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FARMER'S PERCEPTION OF CLIMATE CHANGE: AN ASSESSMENT FROM MEDINA REGION, SAUDI ARABIA

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ABSTRACT

Climate change is destroying sustainable agriculture and increasing food insecurity. It also depletes available natural resources for human beings and animals. KSA is particularly prone to climate change such as arid weather and low rainfall. The current study assessed farmers' perceptions of climate change. 123 farmers in the Medina region were randomly selected for a face-to-face interview. Farmers' perceptions of climate change showed significant differences regarding farmers' education, income, and experience. These results suggest capacity-building activities to improve farmers' adaptability to reduce negative effects of climate change. Moreover, training and workshops with the active involvement of the agricultural extension department and environmental agencies should be arranged to educate farmers about sustainable agricultural practices that would be helpful to mitigate climatic effects.

***Keywords*:** Assessment, Climate change, Perceptions, Saudi Arabia

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1. INTRODUCTION

Anthropogenic-induced climate change has been recognized around the world and has led to an increase in surface temperature by 0.85°C over the past hundred years. It is expected to rise by 1.5°C by the end of the 21st century (Pachauri et al. 2014). Recently global warming has increased poverty and disadvantages. An increase in average global temperature from 1 to 1.5°C and higher are predicted for many populations (Secretariat, 2018). Climate change causes land degradation, low agricultural yield, escalates food insecurity, and misemployment (CC UCO, 2021; Muddassir & Al-Zahrani, 2022). Using a 2005 baseline, predicted that global crop demand would increase from 100–110% by 2050 (Tilman et al. 2011; Muddassir & Al-Zahrani, 2022), which is driven by the rapid increase in population and per capita income (Godfray et al. 2010). Furthermore, using 2014 as a baseline, projected that a 25–70% increase in crop yield is required to fulfill the crop demand in 2050 (Hunter et al. 2017).

Agriculture and farm production are vastly reliant on climatic conditions (Khanal et al. 2021). Temperature variations prolonged the vegetative period and adversely affect crop production (Change, 2016; Ureta et al. 2020). Climate change increases the chances of risky weather (Cobián Álvarez & Resosudarmo, 2019), alters the timing of insect pest outbreaks, maximizes plant diseases (Nelson et al. 2009), declines plant water, and nutrient use efficiency (Asplund et al. 2014) and brings unpredicted fluctuations in crop yield (Torriani et al. 2007). Such devastated episodes of climate change lower farm output (Olayide & Alabi, 2018; Coulibaly et al. 2020; Liu & Dai, 2020).

Climate change not only adversely reduces crop production but also affects livestock health and performance (Key & Sneeringer, 2014). Heat stress increases animal mortality (Fahad et al. 2017). Climate change spreads human and animal diseases; extreme rainfall causes high runoff and wash-off human and animal feces holding zoonotic pathogens which deteriorate drinking water reservoirs (Sterk et al. 2013; Sterk et al. 2016).

Agricultural productivity in Saudi Arabia is highly dependent on the climate situation. Due to the arid climate of Saudi Arabia, sustainable water management is crucial to drive the farming system. According to FAO (Change, 2016), intensive change in rainfall pattern is adversely affecting the rural population. Chowdhury and Al-Zahrani (2015) predicted a temperature rise from 2.1 to 4.1°C in the northern regions of Saudi by 2050 respectively. Such climate conditions could intensify drought conditions that may reduce crop production. High temperatures could increase evapotranspiration by 10.3–27.4% and change the rainfall pattern for the northern region of KSA.

From the perspective of social sciences, perception is used to clarify how individuals understand reality and experience to distinguish and inform their reactions to construct behavior and actions (Given, 2008). Risks related to climate change should be measured to enlighten adaptation and mitigation methods (Zafar et al. 2023). The

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current study investigated farmers' perceptions of climate change and how farmers in the study area perceived risks related to climate change. It could further provide a preoccupied node of inquiry.

2. MATERIALS AND METHODS

Six governorates of Medina region were chosen for data collection. Face to face interview was conducted. The questionnaire was validated by expert extension agents. The majority of the respondents answered questions. The questionnaire consisted of questions about demographic characteristics and farmers' perceptions of climate change; perceptions were measured using 13 statements. The five-point Likert-type scale was used to know the farmer's perceptions, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

The data was collected by using a cross-sectional survey from the Medina region during the period June–August 2024. Three governorates in the Medina region were randomly selected for data collection. The survey was constructed and validated by a panel of expert extension agents. The data were completed by face-to-face interview. A total of 150 questionnaires were distributed; 123 completed the paper-based questionnaires, resulting in an 82% response rate.

The purpose of the study was explained to the respondents, and they were confident that the data gathered would only be used for research purposes. The questions were asked to farmers related to Climate change effects on crop production, water sources, temperature, rainfall pattern, crop diseases appeared, seasonal flood, drought, seeding, crop maturity, windstorm, human health, animal health and sea level. Descriptive statistics were calculated to address the research objectives. Descriptive analysis, frequency, percentage, mean and standard deviation were used. One-way ANOVA was used to analyze differences of farmers' perceptions regarding climate change.

3. RESULTS

Table 1 shows the demographic characteristics of the farmers. 56.9% of the respondents have 15 to 27 years of farming experience and 29.3% and 13.8% of the respondents have 2 to 14 years and 28 to 40 years of farming experience respectively. 52.8% of the respondents had obtained graduation and 26% had obtained higher education. A smaller number of the respondents, 13%, 4.9% and 3.3% had an education attainment primary school, high school and diploma respectively. With regard to income from farming, 40.7% of the respondents earned 25000 SAR from their farms. 24.4%, 21.1% and 13% of the respondents earned 25000 to 50000 SAR, 50000 to 75000 and 75000 to 100000 SAR from their farms.

Table 1: Demographic characteristics of the respondents

Variable	Frequency	Percent
Farming experience		
2-14 years	36	29.3
15-27 years	70	56.9
28-40 years	17	13.8
Level of education		
Primary	16	13.0
High school	6	4.9
Diploma	4	3.3
Graduation	65	52.8
Higher education	32	26.0
Income from farm		
0- 25000 SAR	50	40.7
25000- 50000 SAR	16	13.0
50000-75000 SAR	30	24.4
75000-100000 SAR	27	21.1

3.1. Farmer's Perception of Climate Change

Table 2 depicted that around 98.4% of the farmers were agree and strongly agree that climate change affecting crop production, drying water resources 97.6%, temperature is increasing 98.4%, rainfall pattern changes 91.1%, climate change cause drought 91%, delay seeding 91.1%, increasing windstorm 87%, risky for human health 83.7%, risky for animal health 81.3%. Furthermore, the majority of the farmers 32.5 and 35.8%, strongly disagree and are neutral that new crop diseases appear, and climate change increases seasonal flooding respectively. 76.4 and 70% of farmers agree and are neutral that delay crop maturity and increase in sea level, respectively.

3.2. Level of Farmer's Perception

Based on farmers' perceptions level, Fig. 1 shows that 52% of the respondents hold a high perception of climate change and 48% hold medium perception.

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Table 2: Farmer's perceptions of climate change

Items	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %	Mean	SD
Climate change affecting crop production	0	0	0	56.9	41.5	4.42	0.496
Drying water sources	0	0	0	56.9	40.7	4.42	0.495
Temperature is increasing	0	0	0	56.9	41.5	4.42	0.496
Rainfall pattern changes	0	0	7.3	49.6	41.5	4.35	0.615
New crop diseases appeared	32.5	5.7	26.0	11.4	22.8	2.86	1.556
Climate change increases seasonal flood	32.5	6.5	35.8	16.3	7.3	2.59	1.302
Climate change cause drought	0	0	4.9	52.0	39.0	4.36	0.578
Delay seeding	0	0	7.3	65.9	25.2	4.18	0.548
Delay crop maturity	0	0	12.2	76.4	8.1	3.96	0.458
Increasing windstorm	0	0.8	10.6	51.2	35.8	4.24	0.671
Risky for human health	0	6.5	8.1	58.5	25.2	4.04	0.779
Risky for animal health	0	6.5	10.6	61.0	20.3	3.97	0.763
Increase in sea level	8.9	12.2	70.7	1.6	4.9	2.81	0.820

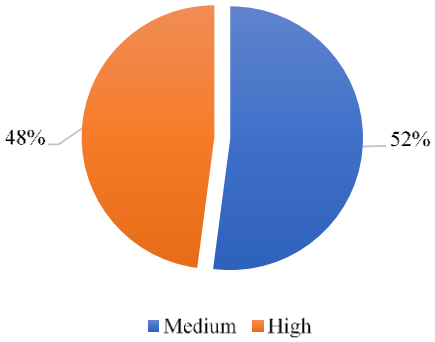

Fig. 1: Overall farmers perception about climate change.

3.3. One-way ANOVA

Table 3 showed significant differences in farmers' perceptions of climate change regarding education (F=11.95; P=0.001). The farmers who obtained a diploma had higher mean (mean= 56.50). Results also demonstrated significant differences in farmers' perceptions of climate change regarding their income (F=17.33; P>0.001). The farmer's group who earned from 0- 25000 SAR had higher mean (mean=53.65). Regarding farming experience, findings presented significant differences in farmers' perceptions of climate change (F=3.94; P=0.001). The farmer's group who had 28-40 years of farming experience showed higher mean (mean=52.35).

Table 3: ANOVA differences in farmers' perceptions of causes of climate change with regard demographic characteristics.

Variables	Farmers' Perceptions			
	Mean	SD	F	Sig 2-Tail
Level of education				
Primary *n* = 16	52.31	5.69	11.95	0.000
High school *n* = 6	51.67	7.03		
Diploma *n* = 4	56.50	1.73		
Graduation *n* = 63	52.17	6.51		
Higher education *n* = 32	44.94	1.37		
Income				
0- 25000 SAR *n* =48	53.65	4.97	17.33	0.000
25000- 50000 SAR *n* = 16	52.63	9.02		
50000-75000 SAR *n* = 30	45.07	1.23		
75000-100000 SAR *n* = 27	49.22	5.88		
Farming experience				
2-14 years *n* =35	52.14	7.12	3.94	0.022
15-27 years *n* = 69	49.02	5.77		
28-40 years *n* = 17	52.35	5.63		

4. DISCUSSION

In recent years, many countries have experienced the negative impacts of climate change. Farmer's perception of climate change is unavoidable because agricultural activities are mainly dependent on climate conditions and

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directly impact on their revenue. Adverse effects of climate change on agricultural production and practices have been observed by the farming community, as our results showed that farmers perceived climate impact on crop production by variation in rainfall, temperature, drought, delay in seedling, variation in crop maturity and emergence of diseases among humans and animals. These results are consistent with Tanure et al. (2024), who revealed that the majority of the farmers perceived high temperatures, variation in drought and growing seasons. Moreover, the findings of Ayanlade et al. (2017) showed similarities with our results that farmers' perceived fluctuation in the early and late growing season and low rainfall. Additionally, impacts of climate change on livestock (63.2%) and maize crops (62.8%) were also noted. Farmers also perceived the negative effects of climate change on human health and livelihoods as a whole (Uddin et al. 2017). Farmers hold different perceptions as our findings revealed that most of the farmers perceived high impacts of climate change. This findings is confirmed by Menapace et al. (2012) that farmers' perceptions may be influenced by their beliefs, farmers who highly believe in climate change showed high perceptions of direct and indirect climate-related upcoming threats. Farmer's belief could be an important determinant of perception as Alotaibi et al. (2020) emphasized that most of the farmers in Saudi Arabia believed that climate change occurred due to human activities and natural change. This result is in line with Shrestha et al. (2022) that report more than 80, 82, and 77% of farmers perceived variation in summer and winter duration, increase in the summer period, and decrease in winter duration respectively. Farmers' perceptions varied according to climate change. For instance Muneer et al. (2024) revealed that farmers perceived high about variation in temperature as compared to variation in rainfall. It means farmers perceived differently, according to researchers' observation, farmers seemed more worried about high temperature in the study area. Saudi Arabia is prone to high temperature due to low rainfall that leads to water scarcity and drought. Therefore, it can be suggested that the high temperature in the study should be reported to environmental agencies and meteorology department. These agencies should collaborate with the extension department and arrange training in sustainable agricultural practices to reduce climate change in the study area.

Farmers who obtained diploma education hold a high perception of climate change in the study area. Significant impact of education on farmer's perceptions of climate change implies that educated farmers are more likely to perceive climate change accurately and consequently have stronger intentions and adaptation preferences compared to uneducated farmers (Abid et al. 2019). Alhassan and Haruna (2024) found that highly educated farmers seemed more experienced due to high knowledge about climate change, and hold high perceptions of the local ecosystem, climate change and sustainable climate adaptation methods.

Education is one of the key factors and has a positive and significant relationship with farmers' perception, highly educated farmers hold higher perception than less educated (Alotaibi et al. 2020; Uddin et al. 2017). It is understandable that educated farmers may have easy access to various sources of agricultural information, that in turn may improve their awareness and perceptions as well (Muddassir et al. 2024). Based on research findings, Roco et al. (2015) publicized that education and perceptions of climate change among farmers could be linked with each other. Our findings correspond with those of Nyang'au et al. (2021) who acknowledged that the education level of farmers enhanced the likelihood of perceiving variations in climate such as the decrease in precipitation and rise in temperature. It implies that educated farmers have the ability to access updated information about climate change than uneducated farmers. Educated farmers developed their knowledge and skill that may support them to sense climate hazards better (Maddison, 2007; Alotaibi et al. 2020).

Farmer's income could also influence perceptions of climate change. Findings reveal that farmers with low incomes perceived high. These results are contradicted by Semenza et al. (2008), who found that farmers who earn high incomes are more likely to identify variations in climate and positively affect farmers' perceptions of climate change. In Chile, the result of Roco et al. (2015) determined that farmers' income influenced their perceptions of climate change. Moreover, farm income improves aspiration to learn about climate change. Farmers may perceive that farm incomes make easy access to sustainable practices that mitigate climate change (Yahya et al. 2024). During crop cultivation, farmers tried to earn high incomes and adopt sustainable agricultural practices. Farmers perceived that high incomes may make them able to build adaptive capacity and perceived that climate protection could be increased if farm incomes increased (Touch et al. 2024). Moreover, Alotaibi et al. (2020) found that farmers who have financial support and high farm incomes held high perceptions and adopted climate-smart agriculture (CSA) practices. In the same context, Setiawan et al. (2019) stated that low crop productivity decreased farm income that adversely affect farmers perceptions of climate change. They further observed that low-income farmers tried to get jobs other than agriculture. During interviews, farmers revealed that low incomes could not make them able to sustain their farms. Farmers required innovative technologies that mitigate climate effects on their crops.

Farming experiences showed significant differences regarding perception of climate change in the study area. Current study supported the finding of Maddison (2007), who observed that experienced farmers are more informative. Furthermore, Asrat & Simane (2018) reported that farming experience determined perception of

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climate change and dearth of farming experience decreased perception of climate change and negatively affected adaptation decisions. This means an increase in years of farming experience improved perceptions of climate change among farmers. another research revealed that farming experience not only improve perceptions but also enhance adoption level (Alnafissa et al. 2024). These findings are similar to Muddassir et al. (2024) who revealed that farming experience motivate farmers towards adoption. It may be resulted from high perceptions. They further deeply investigated that the years of education were highly effective to achieve high perceptions of climate change. Therefore, it was suggested that highly educated farmers should be involved in the agricultural field and the agricultural extension department should educate less educated farmers to adopt sustainable agricultural practices.

5. CONCLUSION

The current study examines farmers' perceptions of climate change. The demographic characteristics of the farmers showed significant differences regarding farmers' perceptions of climate change. However, high perception of climate change among farmers could enhance their adaptation abilities to mitigate climate change impacts. Moreover, the adoption of sustainable agricultural practices at their farms will support the kingdom to implement the Paris Agreement as well as achieve several Sustainable Development Goals (SDGs) related to environmental protection. These findings have implications for agricultural strategies. Government should establish training centers to educate farmers about climate change. Legislation should be implemented to secure the ecosystem in the study area. Promoting education and easy access to information, available resources and institutional support could develop adaptive capacity to climate change and significantly improve farm productivity and livelihoods. In addition, awareness campaigns should be employed to create awareness of climate change among farmers. Administration of agricultural extension should implement training sessions regarding the advantages of climate-smart technologies and mitigation tools.

Author's Contribution

Abdulmalek Alsanhani; data collection, Nageeb Aldawdahi; survey development, Muhammad Irfan Ulllah; final review, Abdulmalek Alsanhani; data analysis, Abdulmalek N. Alsanhani; data curation and Muhammad Irfan Ullah; results and discussion.

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