Unpacking the Levels of Household and Individual Climate Change Adaptation: Empirical Evidence from Leeds, United Kingdom[✉]

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ABSTRACT

This study set out to empirically determine the current state of individual and household adaptation to climate change in the United Kingdom and how policy makers can improve on it. The study utilized both qualitative and quantitative approaches (mixed method). For the quantitative aspect of the study, a quota-sampling technique was employed in the selection of 650 respondents for the study using a well-structured questionnaire. The quota representation was based on age and gender. Data were analyzed using descriptive statistics and binary logit regression. In addition, qualitative content/topic analysis of an in-depth interview of the respondents was employed in further analyzing why and how policy makers can improve climate change adaptation. Findings from the study indicate the dire need for continued government support in household and individual adaptation in Leeds, and this support should also be encouraged in other cities where government intervention is low. Interventions in the form of subsidies, direct regulations, and public awareness are needed. The implementation of these measures is expected to generate a wide range of additional benefits to most vulnerable groups who should be central to the rapidly expanding climate change research and policy agenda in the United Kingdom.

SIGNIFICANCE STATEMENT

Evidence shows that periods of extremely cold winters have been perceived to have increased in frequency in the United Kingdom over the years. This points to the need to uncover what policy and behavioral adaptation measures required to improve individual and household adaptation measures to cold spells in the United Kingdom. We utilized both qualitative and quantitative approaches (mixed method) to find out the drivers and hindrances to adaptation against cold spells, using Leeds as a case study. We found out that over 70% of the respondents adopted all of the short-term coping strategies, whereas 55% did not indicate any changes in their behavior in response to cold spells. Also, government support, the prospect of relocation (people's intention of leaving their home), and the high technicalities in installing adaptation tools significantly affect individuals' tendency to adopt long-term coping strategies.

1. Introduction

As in every other nation of the world, the need for climate change adaptation in the United Kingdom has suddenly become inevitable (Taylor et al. 2014). Previous research indicates that climate change manifests in myriad ways: floods, heat waves, cold spells,

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droughts, and water scarcity (Demski et al. 2017). In the United Kingdom, climate-related risks in the form of cold spells appear to be one of the major manifestations of climate events. Cold spells in the United Kingdom consist of very low temperatures and significant snowfall, which worsen due to the significant overcast and cloud-covered skies. In the spring of 2013, the Met Office reported a record low temperature reaching -10.5°C , and further down to -12.5°C by 2018 (Greenfield 2018). The impacts were consistent with projections for increased U.K. cold weather warnings under climate change (Greenfield and Rawlinson 2018). Subsequent climate CMIP5 model simulations over Europe indicate that the risks of extreme winter cold spells are poised to be heightened significantly (Peings et al. 2013), hence the need for improvement in policy and behavioral adaptation measure against cold spells.

Governments around the world, and indeed the United Kingdom, must grapple with this fact by mainstreaming adaptation frameworks into climate policies, just like greenhouse gas mitigation (Pielke et al. 2007). The U.K. Climate Impacts Program (UKCIP) defines adaptation as a measure (and not just an outcome of a process) that will reduce physical injury or damage arising from the vagaries of climate and climate change (Lonsdale et al. 2010). This definition further acknowledges the realities of climate change, and as stressed in Willows and Cornell (2003), whereas climate change impacts mitigation has become a priority and pivotal in emission-control policies, climate change adaptation must also become central in developmental policy decisions. Literature points to the critical role of individual and household engagement in fostering a climate-ready society (van der Linden et al. 2015), as the individuals and households constitute the level and places where adaptation happens (Porter et al. 2014). It is the individuals who suffer the consequences of climate change, and they are the ones that can also take action to adapt. Hence, there is the need to advance climate change adaptation and coping efforts among individuals or groups of individuals.

Discourse in climate conventions, as typified by the United Nations Framework Convention on Climate Change (UNFCCC) identified various measures and types of adaptation available to individuals and households (UNFCCC 2007). Various literature has also taken diverse approaches to classify these measures (INGV 2007; Smit and Wandel 2006; Porter et al. 2014). INGV (2007) effectively categorized the available household adaptation measures to include the behavioral, managerial, technological, and policy measures. Examples of these include change in food choices, adjustment in farm practices, sea defenses, and government regulations, respectively. This was

more comprehensive and overarching. According to Smit and Wandel (2006), most of the individual and household adaptation decisions fall within the policy and behavioral categories. Porter et al. (2014) then grouped these policy and behavioral measures into two main types, which they termed the “coping responses” and “adaptations.” While the coping responses are more spontaneous, inexpensive, and obtainable, adaptations are more complicated, expensive, and challenging (Porter et al. 2014, p. 3).

In a study undertaken by Taylor et al. (2014) to determine the center of attention of most literature on individual and household adaptation measures, 44 peer-reviewed journal articles relating to climate change adaptation in the United Kingdom were systematically examined. Findings from the study showed that most of the studies were based on systematic reviews and meta-analyses of previous literature, having London and Norwich as the main study areas, and none on Leeds. Their findings also indicated the fact that the bulk of the literature centered more on flooding, flood management, and flood risk insurance, with little or no attention paid to the need for adaptation to cold spells. However, evidence shows that periods of extremely cold winters have been perceived to have increased in frequency in the United Kingdom over the years (Taylor et al. 2014). A Yorkshire and Humber climate change impact scoping study (Atkins 2002) identified the cities of Sheffield, Leeds, Hull, Bradford, and York as regions that need to plan for the consequences of more frequent extreme weather events, sea level rise and variability in temperatures as there is a high possibility of future development of these events in these regions. In response to this, this study, therefore, intends to investigate the different individual and household adaptation measures adopted by citizens of the United Kingdom, using Leeds as a case study. Similarly, Porter et al. (2014), in a systematic assessment of the focus of most literature on individual and household adaptation actions among U.K. households, reported that only about 1.2% of the literature on U.K. household adaptation was empirically robust (Porter et al. 2014). This supports the claim made by Schipper (2009) that majority of the literature on climate change adaptation is theoretical and feeds on a few available empirical studies.

2. Adaptation behaviors and predictors

As pointed in van der Linden et al. (2015), there exists an extrinsic and intrinsic source of motivation to individual adaptation. These sources correspond to either external processes or internal and personal processes that produce motivation for a change in action and behavior. Accordingly, at the individual and household level, van der Linden et al. (2015) posits that to achieve a more

effective and long-lasting proenvironmental behavior, there is a need to appeal to people's intrinsic motivational needs more than the extrinsic incentives. This suggests that policies that focus on extrinsic incentives will be less successful as they succeed only if they are continuously maintained. A study by [Wolf et al. \(2010\)](#) showed that external processes such as high levels of social capital and network play an important role in intrinsic and personal responses to adaptation initiatives. The study, which was conducted in the United Kingdom, suggested that high level of social networks can significantly increase rather than decrease vulnerability to heat waves, as high social bond can perpetuate a negative or positive behavior or action on individuals within a social group depending on the narrative being advanced within the social group. This finding suggests a complex and uncertain relationship between social networks and adaptation to climate change.

Furthermore, in analyzing the predictors of behavioral change, [Semenza et al. \(2011\)](#) posited that individuals can be receptive to behavioral change and motivated to adopt mitigative and adaptation measures when climate change is framed in terms of public health. The study reported that in the study area, citizens will change their behaviors positively if they believe that they are in danger of the impacts of climate change, and those with requisite information about climate change impacts took more adaptation strategies.

As posited in [Gawel et al. \(2016\)](#) and [Walker et al. \(2004\)](#) identification of the drivers and barriers to climate change adaptation is important as it guides policy makers in their efforts in improving intrinsic initiatives as regards the individual level of adaptation. [Porter et al. \(2014\)](#) showed that experience, education, and enlightenment can go a long way in motivating the adoption of adaptation measures, especially when it comes to long-term adaptive strategies. This view was supported by [Grothmann and Patt \(2005\)](#), who included factors like lack of self-motivation and government support as hindrances to adaptation. However, what has remained unclear is how and the extent to which government support is needed.

According to [IPCC \(2007a\)](#), in response to projected and current effects of climate change, there exist presently, some levels of adaptation, but this is only on the periphery and limited. There is, therefore, an urgency to mainstream climate change adaptation in the U.K.'s climate change policy actions. Accordingly, [Willows and Cornell \(2003\)](#) pointed out the fact that up to now, much of the literature on adaptation have been theoretical, which reflects the deficiency of empirical data from available studies on ground ([Willows and Cornell 2003](#)). Due to this shortage of empirical data and research, efforts in mainstreaming adaptation into development policies in the United Kingdom is still been hampered by a lack of empirical evidence. Policy makers do not

TABLE 1. Population of the study area (percentage in parentheses).

Gender	No.
Male	319 (49.1)
Female	331 (50.9)
Age (yr)	
18–44	319 (49)
45–64	202 (31)
≥65	130 (20)

have sufficient evidence on the current level of climate change adaptation in the United Kingdom, making it difficult for them to make an informed decision on pragmatic action plans needed in building capacities that will enable high-level household coping and adaptation strategies ([Pielke et al. 2007](#)), hence, the need for this research. The broad objective is to empirically determine the current state of individual and household adaptation to climate change in the United Kingdom and how policy makers can improve it. The specific objectives are to

- (i) identify the short-term coping strategies and the long-term adaptation features adopted by residence against cold spells in the study area,
- (ii) identify the drivers and hindrances to households' adoption, and
- (iii) determine the role of government in promoting household adaptation in the study area.

3. Research method

The study utilized both qualitative and quantitative approaches (mixed method). For the quantitative aspect of the study, a quota-sampling technique was employed in the selection of 650 respondents for the study. The quota representation was based on age and gender. Based on this, the sample consists of 49.1% males and 50.9% females, of which 49% of the total respondents were between 18 and 44 years old and 31% were between 45 and 64 years old, with the remaining 20% being over 65 years old. This sampling procedure was adopted to reflect the demography and population dynamics of the study population as presented in [Table 1](#). Age and gender have been used in generating the sample as studies have established the possibilities of value differences across age and gender groups ([Shoham et al. 1998](#); [Levi and Hassner 2015](#)). Also, it was difficult to identify every member of the population of study and classify them into one subpopulation—hence, the need to employ the quota-sampling technique.

The quantitative data were obtained through household surveys with the aid of a pretested semistructured questionnaire designed in a way to generate data that would adequately achieve the objectives of the study

(see the online supplemental material for the full text of the questionnaire). Examples of data that were collected included demographic and socioeconomic characteristics of the respondents, such as age, gender, marital status, education level, and income. Other questions focused on previous experience of climate incidences, adaptation measures employed, and their perception of climate change. These data were used to generate information about the adaptation status of the respondents. In addition, some quantitative data were also collected on the drivers of adaptation, and respondents' views about climate change from the household survey. Questions with regard to adaptation process were only addressed to respondents who owned their houses as they are better positioned to answer the questions about long-term household adaptation strategies.

Further qualitative information about the underlying drivers of adaptation, respondents' perception, and historical narratives was elicited by using the qualitative interview method. Interviews are generally considered to be one of the most effective methods of collecting information in climate change research because they allow the people to conduct the analysis of a problem affecting their environment and proffer pragmatic solutions. In this way, they provide an insider perspective, thus allowing the researchers to learn from the people.

To be specific, the interviews, which lasted for about 20–30 min, were used to elicit responses on respondents' perception about climate change; the role of government in climate change adaptation; and economic, social, and environmental issues affecting adaptation strategies as well as more in-depth information about the drivers of adaptation. This approach helped to triangulate findings from the household survey, providing clarity, and generally improved the reliability of the quantitative data. As a type of qualitative data, it provides information about social structures such as internal practices within a particular field, and individual experiences. The objective of understanding the underlying drivers and households' perception of climate change adaptation fall within this scope of analysis and as such justifies its usage in the study. (A sample of the interview transcript can be found in [appendix A](#), and a detailed result of the regression analysis using the StataCorp Stata, release 14 (Stata 14), software program can be found in [appendix B](#).)

Objective i was analyzed using descriptive statistics such as frequency distribution and mean. The binary logit regression (BLR) model was used in analyzing objective ii. For objective iii, qualitative content/topic analysis of the in-depth interview was employed in further analyzing why and how the government can improve climate change adaptation.

The binomial logistic regression

The BLR was employed as the dependent variables assume discrete rather than continuous forms. The BLR applies maximum likelihood estimation after transforming the dependent variable into a logit variable. In this way, logistic regression estimates the odds of a certain event (value) occurring or not occurring, calculates changes in the “log odds” of the dependent variables, but not changes in the dependent variable itself as ordinary least squares regression does. Thus, the dependent variable can only take two values one and zero, thus depicting a binary outcome. The regression model predicted the logit, that is, the natural log of the odds of adopting one adaptation strategy (yes) or not (no). The model can be represented as follows:

$$\ln(\text{odds}) = \frac{\hat{Y}}{1 - \hat{Y}} = a + \mathbf{DiXi} + \mathbf{BiXi}, \quad (1)$$

where $\hat{Y}$ is the predicted probability of adopting an adaptation feature, which is coded 1 for yes; $1 - \hat{Y}$ is the predicted probability of not adopting a particular adaptation strategy, which is coded 0 for no; a is a constant; $\mathbf{DiXi}$ is a vector of the adoption drivers; and $\mathbf{BiXi}$ represents a vector of the barriers.

The independent variables (barriers and drivers) were presented to the respondents in such are they choose either yes or no, meaning that the responses are also dichotomous (0 and 1). This means that there is no continuous variable among the independent variables. So the assumption of linear relationship between any continuous independent variables and the logit transformation of the dependent variable was not violated. To now determine the parameter estimates, a BLR was employed for each of the selected adaptation strategies (double or triple glazing, loft insulation, draft proofing, cavity wall insulation, and upgraded boiler), as the dependent variable and the drivers and barriers were retained as the dependent variables for each of the selected adaptation strategies. The exponentials of the coefficient of the drivers and barriers were extracted from the result tables included in [Figs. B1–B3](#) of [appendix B](#) and are presented in [Table 2](#).

This result can be interpreted in terms of the odd ratio. When the odd ratio (i.e., when the coefficients as presented in [Table 2](#)) is greater than 1, the probability of the event occurring, that is, the adoption of the selected adaptation strategies with a unit increase in the independent variable, is higher than at the original value of the independent variable. On the other hand, when the odd ratio is less than 1, the probability of the event occurring with a unit increase in the independent variable

TABLE 2. A BLR model of the drivers and hindrances to household adaptation to cold spells. The barriers consist of those factors that keep the citizens from adopting any of the included coping strategies outlined, whereas the drivers are motivations to adopt. The single and double asterisk represent significance at the 10% and 5% significance levels, respectively.

	Double (triple) glazing	Loft insulation	Draft proofing	Cavity wall insulation	Upgraded boiler
Barriers					
Not needed	0.002	0.0006	−0.001	−0.007	−0.009
High costs	0.002	0.0003	0.146	−0.0001	0.0001
No government support	0.81	1.95**	0.171	0.061	0.358
Might move	−0.88	−0.743*	−0.414	−0.7813**	−0.717**
Nuisance	−1.14	−0.804	−0.089	−0.956	−0.549
Skilled professional installer requirement	1.20	−0.406	0.008	1.682**	0.908
Drivers					
Save cost	−0.007	0.04	0.15	−0.0005	−0.02
Comfortable	−0.18	−0.31	−0.32	−0.28	0.08
Protect environment	0.22	−0.34	0.04	−0.06	−0.19
Government support	0.39	−0.23	−0.08	−0.08	0.31
People known	−0.43	−0.3047	−0.22	0.42	−0.101

is lower than at the original value of the independent variable (Schüppert 2009).

4. Results

This section presents the results of the analysis. Descriptive statistics and econometric analyses were employed.

a. Current level of adaptation in Leeds

Climate change impacts in the temperate oceanic climatic regions mostly manifest in the form of extremely cold weather (Burroughs 1997), as trends show a constant fall in temperature during winter and more cases of sharp temperature drops (Jones et al. 2012). A cold spell is defined as the national average high temperature dropping below -7°C (Smith and Sheridan 2018). However, according to Borenstein (2014), the precise criterion for a cold wave is determined by

the rate at which the temperature falls and not really the minimum to which it falls. This minimum temperature is dependent on the geographical region and time of year. In Leeds for instance, the usual lowest annual temperature is 2°C (Climate-Data 2020). Hence, temperatures falling below this threshold within 24 h can be considered cold spells.

This study focused on the long-term adaptive capacity or traditional reactive coping responses, as classified by Porter et al. (2014), adopted by the residents of Leeds against cold spells. The extent of adaptation is presented in Figs. 1 and 2.

In general, the result of the analysis indicates that more than half of the sampled population adopted both the long-term and traditional coping strategies. Figures 1 and 2 indicate, in aggregate, that 57.6% of the respondents adopted the long-term adaptation measures, while 55.6% adopted the traditional coping responses. This result shows that more persons (2% extra) adopted more of the long-term adaptation strategy.

FIG. 1. Traditional coping responses adopted by the residents of Leeds against cold spells.

FIG. 2. Long-term adaptive capacity among the residents of Leeds against cold spells.

In specific terms, considering the coping responses adopted by the residents of Leeds against cold spells, Fig. 1 shows a glaring result of an increased coping response to cold spells as over 70% of the respondents adopted all the short-term coping strategies highlighted in Porter et al. (2014) apart from eating more hot meals. The result showed that during increased cold weather, a greater percentage (55%) did not indicate to have changed in their behavior in terms of eating more warm or cold meals. A similar result can be seen when we turn to long-term adaptive capacity. Over 60% of the respondents adopted all the long-term adaptive strategies apart from cavity insulation and draft proofing. The result showed that a little more than 50% did not install cavity insulation while 69% did not adopt the use of draft proofing.

b. Drivers and hindrances to household adaptation to cold spells

The drivers and hindrance to the adoption of the long-term adaptation features were estimated using BLR. The drivers and barriers were determined for each of these adaptation strategies. The BLR was used because the dependent variable is measured on a dichotomous scale (1 if household adopts a measure, 0 otherwise). The independent variables were all dichotomous, hence, no violation of BLR assumptions. The results were presented as log odd (coefficients). Positive coefficients indicate factors that hinder/drive the adoption of the adaptation features. Hypothesis was tested at 5% and 10% levels of significance. The parameter estimates were extracted and presented in Table 2. Details of the analysis can be found in appendix B.

The result of the analysis shows that, among all the tested barriers to household adaptation strategies, no

government support, the prospect of relocation (people's intention of leaving their home), and the skilled professional requirement in installing the adaptation tools were statistically significant. Turning now to the individual adaptation strategies, the result showed that none of the included barriers hindered respondents' attitude toward double glazing. In terms of loft insulation, whereas no government support increased the likelihood of adoption, the prospect of relocation reduced the likelihood. None of the factors were found to significantly influence draft proofing. In terms of cavity wall insulation, the prospect of relocation and skilled professional requirements were found to negatively and positively influence this adaptation strategy, respectively. Last, the prospect of relocation influenced the adaptation strategy of installing upgraded boilers.

c. Role of government in climate change adaptation

The distribution of the respondents showed that the majority (85%) think that the government should support individual and household adaptation, and about 59% of these respondents think that the best way to do this is through subsidizing the cost of these features. Further discussion on this, based on topic analysis of the in-depth interview, is presented in the discussion section of this paper. However, the result of the descriptive statistics can be seen in Fig. 3.

5. Discussion

The a priori expectation based on the findings of IPCC (2007b), INGV (2007), and Smit and Wandel (2006) suggest that individuals and households tend to adopt more of the low-cost coping responses than the expensive adaptive measures. However, this seems contrary to

NEED FOR GOVERNMENT SUPPORT IN CLIMATE CHANGE ADAPTATION

HOW GOVERNMENT CAN PROVIDE SUPPORT

FIG. 3. (left) Distribution of respondents on their perception of the need, showing the view of the respondents on whether the government should provide support in climate change adaptation. (right) Distribution of respondents on how the government can support climate change adaptation (multiple responses allowed), showing the view of the respondents on how the government can provide support in climate change adaptation.

the result obtained from this study as more of the respondents adopted the long-term adaptation strategies. This shows that, given the necessary support and motivation, individuals and households can invest in expensive adaptation measures as much as they would in low-cost coping strategies. The high adoption of such measures like double (or triple) glazing and loft insulation, as revealed by the in-depth interview, is attributed to the fact that the house owners are mandated by policy to install double (or triple) glazing and loft insulations. One of the interviewees who is a tenant said, “I will inform the Unipol if my house owner fails to install double glazed.” This supports the view of [Ford et al. \(2011\)](#) that government intervention is necessary for promoting these kinds of measures. This also shows the reason for a higher aggregate level of adoption of the long-term adaptation measure.

On the other hand, findings from the traditional coping responses show that most households do not acknowledge these measures as necessarily adaptation actions. These are behavioral adjustments that [Porter et al. \(2014\)](#) grouped as coping responses that do not require premeditated plan. This might explain the low level of adoption of these measures. As two of the interviewees mentioned, these actions are inherent, they normally prefer hot meals, and it is not necessarily planned as an adaptive measure. Also, most people who have double and triple glazing installed hardly go for draft excluders as well. The result in general therefore explains the claim that coping responses are more behavioral and obtainable ([Porter et al. 2014](#)).

This has a number of policy implications. First, studies such as [Leiserowitz \(2006\)](#), [Akerlof et al. \(2013\)](#), and [van der Linden et al. \(2015\)](#) have shown working on individuals internal rather than external motivation can lead to better proenvironmental behavior. This shows that, while intrinsic motivations such as experience can increase short-term coping strategies, efforts need to be made in terms of external incentives to produce motivation to change when it comes to long-term adaptive strategies. Therefore, to scale up long-term adaptation, we need to understand the extrinsic motivations to change.

The result of the BLR showed that lack of government support is a hindrance to the adoption of the long-term adaptive features. This is particularly the case when it comes to such measures as the installation of loft insulation. These are expensive installations that need support in the form of policies to ensure that homeowners install this feature at the point of building construction. This further buttresses the need for government intervention not just financially but in policy interventions. In fact, for a measure like installing loft insulation, the coefficient for “no government support” is 1.95, indicating a 95% increase in the probability of adoption with a unit increase in the number of those that view government support as an essential driver of climate change adaptation.

Similarly, the prospect of relocation was found to reduce log odd of installing long-term adaptation strategies. This specifically includes installations like loft insulation, cavity wall insulation, and upgrading of boilers. This shows that homeowners who intend to move away do not have the motivation to install long-term adaptation facilities.

Logistic regression		Number of obs	=	650
		LR chi2(6)	=	12.52
		Prob > chi2	=	0.0514
Log likelihood = -444.23756		Pseudo R2	=	0.0139

q6b_cavity_insulation	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
q9a_not_needed	-.0065163	.0139875	-0.47	0.641	-.0339312	.0208986
q9b_high_costs	-.0000747	.0014201	-0.05	0.958	-.0028581	.0027086
q9c_no_govt_support	.0610245	.8122426	0.08	0.940	-1.530942	1.652991
q9d_might_move	-.7804373	.3810089	-2.05	0.041	-1.527201	-.0336735
q9e_nuisance	-.9563854	.5951772	-1.61	0.108	-2.122911	.2101404
q9f_skilled_prof	1.682059	.8515399	1.98	0.048	.0130717	3.351047
_cons	.2653081	.171101	1.55	0.121	-.0700437	.6006598

Logistic regression		Number of obs	=	650
		LR chi2(6)	=	9.74
		Prob > chi2	=	0.1360
Log likelihood = -199.76397		Pseudo R2	=	0.0238

q6a_double_glazing	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
q9a_not_needed	.0021828	.001417	1.54	0.123	-.0005945	.0049601
q9b_high_costs	.0021672	.0014252	1.52	0.128	-.0006263	.0049606
q9c_no_govt_support	.8096414	1.802903	0.45	0.653	-2.723983	4.343266
q9d_might_move	-.8804396	.6301135	-1.40	0.162	-2.115439	.3545603
q9e_nuisance	-1.141812	.8377636	-1.36	0.173	-2.783798	.5001749
q9f_skilled_prof	1.207464	1.803353	0.67	0.503	-2.327044	4.741971
_cons	2.961937	.3888823	7.62	0.000	2.199742	3.724132

Logistic regression		Number of obs	=	650
		LR chi2(6)	=	21.65
		Prob > chi2	=	0.0014
Log likelihood = -422.25759		Pseudo R2	=	0.0250

q6c_loft_insulation	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
q9a_not_needed	.0005681	.0012836	0.44	0.658	-.0019477	.0030839
q9b_high_costs	.000286	.0014201	0.20	0.840	-.0024974	.0030694
q9c_no_govt_support	1.952793	.9697898	2.01	0.044	.0520398	3.853546
q9d_might_move	-.7434233	.3925977	-1.89	0.058	-1.512901	.026054
q9e_nuisance	-.8046174	.5832755	-1.38	0.168	-1.947816	.3385817
q9f_skilled_prof	-.4065531	.8779294	-0.46	0.643	-2.127263	1.314157
_cons	1.235927	.2056907	6.01	0.000	.8327804	1.639073

FIG. B1. Result on hindrances to adoption (STATA 14).

Findings from the analysis showed that the variable of relocation did not have any statistical influence on installing double or triple glazing and on draft proofing. This can be explained by the fact that draft proofing is very efficient and yet one of the cheapest ways to saving energy in buildings. Hence, a household readily adopts this strategy even if they intend to relocate. Double and triple glazing, on the other hand, are required of all homeowners by policy. Hence, relocating would not matter, as they will have to fulfill local council policy requirements. This reiterates the claim made by [Hurd and van Anders \(2007\)](#) and [Porter et al. \(2014\)](#) that most households will require external support (which might be in form of government regulations and policies) in adopting some structural and complicated measures.

A topic analysis of the in-depth interview was carried out to determine how government interventions could help facilitate adaptation. Although the quantitative survey analysis generally showed that the majority of the respondents preferred subsidy as a means through which the government can encourage adoption, the concept of “orientation and education” was common to all the three interviewees. The interviews were of the opinion that the government has to “improve our knowledge.” This suggests that governments invest efforts in research and awareness campaigns that will build resilience among the citizens. This can be in the form of television adverts, radio jingles, and even posters at public places. As buttressed in [UNFCCC \(2007\)](#), individuals and households with a low level of climate change knowledge are more prone to climate change impacts.

Logistic regression		Number of obs	=	650
		LR chi2(6)	=	10.60
		Prob > chi2	=	0.1014
Log likelihood = -442.47042		Pseudo R2	=	0.0118

q6d_upgraded_boiler	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
q9a_not_needed	-.0008893	.0012477	-0.71	0.476	-.0033348	.0015561
q9b_high_costs	.0000629	.0014201	0.04	0.965	-.0027204	.0028462
q9c_no_govt_support	.3577165	.8201174	0.44	0.663	-1.249684	1.965117
q9d_might_move	-.7168195	.3710948	-1.93	0.053	-1.444152	.0105129
q9e_nuisance	-.5490371	.5611415	-0.98	0.328	-1.648854	.5507801
q9f_skilled_prof	.908369	.8265654	1.10	0.272	-.7116694	2.528407
_cons	.6658948	.1776183	3.75	0.000	.3177693	1.01402

Logistic regression		Number of obs	=	650
		LR chi2(6)	=	4.08
		Prob > chi2	=	0.6663
Log likelihood = -407.65639		Pseudo R2	=	0.0050

q6e_draft_proofing	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
q9a_not_needed	-.0009871	.0012837	-0.77	0.442	-.0035031	.001529
q9b_high_costs	.1457522	.4009275	0.36	0.716	-.6400512	.9315556
q9c_no_govt_support	.1711227	.8027638	0.21	0.831	-1.402266	1.744511
q9d_might_move	-.4137655	.41779	-0.99	0.322	-1.232619	.4050878
q9e_nuisance	.0893401	.6088787	0.15	0.883	-1.10404	1.282721
q9f_skilled_prof	.0086499	.8162467	0.01	0.992	-1.591164	1.608464
_cons	-.8036421	.1924916	-4.17	0.000	-1.180919	-.4263656

FIG. B1. (Continued)

Furthermore, all of the interviewees alleged that it is the social duty of the government to intervene whenever climate disasters occur; therefore, they find it unnecessary to purchase any climate disaster insurance policy. As one of the interviewees said, “Why should I pay for insurance when I can enjoy compensation from the government?” This was reflected in the low willingness to pay (GBP 25 per month) obtained from the survey. According to the IPCC synthesis report (IPCC 2007a), the government needs to make insurance policy regulations that would either encourage or mandate the purchase of disaster insurance policies by the citizens.

6. Conclusions

The analysis presented indicates a need for continued government support in household and individual climate change adaptation in Leeds, and this should also be encouraged in other cities as government interventions play an important role in adaptation awareness. These interventions in the form of subsidies, direct regulations, and public awareness are needed. The implementation of these measures is expected to generate a wide range of additional benefits to most vulnerable groups who should be central to the rapidly expanding climate change research and policy agenda in the United Kingdom.

The main implication of these findings suggests that, in line with Porter et al. (2014), Smit and Wandel (2006), and Pielke et al. (2007), success and failure in adaptation lie in political support and institutional capacity. Hence, there is a need for integrating a wide corpus of information and educational issues designed to fast track the awareness of climate change and available adaptation measures in the study area and beyond. Making climate change adaptation topics at all levels is important.

This paper has been able to critically assess the level of adaptation in the study area, as well as improving the existing body of literature on household adaptation behaviors in the area by supplying empirical evidence to the discourse. This study has also identified the drivers and hindrances to adaptation. This is important as the understanding of the motivations and challenges are necessary for scaling up adaptation. Findings from the study also showed that climate awareness and education also play a critical role in boosting the adoption of adaptation strategies. Understanding households' level of climate change awareness and its effects on individual and household adaptation, therefore, remains a crucial area requiring future research. Also, this paper focused on the homeowners' decision-making. However, an understanding of the adaptation and coping responses of tenants and the homeless can also be a possible area for future study.

Logistic regression			Number of obs			=	650
			LR chi2(5)			=	1.05
			Prob > chi2			=	0.9588
Log likelihood = -204.11149			Pseudo R2			=	0.0026
q6a_double_glazing	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]		
q10a_save_costs	-.0068392	.0669775	-0.10	0.919	-.1381126	.1244342	
q10b_comfortable	-.1753289	.544756	-0.32	0.748	-1.243031	.8923732	
q10c_protect_env	.2187518	.614342	0.36	0.722	-.9853363	1.42284	
q10d_govt_supported	.3920519	.8729358	0.45	0.653	-1.318871	2.102975	
q10e_people_know	-.4285352	.8851065	-0.48	0.628	-2.163312	1.306242	
_cons	2.180781	.3999303	5.45	0.000	1.396932	2.96463	
Logistic regression			Number of obs			=	650
			LR chi2(5)			=	1.43
			Prob > chi2			=	0.9207
Log likelihood = -449.77988			Pseudo R2			=	0.0016
q6b_cavity_insulation	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]		
q10a_save_costs	-.0000594	.0014191	-0.04	0.967	-.0028408	.0027221	
q10b_comfortable	-.2820049	.3347549	-0.84	0.400	-.9381125	.3741026	
q10c_protect_env	-.0575196	.367628	-0.16	0.876	-.7780573	.6630181	
q10d_govt_supported	-.0816213	.5394259	-0.15	0.880	-1.138877	.9756341	
q10e_people_know	.4209419	.5836786	0.72	0.471	-.7230471	1.564931	
_cons	.2117294	.2404061	0.88	0.378	-.259458	.6829167	
Logistic regression			Number of obs			=	650
			LR chi2(5)			=	8.38
			Prob > chi2			=	0.1365
Log likelihood = -428.89149			Pseudo R2			=	0.0097
q6c_loft_insulation	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]		
q10a_save_costs	.038218	.4175052	0.09	0.927	-.7800772	.8565131	
q10b_comfortable	-.3054789	.3744328	-0.82	0.415	-1.039354	.4283959	
q10c_protect_env	.3409107	.429315	0.79	0.427	-.5005311	1.182353	
q10d_govt_supported	.2307235	.598377	0.39	0.700	-.9420739	1.403521	
q10e_people_know	-.3047748	.6130535	-0.50	0.619	-1.506338	.896788	
_cons	.8049814	.3065565	2.63	0.009	.2041418	1.405821	

Note: 2 failures and 0 successes completely determined.

Note: 2 failures and 0 successes completely determined.

FIG. B2. Drivers.

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APPENDIX A

A Summary of All of the Interview Transcripts

Two males and a female were interviewed. Of the three interviewees, two were under 44 years old and the remaining interviewee was over 65 years old.

a. Experience of climate change

One issue that was observed was that two of the respondents did not agree with the fact that flooding and cold spells is because of climate change; they were skeptical of the notion of climate change. One of the respondents was of the opinion that, for a conclusion of climate change, the change should persist for at least 50 years; if not, it is just a weather change and not climate change. However, they all agreed that winter has been colder and colder over the years.

b. Role of government/state

In dealing with the issue of the role of the government, all those interviewed believe that the government should assist and encourage climate change adaptation in Leeds. When I asked about the best method, they all agreed that subsidy is better than tax

Logistic regression		Number of obs	=	650
		LR chi2(5)	=	3.57
		Prob > chi2	=	0.6136
Log likelihood = -445.98993		Pseudo R2	=	0.0040

q6d_upgraded_boiler	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
q10a_save_costs	-.0210629	.3903505	-0.05	0.957	-.7861359 .7440101
q10b_comfortable	.0721588	.3464595	0.21	0.835	-.6068894 .7512069
q10c_protect_env	-.195492	.3907717	-0.50	0.617	-.9613905 .5704065
q10d_govt_supported	.3106326	.5588317	0.56	0.578	-.7846575 1.405923
q10e_people_know	-.1661345	.5775852	-0.29	0.774	-1.298181 .9659116
_cons	.1079549	.2842468	0.38	0.704	-.4491585 .6650684

Logistic regression		Number of obs	=	650
		LR chi2(5)	=	3.98
		Prob > chi2	=	0.5530
Log likelihood = -407.70714		Pseudo R2	=	0.0049

q6e_draft_proofing	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
q10a_save_costs	.1466284	.4066833	0.36	0.718	-.6504563 .9437131
q10b_comfortable	-.319697	.359353	-0.89	0.374	-1.024016 .3846219
q10c_protect_env	.0378725	.4048856	0.09	0.925	-.7556887 .8314336
q10d_govt_supported	-.0811319	.5709419	-0.14	0.887	-1.200158 1.037894
q10e_people_know	.2160363	.5907885	0.37	0.715	-.9418879 1.37396
_cons	-.4917521	.2932226	-1.68	0.094	-1.066458 .0829537

Note: 2 failures and 0 successes completely determined.

FIG. B2. (Continued)

reduction. One of them said, “subsidizing will be will like a motivation. People who have a little money in the first instance can go and purchase the otherwise expensive adaptive tools.” The interviewees believed it is the duty of the government to “improve our knowledge.” This suggests that governments invest efforts in research and awareness campaigns that will build resilience. They also hinted at the role of the government in compensation. One of the interviewees said, “Why should I pay for insurance when I can enjoy compensation from the government?”

c. Inequalities (income and social status)

The female respondents think that females were more vulnerable to climate change than their male counterparts, whereas the males thought otherwise. A female said that “as a lady, there are things that a male can do to resist cold spells in terms of endurance that I can’t do,” whereas one of the males believed the females are more pampered by the government relative to the males. However, all agreed that the high-income class is bettered position in adaptation than fewer income earners.

d. Communication of government ambitions (grant allocation and accessibility)

The interviewees thought that the government is doing well by establishing some avenues and laws that

encourage adaptation, especially in terms of housing. One of the respondents said there is a Unipol in the city and “I will report my landlord to the Unipol if my house is not double glazed.”

Last, in terms of individual wellness and sense of belonging, from the discourse it was observed that how long one has stayed in a place and whether they are about to move out does not really determine their willingness to adapt. One of them mentioned that “it is inherent stuff and almost life dependent, so no matter where I find myself I will like to live well.” However, this was primarily on the issues of coping responses and not mostly the adaptive measures.

APPENDIX B

Detailed Result of the Regression Analysis Using STATA 14

The figures in this appendix shows the detailed output from STATA 14 for the regression analysis performed for this paper. [Figure B1](#) shows results on the hindrances to adoption. [Figure B2](#) gives results about the drivers to adoption of measures to adapt to climate change and more frequent cold spells. Results around the subject of government support for household adaptation measures are given in [Fig. B3](#).

```
. tab q11_govt_support
```

Q11_Govt_su pport	Freq.	Percent	Cum.
0	95	14.62	14.62
1	553	85.08	99.69
999	2	0.31	100.00
Total	650	100.00	

```
. q121_subsidies
```

```
command q121_subsidies is unrecognized  
r(199);
```

```
. tab q12c_public_providers
```

Q12c_Public _providers	Freq.	Percent	Cum.
0	370	56.92	56.92
1	193	29.69	86.62
999	87	13.38	100.00
Total	650	100.00	

```
. tab q12b_tlx_exemptions
```

Q12b_Tlx_ex emptions	Freq.	Percent	Cum.
0	373	57.38	57.38
1	190	29.23	86.62
999	87	13.38	100.00
Total	650	100.00	

```
. tab q11_govt_support
```

Q11_Govt_su pport	Freq.	Percent	Cum.
0	95	14.62	14.62
1	553	85.08	99.69
999	2	0.31	100.00
Total	650	100.00	

```
. tab q12b_tlx_exemptions
```

Q12b_Tlx_ex emptions	Freq.	Percent	Cum.
0	373	57.38	57.38
1	190	29.23	86.62
999	87	13.38	100.00
Total	650	100.00	

FIG. B3. Response on government support.

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