

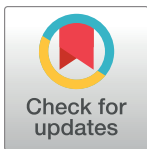
RESEARCH ARTICLE

Public opinion on climate change in China—Evidence from two national surveys

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Abstract

China's ambitious initiatives to address climate change have attracted significant scholarly attention, yet much less focus was on how climate change is understood in Chinese society. This study analyzes the results from two surveys in 2009 and 2016 with nationally representative samples. The findings suggest that Chinese people have a fairly high awareness of the existence and anthropogenic causes of climate change. They consider climate change less urgent than air pollutions but more important than conservation. There is strong support for China to take leadership to address climate change. The respondents consider the government, especially the central government, as the entity most responsible for taking actions on climate change and generally approve its contributions. Policy measures such as carbon tax and cap and trade enjoy high support in China. Finally, the respondents also show a strong willingness to partake in individual actions.

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1. Introduction

China contributed 31 percent of global fossil CO₂ emissions in 2020—it is the single largest carbon-emitting country with emissions totaling greater than those of the US, the 27 European Union countries (EU27), and India combined [1]. China has set a goal to peak its carbon emissions before 2030 and aims to achieve carbon neutrality by 2060. Much of the literature examines the role of the state in shaping and implementing China's climate policy, yet it is also of great importance to understand how Chinese citizens perceive climate change and the policies designed to address it. Over the past two decades, environmental issues have emerged as a major concern for both the Chinese people and the Chinese government [2]. Some scholars have described the shift in terms of the Chinese public moving from a state of "mass unconsciousness" to becoming "citizen stakeholders" [3]. Even with an authoritarian system, the Chinese government has actively managed or accommodated citizens' concerns regarding the environment [4–8]. China has exhibited many, sometimes contradictory, value systems in the past few decades—from communism to market capitalism, revivals of Chinese traditions such as Confucianism, and the recent rising nationalism—making it a particularly interesting case for studying environmental ideologies [9].

Since the late 1990s, the field has produced a growing number of surveys examining people's awareness and perceptions regarding climate change [10]. In the 2000s, most surveys

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were carried out by commercial entities, such as GlobalScan and Gallup, and think tanks, such as Pew Research Center. In recent years, scholars have used refined survey instruments and targeted sample populations to advance understanding of China's public opinion on climate change [11–20]. As noted by Wang and Zhou's thorough review [21], however, many surveys suffer from weak sampling schemes—sample sizes tend to be smaller than ideal and samples often lack representativeness. The most in-depth study among this literature comes from the "Climate Change in the Chinese Mind" project by the China Center of Climate Change Communication (the "China4C" survey) at Renmin University [22–24], for which two surveys were conducted in 2012 and 2017, respectively, covering more than 4,000 samples. Despite the growing literature, empirical research on this topic remains scarce. Although there are nationally representative surveys, such as the Chinese General Social Survey, the data from these queries often does not delve into climate issues in particular or does not address the scale of China's emissions. Compared to China, the United States has seen many surveys examining every dimension of public opinion on climate change.

This research analyzes two of the few climate change public opinion surveys with nationally representative samples in China. These two surveys offer a rare perspective on how perceptions of climate change have changed over time and explore other dimensions that are not examined in other surveys. National-level studies on this topic in China remain rare, and this paper adds essential data points, enabling triangulations. The findings suggest that Chinese people have a high awareness of climate change's existence and its anthropogenic causes. The majority of Chinese people surveyed consider climate change less urgent than air pollution but more important than ecological conservation. The respondents view the government as the entity most responsible for taking action on climate change and generally approve of its contributions. Policy measures such as carbon tax and cap and trade have high levels of public support in China. The survey's respondents also show a strong willingness to undertake individual actions.

2. Methods

The two surveys used in this paper were conducted in 2009 and 2016, respectively (hereafter "2009 survey" and "2016 survey"). The surveys have an identical sampling frame and use some of the same questions. Both draw from nationally representative samples from seven major cities in China (Beijing, Shanghai, Guangzhou, Wuhan, Chengdu, Shenyang, and Xi'an) and seven smaller towns and nearby rural villages. Fig 1 shows the locations where the surveys were conducted. In each location individual respondents were randomly selected from neighborhood committee lists using the KISH method [25]. The survey drew no fewer than 250, 150, and 100 samples in each city, town, and village, respectively. The respondents, who were at least 18 years old, must not have participated in survey research in the past six months, and they and their family members could not work for survey research companies. Both surveys used face-to-face settings where interviewers read the questionnaire to respondents and recorded their answers. Each respondent received a small gift after completion.

Table 1 summarizes the descriptive statistics of the two surveys. The 2009 survey has 3785 respondents, while the 2016 survey has 3794 respondents. The sex ratios for both are roughly 48 percent male and 52 percent female. The 2009 sample is more rural and less educated than the 2016 sample, yet the difference matches well with the demographic changes during the seven-year gap between the two studies.

This study has larger sample sizes compared to typical climate change survey studies in the United States and Europe. It shares some similarities with the "China4C" survey—both feature two waves, national representative samples, and are administered by independent third parties.

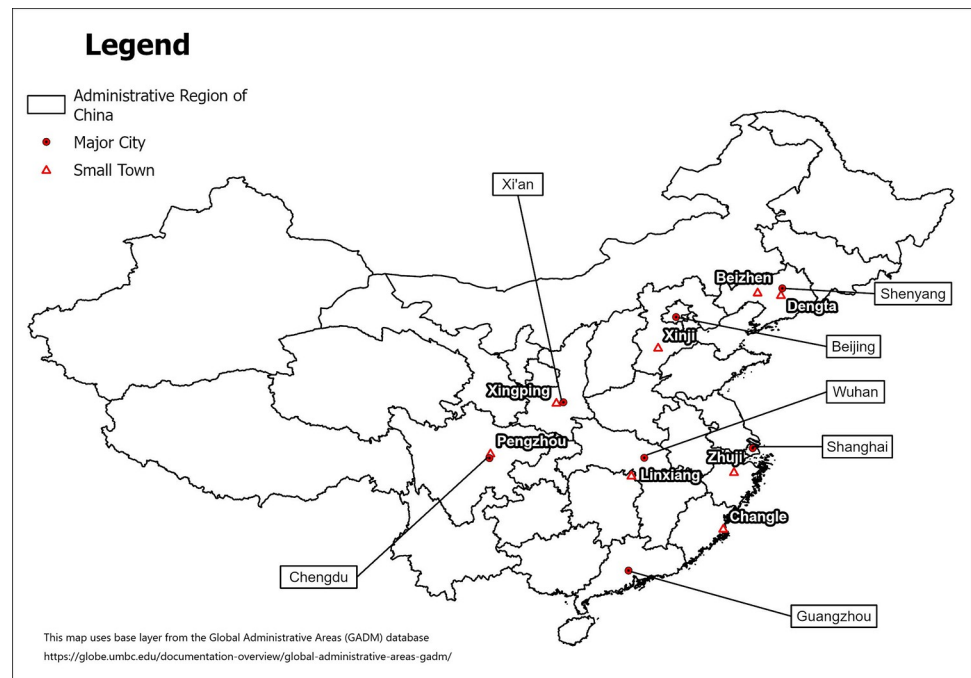


Fig 1. Survey locations.

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Yet, this study's data has some important distinctions. First, the surveys are conducted with face-to-face interviews instead of computer-aided phone surveys (CATI). The different sampling and survey methods may help triangulate research findings with other survey studies. Second, the surveys were conducted during two different administrations in China: in 2009 when President Hu Jintao was in office, and in 2016, four years into Xi Jinping's administration. The two surveys in this study also were administered around the time of the Copenhagen Climate Summit (December 2009) and Paris Climate Summit (December 2015), when media at all levels had heightened attention on climate change. This data can be viewed as reflecting two different eras in China's recent development.

3. Results

In this section, the paper will report survey results sorted by 1) climate change perception and concerns, along with their socio-demographic determinants, 2) climate change responsibility, and 3) policy support and individual actions. The averages are weighted by the population sizes of the survey locations and the population shares of cities, towns, and villages in China.

3.1 Climate change perception and concern

The first set of questions from the 2016 survey addresses how Chinese people perceive climate change. When asked if climate change, defined as changing average climatic conditions over time, is occurring about 80 percent believe that climate change is happening, and roughly 17 percent do not think climate change is happening, as shown in Table 2. The next question asks if human activities cause climate change. The result shows that about 5 percent of respondents shifted their response from yes to no—one can infer this subset of people believe climate change to be happening but not caused by humans. The results show a lower level of perception of climate change's existence than does the China4C survey, in which more than 90

Table 1. Summary statistics of the two surveys.

Variable	Obs.	Mean	Std. Dev.	min	max
2009 Survey					
Male	3785	0.4805	.499	0	1
Age	3785	38.51	11.104	18	60
Income	2447	1776.1	1180.8	0	15000
Education					
Mid. school and less	1731	45.9%			
High School	1368	36.1%			
J. College and more	684	18.1%			
Urban/Rural					
City	1522	40.2%			
Town	1140	30.1%			
Village	1123	29.7%			
2016 Survey					
Male	3794	.4862	.499	0	1
Age	3794	39.86	12.042	18	86
Income	3589	3525.3	2102.5	0	21000
Education					
Mid. school and less	1056	27.8%			
High School	1477	38.9%			
J. College and more	1261	33.2%			
Urban/Rural					
City	1850	48.8%			
Town	1118	31.3%			
Village	756	19.9%			

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percent (93 percent in 2012 and 94 percent in 2017) of respondents think climate change is happening; on the other hand, this paper shows higher recognition that climate change is due to human activities, whereas less than two-thirds of the China4C survey's respondents (55 percent in 2012 and 66 percent in 2017) expressed the same view.

Table 2. Climate change perception and concern.

<i>Is Climate Change Happening? (perception)</i>	
Yes	78.9%
No	17.3%
Don't know/No Answer	3.8%
<i>Is Climate Change caused by human activities? (cause)</i>	
Yes	73.4%
No	22.6%
Don't know/No Answer	4%
<i>Level of Concern about Climate Change (1–10) (concern)</i>	
4 or less	3.7%
5	7.2%
6	15%
7	25%
8	27.3%
9	11.7%
10	11%

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Table 3. Determinants of climate change perception and concern.

Variable	Perception	Cause	Concern
	(1) Logit	(2) Logit	(3) OLS(Weighted)
Male	0.0811	0.198**	0.101*
	-0.0869	-0.0822	-0.0517
Income	4.35e-05*	-4.08e-05*	-3.76E-06
	-2.63E-05	-2.25E-05	-1.60E-05
High School	0.311***	0.0372	-0.0055
	-0.109	-0.101	-0.0618
J. College and more	0.0973	0.512***	-0.0513
	-0.129	-0.126	-0.0818
31–45 yrs	0.04	0.0203	0.0408
	-0.106	-0.1	-0.0639
46 yrs+	0.0576	0.131	-0.187***
	-0.118	-0.112	-0.07
Town	-0.0169	0.136	-0.189**
	-0.108	-0.103	-0.0787
Village	-0.0938	-0.0284	-0.609***
	-0.127	-0.119	-0.0741
Constant	1.021***	0.935***	7.677***
	-0.166	-0.154	-0.111
Observations	3,577	3,577	3,577
R-squared			0.038

Note: middle school and less, 18 to 30 years of age, and city residence are the omitted categories in the analysis.

Standard errors in parentheses

*** $p < 0.01$

** $p < 0.05$

* $p < 0.1$

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To put these numbers into perspective, in the April 2020 "Climate Change in the American Mind" report tracked by Yale researchers [26], about seven in ten Americans (73%) think global warming is happening, and six in ten (62%) understand that global warming is mostly human-caused. This research shows that Chinese people have a greater awareness of climate change and its causes than do Americans, but not by a large margin.

The survey asks respondents to rank their level of concern about climate change—one being not concerned at all and ten being most concerned. The average answer is 7.28, slightly higher than the result (6.215 on a 0–10 scale) reported by a previous study [18].

This study uses regression models to test whether gender, income, age, education, and urban/rural residence are determinants of people's perception of and concern for climate change. The results are shown in Table 3.

The results reveal interesting distinctions between answers to the *perception* question (is climate change happening?) and the *cause* question (is climate change caused by human activities?). While education does not matter much in perception, the group with the highest education level (junior college and more) consistently expresses higher awareness that humans cause climate change. The results also show that male respondents are more likely to agree with the anthropogenic cause and are generally more concerned about climate change. These findings align with previous research showing that Chinese men have greater environmental awareness and concern than do Chinese women [27, 28].

Table 4. Select the most serious environmental issue.

Environmental Issue	Percentage
Air pollution	41.8%
Food Safety	23%
Climate Change	15.6%
Water Pollution	15.5%
Natural Habitat and Species Loss	4.1%

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Age and urban residence are not shown to explain the variations in perception and cause, yet both factors are important determinants for *concern*. The oldest group (46 years old and more) and rural residents are less concerned about climate change. This means that younger and more urban populations in China are more concerned about climate change than are their older and more rural countrymen.

In the 2016 survey, the next question asks respondents to rank the most serious environmental issue among a list of five: air pollution, water pollution, climate change, biodiversity loss, and food safety. As shown in Table 4, for people who made a choice, about 15 percent of respondents consider climate change the most important environmental issue, lower than air pollution and food safety but higher than biodiversity loss.

The 2009 survey asked a similar question, asking respondents to rank priority among environmental issues. The question was worded differently from the 2016 version: respondents were asked to select the top three most urgent environmental problems among ten options. Climate change ranked fourth, behind air quality, waste, and wastewater, and higher than other topics such as energy, urban development, and endangered species.

The two surveys are not precisely the same, yet the results provide evidence that Chinese people are more concerned about air pollution and other issues that visibly touch everyday lives than they are about climate change. Meanwhile, climate change seems to resonate more than issues perceived as less human-centered. These findings are consistent with previous survey results showing that Chinese citizens care more about local environmental issues than they do global problems [29].

3.2 Climate change responsibility

The next set of questions addresses responsibility for managing climate change. The first question in this set asks respondents to choose, among government, civic organizations, individuals, and businesses, the entity they believe to be most responsible for addressing climate change. The result in Table 5 shows that Chinese people overwhelmingly consider the government as most responsible to act.

The surveys also track respondent's satisfaction with the climate actions taken by the chosen entities. Table 6 displays the level of satisfaction for people who chose government as the most

Table 5. Who should be responsible for dealing with climate change?.

2009		2016	
Government	72.3%	Government	66.2%
Civic Organzaitons	9.6%	Civic Organzaitons	11.6%
Individuals	6.2%	Individuals	5.5%
Businesses	7.5%	Businesses	11.6%
DK /NA	4.4%	DK /NA	5%

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Table 6. Satisfaction with government's climate actions.

2009 (n = 2735)		2016 (n = 2512)	
Very Satisfied	1.1%	Very Satisfied	3.4%
Satisfied	39.8%	Satisfied	60.6%
Neutral	37.5%	Neutral	23.2%
Unsatisfied	16.3%	Unsatisfied	11%
Very unsatisfied	1.2%	Very unsatisfied	1.3%
DK /NA	4.1%	DK /NA	0.5%

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responsible actors (2009: n = 2735; 2016: n = 2512), showing a clear improvement in satisfaction from 2009 to 2016. This change mirrors the overall improvement in public satisfaction with the government in China in the last two decades [30, 31] and coincides with China's aggressive expansion on green investments.

The 2016 survey further investigates what level of government the respondents have in mind when they say "government" should lead climate actions. The survey asks respondents to rank climate action contribution by central, provincial/municipal, prefectural, and local township governments. The results show that, respondents generally perceive the central government has made the most contribution. The perceived contribution decreases as the level gets closer to local authorities. This result exhibits the well-established "hierarchical trust" pattern found in previous studies [32–34].

Climate change cannot be addressed by China alone. To gauge how Chinese people perceive their country's role in global climate politics, the 2016 survey posits two somewhat contradictory statements: the first argues that China should not abide by the standards of developed countries; the second affirms that China should take leadership due to its large population. Table 7 shows that both statements have strong support, implying that the general sentiment is that China should take a leading role in the international arena but with somewhat less stringent standards than those constraining more developed countries.

3.3 Policy support and individual actions

The 2016 survey also measured Chinese people's support for two key climate policy instruments: carbon tax and cap and trade. By 2016, China had implemented several pilot cap and trade programs and announced a plan to establish a national system; a separate national carbon tax plan was also discussed. As shown in Table 8, the survey respondents expressed overwhelming support for both policy measures. The cap and trade program (~73%) had slightly higher support than the carbon tax (~68%), yet both levels of support are high relative to other countries. The support for these policies in China is especially high among urban residents.

Table 7. China's position in global climate actions.

<i>Since China is still a developing country, it should not be required to follow international environmental standards like developed countries in North America and Europe.</i>	
Agree	60.9%
Disagree	29.8%
Don't Know/No Answer	9.3%
<i>As China is the most populous country in the world, it should thus take leadership to address global environmental problems.</i>	
Agree	70%
Disagree	22%
Don't Know/No Answer	8%

<https://doi.org/10.1371/journal.pclm.0000065.t007>

Table 8. Support for carbon pricing policies.

Cap and Trade		Carbon Tax	
Support	73.5%	Support	68.3%
Oppose	22%	Oppose	22.6%
DK /NA	4.5%	DK /NA	9.1%

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Table 9. Views on personal climate actions.

Statements (1 = Strongly disagree to 5 = strongly agree)	2009	2016
<i>Mitigation of climate change should start by changing personal behaviors</i>	4.08	4.04
<i>Changing personal behaviors has no effect on addressing climate change</i>	2.65	3.17
<i>I am willing to change to a more environmental-friendly and green lifestyle</i>	3.96	3.93
<i>I am willing to spend more money buying environmental-friendly products</i>	3.73	3.83
<i>I am willing to spend more time taking environmental-friendly actions</i>	3.81	3.89

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Both the 2009 and 2016 surveys put forth a series of statements about personal climate actions, allowing respondents to give their ratings on a scale of 1 to 5. The first two statements concern the effectiveness of changing individual behaviors. Most respondents agree that mitigation of climate change should start by changing their own behaviors, but people are less certain whether such change would have meaningful impacts. The following three questions probe people's willingness to address climate change through changing lifestyles, purchasing green products, and taking direct environmental actions. Table 9 shows that the majority of respondents said that they are willing to enact such measures. These results are broadly consistent between the 2009 and 2016 surveys.

4. Discussion and conclusion

The paper analyses two surveys on public opinions regarding climate change, with nationally representative samples in China. The results show that Chinese citizens have a high awareness of the existence and anthropogenic cause of climate change; they also view climate change as less urgent than other environmental issues. Compared to the China4C survey [23], the paper shows a lower perception of climate change but higher awareness that climate change is caused by human activities. Compared with the China Governance and Public Policy Survey (CGPPS) [18], this paper reports a slightly higher level of climate change concern. This study also finds that gender, age, education, and urban residence is associated with how people think about climate change. Respondents show a willingness to change their behaviors, while expecting that the government bears the most responsibility for taking action. These insights could help communicators better craft their messages to improve the publics' understanding of climate change and relevant policies.

This paper shows the dominance of the Chinese state in climate governance. The Chinese public overwhelmingly expects the government to take action and expresses strong support for its initiatives. The respondents also affirm public perception of China's leadership role on the global stage, a dimension less explored by previous surveys. These results are useful contexts for understanding China's geopolitical moves with regard to the climate.

We recognize that this research area evolves quickly. Six years have passed since the latest survey data was collected in 2016, and much has changed since then. The Trump administration retreated from the Paris Agreement; China, to a certain extent, filled in the leadership role. A trade war strained Sino-US relation. President Biden re-entered the UNFCCC

framework, and yet climate change remains one of the most important and contentious issues in US-China relations.

Within China, observers have witnessed rising nationalism along with a more assertive, even aggressive, stance in international affairs [35]. Climate change is often entangled with nationalist sentiments [36]. The Chinese state media and many netizens openly deride and shame climate activist Greta Thunberg [37]; the WildAid's climate campaign turned into a fiasco due to their foreign origin [38]. To understand rapidly evolving public opinions and to develop insights from survey studies like this paper, this field would benefit from innovative research methods designed to contextualize how Chinese people perceive and respond to climate change.

Author Contributions

Conceptualization: John Chung-En Liu.

Data curation: John Chung-En Liu.

Formal analysis: John Chung-En Liu.

Funding acquisition: John Chung-En Liu.

Investigation: John Chung-En Liu.

Writing – original draft: John Chung-En Liu.

Writing – review & editing: John Chung-En Liu.

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