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Norwegian mayoral awareness of and attitudes towards climate change

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The willingness of local politicians to implement measures for curbing greenhouse gas emissions and to adapt to emerging conditions is essential for successful climate change policies. This article reports findings from a survey of attitudes amongst Norwegian mayors, who prove to be fairly well informed about, and have confidence in, the climate change message. They think that Norway should do more to curb emissions, and that the municipal level should have a stronger role in policy design, but the central government should pay the costs. Most mayors favour a reduction in car driving, but have mixed opinions about jobs and environmental concerns, potentially causing tensions in policy-making. Mayors with an environmental education, representing left-wing parties, and from central rather than peripheral areas contribute to a more supportive attitude towards climate change policies.

Keywords: Climate change; Local policy; Norwegian mayors

1. Introduction

Messages about the expected impacts of climate change and tactics for mitigation (reducing greenhouse gas sources and enhancing greenhouse gas sinks) and adaptation (reducing harm from expected or actual climate change impacts) have gained ground in recent years. It appears necessary to mitigate climate change while confronting the consequences, on the basis of relevant science and work on climate change policy [1,2]. That requires a broad range of actions at different political-administrative levels: international, national, regional, and local [3,4].

In short, policies ought to adopt a scalar approach. Although commitments at single levels are necessary, they are not sufficient for facing the full scope of climate change topics. For example, Swart *et al.* [5] show in a review of European climate change adaptation strategies that, notwithstanding the need for actions at higher scales, regional and local scales must be involved for successful implementation of adaptation policies. Local actions are part and parcel of global actions, and this makes combining several scales necessary, especially when considering the interaction between global and local justice [6]. Despite the need for scalar research, studies focusing on particular geographical levels permit the depth of investigation needed to determine the attitudes and interests of individuals with

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regard to climate change. Accordingly, the focus here is on the local level as represented by a survey comprising all 431 municipal mayors in Norway (the number of municipalities in 2007) and their stated knowledge and opinions about climate change.

The original contribution of the article is reporting the awareness of and attitudes towards climate change of Norway's mayors, thereby improving the understanding of how the local level might act and react. The research questions investigated are:

1. What level of confidence in and concern about climate change information do Norwegian mayors have?
2. What are the attitudes of Norwegian mayors towards acting on climate change mitigation and adaptation?
3. What factors influence 1 and 2, notably demographic characteristics, human capital, political affiliation, territorial characteristics, and prior experience with extreme weather events?

To answer these questions, the article analyses the survey of Norwegian mayors. A first set of questions focuses on knowledge about and confidence in the climate change message as it has been presented by the United Nation's Intergovernmental Panel on Climate Change (IPCC) [1], whether the mayors' opinion regarding the climate change message has changed in recent years, and how concerned the mayors are about climate change in general and more particularly related to their own municipality. A second set of questions focuses on actions to be taken regarding climate change mitigation and adaptation, as defined by IPCC [1], covering Norway's international responsibilities along with national, regional and local responsibilities and actions, together with two questions on general environmental policy issues.

The next section of the article summarises the survey methodology and statistical analyses used within the context of the theoretical background and literature basis of the analysis. Section three reports results from the survey and of the regression analyses; organised by i) confidence in and concern about climate change information, and ii) attitudes towards taking action. Section four discusses the results on the basis of the independent variables used. Finally, the conclusions answer the research questions, indicate this paper's contribution to knowledge, and suggest direction for further work.

2. Theoretical perspectives and methodological basis

In Norway, mayors are elected by the municipal councils on the basis of municipal elections in which representatives of political parties are elected to council seats. The mayors are not elected directly by the population, but by councils, which themselves have been elected by the voters. Consequently, our analysis must consider political ideologies, which are linked to the dynamics of social relations amongst actors engaged in political and economic activities at different scales. That relates to power relations regarding control of and choices on resource allocation [7,8] which, next, linked to places and communities [9,10].

Attitudes expressed by mayors, however, might also be influenced by individual characteristics other than political ideology – for instance, sex, age, and education – or by characteristics from the mayor's municipality. Our analysis follows a critical realist approach; that is, we adopt a theoretical perspective as a frame for the empirical analysis, and then return to theory [11–13]. The critical dimension of our approach means that we engage

with and try to reveal political conflicts linked to our topic of study. Reducing emissions of greenhouse gases and adapting to climate change are linked to political struggles amongst categories of actors and people; not only amongst countries but also amongst regions and places. Our analysis is quantitative, using categories of dependent variables which are the questions being analysed and using independent variables which might contribute to explain different score patterns. Below, we examine the independent variables included in the analysis, supporting these choices with previous literature.

The political ideology dimension is first represented by mayors' party affiliations. Three of the political parties represented comprise a sufficient number of mayoral respondents for statistical analysis: the Labour Party (DNA) which is left-of-centre by Norwegian standards, the Centre Party (SP) which is centrist by Norwegian standards, and the Conservative Party (H) which is right-of-centre by Norwegian standards. In ordering the three parties, we use the traditional left–right axis of DNA-SP-H. This is confirmed to play a role for attitudes and actions [14,15], as shown by different polls around the world [16].

It is apparent that the Centre Party (SP) occupies one end, either representing a 'green' dimension [15], 'small is beautiful' dimension, or purely favouring the periphery. These dimensions blur the difference between the Labour Party (DNA) and the Conservative Party (H) because both these parties have a strong industrial tradition: a 'big is beautiful' ideology, not any strong environmentalism. Nonetheless, local politics is not the same as national politics; there may be a pragmatic approach locally. Affiliation with a national political party is not always a main feature of local politics [17].

Focusing on green politics, Aardal [18] showed that the green dimension was incorporated by existing parties but also that the Liberal Party and the Socialist Left Party were the parties with the strongest environmental concern. Recent polls [19] about climate change confirm this. The supporters of the Socialist Left Party and of the Liberal Party show the strongest support for the climate change message. Additionally, these two parties are alone in thinking that climate change is amongst the three most important challenges facing Norway today. Except for the Progressive Party (for which climate change ranks 12th), climate change ranks as the sixth or seventh most important challenge amongst the five other main parties. This indicates that a green–blue axis of the Labour Party, the Centre Party and the Conservative Party might not be so important for climate change.

The centre-periphery dimension has long been important in Norwegian politics. Rokkan and Valen's [20,21] seminal work on cleavages in the political landscape of Norway still has relevance. These researchers identified territorial conflicts as one of five structuring conflicts of Norwegian politics, with the others being socio-cultural, religious, the economic commodity market, and the economic labour market. The territorial dimension comprises a conflict between the capital city-region on the one hand and the rest or parts of the rest of the country on the other hand, contingent upon circumstances. Furthermore, there is a conflict between the functional centre and the functional periphery, often materialising as a political conflict between cities/towns and the countryside, again contingent upon circumstances.

Kinsey [22] traced the pattern of regional cleavages in party voting back to the period 1890–1930, concluding that 'The origin and persistence of distinct voting patterns may be partly the product of the interaction between the consequences of social contexts for political behaviour and the mobilisation calculus of political parties' (p. 279). The territorial cleavages have lingered on, but over time the topics change, now also appearing in relation to cases such as i) managing big carnivores such as wolves, bears, lynxes, and wolverines in relation to sheep farming [23,24]; ii) using nature for leisure including

nature-based tourism or economic production such as through natural resources [25,26]; and iii) accusing the capital city's elite of arrogance as an argument against a proposed power line to Bergen that was running through a highly praised cultural landscape of West Coast fjords [27]. Thus, the territorial dimension is linked to a mix of political, cultural, and economic driving forces.

In order to acknowledge this dimension, we introduce two variables. The first variable, representing the centre-periphery axis, is a functional classification, ordering municipalities in classes according to functional centrality. The second variable identifies main geographical regions of Norway. After some testing by using cross-tabulations, the three categories identified are the capital region (the counties of Oslo and Akershus), northern Norway (the three northernmost counties), and the remaining counties. That represents a mix of the capital–district conflict and the centre–periphery conflict.

Certain dimensions and characteristics can cut across political ideology, as well as the territorial dimension. Studies have long shown gender to represent a driving force for attitudes and actions [28,29]. A body of research on adults in affluent countries [30–32] claims that women tend to be more concerned about environmental issues than men; that is, the female gender is argued to be more caring than the male. This is especially claimed to be the case for issues focusing on specific risks. Climate change is highlighted in these references, said to produce larger gender gaps with more concern from females than from males. Other research suggests that gender does not produce any significant degree of difference regarding environmental attitudes [33].

Research also shows that attitudes differ between generations. Generally the younger are characterised as being more radical than the older, who are described as more traditional, but periodic effects also enter the scene facilitating a generation–periodic interaction [34,35]. Then, it could also be argued that fighting for environmentally friendly policies under an economic market/capitalist system is to be a radical but the periodic effect might blur this conclusion, as some would argue is the case for today's trend towards neo-liberal economic politics.

The educational level also differs between generations in that younger generations tend to have more education than older. Consequently, different attitudes between generations might be influenced by education, making it difficult to untangle the different variables from one another. Johnson and Scicchitano [36] emphasise that education level is expected to 'make individuals more comfortable with the information presented to them by decision makers', and thus make them willing to act on environmental degradation, assuming an environmentally friendly attitude is present. For us, this means that education makes citizens require well founded facts and analytic arguments.

Disciplinary background should also be taken into account. Education is about knowledge and a certain type of competence of a scientific character, differing from the purely experience-based layperson's competence [37]. This can be linked to the interplay between explicit (coded and written) and tacit (un-coded and unspoken) knowledge [38,39], as well as how these two types of knowledge are constituted through the process of transforming tacit knowledge into explicit knowledge [40].

An important additional question is whether or not previous experiences with extreme weather events influence mayors' attitudes, as indicated in the literature [41,42]. For this factor, we have several measures: the phenomena of floods, storms, slides, and all of them put together, as measured by incidences and costs, as well as covering different time periods, for instance, 1983–2007 representing long-term experiences and 2003–2007 representing recent experiences.

A simple correlation test revealed fairly high correlations (in the range of 0.5 to 0.8) between some of these measures. We ended up choosing storms and floods measured by costs per resident of the municipalities for the period 1983–2007.

Appendix 1 presents our chosen variables in detail. The empirical basis is a survey carried out electronically in 2007, covering all 431 municipalities of Norway, using SPSS Dimensions. The first invitation was mailed electronically in February 2007 followed by two reminders, the last one in April 2007. The response rate among mayors was 46%, and tests of representativeness revealed no significant bias regarding population figures or centrality of the municipalities [43]. They did not find any systematic bias between political parties either, but the response rate from mayors in northern Norway as well as the capital city region of Oslo-Akershus was lower than for the rest of the country. In spite of some differences in response rates, the conclusion is that the data basis is reliable, as also shown by Amundsen *et al.* [42] who used some of the data to publish a form of analysis different from that presented here.

Our analysis applies several methods: simple frequencies to provide an overall pattern of attitudes, simple correlations for establishing some links between dependent and independent variables (Pearson correlation), and then multivariate regression analysis to identify independent variables that stand out as being statistically significant. The dependent variables – the questions from the survey – are mostly ordinal, with four levels, but two questions provided the options of yes, no, and no answer. One way of analysing these two questions is to make them dichotomous and leave ‘no answer’ out, but the no answer option could also be interpreted as falling in-between yes and no. On the other hand, some might have chosen the option ‘no answer’ for other reasons. Therefore, the dichotomous version is used for these two variables.

The independent variables are generally categorical, except for storms and floods that are reported in total monetary expenses. In the analysis, the storms and floods variables are made categorical through a scale comprising five levels. The other independent variables are defined as either scaled or nominal. For those variables that are defined as nominal, a two-step procedure is applied for the regression analysis: first, a categorical regression and then, for those dependent (nominal) variables that are statistically significant, simple correlations (Pearson) to indicate the best ordering of variable values. In the text below, when these variables appear, the best order of the nominal values is indicated by a ranking listed in brackets following the variable. Both sex and educational discipline are defined as nominal variables, following the same procedure as indicated for party affiliation. For educational discipline, the disciplines of humanities/social science, economics, technical background, and environment are used.

It is reasonable to assume that the opinions of the mayors are formed to some extent by what is written in the press and presented on television, especially since the media also influence the electorate who will then vote for politicians according to such views. Additionally, some of the more engaged mayors might consult popular science articles or talk to scientists. The survey analysed here was carried out during the presentation of the results from Working Group I of the IPCC Fourth Assessment Report [1]. The policy summary report of Working Group I was presented in February, and the full report was published in March. But, the results from Working Group II (Impacts, Adaptation and Vulnerability) and Working Group III (Mitigation of Climate Change) were published after the survey ended. Consequently, it is reasonable to expect that the mayors would have received some information about the physical basis of climate change, although without the accompanying publicity generated by the other two groups.

3. Results

3.1. Confidence in and concern about climate change information

Table 1 gives the survey results. Most mayors claim to have knowledge about the consequences of climate change as exemplified by the IPCC, and most of them express either 'a lot' of confidence or some confidence in these results. The fairly large proportion expressing only some confidence indicates that scepticism about the climate change message lingers on.

More than 60% of the mayors have changed their opinion during the five years preceding 2007. Although some might have become more sceptical, most of these mayors now have stronger confidence in the climate change message. Out of those having changed their opinion, 64% now state 'a lot' of confidence in the message from the IPCC, while only 1% express little confidence. The corresponding figures for those not having changed their opinion are 46% and 8%.

The relevance of standard climate change scenarios regarding their own municipality is higher for the future than for today, which is reasonable because this is the message of climate change scenarios. For both 'today' and 'tomorrow', between 55% and 60% of mayors think the scenario is of some relevance. The second most marked alternative for the 'today' question is 'little relevance', whereas 'a lot of relevance' stands out for the 'tomorrow' question. Consequently, the some-little of today is changed into the some-a lot of tomorrow. Nevertheless, the large share for 'some' relevance indicates that the mayors believe their own municipality will experience modest effects and that they show some scepticism towards the climate change message. This matches findings from the US that people think the threat of climate change will be much greater for people in other countries than in their own local community [44].

Regarding the general concern over future climate change and the more particular concern over their own municipality's ability to handle the consequences of climate change, the 'some' concern alternative dominates, with 50–55%. Yet, whereas 'little concern' is the second most popular response for the mayor's own municipality, 'a lot of concern' is

Table 1. Expressed awareness, confidence, and concern over the climate change message

	A lot	Some	Little	Not at all	No
Do you know the conclusions from the UN's climate panel? Yes = 75.2%, No = 24.8% (206)					
If yes, how strongly do you have confidence in these conclusions?	54.9	41.2	3.9	0	153
Has your opinion about climate-related environmental changes changed during the last five years? Yes: 62.4% No= 37.6% (178)					
To what degree are you concerned about future climate change?	35.8	54.9	8.8	0.5	215
<i>Climate scenarios tell about increasing temperatures and more precipitation in most parts of Norway, and extreme weather events will appear more frequently:</i>					
To what degree do you think this scenario is relevant for your municipality today?	11.7	55.9	23.1	3.4	179
To what degree do you think this scenario is relevant for your municipality in the future?	31.5	58.4	9.6	0.6	178
To what degree are you concerned about whether your municipality will manage to handle these effects?	12.9	50.0	34.8	2.2	178

the second most popular response for future climate change in general. This observation might show a belief that climate change is a problem for others than oneself.

A simple correlation of these opinions reveals two results. First, those who express confidence in (and hence who have already claimed knowledge about) the IPCC's message are also concerned about future climate change. Second, there is a link between those concerned about future climate change and those that think the climate change scenario is relevant for their respective municipality 'today' and 'tomorrow'. For the confidence and concern relation, the correlation coefficient is 0.402, whereas for the concern and the hazards today and tomorrow, the correlation coefficients are 0.328 and 0.325 respectively. All three are significant at the 0.01 level. This indicates a certain robustness regarding the answers, matching previous work correlating knowledge and concern regarding environmental topics [45].

Turning to the regression analysis (table 2), the logistic regression model did not reveal any variables that were statistically significant for *knowledge about the IPCC climate change message* although educational level might be expected to have appeared because it had a significant correlation with knowing the IPCC conclusions. Applying the categorical regression model, the analysis finds that more variables appear to be statistically significant and contribute to explaining the variance of *confidence in the IPCC climate change message*: confidence increases with centrality and flood costs, but decreases with age. Political affiliation also became statistically significant (confidence decreasing along the green/small–blue/big axis). In regard to having *changed one's view*, the logistic regression analysis indicates statistical significance for region (increasing along the capital region–northern Norway axis), education (increasing with education level), and discipline (humanities/social science and the rest).

Three variables are statistically significant (categorical regression model) for *concern about future climate change*. The strongest is the centre–periphery variable, with mayors in central areas most concerned. Next, political affiliation is important (decreasing concern along the left–right axis). Lastly, educational discipline is important (decreasing concern along the humanities/social science–environment–economics–technical axis).

As for the *relevance of the climate change scenario for each mayor's municipality 'today' and 'tomorrow'*, the categorical regression indicates that for both 'today' and 'tomorrow', the expressed relevance increases with centrality. The mayor's educational discipline is also important for both; technical discipline lower than the three others for 'today', and then decreasing from environment and humanities/social science to economics and technical for 'tomorrow'. For the 'today' dependent variable, region is also important; lowest support for the scenarios in northern Norway. Political affiliation is significant for 'tomorrow'; decreasing support along the green/small–blue/big axis, but less important than the others.

Some interesting patterns emerge from the regression analyses. Educational discipline appears in relation to several of the topics, generally increasing confidence and increasing concern. The centre–periphery variable appears as important for several topics as well, generally increasing confidence and increasing concern from periphery to centre. In addition, the green/small–blue/big political axis seems to decrease the confidence in the climate change message, whereas the left–right axis seems to decrease the concern about climate change.

3.2. Attitudes towards taking action

The questions and statements about reductions of greenhouse gas emissions (*mitigation policies*) provide a fairly clear pattern; see the sections on climate change actions in tables

Table 2. Confidence and concern (categorical regression model with standardized Beta coefficients for statistically significant variables)

Background variables:	Questions		
	<i>Do you know the conclusions from the UN's climate panel? Yes - how strongly do you have confidence in these conclusions? ^a</i>	To what degree are you concerned about future climate change? ^a	<i>Climate scenarios tell about increasing temperatures and more precipitation in most parts of Norway, and extreme weather events will appear more frequently:</i> To what degree do you think this scenario is relevant for your municipality today? ^a To what degree do you think this scenario is relevant for your municipality in the future? ^a To what degree are you concerned about whether your municipality will manage to handle these effects? ^a
Age	.411***		
Gender			
Education level			
Education discipline		.217**	.187*
Party affiliation	-.426***	.276***	.335***
Centre-periphery	-.304*	-.372***	.171*
Regions			-.292**
Storms8307NokPop			
Floods8307NokPop	-.314**		
R square	.313	.294	.235
N	70	97	96
			-.230*
			-.299**
			.220
			.269***

^aValues: 1: very much; 2: somewhat; 3: a little; 4: not at all. Significance levels: *** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$.

3 and 4. Norwegian mayors strongly believe that the state should do more to reduce emissions, but in general they do not think that much responsibility falls on the municipalities, especially not the economic responsibility. They also think that the municipalities should engage more in adaptation measures, but again that the economic responsibility falls on the state.

The categorical regression analysis reveals that the support for *Norway contributing more to reducing emissions*, and *municipalities engage more in taking mitigation actions* increases with centrality. Besides, educational discipline is important for both; decreasing support along the environment–humanities/social science–economics–and technical axis. Increasing education is also linked to stronger support for Norway contributing more, whereas increasing storm expenses and political affiliation (along the left–right axis) are linked to stronger support for municipalities engaging more in mitigation actions.

Table 3. Opinions regarding mitigation and adaptation policies

Climate change actions – mitigation and adaptation	A lot	Some	Little	Not at all	No.
To what degree should Norway as a rich nation contribute more to <i>reduce emissions</i> of greenhouse gases?	66.0	28.8	0.7	4.6	153
To what degree should municipalities play a central role in the efforts for <i>reducing emissions</i> of greenhouse gases?	19.3	59.4	19.3	1.9	207
To what degree should municipalities have a political responsibility in <i>reducing emissions</i> of greenhouse gases?	26.7	56.2	15.7	1.4	210
To what degree should municipalities have an economic responsibility in <i>reducing emissions</i> of greenhouse gases?	4.8	37.7	43.5	14.0	207
To what degree should municipalities do more to start long-term <i>adaptation</i> to climate change?	28.8	59.6	10.1	1.4	208
Which political level should have the main responsibility for <i>adapting</i> to climate change? (N = 178)	The municipal level:			3.9	
	County level:			0.6	
	The national level:			70.2	
	International level (UN):			25.3	
Which level should have the economic responsibility for <i>adapting</i> to climate change? (N = 178)	The municipal level:			0.6	
	The county level:			1.1	
	The national level:			98.3	
General actions and policies:	Totally disagree	Partly disagree	Partly agree	Totally agree	No.
The concern for jobs and industrial development weighs more heavily than a concern for the environment	15.9	41.5	36.4	6.3	176
It is important to reduce car driving in order to reduce air pollution in cities and towns, and reduce emissions of greenhouse gases	2.8	7.4	43.2	46.6	176
The construction of public transportation must be prioritized above increasing the capacity for car driving and car parking	5.1	19.9	46.0	29.0	176
Very often environmental measures cause too strong regulations and restrictions	17.7	42.9	32.0	7.4	175

Table 4. Taking action and attitudes (categorical regression model with standardized Beta coefficients for statistically significant variables)

Background variables	Norway as a rich country should contribute more to reduce emissions ^a	Municipalities should have a central role in efforts for reducing emissions ^a	Municipalities should have political responsibility to reduce emissions ^a
Age			
Gender			
Education level	.241*		
Education discipline	.399***	.392***	.173*
Party affiliation		.200**	
Centre-periphery	-.303*	-.311**	-.232*
Regions			
Storms8307NokPop		-.233*	
Floods8307NokPop			
R square	.304	.266	.181
N	71	96	97
	Municipalities should have economic responsibility to reduce emissions ^a	Municipalities should do more to start long term adaptation to climate change ^a	It is important to reduce car driving in order to reduce air pollution in cities and towns, and reduce emissions of greenhouse gases ^b
Age			
Gender			
Education level			
Education discipline	.220**	.183**	-.287***
Party affiliation		.311***	-.272**
Centre-periphery		-.334***	.272**
Regions	.438***		
Storms8307NokPop			.271*
Floods8307NokPop			
R square	.223	.258	.239
N	95	97	95
	The construction of public transportation must be prioritised above increasing the capacity for car driving and car parking ^b	Concern for jobs and industrial development weighs more heavily than a concern for the environment ^b	Very often environmental measures cause too strong regulations and restrictions ^b
Age	.259**		
Gender		-.216*	
Education level	.201*		
Education discipline		.238**	.208**
Party affiliation		-.201*	
Centre-periphery			-.538***
Regions			.268***
Storms8307NokPop			
Floods8307NokPop			
R square	.179	.199	.245
N	95	96	95

^aValues: 1: very much; 2: somewhat; 3: a little; 4: not at all.

^bValues: 1: totally disagree; 2: partly disagree; 3: partly agree; 4: totally agree.

Significance levels: *** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$.

In regard to the *municipalities' political responsibility for mitigation actions*, increasing centrality means increasing support. Less important but statistically significant is educational discipline; decreasing support along the environment–humanities/social science–economics–and technical axis. As for *economic responsibility*, the variable of region appears to be the most important; decreasing support along the Oslo/Akershus–northern Norway axis. Another nominal variable, educational discipline is also statistically significant; decreasing support along environment–humanities/social science–economics–and technical axis.

Regarding *adaptation policies*, the categorical regression indicates that increasing centrality and party affiliation (with the left/green in one camp and right/blue in the other) strengthen the support for *municipalities to do more to start adapting to climate change*. Less important, educational discipline (technical discipline showing less support) also appears.

Three variables indicate how concerned the mayors are for the *capacity and ability of municipalities to handle the consequences of climate change*: high storm expenses and high flood expenses increases the concern, as does the educational discipline: increasing concern along the environment–humanities/social science–economics–technical axis. The logistic regression for the national–international dichotomy regarding political responsibility for adaptation only shows statistical significance (.037) for sex: females are more in favour of the international responsibility than males (Beta coefficient -1.51 and Wald test 4.36).

In regard to transportation measures, there is dominant agreement that *car driving should be reduced to curb emissions* along with *improving public transportation*. For public transport, however, ‘partly agree’ has the largest percentage compared to ‘totally agree’ having the largest percentage for reducing car driving. This indicates the presence of some ambiguities. The categorical regression shows that four independent variables have approximately the same impact on *reducing car driving*: educational discipline, political affiliation, centrality, and storm expenses. For the last two, support for reducing car driving increases with centrality and higher storm expenses. Regarding educational discipline, the second step of correlations indicates decreasing support for reducing car driving from the environment discipline and the humanities/social science discipline to the two others. Regarding *enhancing public transportation*, increasing age and increasing education are statistically significant and support the statement.

It is also common that policies contradict and countermand each other. Therefore, two more general attitude questions focusing on environmental measures were included. These two questions are ‘*concern for jobs and industrial development weighs more heavily than a concern for the environment*’ and ‘*very often environmental measures cause too strong regulations and restrictions*’. The responses reveal a more divided pattern among the mayors.

Generally, most mayors are in favour of the environmental side, but a large minority still favours the anti-environmental stance. Before going into those details, we note the claim that jobs and industrial activities do not necessarily contradict environmentally sound policies [46,47]. Nonetheless, the question is formulated with a focus on ranking of ‘concerns’ in one or the other direction, not assuming any dichotomy. Moreover, under the current political-economic system in Norway, as well as other countries around the world, politicians face investors and enterprises (private or public) lobbying for plans on industrial activities and construction projects. The question regularly turns out to relate to an assessment of both jobs and environmental consequences. This is also institutionalised by Social and Environmental Impact Assessment regimes.

One current example in Norway concerns drilling for oil outside Lofoten [48], in a popular tourist area in the north of Norway. Arguments about jobs and the economy meet arguments about environmental protection and nature-based tourism. Another case is enlarging existing and creating new mountain cabin villages in the Norwegian periphery areas. These are often fragile mountain/timberline areas. Development is likely to encroach into existing animal sanctuaries along with possible impacts on wild reindeer herds [49].

In the categorical regression for these two questions, storm expenses and flood expenses were left out because it is not reasonable to expect answers on those to explain these attitudes. On this basis, the regression analysis revealed that educational discipline meant a *preference for jobs above the environment*, whereas sex and political affiliation meant stronger disagreement with the statement. Regarding educational discipline, the second step of correlations revealed a different tendency from previous questions, with humanities/social science and economics producing support for the statement. Regarding sex, males are most supportive of the statement. As for political affiliation, the second step indicated increasing support along the left–right axis.

More variables were statistically significant for the statement *environmental policies cause too strong restrictions*, but the strongest by far was centrality: mayors from central municipalities strongly disagree with the statement. Two nominal variables showed up: the region variable (northern Norway shows stronger support than the rest of the country) and educational discipline (the environmental discipline and the humanities/social science discipline fit together, with less support from the two others).

Thus, educational discipline is seen to be important for taking actions, and mostly along the axis from environmental to technical. Centrality also stands out as an important independent variable; increasing centrality is linked to being more supportive of taking action against climate change. A similar, but weaker tendency is also evident for the left/green-blue/big axes of political affiliation.

4. Discussion of the results and the independent variables

4.1. Educational discipline and educational level

The analysis reveals that the educational *discipline* variable is far more important than the educational level. For some questions, educational level also appears to be statistically significant. For the statement ‘Norway should do more to reduce emissions’, it appears together with educational discipline. This shows that it is not just about disciplines but also about the level of educational achievement. The mayors seem to govern in a manner linked to their professional background: the message predicting substantial environmental changes, arguing in favour of substantial changes, and also with implications favouring developing and poor countries, might find acceptance with those who have education in certain disciplines. Our analysis confirms research showing that the link between knowledge and action is complex for climate change and wider environmental issues [50,51].

4.2. The territorial dimension

Our analysis indicates systematic differences along the functional centre–periphery axis. Mayors in the centre are more knowledgeable, and show stronger confidence in the climate change message. They are more concerned, more willing to take actions, and more supportive of environmental policies. For some questions, this pattern is complemented by the

capital region–northern Norway axis, as for instance the north’s support for the statement that environmental policies are causing too many regulations and restrictions.

Consequently, the territorial cleavages of Rokkan and Valen [20,21] appear in relation to climate change, and general environmental attitudes. This also means that a territorial component should complement the political party dimension of environmental concerns that Aardal’s study [18] documented. That study also showed that people in Norway support both high economic growth and productivity and environmental protection. Our study is not conclusive in this respect. The regression analysis shows signs of different attitudes along the left–right axis, but the analysis does not reveal any differences along the centre–periphery axis. *That* difference – in respect to environmental regulations – signals a more general political cleavage in regard to the environment. These findings support the view of Hovik *et al.* [52] that the national policy of the last 20 years of establishing environmental protection areas ‘has upset many local actors’ (p. 164).

Our analysis cannot provide further insights into any perceived tension between economic growth and environmental protection. Following Kinsey’s [22] focus on the role of context for political behaviour, we might ask, however, whether peripheral (sparsely populated) municipalities have the same experience with pressure on the environment as more central and urbanised municipalities. The room for exploiting nature is larger because there is more in comparison to the settlement size, and rural people are less inclined to protect smaller areas than are urban residents. People living in the periphery often depend on natural resources for making a living. Regulations, originating at the centre, which restrict the local scope of action regarding natural resources can be sources of conflicts.

Furthermore, peripheral municipalities in the northern part of the country, along the coast, and in mountain areas are more accustomed to extreme weather events. In addition, specific cultural values of the periphery have been documented; that is, being male, manual workers or farmers fond of weapons, driving cars and motorcycles as well as preferring anti-environmentalist attitudes [53]. Environmental regulations and protection of natural areas might be expected to be an unpopular policy in those circles. Studies in other countries give varying results regarding a rural–urban divide for environmental attitudes and behaviour [54,55].

4.3. Party affiliation

Party affiliation, either along the left–right axis or the green/small–blue/big axis, appears in several statements, although often with moderate regression coefficient values. This pattern resembles the findings of the TNS poll [19] of green–blue differences regarding support for climate change as anthropogenic, but not any differences regarding climate change as a challenge compared to other challenges. Nevertheless, the left end and/or the green/small end show stronger support for the climate change message and for taking actions than the right end and blue/big end. Comparing the left and the green, the left–right axis appears more than the green/small–blue/big axis. Consequently, there are traces of the standard simple view of left–right politics, and there are also traces of expected opinions from green politics. Yet the observed political patterns seem to be more blurred on the local level than at the national level, making political categories and labels fuzzier. This is also a well-known characteristic of local politics, as underlined above. None of the three parties are amongst those identified by Aardal [18] as being most supportive of environmentally friendly policies. Our analysis shows the Centre Party to be more environmentally friendly. This corrects the pattern described by Aardal [18] 20 years ago.

4.4. Previous experiences with extreme weather events

Our analysis applies the same empirical data (established by the Norwegian Pool of Natural Perils) as the study by Amundsen *et al.* [42] who found that municipalities that had experienced three large extreme events (two floods and one storm) had taken measures after the storm to prevent further damages from similar events. But, our analysis is conducted more generally for storm expenses and flood expenses during the period 1983–2007, and instead of focusing on reported actions we looked for any potential impacts on the attitude among mayors towards climate change issues.

Our study finds some relation between extreme weather events and attitudes among mayors: confidence in the climate change message and concern over whether the municipality will manage to handle the challenges increase with flood expenses. Furthermore, the storm expenses variable shows up sometimes: concern about municipalities' capacity to handle the challenges, action by municipalities to reduce emissions, and restrict car driving. Consequently, there is evidence for links between experiencing extreme weather events and climate change attitudes; for instance, both floods and storms are linked to concern over whether municipalities will manage to handle the consequences of climate change. But, the case is not conclusive, partly because of a somewhat random appearance of the two variables, and partly because they are not linked to the same questions.

One possible explanation for storms being statistically significant for more questions is that the spatial scale of storms and floods differs. Everyone will experience a storm that hits a settlement, while floods in Norway are usually experienced directly by far fewer people in the town affected. Norway has relatively steep topography, so a town is rarely inundated entirely, even with storm surge. This phenomenon, of floods affecting a small spatial area in towns affected, was also observed in England during a combination of flash flooding and slow-rise flooding in autumn 2000 [56]. A contrasting example is Hurricane Katrina affecting the USA's Gulf Coast in 2005 where large swathes of land below sea level were inundated. Further, media coverage of a flood could be higher because of more unusual effects (rarer events tend to be more newsworthy) with higher costs than a storm.

Since the respondents are mayors, it is reasonable to expect them to take into account the municipality as a whole. They could notice floods because these events normally result in higher costs, but they would also recognise storms because more residents would be affected. The underlying question is whether each mayor's opinion is formed by private experiences or by the community as a whole. That topic has been studied for a long time [57]. It is obvious that opinions are formed by various factors and that, at the local political level, sometimes mayors lead public opinion and sometimes follow it. Another question is whether extreme weather events really are *local* experiences in today's media society. It is a reasonable hypothesis that the opinion of mayors is also formed on the basis of regional as well as national occurrences of extreme weather events, depending on aspects such as media coverage and national level responses.

4.5. Gender and age

Given claims in the literature about females' stronger support for environmental policies, it is surprising that sex is almost completely absent from providing any statistical significance in the regression analysis. Age also appears to lack statistical significance, although younger mayors show a stronger confidence in the IPCC's conclusions than older mayors. Part of the explanation might be that older mayors grew up in a period when a strong

green movement [58] had a pronounced impact on Norway and the 1970s witnessed the emergence of a strong environmental movement, with works by Deep Ecology's founder Arne Naess [59], clashes over river dam projects such as the Mardøla waterfall and the Alta River, and demonstrations against polluting industries like pulp and paper. Younger mayors have had their formative years in a period dominated by neo-liberalism, with a focus on economic growth and increasing consumption as a means of creating jobs.

5. Conclusions

The analysis shows that Norwegian mayors claim to be fairly well informed about the climate change message and those who are informed generally have confidence in the message. There is also a pronounced concern about the consequences of climate change, but when it comes to concern about one's own municipality, the opinions are more mixed. Regarding mitigation policies, mayors are overwhelmingly in favour of Norway contributing more to reducing greenhouse gas emissions. Less support exists for municipalities playing a central role in this work. The mayors have even less interest in taking on economic responsibility. The fairly strong support for reducing emissions is matched by a similarly strong support for reducing car driving, but the support for public transportation is weaker. A similar pattern emerges for adaptation policies. Furthermore, the policy questions of 'jobs/industry being of greater concern than the environment' and 'environmental measures causing too strong regulations and restrictions' show a mixed pattern, indicating perceived trade-offs in policy-making and action.

There emerge from these data a political economy component and a human capital component. Discussions about who should make decisions and who should pay the costs are core elements of political economy. Globally, the claim that developing countries will fare much worse than developed countries, partly due to nature and partly due to institutional capacities, has caused cleavages among groups of countries [60] along distinct centre-periphery lines. This also pertains to how climate change is interpreted: by the centre (the North) as a technical question to be solved with mitigation and adaptation technologies and by the periphery (the South) a question of survival and development to be solved with technology as well as behavioural change [61].

Resembling the global cleavage, our analysis examines territorial cleavages in Norway, very likely linked to those identified by Rokkan and Valen [20,21], Kinsey [22], and Valen [62] and pertaining to environmental topics; with the centre to a larger degree supporting and having confidence in the climate change message, as well as being friendlier towards environmental regulations. These cleavages indicate struggle over determining and implementing core climate change policies without alienating local and regional constituencies [20–22].

Consequently, national scale efforts at designing and implementing climate change policies to be implemented at local and regional scales might face challenges analogous to the global cleavages [60,61]. But, the framework and context for policy-making and policy implementing differ. The global cleavage is more about poverty and vulnerability [61] whereas the territorial cleavage in Norway is about how environmental topics are perceived at different decision-making scales but mixed with the struggle for making a living in peripheral areas. Yet the governing structure of Norway is characterised as decentralised, so that municipalities have both power and a burden of responsibility. Hovik and Reitan [63] argue that local institutional capacities have been weakened, with impact on

environmental policy. Consequently, the implementation of climate change policy measures might differ along a territorial axis, with peripheral areas lagging. This view would be congruent with other findings [54,55].

Arguments in favour of a decentralised governing structure are that the local level better knows what the needs are, and so should be granted the opportunity to prioritise amongst different tasks [64]. These arguments clearly fall within Elster's [6] local justice dimension, the dynamics of which risk contributing to the global injustice of climate change.

In regard to the human capital dimension, the importance of educational discipline and educational level relates to knowledge and the process of learning: the interaction between tacit knowledge and explicit knowledge, and the process of the socialisation–externalisation–combination–internalisation cycle [40]. The climate change message fits into existing knowledge patterns in certain disciplines, and so becomes easier to accept [4,10]. The educational background also cuts across more traditional fronts along political ideologies and class interests.

Knowledge of the role of the centre–periphery axis and the importance of educational discipline for mayoral attitudes may improve social science studies of climate change in two main ways. First, this may shed light on neglected factors concerning support for the climate change message and environmental topics. Second, this may illuminate the scholarly discussion on policy-making and implementation regarding root causes of pursuing certain environmental policies at the local level.

It may be useful to repeat the survey every electoral cycle, with minimal changes to the questions, in order to obtain current knowledge of these factors. For instance, is falling support for and confidence in the climate change message amongst Norwegians [19] linked to any particular background variable? It is also important to complement the findings of surveys and quantitative analyses with qualitative analyses aiming at revealing the reasoning behind certain opinions and attitudes [15]. That could include detailed interviews with politicians in central and peripheral municipalities, especially those covering a range of background educational disciplines. Our study revealed systemic differences in climate change attitudes and opinions, and also different attitudes towards environmental regulations, along the centre–periphery axis, but not any differences regarding jobs and industrial development versus the environment; exposing potential contradictions in the attitudes of those surveyed. What are the reasoning and arguments behind these patterns?

The importance of educational discipline, with decreasing support for the climate change message and for taking action from the environmental discipline to the technical discipline, indicates that it is not straightforward to implement climate change actions at the local level. Assuming the truth of the climate change message, one could argue in favour of introducing relevant environmental topics into educational curricula across disciplines. Whether or not that affects individual behaviour, it should have an impact at the governance level for trying to deal with such topics [65]. But, it must be remembered that environmental knowledge and environmental behaviour are not independent variables that can be connected in a linear sequence [66].

Nevertheless, one necessary step might be policies targeting education, and participation campaigns for local contexts and interests, even within a comparatively homogenous country such as Norway. Findings that some people do not consider climate change to be very serious due to the fact that politicians are not taking any actions should make this even more urgent [67]. Policies should also introduce elements of social learning, although this by itself is not any guarantee for success [68], even though participatory planning could

create the necessary confidence for action to take place. And at the end of day, just and fair policies are needed within regions and countries as well as globally.

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Appendix 1. Definition of variables applied in the regression analysis

Variable	Variable categories
Age (scaled numerical)	1: under 45 years (27); 2: 45–59 years (87); 3: 60 years + (55)
Sex (nominal)	1: male (141) 2: female (30)
Educational level (scaled numerical)	1: secondary school (40); 2: college/university (76); 3: university – master's level or above (53)
Educational discipline (nominal)	1: environmental (natural science, agriculture) (38); 2: humanities, social science (46); 3: economics, law (33); 4: engineering (40)
Political affiliation (Nominal)	left-right: 1: DNA (53); SP (37); H (21) green-blue: 1: SP (37); 2: DNA (53); 3: H (21)
Centre–periphery (scaled numerical)	1: periphery (62); less central (31); 3: somewhat central (19); 4: central-1 (35); 5: central-2/3 (28); most central (21)
Region (nominal)	1: capital region (7); 2: middle (151); 3: northern Norway (38)
Storms (scaled numerical)	increasing cost of storms per inhabitant in municipality
Floods (scaled numerical)	increasing cost of floods per inhabitant in municipality

Numbers in brackets represent the sample size.

The Centre–Periphery variable:

	Population size of largest centre	Travel time to a centre of higher order	Size of labour market region
1: Periphery	< 2000	< 30 minutes	< 20,000
2: Less central	2000–4999	< 30 minutes	< 20,000
3: Somewhat central	5000–14,999	< 45 minutes	< 20,000
4: Central – 1	15,000–49,000	< 60 minutes	< 20,000
5: Central – 2/3	15,000–49,000	< 60 minutes	20,000–199,000
6: Most central	> 50,000	< 90 minutes	200,000 +