Northern Cyprus, which are Mediterranean countries where climate change is strongly felt, reflect the case study of this research. The study carried out a design and distribution of a structured interview form, using both open-ended and closed-ended questions for response collection on the farmers' perceptions and awareness of designed items in the survey. The questionnaire contains three distinct sections with each collecting data with regard to the following: survey demography, farmers' perception of climate change, and information regarding climate change in their respective countries. Survey data is analyzed using statistical analysis and correlation analysis between the two countries used as case studies. Table 1 shows the list of questionnaire items and the studies they were adopted from.

### *Study sample*

The questionnaire design in this study is designed and aimed at a sample target made up of North Cyprus and Libyan farmers. The questionnaire distribution was carried out towards an equal number of farmers in both North Cyprus and Libya, with each country having a total of 15 survey respondents making a total of 30 survey respondents. Demographic distribution analysis has revealed 30% of the survey respondents are female, and 70% of the survey respondents are male farmers. Respondent coding was used in this study to ease respondent feedback analysis and ensure anonymity and privacy, the coding system used in this study is F1 through F30; where each code is assigned to a survey respondent. The educational background of the study's respondents was asked and according to the respondent's answers, 63% of the study's respondents have a higher education qualification in university or other tertiary institutions, this indicates a majority of the study's respondents are adequately literate. The study respondents were also asked about their years of individual farming experience, over 30% of the survey respondents have between 6 years to 10 years of farming experience. Figure 1 illustrates the farming years of experience among the survey respondents.

## 4. Results

The research design of this study has led to a collection of response data using both closed-ended questions and open-ended questions to enable a robust response and data analysis. The following are the findings from the analysis of data collected in the survey.

### *Perceptions of farmers on climate change*

When farmers were asked if they felt the temperatures of their countries were getting warmer, 100% of all the respondents from both Libya and North Cyrus responded yes, and when they were asked about the fluctuations of rainfall in their countries 86% of the respondents responded yes there have been rainfall fluctuations in their country. Notably out of the respondents who said they have not observed rainfall fluctuations 3 of them were North Cyprus farmers and 1 was a Libyan farmer. 90% of the farmers responded to observing a change in weather and climate patterns in their country in recent years, and 90% of all farmers also agreed the change in weather and climate patterns is negatively impacting their agricultural productions in their respective countries. 93.3% of the farmers agreed that the changes in weather patterns and rainfall are negatively impacting their country's agricultural production.When farmers were asked about the economic impacts of climate change, farmers of 73.3% of farmers from North Cyprus and 73.3% of farmers from Libya said yes there was a significant economic impact of climate change due to agricultural decline with respect to climate change. When farmers were asked about their understanding of the causes of climate change, 100% of North Cyprus farmers said they fully understand the causes of climate change and 80% of Libyan farmers said they fully understand the causes of climate change. When farmers were asked about their opinion with regards to farmers believing climate change is a serious problem, 70% of the farmers indicated they believe farmers understand climate change is a significant problem, Figure 2 illustrates the distribution of farmers' responses on this. 66.7% of North Cyprus farmers said they are aware of the initiatives being taken on climate change by their government, and 60% of Libyan farmers said they are aware of the initiatives taken by their country on climate change. In total, 63% of the farmers in this study indicated they know the initiatives taken by their government against climate change.

### *Information on climate change*

This section of the study survey was itemized with open-ended questions to investigate the opinion of farmers on the major environmental problems in their country, and what they think climate change's harmful effects are on nature. The data collected in this section are coded based on the themes of the survey questions and responses given by the respondents. The coded responses are then used for frequency analysis, Table 1 shows detailed coding, themes, and respective frequency data.

**Table 1.** Questionnaire Items

| Questionnaire section | Items | References |
|---|---|---|
| Perceptions of climate change | Do you feel the temperature is getting warmer in your country?<br>Do you feel rainfall fluctuations have been occurring in your country?<br>Do you feel the weather pattern is changing in your country?<br>Do you think climate change is a real problem for your country?<br>Do you feel climate change impacts agricultural production in your country?<br>Do you feel climate change impacts the economy in your country?<br>Do you have an understanding of the causes of climate change?<br>Do you feel climate change affects our ways of life?<br>Do you feel climate change affects our ways of life?<br>Are you aware of the global policies or initiatives are taken by various organizations to reduce climate change?<br><br>Are you aware of the environmental policies in your country? | Sulewski & Gołaś, (2019)<br>Alotaibi et al. (2019)<br>Chèze et al., (2021) |
| Climate change information | What are the major environmental problems of your country in your opinion?<br>What do you think about climate change's harmful effects on nature?<br>What are the main causes of climate change in your opinion? | Piwowar (2020)<br>Okumah et al. (2018) |

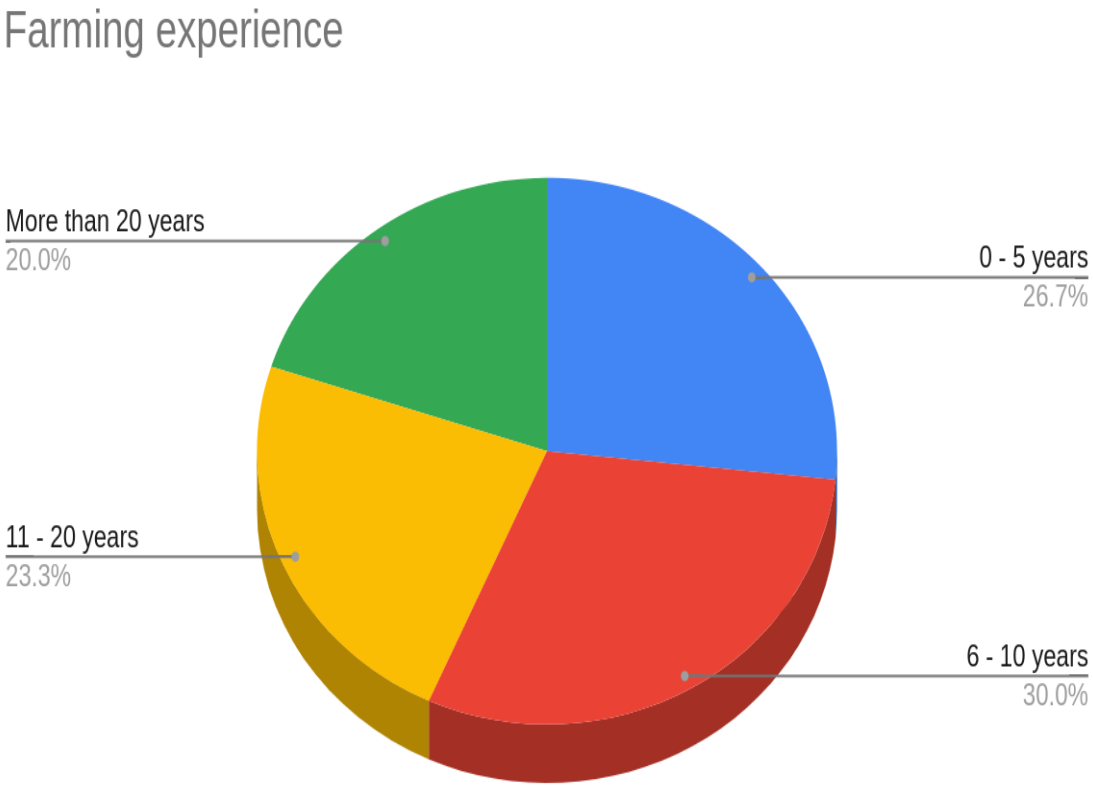


**Figure 1:** Distribution of respondents' years of farming experience

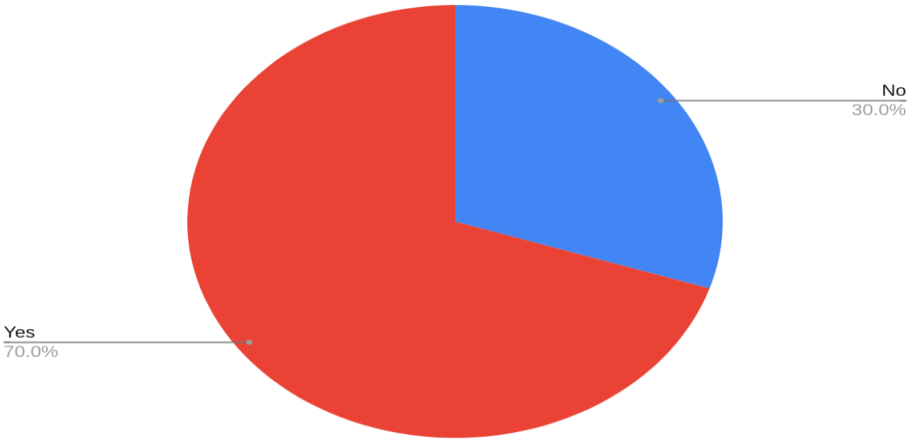


**Figure 2:** Distribution of respondents' perception of climate change is a significant problem for farmers.

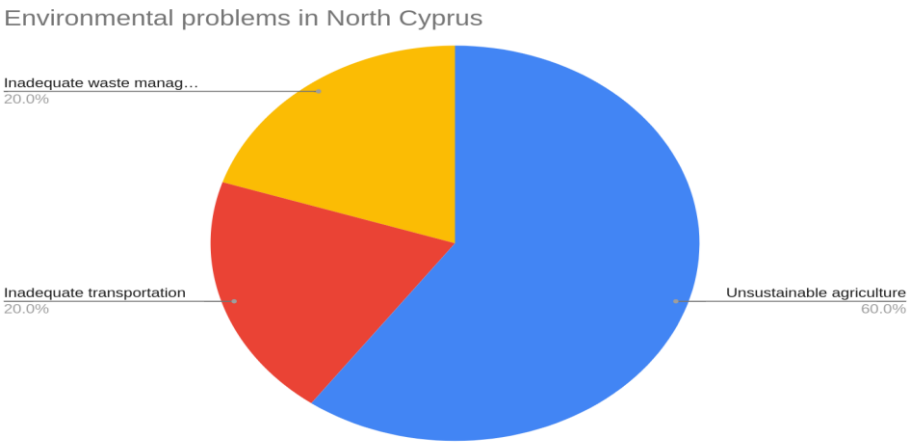


**Figure 3:** Environmental problems in North Cyprus according to farmers

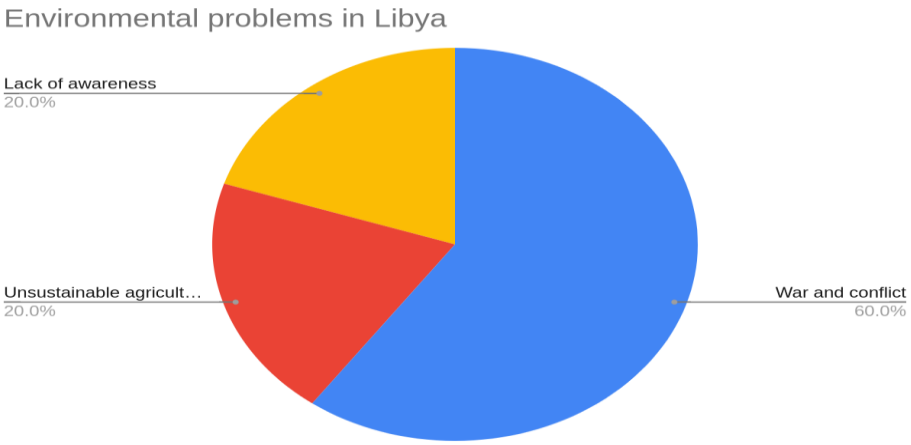


**Figure 4:** Environmental problems in North Cyprus according to farmers

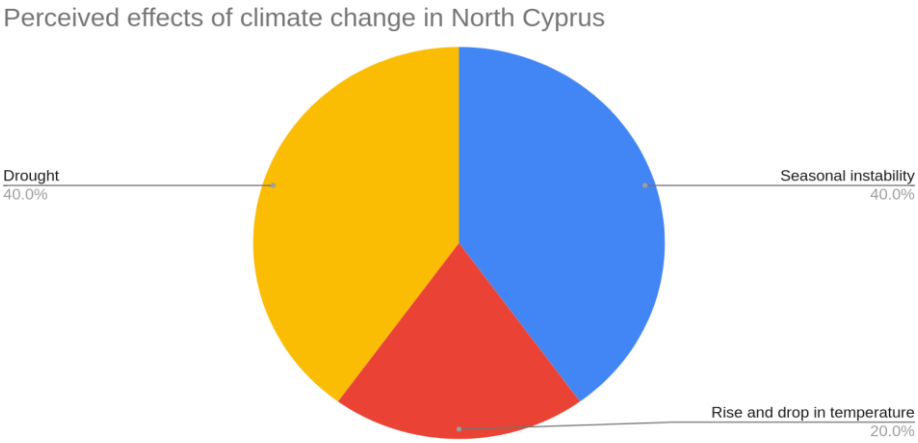


**Figure 5:** Perceived effects of climate change among North Cyprus farmers

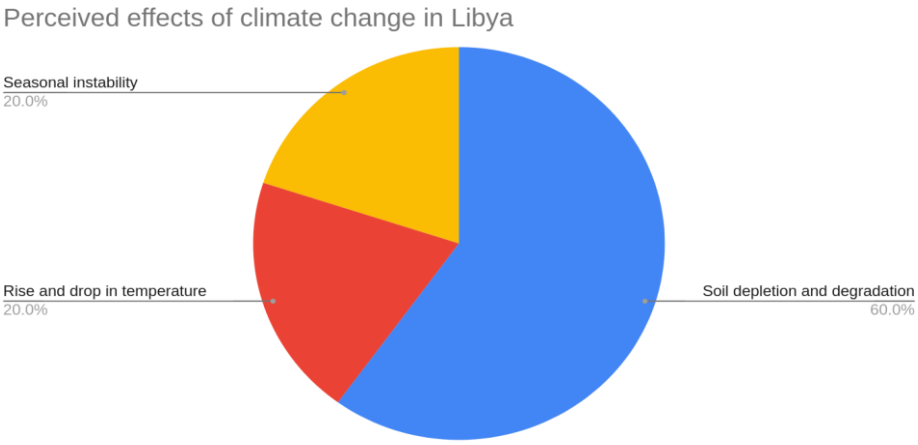


**Figure 6:** Perceived effects of climate change among Libyan farmers

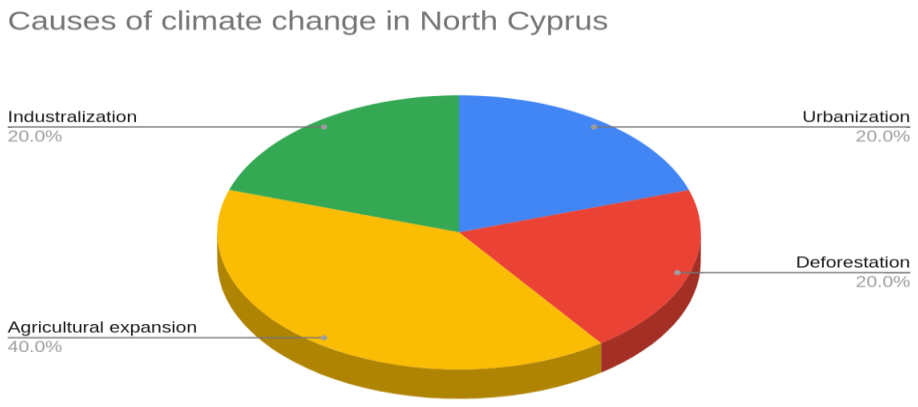


**Figure 7:** Main cause of climate change according to North Cyprus farmers.

**Table 2.** Study themes, codes, and frequency of response data

| Themes | Country | Codes | Frequency | Percentage |
|---|---|---|---|---|
| **Environmental problems** | North Cyprus | Unsustainable agriculture | 9 | 60% |
| | | Inadequate transportation | 3 | 20% |
| | | Inadequate waste management | 3 | 20% |
| | Libya | War and conflict | 9 | 60% |
| | | Unsustainable agriculture | 3 | 20% |
| | | Lack of awareness | 3 | 20% |
| **Effects of climate change** | North Cyprus | Seasonal instability | 6 | 40% |
| | | Rise and drop in temperature | 3 | 20% |
| | | Drought | 6 | 40% |
| | Libya | Soil depletion and degradation | 9 | 60% |
| | | Rise and drop in temperature | 3 | 20% |
| | | Seasonal instability | 3 | 20% |
| **Main causes of climate change** | North Cyprus | Industrialization | 3 | 20% |
| | | Urbanization | 3 | 20% |
| | | Deforestation | 3 | 20% |
| | | Agricultural expansion | 6 | 40% |
| | Libya | Industrialization | 4 | 26.7% |
| | | Urbanization | 1 | 6.7% |
| | | Deforestation | 9 | 60% |
| | | Rapid population growth | 1 | 6.7% |

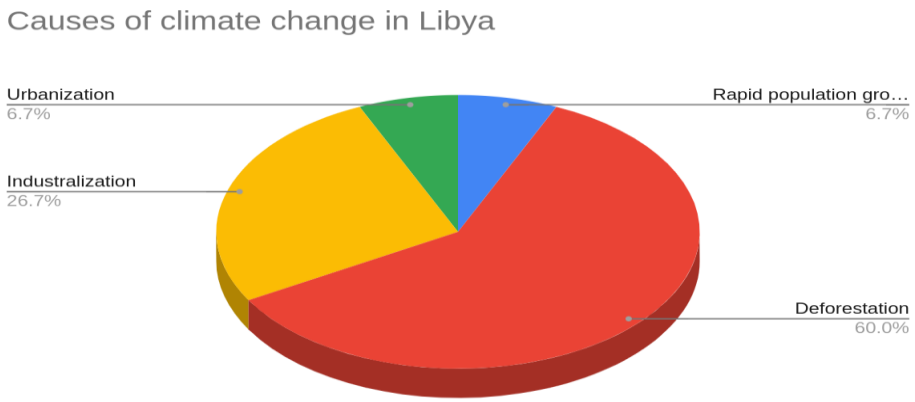


**Figure 8:** Main cause of climate change according to Libyan farmers.

***Theme: effects of climate change***

When the respondents in this study were asked about their opinions on the perceived effects of climate change, the farmers in North Cyprus indicated drought and seasonal instability as the main effects of climate change in their country. Respondents F1, F3, F6, F8, F9, and F11 indicated seasonal instability, while respondents F12, F2, F5, F7, F13, and F14 indicated drought as the main effect of climate change in North Cyprus due to the low rainfall rates experienced in recent years which they have attributed to climate change as the main cause. The farmers in Libya with regard to this theme have a different perception of the main effect of climate change in their country. The farmers in Libya had indicated soil depletion and soil degradation as the main effect of climate change in Libya, with up to 60% of the respondents in Libya indicating this as the main effect. Figure 5 and Figure 6 illustrate the distribution of the farmers' perceived effects of climate change in North Cyprus and Libya respectively.

***Theme: main causes of climate change***

When the respondents of this study were asked about their perceived causes of climate change in their country, the majority of farmers from North Cyprus indicated agricultural expansion as the main cause of climate change; 40%. Other perceived causes of climate change among North Cyprus farmers are urbanization, industrialization, and deforestation practices that lead to depletion of the natural resources. Figure 7 illustrates the perceived causes of climate change among North Cyprus farmers. The farmers in Libya indicated deforestation as the main cause of climate change as they perceive it, 60% of the farmers from Libya indicated deforestation as the main cause of climate change. Other factors indicated among Libyan farmers as causes of climate change include urbanization, rapid population growth, and industrialization. Figure 8 illustrates the distribution of the perceived causes of climate change among Libyan farmers.

## 5. Discussion

According to the findings of this study, both North Cyprus and Libyan farmers agree climate change is a significant and critical issue affecting the world and the agricultural sector. Farmers from both countries have indicated changing weather patterns, rainfall variation, and erratic seasonal changes as significant indicators of climate change. The farmers from both countries however expressed they have no adequate knowledge about the efforts made in policies towards the mitigation of climate change by their respective countries. Also, over 70% of farmers from both North Cyprus and Libya agree that climate change is causing a significant undesirable impact on the economy of their countries and the agricultural sector due to poor agricultural yield and a decline in sustainable agricultural practices. The majority of farmers from North Cyprus and Libya have expressed they fully understand climate change as an issue. The finding in this study with regard to the impact of climate change on agriculture is similar to the findings of other studies. Where the observed climatic and seasonal changes impact the yield and economic activities of farmers in South Africa [19], and Pakistan [20].

Farmers from both North Cyprus and Libya expressed the environmental problems in their countries as being unsustainable human activities such as poor or inadequate waste management, unsustainable agricultural practices, lack of environmental awareness, and the case of war and conflict specifically in Libya. The perceived effects or impacts of climate change as expressed by the farmers from both countries are primarily associated with the agricultural factors of their professions. The farmers expressed the effects of climate change as drought, erratic changes in seasons and temperatures, and soil degradation and depletion. Also, farmers from both North Cyprus and Libya have similar perceived causes of climate change, where farmers from both countries expressed urbanization processes, industrialization, deforestation, and rapid population growth as the main causes of climate change. According to a study by Singh (2020)[21], farmers are exposed to the direct impacts of climate change and are influenced by the direct cost of their livelihood to understand the phenomenon of climate change and its cause. However, the policies set up by countries are often unknown to the farmers even though it has a direct impact on their profession and livelihood as seen in the case of this study.

## 6. Conclusion

This study was carried out to investigate the perceptions of farmers on the subject of climate change among farmers in North Cyprus and Libya as a case study. The findings of this study have shown all the farmers surveyed in Libya and North Cyprus have indicated they know climate change is a significant problem through observations of the changes in temperature and rainfall patterns in their respective countries. The farmers surveyed in both North Cyprus and Libya have majorly indicated climate change and environmental challenges negatively impacting their agricultural production. The study found out the majority of the farmers in North Cyprus and Libya all agree on the impacts of climate change and the environment, the only observed significant difference is the subjective causes of climate change in the two countries, where Libya indicated deforestation being a major cause of climate change due to the high rates of deforestation practices in the country, and North Cyprus indicated Agricultural expansion as the major cause of climate change.

***Recommendation***

Based on the findings of this research, the recommendations proffered by this study are as follows. Governments and policymakers from both countries should make adequate efforts in communicating the policies and laws being set up to mitigate climate change. The governments and major stakeholders need to forward an awareness campaign on

environmental sustainability practices of agriculture and the provision of necessary resources for such practices.

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