

## Awareness and Willingness of Chinese Households to Reduce Carbon Footprint in Daily Life

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### Abstract

This study investigates variations in carbon reduction willingness among households across different regions of China, exploring associations with household structure, economic status, and living conditions. A methodology was developed to calculate households' willingness to reduce carbon emissions. Efforts were made to assess carbon reduction willingness across various provinces and cities in areas such as transportation, food, products, energy usage, and awareness of carbon neutrality. The findings suggest that while Chinese households demonstrate a proactive willingness to reduce carbon emissions related to food and products, there is an evident need to enhance their willingness in the areas of transportation and energy usage. Furthermore, the research identifies household income, geographic location, residential area, and length of residence as significant determinants of household carbon reduction willingness.

### Keywords

Households carbon footprint; Carbon reduction willingness; Household structure

### 1 Introduction

The substantial increase in carbon emissions constitutes one of the most urgent challenges faced by the contemporary world. Since the Industrial Revolution, human activities, particularly the combustion of fossil fuels, have become the primary drivers of increased greenhouse gas emissions. The IPCC's Sixth Assessment Report underscores that in 2019, atmospheric concentrations of carbon dioxide (410 parts per million) exceeded levels from any time in the past two million years. Managing carbon emissions has thus become central to mitigating climate change (IPCC, 2022). Excessive carbon emissions not only contribute to global warming but also heighten the risk of extreme weather, climatic, and hydrological events (Miner et al., 2021; UK-China Cooperation on Climate Change Risk Assessment, 2021). In response to this crisis, nations worldwide have formulated various international policies and agreements, such as the Paris Agreement (UNFCCC, 2015), aiming to limit the global temperature increase to within 2 degrees Celsius and thereby promote a low-carbon economic transition globally. These agreements stipulate that greenhouse gas emissions must peak by 2025 at the latest and reduce by 43% by 2030. The severity of climate change necessitates immediate and large-scale carbon reduction actions by the international community to alleviate the escalating impacts of climate change (An et al., 2024).

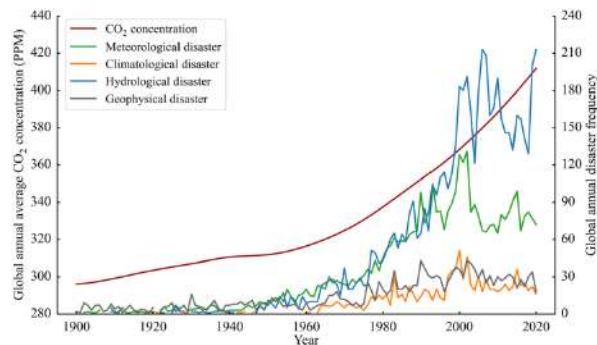


Figure 1: The correlation between extreme events caused by global climate change and the increase in CO<sub>2</sub> concentrations(Jiang et al., 2022; SCPRC, 2021)

Facing stringent carbon reduction targets, household carbon footprints (HCF) constitute a significant portion of overall emissions, with households being major contributors to greenhouse gas emissions (Ivanova et al., 2016). The HCF measures the greenhouse gas emissions produced by households in daily life, encompassing both direct consumption of fossil fuels and indirect emissions from the use of products and services, typically calculated in terms of carbon dioxide equivalents (CO<sub>2</sub> eq) (An et al., 2024). Reducing household carbon emissions can mitigate climate change and contribute to achieving carbon neutrality. According to research by the Potsdam Research Institute for the Effects of Climate Change, in 2021, China emitted 14.3 billion tonnes of CO<sub>2</sub> equivalent, making it the largest emitter globally. Over the past two decades, alongside significant economic growth and urbanization, household carbon footprints have not only increased substantially but also varied greatly (Wang et al., 2022), necessitating greater focus on the potential for household carbon reduction. However, proposing effective, accurate, and reasonable policies for reducing household carbon footprints presents a complex challenge for policymakers.

Understanding the composition and determining factors of household carbon footprints (HCF) has become crucial. Existing research has explored the impact of socio-economic characteristics, such as household income, as well as household features including the age of members, household size, and education levels, and geographical factors like the location of the household (Zhang et al., 2015). There is also scholarly focus on the inequalities within HCF, highlighting that affluent households emit significantly more carbon than poorer ones (Wiedenhofer et al., 2017). However, there has been limited investigation into the role of lifestyle changes on HCF. To date, only a few scholars have studied the awareness of households regarding reducing their carbon footprint. Khanam et al. assessed the awareness and willingness to reduce HCF in daily consumption from an expert perspective (Khanam et al., 2022), while Brounen et al. discovered that awareness of social and environmental issues can inspire lifestyle changes (Brounen et al., 2013). Li et al. examined the impact of different subjective social awareness indicators on the carbon emissions of Chinese households (Li et al., 2019). This indicates that under the goal of carbon neutrality, adopting sustainable lifestyles and consumption behaviours can significantly reduce carbon emissions (Koide et al., 2021). For example, using energy-efficient appliances (Dias et al., 2019), reducing the use of disposable plastic products (Senturk & Dumludag, 2022), opting for local seasonal food (Tantiwatthanaphanich et al., 2022), minimizing food waste (Parashar et al., 2020),

and reducing car ownership are all sustainable practices that can significantly control HCF. Therefore, it is necessary to conduct focused research on the behaviours and awareness of Chinese households in reducing their carbon footprint in daily life, to thoroughly understand how different levels of awareness impact HCF and thus develop tailored emission reduction strategies and sustainable development plans for diverse families.

Consequently, this study aims to assess the willingness of households across different regions of China to reduce their carbon footprints (CF), categorizing this willingness into five levels: transportation, food, products, energy, and carbon neutrality awareness. It also provides a regional distribution of these indices, seeking to identify which type of willingness in different regions can encourage families to adopt low-carbon lifestyles, thus proposing suitable policies for household carbon reduction in various areas to balance the reduction of HCF with climate change mitigation. To this end, the study collects baseline data on China's HCF for 2021, including various household characteristics (such as number of family members, ages, gender, and employment status) and socio-economic levels (such as household income, geographical location, and living area). It combines these with a regional analysis of the five fundamental sectors: transportation, food, products, energy, and carbon neutrality awareness. The HCF considered in this study includes CF based on daily and usual consumption (for example, the transportation category considers the everyday and regular modes of transport used by people, while the food category accounts for local sourcing and packaging levels). The study attempts to identify the factors influencing HCF in different regions and their emission reduction potential. It also advocates assigning higher reduction tasks to households in high-emission areas, which is crucial for mitigating climate change, ensuring social equity, and maintaining sustainable development.

## **2 Method**

### **2.1 Questionnaire Design and Data Collection**

The primary data for this study was collected as part of a summer social practice project, "Exploring HCF Potential," conducted by a university from July to October 2022. The project received university approval, and the HCF questionnaire was disseminated online. A total of 3,839 respondents from 1,132 households participated in the survey, with 1,099 of the responses being valid, yielding a response validity rate of 97.0%. The data collection did not involve any sensitive information such as respondents' names, focusing solely on households' daily consumption habits. To ensure the ethical standards of the survey, all participants were provided with an informed consent form before participating.

Given that the data originated from a questionnaire survey, the questionnaire's validity was ensured through a pilot survey, which led to revisions based on the findings. The pilot phase also revealed a significant number of incomplete responses, prompting a revision of the approach to actively contact respondents by phone before the official survey. This method encouraged respondents to read questions carefully before answering, to prevent casual or incomplete responses and ensure the accuracy and authenticity of the data provided.

The questionnaire data was divided into two main parts: (1) Basic Household Information: This section collected data on basic demographic and socio-economic conditions, including population, gender, age, and employment status. (2) Household Consumption Preferences: This section gathered information on daily lifestyle choices, such as dietary habits, the proportion of organic foods consumed, frequency of dining out, use of disposable products, choices of reading materials,

clothing purchases, and frequency of household appliance updates. It also included data on carbon neutrality behaviours and awareness, such as the frequency of community promotions on low-carbon knowledge.

Through the data collected via the questionnaire, this study aims to understand Chinese households' awareness of carbon neutrality and their everyday behaviours to explore the drivers behind the transition towards household carbon neutrality in China. Compared to previous studies based on expert samples (Bai & Liu, 2013; Khanam et al., 2022), the sample size of the current study is significantly larger, providing a more robust basis for analysis.

## **2.2 HCF calculation formula**

The questionnaire comprised a total of 37 questions, with questions 1-11 dedicated to gathering basic information about the respondents. This section included questions on household population size, gender, age, and employment status. Questions 12-37 were related to carbon reduction willingness (WRCF), divided into categories of transportation, food, products, energy, and carbon neutrality awareness, as detailed in Table 1. The questionnaire can be found in the supplementary file.

Table 1. WRCF Questionnaire and Scoring

Category	Question	Scoring				
		Strongly disagree	Disagree	No opinion	Agree	Strongly agree
Transportation	Q12: Does your family own a private car?	Yes=0 No=2				
	Q13: Is your family's private car electric?	Yes=2 No=0 (For those without a private car, score this item as 0)				
Food	Q14: Does your family often eat meat?	2	1.5	1	0.5	0
	Q15: What percentage of your family's food is unprocessed/natural?	100%=2	75%=1.5	50%=1	25%=0.5	0%=0
	Q16: How much of the food your family consumes is unpackaged?	100%=2	75%=1.5	50%=1	25%=0.5	0%=0
	Q17: What percentage of the food your family consumes is locally sourced?	100%=2	75%=1.5	50%=1	25%=0.5	0%=0
	Q18: How often does your family consume takeout/dining out?	2	1.5	1	0.5	0
Household Products	Q19: What new clothes, shoes, or sports equipment does your family purchase monthly?	2		1	0.5	0
	Q20: How often does your family purchase new household items?	2		1	0.5	0
	Q21: How frequently does your family purchase household appliances	2		1		0
	Q22: How frequently does your family purchase electronic devices	2		1		0

	Q23: How frequently does your family purchase paper-based books, magazines, and newspapers?	2		1	0.5	0
	Q24: Does your family engage in paper recycling?	0	0.5	1	1.5	2
	Q25: Does your household engage in plastic recycling?	0	0.5	1	1.5	2
	Q26: Does your family use second-hand clothes and books?	Yes=0 No=2				
	Q27: Does your family have heating/cooling equipment?	Both heating and cooling=2 Only one type=1 No=0				
	Q28: Does your family's electricity come from renewable sources?	0	0.5	1	1.5	2
Energy	Q29: How would you rate your family's energy efficiency?	0	0.5	1	1.5	2
	Q30: Is the energy label an important factor for you when purchasing appliances?	2		0		1
	Q31: Do you understand the meaning of carbon neutrality?	2		1		0
	Q32: Do you believe that household carbon emissions contribute to global warming?	2		1		0
	Q33: Do you prioritize comfort in your daily life over energy consumption?	0		1		2
	Q34: Are you willing to change your personal lifestyle for energy efficiency and participate in family energy-saving and emission reduction activities?	2		1		0
Carbon Neutrality Awareness	Q35: Does your family include individuals working in the environmental industry?	Yes=2 No=0				

Q36: How often do you pay attention to energy and environmental issues?	2	1	0
Q37: Does your residential community or neighborhood take relevant low-carbon actions?	2	1	0

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### 2.3 Measuring Household.WRCF

This article references the definitions of willingness to pay (WTP) values as outlined by Le Gall-Ely and Venkatachalam (Le Gall-Ely, 2009; Venkatachalam, 2004). WTP is the maximum amount an individual is willing to sacrifice or pay for a service or product. It serves as a crucial indicator for measuring consumers' perceived value and demand intensity for a good or service. WTP represents the peak of a consumer's demand curve, indicating the price point at or below which a consumer is prepared to purchase a particular good or service. Consequently, this paper, drawing upon Khanam et al.'s discussion on European carbon reduction behaviours and awareness (Khanam et al., 2022), employs the term Willingness to Reduce Carbon Footprint (WRCF) to denote the inclination of households to reduce carbon emissions in their daily lives. The calculation of WRCF involves dividing the total scores obtained across various sectors by the total number of questions in those sectors, encompassing current daily activities, performances, and consumption habits of households.

$$WRCF_t = \frac{WRCF_T}{q_t} \quad (1)$$

$$WRCF_f = \frac{WRCF_F}{q_f} \quad (2)$$

$$WRCF_p = \frac{WRCF_P}{q_p} \quad (3)$$

$$WRCF_e = \frac{WRCF_E}{q_e} \quad (4)$$

$$WRCF_n = \frac{WRCF_N}{q_n} \quad (5)$$

Equations (1), (2), (3), (4), and (5) each represent the willingness to reduce carbon emissions in the areas of transportation, food, products, energy, and carbon neutrality awareness, respectively. The calculation of WRCF for each sector involves dividing the total scores obtained in that sector by the total number of questions for that sector. The total scores for different sectors are denoted as  $WRCF_T$ ,  $WRCF_F$ ,  $WRCF_P$ ,  $WRCF_E$  and  $WRCF_N$ , which represent the sum of all values within each section as detailed in Table 1. The number of questions in each part is represented by  $q_t$ ,  $q_f$ ,  $q_p$ ,  $q_e$ , and  $q_n$  respectively (with a total of  $q=26$ , excluding demographic questions). Thus,  $WRCF_t$ ,  $WRCF_f$ ,  $WRCF_p$ ,  $WRCF_e$  and  $WRCF_n$  each reflect the willingness of households in various provinces to reduce their carbon footprint in the areas of transportation, food, products, energy, and carbon neutrality awareness.

$$WRCF_{total} = \frac{WRCF_t + WRCF_f + WRCF_p + WRCF_e + WRCF_n}{q} \quad (6)$$

In Equation 6, the overall willingness of households to reduce their Carbon Footprint (CF) is estimated. Here,  $WRCF_t$ ,  $WRCF_f$ ,  $WRCF_p$ ,  $WRCF_e$ , and  $WRCF_n$  represent the willingness of

individual respondents from specific sectors to reduce their CF in transportation, food, products, energy, and carbon neutrality awareness, respectively. The total number of questions is represented by  $q$  (total  $q=26$ ).

Based on the calculated scores, values below 0.5 indicate almost no willingness to reduce the carbon footprint (WRCF), scores from 0.5 to 1 indicate a low level of willingness, scores from 1 to 1.5 suggest a moderate level of willingness, and scores above 1.5 denote a strong willingness to reduce the carbon footprint. This scoring system provides a quantitative measure to assess the degree of engagement across different areas of carbon reduction efforts.

#### 2.4 Correlation Analysis of Household WRCF

Considering that household WRCF may be influenced by various demographic factors such as age and gender, this paper employs SPSS software to process and analyze the data. This analysis evaluates the correlation between different factors and HCF to identify the most significant factors impacting carbon reduction behaviours in households.

$$r = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2(Y - \bar{Y})^2}} \quad (7)$$

Where

$r$  represents the Pearson correlation coefficient.  $X$  and  $Y$  represent the values of WRCF and various household characteristics, respectively.  $\bar{X}$  and  $\bar{Y}$  are the mean values of WRCF and the different household characteristics,

### 3 Result

#### 3.1 Questionnaire

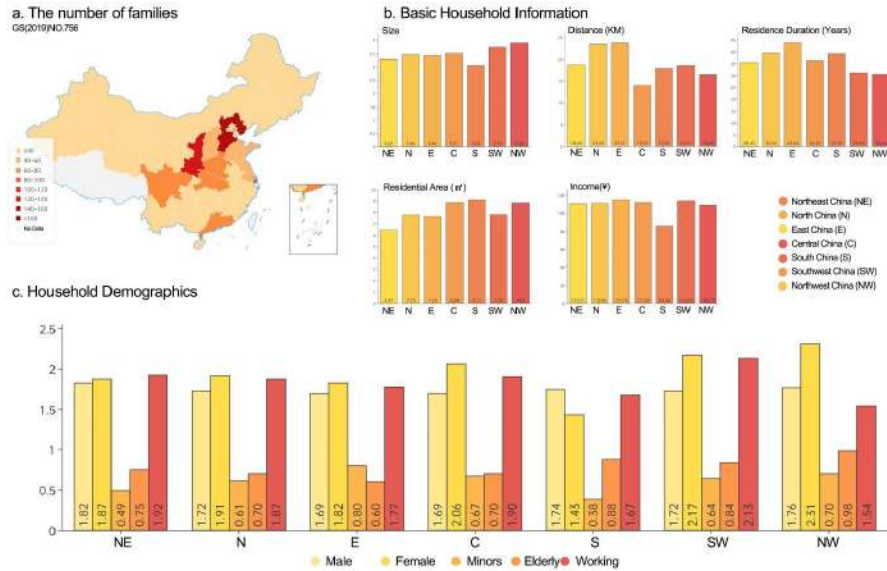


Figure 2: Basic Household Information. a. The number of families; b. Basic Household Information; c. Household Demographics

Figure 2 presents the foundational results of the survey. In terms of household composition, families of three constitute nearly 40% of the household population, with an average household size of 3.5 people. On average, each household comprises 0.67 children, 0.74 elderly individuals, and 1.85 working adults. Forty-six per cent of households have children, with an average annual family income of 186,500 RMB. Seventy per cent of respondents live within 20 kilometres of urban centres, and 57% of households occupy homes smaller than 100 square meters. Given that the survey encompasses the entirety of China, for ease of calculation and analysis, this paper divides the study area into the following eight regions based on geographical and climatic differences: Central China, Eastern China, Southern China, Northeast China, North China, Southwest China, Northwest China, and the Hong Kong, Macau, and Taiwan regions. Specific provinces and areas included are listed in Table 2. The questionnaire did not gather data from the Hong Kong, Macau, Taiwan, and Tibet regions; hence, these are treated as no data.

Table 2. The study area

<b>Region</b>	<b>Included Provinces and Cities</b>
Northeast China (NE)	Liaoning, Jilin, Heilongjiang, Inner Mongolia
North China (N)	Beijing, Tianjin, Hebei, Shanxi, Shandong
East China (E)	Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong
Central China (C)	Henan, Hubei, Hunan
South China (S)	Guangdong, Guangxi, Hainan
Southwest China (SW)	Sichuan, Guizhou, Yunnan, Chongqing, Tibet
Northwest China (NW)	Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang
Taiwan, Hong Kong and Macao regions of China (THM)	Taiwan, Hongkong, Macao

Overall, Regarding household size, regional differences are relatively small, with the average household size in the Northwest being 3.88 people, slightly higher than 3.29 people in the Northeast, suggesting a more relaxed family structure in the Northwest. There are more significant differences in living space. Data indicates that the living area in North China is the largest, nearly 34% higher than in South China, reflecting differences in economic development levels and living conditions between regions. The duration of residence in homes varies from 6.47 years in the Northeast to 9.11 years in South China, which may relate to the stability of the real estate market and residential migration habits in these regions. Differences in the distance from residential areas to city centres are not substantial, but the greatest variance between North China and Northwest is about 13 kilometres, with the furthest distance in North China being 43.64 KM and the closest in Northwest being 30.44 KM, indicating that residents in North China may tend to live further from city centres.

Regarding household demographic composition, the Southwest region has the highest number of employed individuals, averaging 2.13 per household. Across all surveyed regions, the proportion of elderly in households generally exceeds that of minors, with the most significant difference in South China, where the elderly population is 1.3 times that of the minor population. Additionally, the male-to-female ratio also shows notable differences across regions; the Northwest region has 30% more females than males, while South China is the only region where the male population exceeds the female population. These data reveal regional characteristics and differences in family structure, living conditions, and gender ratios across various areas of China. These differences reflect the diverse impacts of economic development, cultural backgrounds, living habits, and social policies between regions.

### 3.2 WRCF in different regions

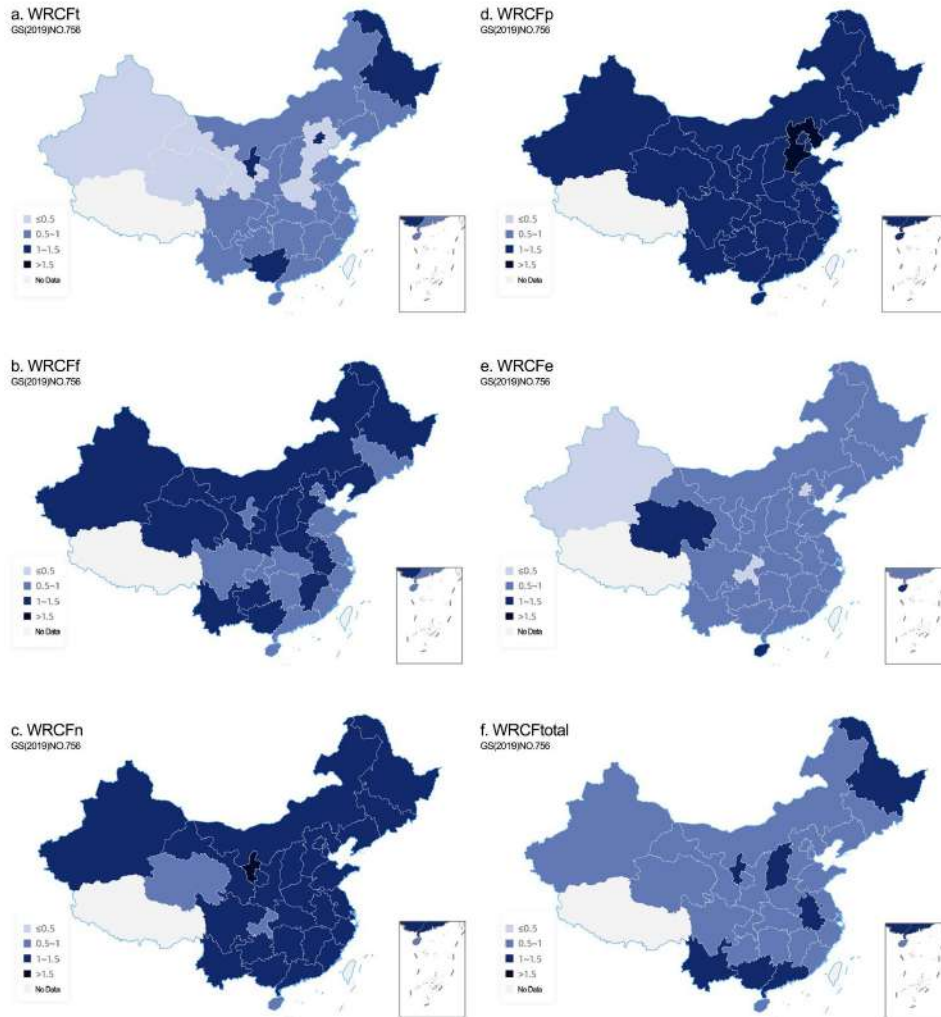


Figure 3 Different categories of WRCF

The study on the distribution and impact of WRCF demonstrates significant regional variations in different types of WRCF. Specifically, in the transportation sector, Heilongjiang Province, Beijing, Ningxia Hui Autonomous Region, and Guangxi Zhuang Autonomous Region exhibit strong

WRCF, likely due to aggressive local government promotion of low-carbon transportation policies. However, in other provinces and regions, the WRCF related to transportation is relatively low, possibly due to a lack of effective incentives or insufficient public awareness of the importance of carbon reduction in transportation.

Compared to transportation, the willingness to WRCFf is more pronounced nationwide. A substantial number of families across almost all regions show a willingness to reduce their food carbon footprint, especially notable in North China, Northeast China, and Southwest China. This reflects the growing concern among Chinese families about the carbon footprint associated with food consumption and their willingness to adopt measures to reduce food-related emissions. The willingness to reduce carbon emissions from household products (WRCFp) is similar to that for food, with a positive attitude observed across all provinces, particularly pronounced in Hebei Province. This indicates that an increasing number of consumers prefer eco-friendly and low-carbon products, reflecting a rise in public environmental awareness and market demand for such products.

However, the WRCFe across the country is not ideal. Apart from Qinghai Province, the desire to reduce energy consumption is generally low throughout the country, especially in Chongqing, Beijing, and Xinjiang, where there is almost no inclination to reduce energy consumption. This could be related to the energy structure and pricing policies in these areas, or possibly due to inadequate public understanding of the importance of energy carbon reduction. Apart from Qinghai Province, the national willingness to reduce energy consumption is low, with almost no willingness observed in Chongqing, Beijing, and Xinjiang. Regarding WRCFn, there is a strong awareness of carbon neutrality nationwide, particularly in the Ningxia region. This indicates that national campaigns on carbon neutrality have been somewhat effective, with most families having a fair understanding and support for it.

In terms of overall WRCF (WRCFtotal), only a few provinces like Yunnan, Guangxi, Shanxi, Heilongjiang, Gansu, and Anhui show significant overall WRCF, while other provinces exhibit lower WRCF. This disparity highlights the uneven distribution of environmental awareness and practices across China, suggesting that future efforts should not only maintain the willingness to reduce carbon in food and products but also enhance the promotion of energy carbon reduction.

### 3.3 Correlation-based influences on WRCF

To further analyze the primary factors influencing WRCF, we employed Pearson correlation analysis to explore how household characteristics (such as household size, ages of members, gender, and employment status) affect the willingness to reduce carbon emissions in various aspects including transportation, food, products, energy, and carbon neutrality awareness across different provinces. Figure 4 illustrates the main influencing factors for different categories of WRCF, where the significance levels (two-tailed) indicate whether these relationships are statistically significant. Except for household population, gender, elderly, minors, and working population, the correlations for all other factors were found to be significant ( $p$ -value  $<0.05$  or  $<0.01$ ).

Figure 4 Main influencing factors for different categories of WRCFs

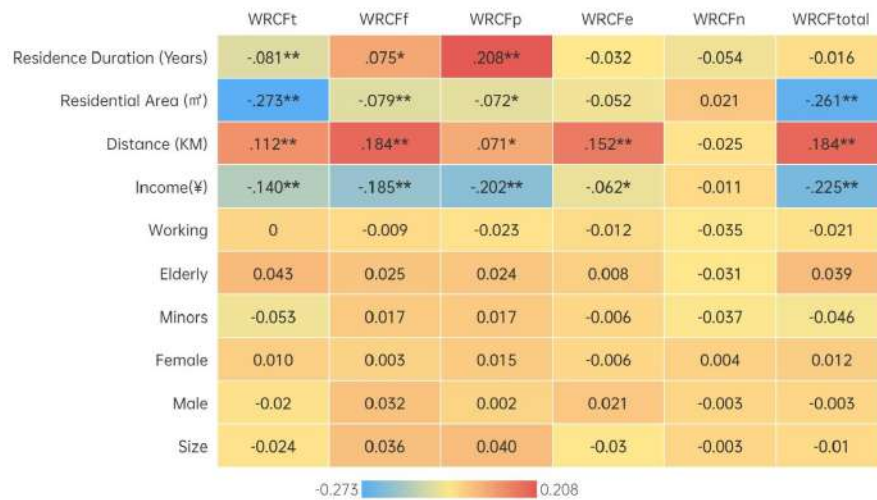


Figure 4 indicates that the gender ratio, total population, and number of employed individuals in households do not significantly influence the WRCF, suggesting that these factors may not directly determine a family's carbon reduction behaviours. However, other aspects such as household income, geographical location, residential area, and duration of residence significantly affect carbon reduction awareness in households. Specifically, the size of a household's living area shows a significant negative correlation with their awareness of transportation carbon reduction. This may be because families with larger living areas typically own more vehicles or use private cars more frequently, which reduces their focus on reducing carbon emissions in transportation. Additionally, such families are likely to reside in suburban or peripheral urban areas, increasing their dependency on vehicles. The proximity of residences to city centres is positively correlated with the household's awareness and actions toward reducing carbon emissions in transportation, food, and energy. Families living near city centres tend to adopt a low-carbon lifestyle, such as using public transportation, opting for local food, and utilising energy more efficiently, likely because of better accessibility to transport and environmental resources in city centres. Household income is also a crucial factor affecting carbon reduction consciousness. Data shows that higher-income families demonstrate a lower willingness to reduce carbon emissions in food, products, and energy, possibly because such families have greater financial flexibility for consumption, may not focus on conserving resources and protecting the environment, or their lifestyle and consumption patterns are closely linked with higher carbon emissions. This observation aligns with the findings of researchers like Wiedenhofer et al (An et al., 2024; Gao et al., 2024; Wiedenhofer et al., 2017). The duration of residence is positively correlated with the willingness to reduce the carbon footprint of products; families residing longer in their homes are more likely to adopt measures to reduce product carbon footprints, such as choosing sustainably produced goods and reusing products. Overall, the general awareness of carbon reduction negatively correlates with the size of a family's residential area but positively with their geographical location. This suggests that families living in smaller residences closer to city centres are likely to exhibit

stronger environmental awareness and behaviour, possibly due to stricter environmental policies in these areas or because residents in smaller spaces focus more on efficient resource use.

Overall, the general awareness of carbon reduction is negatively correlated with the size of a family's living area and positively correlated with their geographical location. This suggests that households with smaller living spaces and those closer to city centres are more likely to exhibit stronger environmental consciousness and behaviours. This could be due to stricter environmental policies in these areas or because residents in smaller spaces focus more on efficient resource use.

#### **4 Discussion and Conclusion**

This study integrates the WTP approach and survey methods to explore the variations in WRCF among different types of households across various regions of China, and their relationship with household structure, economic status, and living conditions, providing a basis for future differentiated low-carbon policies. The results show that while there is little variation in family size across regions, there are significant differences in living space, duration of residence, and distance from city centres. These variations reflect regional differences in economic development, real estate market stability, residential migration habits, and urban planning. Additionally, the composition of household populations in terms of gender ratios and age structures also shows regional characteristics; in South China, the elderly population exceeds the minor population, while in Northwest China, the female population significantly outnumbers the male population. These findings reveal the diversity and specificity of family structures and living conditions across different regions of China.

Significant regional differences are evident in the types of WRCF. Chinese families have made some progress in WRCF related to food and products, but there is still room for improvement in transportation and energy use. Nevertheless, there is a strong national consciousness about carbon neutrality, and promotions regarding carbon neutrality have been somewhat effective, with most families having a fair understanding and support for it. Future efforts should maintain the progress in food and product WRCF while enhancing the promotion and policy guidance on energy carbon reduction to ensure a comprehensive advancement of low-carbon lifestyles.

Factors such as household income, geographical location, residential area, and duration of residence significantly correlate with household carbon reduction consciousness. Families with larger living areas tend to have a lower awareness of transportation carbon reduction, possibly due to greater reliance on private vehicles. Meanwhile, families living closer to city centres are more likely to adopt low-carbon lifestyles due to convenient transportation and efficient resource utilization. This insight suggests that policymakers should consider carbon reduction factors in urban planning and housing policies, such as encouraging the development of compact cities and enhancing the convenience and efficiency of public transportation systems (Souaid et al., 2024). Research has found that high-income families generally have lower WRCF, which may be related to their greater consumption power and lifestyle choices (Sommer & Kratena, 2017). Therefore, enhancing environmental education and improving the availability of eco-friendly products and technologies might be effective strategies to increase WRCF among higher-income groups (Wiedenhofer et al., 2017).

Future government carbon reduction strategies could consider the specific circumstances of households, such as income level, residential location, and type of housing, to design more targeted incentive measures. For example, families living in small residences in city centres could be provided with more low-carbon lifestyle conveniences, such as discounted public transportation services and expanded public resource-sharing facilities. Simultaneously, differentiated educational and promotional strategies should be launched for various income levels, particularly emphasizing the importance of a low-carbon lifestyle to high-income families to motivate their participation in carbon reduction. In addition, effective carbon reduction promotional activities should be implemented to widely communicate the importance and urgency of carbon reduction to the public. Currently, China has introduced a series of policies to reduce Household Carbon Footprint (HCF), such as promoting low-carbon buildings, developing new energy vehicles, advocating low-carbon lifestyles, enhancing energy conservation, and using new energy sources, aimed at reducing HCF, promoting sustainable development, and improving the quality of life. These measures not only aim to reduce carbon emissions, promote sustainable development, and enhance the quality of life but also make significant contributions to global climate governance and international cooperation, advancing global efforts to combat climate change and helping achieve the long-term goals of reaching carbon peak by 2030 and carbon neutrality by 2060.

This paper still has some limitations, such as potential biases in the survey or questionnaire design that might affect the respondents' answers, thus impacting the reliability and validity of the data. Future research should consider improving the design issues in the survey to enhance the reliability of the study.

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#### **Statements and Declarations**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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