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An analysis of climate change impacts in the context of farmers' awareness and perception: Evidence from the UK

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Abstract
This study was undertaken to assess farmers' awareness and perceptions of climate change impacts from the UK's perspective. The data was analysed using descriptive statistics and a regression model. According to the findings of a descriptive analysis, the majority of respondents were aware of climate concerns, but their perceptions of the effects of climate change on production and annual revenue differed. Climate-related information is very relevant in determining farmers' understanding of climate change implications, according to a regression test. A probit analysis shows that awareness, perception, education, crop production, soil fertility and annual revenue are highly influential on farmers' climate change impacts adaptation. The findings show that effective adaptation to climate change impacts is heavily reliant on community awareness and farmers' perceptions of climate change impacts.

Keywords: climate change, impacts, adaptation, awareness, perceptions

Introduction

Climate change is increasingly acknowledged and accepted in science arenas. The emerging reality of climate change potentially increases the level of concern about issues of sustainability generally. Many agricultural industries will be impacted by climate change, and agriculture in the UK is projected to be especially affected (Wreford and Topp, 2020) [12]. The consequences of climate change will be wide ranging. For example, results from a number of studies have revealed an increase in temperature and a decrease in rainfall reliability in some rural areas in the UK (Knox et al. 2010; Rio et al. 2018) [6]. Risk awareness, risk perception, and capacity to mitigate negative consequences on the production system are factors that need to be considered while adapting to climate change impacts (Khan et al. 2020; Fahad and Wang, 2018) [4]. According to prior studies, there is a clear link between farmers' awareness and perceptions of climate change, as well as their adaptation to its consequences (Aydogdu and Yenigün, 2016; Li et al. 2017) [3]. Arbuckle et al. (2015) [2] give an emphasis in their study that farmers' awareness and perceptions of climate change are very crucial. Misconceptions about climate change and its associated risks may result in no adaptation or maladaptation, thus increasing the undesirable impacts of climate change (Ado et al. 2019; Mustafa et al. 2019) [1, 8]. Therefore, knowing the extent of community awareness of climate change and how farmers perceive the impacts of climate change on their livelihoods is very important for understanding the local exposure to climate risks and the farmers' adaptive capacity to cope with climate change impacts. In addition, even though farmers' climate change education, perceptions, and adaptation alternatives have been investigated by Nguyen et al. (2016) [9], they failed to assess the effects of awareness and perception on adaptation. Furthermore, very little is said about the factors influencing farmers' awareness. Based on these situations, this study will measure farmer understanding and perceptions of climate change impacts, specifically higher rainfall unpredictability and higher temperatures, in order to fill a vacuum in the existing studies. This study is also very critical for policymakers and other similar actors that want to assist vulnerable households in making informed decisions about climate change adaptation.

Research design and methodology

Study area

The study was undertaken in the North West, England. Due to the increasing farming challenges associated with adverse climatic conditions, the some region in the North West, England is facing an acute food shortage. Moreover, the regions are also struggling with issues of land tenure and related conflicts, and consequently, environmental degradation of common-use resources. As a result, there is often a limited availability of pasture, especially in the dry season due to increased competition for grazing and water resources.

Data collection

This study used quantitative and qualitative research methods. We visited some villages to conduct interviews, taking place 3 months (July-October 2019). A total of 25 household heads were interviewed depending on their availability and willingness between July and October 2019. The collected data were used as a guideline for the construction of the semi-structured questionnaire. Before commencing the survey of the household heads, the questionnaire was pretested on 20 key informant farmers. The survey of this study took 3 months (December 2019 – February 2020) to complete. A total of 258 questioners were analysed in this study. We could not collect more data due the pandemic cases, affecting the UK in the end of March

2020.

Data measurement

Climate change awareness was coded as a binary variable, and later choice options were coded using a Likert scale (‘yes’ or ‘no’ scoring 1 and 0, respectively); the respondents were asked to indicate their status of climate change awareness. They were then asked to identify their sources of information about weather and climate variability. The respondents were also asked to rank their perception of climate change impacts on crop production and associated household revenue in terms of a decrease or an increase using a seven point Likert scale (-3, 3), where 0 = no change, +1 = Low increase, −1 = Low decrease, +2 = Medium increase, −2 = Medium decrease, +3 = High increase and −3 = High decrease.

Data analysis

For analysis data, we used an IBM SPSS Statistics 25. It is one of the most widely used application programs for statistical analysis in the social sciences, including in a study of veterinary and animal science (Petrie and Watson, 2013).

Findings

Descriptive analysis

Results of the descriptive analysis are summarised in Table 1. It shows that the majority of respondents are male (88.8%), with an average age of 37.48. If looking at the marital status, the majority of respondents (96%) were married. Nearly half of the respondents (48%) did not have access to formal education, while 31% had finished at least basic school and 21% had benefited from crop production mentoring and extension services. In addition, 85.6 percent of farmers have access to climate change information. Agriculture and livestock are the primary household activities, with 3.84 hectares of cropland and 2.51 units of tropical livestock (UTL) on average. Farmers have an average of 31 years of farming experience and a per capita income of USD$111.80. Then. Agro-pastoralism is the most popular way of making a living (89 percent).

Table 1: Descriptive statistics of farmer characteristics

Variables	Scales	Mean
Projects support	0=Yes	0.75
	1=No	0.25
Gender	1=Male	0.89
	2=Female	0.11
Age	1 for each year	37.48
Experience in agriculture	1 for each year	31.09
Marital status	1=Single	0.04
	2=Married	0.96
Education	0=Illiterate	0.48
	2=Adult courses	0.21
	1=Attended schooling system	0.31
Income	USD$	111.80
Association membership	0=No	0.71
	1=Yes	0.29
Livelihood strategies	1=Farmers	0.11
	2=Agro-pastoralist	0.89
Livestock ratio	UTL	2.51
Farm size	Hectare	3.84
Soil fertility	0=Low	0.27
	1=Medium	0.42
	2=High	0.31
Food production	Kilograms	1163.62
Climate change information	0=No	14.40
	1=Yes	85.60

Factors affecting farmers’ awareness of climate change

A logistic regression model was used to determine the most influential elements influencing farmers' awareness of climate change. The results are presented in Table 2.

Table 2: Most influential factors influencing farmers’ awareness of climate change

Variables	B	S.E.	Wald	Sig	Exp(B)
Education level	0.541	0.310	3,043	0.081	1,718
Farm size	−0.217	0.104	4,346	0.037	0.805
Livestock ratio	−0.185	0.072	6,488	0.011	0.831
Farming experience	0.222	0.081	7,546	0.006	1,248
Climate change information	1,619	0.704	5,283	0.022	5,049
Income	0.000	0.000	7,474	0.006	1,000
Marital status	−2.764	1,259	4,819	0.028	0.063
Soil fertility	−0.727	0.395	3,393	0.065	0.483
Model fit test					
Model test	Chi-square	Sig.	−2 Log Likelihood	Percentage correct	
Test for overall model	32,446	0.000	115,592	81.4	
Hosmer and Lemeshow Test	31,405	0.925			

As reported in Table 2, it suggests that the associated *p* value for the overall model is equal to 0.000, with the overall percentage of correctness of the model is 81.4 percent, and the Chi-square value is 32.45. These numbers

inform us about a good fit between the model and the data. As a result, we can infer that all of the selected variables are well-fitting and can accurately predict the factors influencing farmers' climate change awareness.

According to the regression test, farmers' understanding of climate change is strongly and favourably influenced by the household head's education level, farming experience, and access to climate information. A one-year increase in farming experience raises the likelihood of being aware by one unit. This means that the more farming experience a farmer has, the more likely he or she is to be conscious of climate change. Farmers who have access to climate information are also eight times more likely to be aware of climate change.

Moreover the regression results inform that farmers' awareness of climate change is significantly and negatively associated with farm size, soil fertility, and livestock ratio. Increases in soil fertility and livestock ratio, as well as a reduction in farm size by one unit, might enhance the probability of awareness by 21, 52, and 18 percent, respectively. As a result, the smaller the farm, the better the soil quality, and the higher the livestock ratio, the more likely a farmer is to be aware of climate change.

Farmers' perceptions of climate change impacts

The research examined how the respondents perceived climate change impacts on their livelihood, and particularly on crop production and revenue. They were required to indicate to what extent rainfall variability and high temperatures affected their crop production and revenue. The results are reported in Table 3. In general, climate change implications were perceived differently by the respondents. Ninety-five percent (95%) of respondents said climate change has had a negative impact on their crop production, and 92.25 percent said it has had a negative impact on their household revenue.

Table 3: Farmers' perceptions of climate change impacts on crop production and annual revenue

Livelihood assets	Scales	Respondents' perception of negative impacts	Respondents' perception of positive impacts	Farmers perception	Agro-pastoralists' perceptions
Production	High	42.50	0.00	44.40	43.30
	Medium	29.37	0.63	33.30	29.80
	Low	23.13	1.25	16.70	24.10
	Not at all	3.12		5.60	2.80
Revenue	High	43.75	0.00	50.00	44.00
	Medium	27.50	0.63	16.70	29.10
	Low	25.00	0.62	27.80	24.80
	Not at all	2.50		5.60	2.10

Referring to data in Table 3, very few of the respondents reported positive impacts of climate change on their crop production (1.88%) and revenue (1.25%). In addition, Table 3 reveals that very few of the respondents perceived any impacts from climate change on their crop production (3.12%) and revenue (2.5%). When it came to livelihood strategy, agro-pastoralists had the highest perceived climate change impacts on crop production and revenue. This is because of the high dependency of agro-pastoralists on the agriculture sector. Livestock is reliant on agricultural productivity, which is also dependent on climate variability. Agricultural production has an impact on livestock because it affects the availability of fodder. This does not, however, indicate that agro-pastoralists are more exposed to the effects of climate change. Their vulnerability depends on the adaptive capacity of their livelihood strategy.

Adaptation to climate change impacts

The impact of respondents' awareness, perception, and socioeconomic characteristics on their adaptive capacity is examined in this section. The influence of chosen variables on adaptability to climate change impacts was assessed using a probit model. The results are summarised in Table 4. Table 4 shows that farmers' adaptation capacity is influenced by their awareness and perception of climate change impacts, project support, education level, soil fertility, food production, annual revenue, and farming experience.

Table 4: Effects of socio-economic characteristics and different land uses on adaptation to climate change impacts

Variables	Estimate	Std. Error
Project support	−0.049*	0.021
Household head education level	−0.147***	0.013
Household size	−0.011	0.012
Education rate	0.042	0.101
Association membership	−0.008	0.011
Farming experience	0.006	0.012
Soil fertility	0.091*	0.004
Awareness of climate change	0.189***	0.032
Perception of climate change impacts on crop production	0.170**	0.051
Perception of climate change impacts on revenue	0.081*	0.022
Farm size	0.005	0.014
Food production	0.000**	0.051
Livelihood strategy	0.070	0.062
Livestock ratio	0.004	0.032
Revenue	0.000***	0.021
*, ** and *** Signifcant at 10, 5, and 1% probability levels, respectively		

The test demonstrates that respondents' level of adaptability is positively influenced by their awareness and perception of climate change impacts. So, the likelihood of adaption improves by 18.9% when people are aware of climate change. Project support has a positive and significant impact on climate change adaptation. According to the results of the probit analysis, project support raises the likelihood of households' adaptation by 4.9 percent. This means, households who get project support are more likely to adjust to the effects of climate change.

Furthermore, climate change adaptation is thought to be influenced by education. Table 4 shows that education has a large and beneficial impact on respondents' ability to adjust to the effects of climate change. A one-year increase in formal education raises the likelihood of households' adaptation by 14.7 percent. Another crucial component in climate change adaptation is soil fertility. The study found that as soil fertility rises, the likelihood of adaption rises as well. A one-unit improvement in soil fertility will result in a 9.1% increase in the likelihood of adaptation to climate change impacts.

In addition, as shown in Table 4, there is a significant and positive association between crop production, annual revenue and adaptation. Farmers that produce a lot of crops are more likely to adapt to climate change impacts, and the more money a household has, the more probable it is to adapt to climate change impacts.

Conclusion

Information about climate change was found to be the most significant factor determining farmers' awareness. Other factors influencing farmers' understanding of climate change were education, years of farming experience, marital status, annual revenue, soil fertility, livestock ratio, and farm size. Then this study suggests that farmers had different perspectives on the effects of climate change. The majority of respondents said climate change had a negative impact on their crop production and annual revenue (95 and 96.25 percent, respectively), while only a minority said it had a positive impact (an increase) on their crop production and annual revenue (1.88 and 1.25 percent, respectively). Climate change has no impact on crop production or annual revenue, according to about 3 and 2.5 percent of respondents, respectively. Nonetheless, the probit test suggests that the most relevant elements linked with climate change impacts adaptability include awareness, education, perception, soil fertility, crop productivity, and annual revenue.

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