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REVIEW ARTICLE

How do people in China perceive water? From health threat perception to environmental policy change

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Abstract

The vast majority of environmental studies examine the real impacts of human activities on the quality of ecosystems and measure the extent of pollution of natural resources using natural science methods. However, research on risk has shown that there is a gap between the real risks as described by technical experts and the public perception of risk. Research on risk perception studies is important to determine how people understand and evaluate risks, enabling policy makers to better communicate risks and develop environmental measures and policies. This paper presents a systematic review of studies that address public perceptions of water-related environmental problems in China. The systematic review provides a knowledge base for further research on water perception and develops the field of environmental psychology. Only through a synthesis of how people perceive water, and how they understand the problems and risks associated with water, we can better understand the underlying assumptions of their thinking and environmental attitudes. Environmental problems are also social and political problems because only through changing human behaviour we can arrive at solutions.

Keywords China · Risk perception · Water perception · Water pollution · Environmental politics · Health risk

Introduction

The quality and quantity of water resources are of interest to scientists and policy makers worldwide as they have a major impact on human health (Boelee et al. 2019; Afroz and Rahman 2017), human well-being (Diener and Tay 2015; Nadeem et al. 2020) and the sustainability of all industrial-agricultural processes (Willet et al. 2019; Forouzani and Karami 2011). Globally, around 80% of wastewater is discharged back into the environment, causing serious risks to human health and safety (Denchak 2022). According to Landrigan et al. (2018), 1.8 million people die annually as a result of water pollution.

Studies across continents point to various types of problems related to drinking water quality (Slavik et al. 2020; Vanny et al. 2015), groundwater contamination (Araya et al. 2022; Chaudhuri and Ale 2014; Chaudhuri et al. 2012; Gandhi et al. 2022), severe pollution of water resources (Kendirli et al. 2005; Gyamfi et al. 2019), sustainable drinking water supplies (Chaudhuri et al. 2020; Poonia and Punia 2018; Odjegba et al. 2020) and water scarcity (Kummu et al. 2016; Mekonnen and Hoekstra 2016; Oppliger et al. 2019). Water perception studies are also important for policy makers in terms of adopting adequate risk communication and developing the well-being of the population. These are, for example, studies from the America (Jones et al. 2018; Graydon et al. 2019), Europe (Hooks et al. 2019), Africa (Varickanickal et al. 2020; Mumbi et al. 2020; Mussa et al. 2019), Australia (Sivagurunathan et al. 2022; Ragusa and Crampton 2016) or Asia (Singh et al. 2018; Afroz et al. 2016; Hong et al. 2018) that show public opinion on water-related issues.

All of the above problems also apply to China, where dramatic economic growth over several decades has been realised at the expense of the environment, which has suffered enormous ecological damage (Hu and Cheng 2013; Gardner 2018; Tsai and Lu 2000). Water resources are no exception and are being polluted for a number of reasons (Zhao et al. 2021), such as industrial emissions (Li et al. 2019), sewage (Shi et al. 2021), fertilisers and other pollutants used in agriculture (Lai 2017; Schaffner et al. 2011), urban runoff (Zhang et al. 2019) and livestock and poultry breeding (Zhou et al. 2017). The most serious consequence

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of polluted water is its negative impact on human health (Ikehata et al. 2015; Shi et al. 2020; Wang and Yang 2016; Wu et al. 1999).

Despite government programmes to address environmental issues, China still faces serious problems such as water pollution and scarcity. As a World Bank (2018) report shows, although China is the second largest economy and has the largest population in the world, it has only 6% of the world's water resources, and water use efficiency is very low. Pollution levels are reaching enormous proportions. Data for 2017 shows that 67% of groundwater was polluted and 37% of surface water did not meet drinking water quality standards. Moreover, it should be mentioned that 70 million people are at risk due to poor drinking water security and in 2015 only 64% of rural areas had good access to water.

Deepening water scarcity is a major concern for China, with per capita freshwater resources accounting for less than a third of the world's value (Xue et al. 2020). However, the problem is even more complicated, as water in China is distributed very unevenly — southern China has enough water annually but experiences seasonal water shortages (Ma et al. 2020), while the northern part suffers from acute water scarcity — it has roughly 20% of the nation's water resources and 64% of its land area (Blanke et al. 2007). Another serious problem facing China is groundwater depletion. The situation is very serious in North China. Feng et al. (2013) show that approximately 50 km^3 of groundwater was depleted in the study area between 2003 and 2010. This amount is more than the capacity of China's Three Gorges Dam. Water pollution is a very serious problem that cannot be underestimated. This is because it fundamentally harms human health (Li and Wu 2019). Contaminated drinking water can cause diseases such as cholera, diarrhoea, dysentery and polio (WHO 2022), endangers food safety and agricultural production (Zhang et al. 2015).

Most existing studies concerning the impact of environmental problems on human well-being focus on air pollution (Li and Zhou 2020). However, according to the survey by Zhang et al. (2013) conducted in Beijing, 74% of respondents considered water pollution as a more serious problem than air pollution. It appears that people in China are becoming aware of the seriousness of water pollution and are increasingly making demands for improvements in water quality. As mentioned by Xu et al. (2019), the Chinese public is making higher demands for solutions to environmental problems. Environmental policy is becoming one of the key prerequisites for the well-being of the population, and even top government officials are realising this tendency.

This article offers a systematic review of studies that address perceptions of water in China. Only through a synthesis of how people perceive water, and how they understand the problems and risks associated with water, we can better understand the underlying assumptions of their thinking and environmental attitudes. Environmental problems are also social and political problems because only through changing human behaviour we can arrive at solutions. People's perceptions of the problems are also important for putting pressure on government and organizations to address environmental problems.

Research on the perception of environmental problems is a very complex issue as it is closely related to psychological, social and cultural determinants of risk perception. Chen (2010) argues that pollution is also a social problem that cannot be solved by technical means alone. He shows that problematising environmental pollution is a prerequisite for successful environmental management. It is research on the perception of water quality and the risks associated with it that is important for changing the understanding of pollution as a social problem (Chen 2019).

The findings of this study are useful for guiding future research in several areas, as research on water perception is highly interdisciplinary. First and foremost, the results are relevant to environmental science and mapping perceived levels of water resource protection, which helps to target the measurement of pollution levels in specific water bodies. This is also related to the implementation of environmental policies and measures that will guide the direction of public behaviour to protect water resources. A number of perception studies point to the level of willingness of residents to change their behaviour or pay for ecosystem protection. Public perceptions of the environment can also be understood through environmental psychology and risk research. The findings allow us to characterise what are the most significant determinants of perceptions of water quality in China and whether residents adequately assess the risks associated with pollution. The identification of communication barriers between residents and the government is very valuable in terms of protecting human health. Thus, mapping public perceptions and social interactions and stakeholder communication is very important research that can lead to saving lives.

Political background

A realistic depiction of the contradiction between economic growth and environmental protection is captured by Elisabeth Economy (2004) in her book *River Runs Black*, which has become one of the important representations of China's environmental crisis in the national debate.

Economy (2004) analyses the reasons for the lack of environmental protection and finds that it is not the government's unwillingness to address the environmental situation, but the rate and level of pollution that exceeds the practical capacity of the state, as well as the low ability to enforce regulations targeted at environmental protection. As Morton (2005)

shows, it is politics that is the source of both the positive and negative forces shaping environmental change in China.

Gallagher (2006) argues that compelling depictions of environmental disasters and political-historical context, as in the case of *River Runs Black*, lead to important pressures on government. However, Morton (2005) points out that the appeal of environmental protection cannot be separated from the serious questions of how to ensure that policies leading to environmental protection do not disproportionately affect the poorest people. Getting support is not only enough from the government, but it is also necessary to secure support from the people themselves in order to promote change in society.

For example, national surveys in 1995 and 1998 showed that residents rated the environment as a less important issue than public policy, education, population and employment. Economic development was considered a top priority in China's development goals (Lee 2005). As Zhang and Barr (2013) show, China does not limit the sustainability of economic development to environmental sustainability, but also targets politically and socially sustainable programmes.

Citizens, who organise themselves in environmental movements or NGOs, play an important role in shaping environmental change. As Economy (2004) shows, emerging NGOs are tolerated by the Chinese government only as long as they do not pose a threat to it. In this regard, Tong (2005) mentions that in contrast to advanced industrial countries with democratic systems where citizens' activities are legally protected, in countries with authoritarian regimes, the space for any kind of citizen activities and social movements is limited. China represents a transitional society where there is a gradual transition from a tightly controlled political structure to a more liberal system.

Despite the constraints, there was still room for the development of NGOs in China's transitional society, which saw a significant increase in the late 1990s and had a great impact on the rise of civil society (Zhang and Barr 2013). In addition to these organizations, pollution-driven grass-roots environmental protests have played an important role in raising environmental awareness and putting pressure on the government. However, as Tong (2005) mentions, although these protests are numerous, the lack of an effective legal system means that this grassroots pressure usually fails to get government authorities to address environmental problems; moreover, protesters are often punished. In contrast to these protests, as Chen (2008) shows, there may be groups of people who adopt a silence position as a result of failing to confront both the effects of pollution and powerful corporations and governments.

The way out of a complex environmental situation seems to be cooperation between all stakeholders. As Zhang and Barr (2013 p. 14) mention, the goal of Chinese ENGOs should not be to create a social sphere bringing together like-minded citizens, but to try to connect different social spheres. In this regard, the role of academics as mediators between state and society is significant. This article summarises the results of recent studies that highlight the Chinese public's perception of water, contributing to this dialogue between government and the public, and outlines directions for future research.

Materials and method

This study is based on a systematic review, which can be considered a separate research genre (Ramey and Rao 2011). A systematic literature review is a stand-alone piece that is created for a specific purpose (Templier and Paré 2015). This article employs a descriptive approach to literature review, which aims to describe the state of the literature related to a particular issue (Xiao and Watson 2019). In the case of this study, the issue is the perception of water in China. Due to the diversity of studies dealing with water perception issues, this study uses a narrative literature review (Green et al. 2006; Kastner et al. 2012) to present the results of previous research in a clear manner.

The articles were searched in the Web of Science (WoS) database, under the "topic" search. WoS was chosen because of its efforts to identify articles published in highly ranked journals that could guarantee quality research and more rigorous peer-review. However, even in high-impact journals, we find studies that appear to be problematic (see section "Limitations of research"). A total of six keywords were used to search the database: KW1: "water", and "perception", and "China"; KW2: "water", and "consciousness", and "China"; KW3: "water", and "satisfaction", and "China"; KW4: "water", and "quality", and "awareness", and "China"; KW5: "water", and "happiness", and "China"; KW6: "glacier", and "perception", and "China". The main criteria for inclusion in the review were the following: article (a) relates to China, (b) relates to people's perceptions, (c) relates to water, (d) was published after 2000, (e) the data is not reliable. The search results and the number of articles meeting the topic criterion are shown in Table 1.

The review does not include studies that were only remotely related to the perception of water through their relationship to a nearby concept such as climate change or drought. These studies were not included because respondents did not directly assess water-related phenomena. Furthermore, studies dealing with indicators of well-being, for which it was not possible to extract respondents' direct perceptions of water-related issues, were not included in the review. Two studies were withdrawn from the review due to unreliable data. The review also did not include papers that did not present the results of empirical research.

Table 1 Web of Science search and keyword inclusion criteria

Keyword:	KW1	KW2	KW3	KW4	KW5	KW6
Web of Science (topic search)	380	47	142	118	16	10
Excluded due to failure to meet criteria ("relates to China", "relates to people's perceptions", "relates to water", "published after 2000")	334	45	133	115	16	7
Screened out for duplication	0	2	2	2	0	0
Finally considered documents	44	0	6	1	0	3
Total number of documents	**54**					

KW1: "water", and "perception", and "China"

KW2: "water", and "consciousness", and "China"

KW3: "water", and "satisfaction", and "China"

KW4: "water", and "quality", and "awareness", and "China"

KW5: "water", and "happiness", and "China"

KW6: "glacier", and "perception", and "China"

The articles meeting the criteria were analysed and notes were made regarding the research objective, method, research sample and results (see Appendix 1 for a complete table of key data). The studies were sorted into thematic categories which form parts of the results presented in the following section of the paper.

Research on water perception

Perception of water quality

Perception of water quality is closely related to perceptions of pollution and pollution sources. The results of these studies tell us about public awareness of the severity of environmental pollution and its consequences.

A survey of residents' awareness of water resources in the Haihe River Basin revealed a low level of satisfaction with water resources in the area (lower than the national average). Negative events associated with water resources have also been shown to affect residents' overall perceptions. For example, the previous "dead fish incident" in the middle reaches of the Haihe River (in Baiyangdian) in 2000 and 2006 made middle reach residents significantly more concerned with the water environment than upstream residents. The results of the residents' perceptions also showed the serious pollution condition of the watercourse (Liu et al. 2010).

Zhang (2011) conducted research around Lake Tai (located in the centre of the Yangtze River Delta). The study focused on the value of lake water quality improvement, which indirectly relates to perceptions of water pollution as measured by willingness to pay (WTP) for water quality improvement. The study results show that respondents are willing to pay approximately CNY 141 per household per year. WTP increases with the income of residents. The results also show that women are willing to pay more than men are. Another point is that residents who are dissatisfied with the water quality would pay more than those who are satisfied.

In their study, Zhen et al. (2011) investigate pollution perceptions and willingness to reduce pollution threats in the Poyang Lake area (Jiangxi Province). Respondents cited water pollution (65%), solid waste pollution (58%), soil loss through water erosion (40%), sedimentation (26%) and flood risks (20%) as the main problems. In terms of adapting their activities to protect the lake, most respondents (60%) were willing to convert their lakeside fields into natural wetlands.

Article by Wang et al. (2013) discusses how people are informed about environmental issues in the Min River Watershed in Fujian Province. It has been found that people are very aware of the environmental and health issues related to the watershed, but simultaneously they do not have enough awareness of the government's management of the watershed, what the watershed is and the contexts associated with it. The analysis shows that although more than 80% of respondents were willing to be involved in decision-making activities related to watershed protection, in reality, only 1% of them had ever been involved in such activities. It also reveals that almost half of the respondents considered the condition of the watershed to be poor, 44% were neutral, and only 11% considered it to be good.

For the study by Ding et al. (2014), the Human-Water Harmony Index (HWHI) method (based on the concept of harmony between humans and water) was used and applied to five major cities in China (Beijing, Shanghai, Guangzhou, Xi'an and Nanjing). Respondents were asked to express their level of satisfaction regarding water pollution treatment. The results for each city were very similar; specifically, Nanjing had the highest satisfaction rating (62.8%) and Xi'an the lowest (50.1%). The authors reason that although Nanjing and Shanghai are close and share the same water

resource constraints, Nanjing faces fewer pressures in terms of population, industrial production and wastewater treatment. Guangzhou has the best water quality and the largest amount of water per unit area and per capita among these cities. However, it is ranked third in the residents' satisfaction dimension.

Next research was carried out with local residents of the Shiyang (Gansu Province) and Weihe (Shaanxi Province) river basins, which suffer from water scarcity and pollution. Respondents were asked to indicate how severe they considered water-related problems. It was found that 60% of Shiyang Basin residents perceived water management and the environment as the top two most important issues. Weihe Basin residents ranked these items third and fourth. In contrast, both groups of residents consider infrastructure and poverty reduction to be the least important. Demographic factors were shown to play an important role in the perception of issues, for example, education level increased the ranking of environmental items to the top. Regarding the gender difference, men prioritise environmental issues over other issues more than women do (Aregay et al. 2016).

Qiu et al. (2016) examined factors influencing immigrant satisfaction in Danjiangkou Reservoir. Among other factors, their research focused on environmental conditions, including drinking water quality. A questionnaire survey showed that 45% of respondents considered drinking water quality to be good, 49% considered it to be general and 6% considered it to be poor.

Research by Yue et al. (2017) looked at the impact of investment on rural people's perceptions of water quality between years 2004 and 2011 in five Chinese provinces. The results showed high levels of satisfaction, especially in villages with drinking water. The 2011 results demonstrated a significant improvement in the perception of water quality (compared to the 2004 results): only 7% reported that the water came from a polluted source (previously 19%), 5% noticed a bad taste or smell in the water (previously 17%) and 11% noted impurities in the water (previously 13%). Negative ratings were recorded much higher for communities without tap water, e.g. up to a quarter of respondents noted visible impurities, bad colour, taste and smell.

Chen et al. (2017) conducted a nationwide survey in China on public perceptions and responses to environmental pollution and health risks. Face-to-face surveys were conducted on trains and at railway stations. The researchers asked respondents to rate the general conditions and changes in air and water quality in the city and their experiences with pollution. To assess the accuracy of public perceptions, the research team used data from the Ministry of Environmental Protection of the People's Republic of China in 109 major cities during 2008–2012. While 95% of respondents considered environmental pollution to be a serious threat to health, 62.2% of respondents admitted that pollution is closely linked to human health, and they believed they knew the health risks of pollution. The results showed that people with direct experience of pollution damage had the lowest accuracy rate (37.4%). These respondents also had the most pessimistic attitudes (60.4%). In cases where the experience was based on information from friends, relatives or the media, a higher accuracy ratio of approximately 50% was achieved. The results revealed that the public is not prepared to deal with the health risks associated with a polluted environment. At the same time, public indifference to dealing with these issues was demonstrated and the authors estimate a long way to go to improve the situation.

Another type of research deals with the perception of environmental risks associated with sudden accidents that may impact water pollution. Research by Du et al. (2017) focused on how residents of five districts and two counties of Zhangjiakou City (Hebei Province) perceive these environmental risks. The results show that residents of Wanquan and Xuanhua districts, which are characterised by a significant level of industry, perceived the risks more compared to residents of other areas. People in Chongli and Chicheng areas were influenced in their perception by tailings dam failure. In addition, some groups of residents have lower risk tolerance. These were women, people aged 21–40, people with higher education and income, and government employees.

Du et al. (2018) carried out a comparison of environmental awareness in 2006 and 2015 in three villages near Miyun Reservoir, which is the main source of drinking water for Beijing. The survey results show that the environmental awareness of the residents has increased significantly. The number of respondents who considered the water quality to be normal decreased from 68.6 to 51.2% between 2006 and 2015. While 8% of respondents considered the water to be bad in 2006, it was already 23.3% in 2015. Water pollution was considered a very serious problem by 27.2% of the respondents in 2006, but in 2015, 45.7% of respondents did so. In 2015, 60% of the respondents thought that sewage and household garbage pollute the river water, while in 2006 it was just 40%.

Yao et al. (2018) conducted psychometric research focusing on risk perception of aquatic pollution originating from chemical industry clusters in the coastal area of Jiangsu Province. Middle-aged people were more concerned about pollution. There was no difference in the three study areas regarding risk perception. The research results showed that while the respondents had knowledge about water pollution, they were weak in their awareness of aquatic pollution risks. The research also showed that respondents were in favour of the development of the chemical industry, despite the fact that companies do not disclose all locations where water pollution occurs. Finally, respondents who are closer to the chemical industry perceive more risk.

Another article looked at how local farmers and pastoralists, who have lived in the area for at least 10 years, perceive environmental changes in the lower reaches of the Heihe River Basin. The data showed that most respondents had a pessimistic view of ecological conditions for the decade 2014–2024. Furthermore, 57% of respondents expected the flow of the Heihe River to decline and 77% expected the water in the lake to decline (Zhou et al. 2018).

Baranovitch (2019) explores the perceptions of environmental pollution by Uyghurs in Xinjiang through an analysis of well-known Uyghur texts that mention the issue. An example is the well-known short story "Wild Pigeon" by the Uyghur writer Nurmuhemmet Yasin, which was published in 2004. Another example is a song called "Polluted Water" by the famous Uyghur musician Omarjan Alim, which was included in a cassette album in 1996. In his research, Baranovitch conducted several interviews with Uyghur informants about their interpretation of these Uyghur lyrics that talk about water pollution but do not mention the causes. For Uyghurs, water pollution is a political issue and they are cautious in their responses. In other words, they are aware of serious water pollution and its threat to their health, livelihoods and culture, and most often associate this pollution with the activities of Han settlers.

Another research (Wang et al. 2019) looks at factors affecting residents' satisfaction with air and water quality in 32 major Chinese cities. Participants were found to underestimate their level of satisfaction, but were actually satisfied with the current situation. However, it was possible to estimate their true level of satisfaction (methodological bias). For example, 44.5% of respondents reported satisfaction with water quality, but the true level of satisfaction was 57.5%. More educated people and people with higher income were less satisfied. On the other hand, older people and female respondents were more satisfied with water and air quality.

Next study examines the scientific and public assessment of water quality in 189 urban landscape lakes in China. Participants were asked to express their satisfaction with the landscape lakes regarding water colour, odour, clarity, etc. Likert scale was used to measure satisfaction (1 — dislike a lot, 2 — dislike, 3 — neutral, 4 — like and 5 — like a lot). Most of the respondents (35.4%) marked 4, 12.2% marked 5, 30.7% were neutral and the remaining 21.7% were not satisfied (Chang et al. 2019).

One of the consequences of the rapid urbanization and economic development of Chinese cities are urban malodorous black rivers (MBR). Such water contains no plants or animals and is characterised by floating waste on the water surface and a pungent smell. In their research, Yu et al. (2021) examine public satisfaction with the treatment of MBR in Nanjing. Fifty-one percent of the respondents consider urban pollution and 34.9% consider industrial pollution as the main cause of black rivers. In addition, 51.3% of respondents believe that these rivers can pollute drinking water and pose a health risk. It is the perception of health risks that has a significant impact on the overall satisfaction of residents. The distance between the residence and the polluted water also played an important role — the shorter the distance, the greater the impact on residents and the more attention residents paid to the polluted water. The study summarises that residents are very concerned about their health. Firstly, the study proposes the creation of a platform for the public to report environmental problems. Secondly, it urges that these complaints from the citizens be addressed urgently.

Perception of tap water

The issue of tap water quality is of great importance because tap water is used in households for a number of purposes and also as drinking water, which can carry health risks if the quality is poor.

Zhang and Brown (2005) implemented research on water use and perceptions in Beijing and Tianjin. When asked what should be improved about water, Beijing residents considered water purity to be the most important (74.2%), followed by maintenance (45.1%) and the billing system (31.4%). Families in Tianjin considered the billing system (61.7%) to be the most important, followed by water purity (54.1%) and water quantity (41.2%). The survey results show that when evaluating environmental problems, 36.7% of Beijing residents and 35% of Tianjin residents considered air pollution as the most serious. The authors believe that the results may have been influenced by dust storms that occurred in the area prior to the survey. People in Beijing cited water shortage (21.7%), water pollution (16.3%) and poverty (12.2%) as other serious problems, while people in Tianjin cited neighbourhood environmental quality (21.0%), water shortage (16.1%) and wastewater treatment (9.8%).

Bi et al. (2010) carried out a questionnaire survey in Wujin County in Jiangsu Province. Their research focused on public perception of environmental issues, with several questions related to water perception. The results showed that residents, who live in an urban community and have more information about the environment, consider water quality a more serious problem. Men, students and civil servants perceived water quality as poorer than peasants and workers did. Based on responses to other questions, the authors created an index of concerns about environmental and social issues. While 19% of respondents placed importance to social issues, 65% considered environmental issues to be more important. Another section of questions showed that 66.2% preferred environmental protection, while 33.8% prioritised economic growth.

Zhou et al. (2011) conducted research in Shanghai on drinking water safety in areas with a predominantly poor population. The research showed that the environmental sanitation system in the study areas has been ignored during city planning. In addition, city residents do not get information through official channels but only through the media. To improve living conditions, the researchers suggest creating an effective communication system between policy makers, policy executors and inhabitants.

Other researchers Chen et al. (2012) examined how residents' preferences for types of water for drinking changed between 2001 and 2011 in Shanghai. The results showed that tap water remained the predominant source of drinking water (58.99% in 2001, 58.25% in 2011). However, bottled water consumption decreased from 36.86 to 25.75%, and household consumption of filtered water increased from 4.15 to 16%. The analysis showed a high correlation between health beliefs and water choice. Diarrhoea was experienced by respondents using all types of water (42.75%). People also continued to indulge in inappropriate hygiene behaviour.

Jin et al. (2016) conducted a survey of residents' willingness to pay for drinking water quality improvements in Songzi. A questionnaire survey showed that residents were willing to pay an average of CNY 16.17 per month. The willingness was higher for households with higher incomes, fewer members and more educated respondents. The authors also conclude that perceptions of water quality and health risks can have a significant impact on willingness to pay extra for water quality.

Researchers Wang et al. (2018) investigated perceptions of drinking water quality, safety and accidents associated with water pollution in two rural districts of Hainan Province. According to the results, only 18.3% of respondents were not satisfied with the quality of drinking water, 20.5% were very satisfied, and just under 60% were relatively satisfied. The influence of demographic factors such as age and gender did not prove to be significant in this study; however, higher levels of education increased awareness of water quality. In terms of water use for drinking, up to 70% of respondents use tap water, 22.8% drink well water and only 5.2% drink bottled or barrel water.

In 2013, Zhen et al. (2018, 2019a, b) conducted quantitative research on the risk perception of tap water consumption by Shanghai residents in the context of their trust in public water authorities. The survey shows that hukou status and education play a more important role than age or gender in assessing trust in water supply institutions in Shanghai. In fact, people with urban hukou and higher education trust these organizations less. In relation to tap water perception, it was found that 4.3% of residents perceived no risk and 67.5% perceived low risk. This means that tap water is safe for cooking and washing, but probably not safe for drinking. 24.4% of respondents perceived tap water consumption as medium risk, meaning safe for washing but unsafe for cooking and drinking. However, only 3.8% perceived tap water as high risk. The results also revealed an interesting fact, namely that up to 71% of respondents believe that water companies would not tell them the truth if the water was unsafe. Although almost half of the respondents do not trust the honesty of these organizations, on the other hand, most of them believe that they provide safe drinking water — such an attitude is related to the idea of social stability (weiwen 维稳), which means that residents have already come to terms with this condition and therefore do not expect justice from these organizations. Data analysis is complicated by the fact that one-third of respondents did not express their opinion. The results led to the conclusion that political trust in the ability of water authorities significantly reduces the risk perception of tap water consumption. However, the authors of the study do not discuss the extent to which the Chinese population's responses were influenced by their fear of expressing concerns about tap water quality. The paper argues that although China has an authoritarian government, it enjoys a relatively high level of political trust, but does not discuss the extent to which this trust is biased by fear of defying authoritarianism.

Using a social practice approach, researchers Zhen et al. (2019a, b) examined three household drinking water consumption practices in Shanghai: boiling water, filtering water and buying water. The most common access to drinking water was boiling tap water using a kettle, which was reported by 45% of respondents. Some people admitted that they could not afford to buy bottled water, even though they wanted to. Others, in turn, trust boiled tap water more because it still flows, but when it comes to bottled water, we do not know how long it has been stored, how it has been treated in the bottle or barrel, where it has been transported from, claiming there may be sediments, and some respondents did not trust questionable brands of bottled water. Others said they do not need a water filter because the cheap one is ineffective, and the effective one costs several thousand yuan. One interviewee admitted: "Even if the government knows that some pollution indicators exceed the standard, they won't tell the public because it is not good for maintaining social stability". The interviews also revealed the great influence of the media on perceptions of water use. For example, one woman only drinks boiled tap water because the TV said it was the healthiest water (Zhen et al. 2019a, b).

Chen and Zhou (2020) conducted research regarding the use of water purifiers. The data comes from rural farmers in Hunan and Jiangxi provinces, which are severely polluted by heavy metals. According to the results, 14.8% of respondents think drinking water exceeded safe levels. Furthermore, 26% said their relatives would buy a water purifier with a filter that reduces the health risks of cadmium. Demographic factors, such as gender, age or education,

emerged as significant. The results show that there is a need to raise awareness of the environmental risks of heavy metal pollution.

Li et al. (2021a, b) investigated change in risk perception of Chinese residents over a 10-year period in Nanjing, Hefei and Kunming. Among the risks surveyed was the risk of drinking water pollution. The study results show that the perceived risk of drinking water pollution in the three cities increased significantly in the past 10 years. Acceptance of this risk declined in all cities, particularly in Nanjing and Hefei. The study shows that the decline in risk acceptance may be related to the increasing demand for environmental quality, which is also a consequence of the emergence of the middle class. The authors conclude that risk perception is influenced by multiple factors and is a very complex variable. For this reason, they recommend further, more detailed research.

Perception of water conservation

Water scarcity leads to the need to find ways to save water and to make water use more efficient. The various ways to save water have an impact on the population and it is therefore essential to know their attitudes and perceptions.

A study by Burnham et al. (2014) examines the perceptions of water saving irrigation (WSI) among smallholder farmers in Northeast China. Of the 13 villages, only two villages in Gansu Province had experience with water-saving irrigation. For most farmers, it is effective and meets their expectations. However, some have encountered minor technical problems. Finance was a barrier to implementing WSI, and some argued that they only had a small amount of land.

Another study looks at how farmers perceive established agricultural policies related to water conservation. The research took place in Gansu Province, in two river basins, which suffer from severe water scarcity and therefore mandatory water consumption limits have been introduced. It was found that the effect of awareness of policy implementation was significant on farmers' attitudes, but the effect of demographic factors (sex, age, education, experience) and collectivism on attitudes was not significant. Finances associated with the purchase of appliances were shown to be the biggest problem associated with the implementation of water conservation in the household. Interviews with farmers also revealed how the established water saving policies significantly influence farmers' attitudes — most were opposed to water price increases and some held negative attitudes towards the policies introduced, claiming that they would reduce their income and production. Due to the water saving obligation imposed on all farmers, social pressures do not play an important role. Farmers were found to lack awareness — i.e. they did not know why such policies were introduced and how it may benefit them (Chang et al. 2016).

The paper by Tong et al. (2017) explores the impact of awareness and perception on water conservation practices in Shaanxi Plain in the Wei River Basin. It was found that women consumed about twice as much water (93 l/day) as men for a variety of activities, especially for watering vegetables and garden, for laundry and for kitchen purposes. Although men had more knowledge and better attitudes towards water conservation, women adopted more water conservation practices due to past experiences related to water scarcity.

Researchers Zhao et al. (2019) conducted the survey in Zhangye city in the Heihe River Basin. Questions focused on attitudes of the importance of water use for the three dimensions of sustainable development: social equality, economic development and environmental protection. The study sought to understand the perception of these dimensions from the farmers' perspective. Their perceptions are socially constructed, influenced by contextual factors, individual factors or past experiences which was also supported by previous research (Knowler and Bradshaw 2007; Franz et al. 2010; Wei et al. 2009; Bennett 2016). The factors that influence farmers' perceptions were divided into four categories in this study, namely personal characteristics of farmers, family characteristics, characteristics of farmers region and policy measures. The results showed that almost half of the respondents (43%) attributed the greatest importance to water use for economic development. Furthermore, 29% of farmers chose environmental protection and 28% considered social equality as most important. The high ranking for environmental protection can be attributed to farmers' awareness of ecological degradation in Zhangye city — an increasing scarcity of water and sandstorms present (Zhao et al. 2019). Among other things, farmers' perception of the ecological problems is important to understand their future actions.

Compared to other countries, studies on public perceptions of a particular environmental issue are less widespread in China. The involvement of the public in environmental decision-making is also important for the design of future environmental measures. Researchers Pan et al. (2020) demonstrated that women, predominantly older women, were more willing to reduce water consumption and contribute to other environmental activities than men were.

Another paper (Li et al. 2020) deals with the phenomenon of intermittent water supply (IWS) — water is supplied to users for less than 24 h one or more days per week. It is an adaptation measure to water scarcity, but also a consequence of insufficient funding and technical support. This method is used all over the world; in China, it is very widespread, especially in rural areas. The study investigates the perceived satisfaction of this phenomenon among residents of two Chinese provinces, Shandong and Hubei. The outcome variable of this analysis was to determine the level of satisfaction with the local water supply. It showed that IWS affected

Shandong residents more substantially than Hubei residents. The influence of factors such as income, education and culture on perceptions of IWS was also examined. When asked if they were satisfied with the quality of drinking water, more people from Shandong (87%) than from Hubei (77%) answered positively.

Perception of water scarcity

In agricultural areas, farmers are facing severe water shortages for irrigation as a result of climate change. There are many studies in China that examine how residents, especially farmers, perceive climate change. This section presents studies that directly address the issue of water scarcity with their research questions.

The research by Tang et al. (2013) investigated the perception of water scarcity in Guanzhong Plain, Shaanxi Province. It was found that 37% farmers in this area perceived water scarcity, but 61% farmers were seriously concerned about it. Water price and previous experience of drought have been shown to have the strongest influence on perceptions of water scarcity. However, the use of social networks also significantly increases perceptions of water scarcity and helps to save water.

Hu et al. (2014) looked at the attitudes of farmers living in Minqin Oasis towards water scarcity in the area. Farmers were asked to answer questions regarding their willingness to use water-saving technologies, their response to irrigation or their adoption of water pricing reforms. More than 70% of farmers expressed negative attitudes towards rising water prices, especially in terms of more expensive surface water, with up to 80% of farmers being opposed.

According to Tang et al. (2015), half of the irrigation canals in China are in poor condition. Among other things, uneven investment is also a problem, as the government underinvests in the repair of existing canals, rather promoting new large projects such as dams or reservoirs, which account for up to 77% of total investments in water projects, while according to the China Water Statistical Yearbook (Ministry of Water Reasources 2012), only 20% of total annual investments goes to the renovation of existing projects (Tang et al. 2015, p. 51). Research in the Guanzhong Plain attempted to analyse the perception of efficient use of irrigated land. In addition, higher water prices or better irrigation infrastructure were found to increase perceptions of water scarcity and irrigation efficiency. In this study, respondents were asked to answer questions regarding perceptions of water scarcity for irrigation. For example, 62.54% of the respondents answered negatively to the statement whether they considered water for irrigation scarce in their area. As many as 56.47% disagreed with the statement that water for irrigation is scarce, 10% held a neutral view and the rest agreed. Furthermore, 45% of the respondents were neutral and 29% agreed with the statement that water for irrigation will be less and less in the next 2 years (Tang et al. 2015).

Fan et al. (2018) conducted research focusing on smallholder farmers' participation in and knowledge of village-based water user associations in Minqin County in Gansu Province. The research included questions focused on farmers' perceptions and attitudes regarding local water scarcity and water conservation. The results of the study show that farmers' perceptions and attitudes, as well as the effectiveness of water conservation, are critical in shaping their management and decision-making, such as crop selection decisions, cropping patterns and choice of irrigation technologies. The study empirically demonstrates that there is a significant influence of farmers' perceptions of water scarcity and attitudes towards water conservation on membership of water user associations and on the installation and application of micro-irrigation. Other important factors include the availability of information.

The qualitative research by Su et al. (2017) addresses the different attitudes of men and women towards drought problems in Yunnan Province. Questions covered responses to water scarcity and their impact on livelihoods, perceptions of the causes of water scarcity, household water consumption, water use, etc. Up to 75% of respondents said that water availability is decreasing, and respectively they have to go to more and more remote places to get water. Results regarding future drought predictions showed that men are more pessimistic than women, with 59% of men thinking there will be a drought in the future, but only 29% of women having such an expectation. Women were also shown to be more proactive in responding to drought, with almost half of them diverting water to water crops, while just under a fifth of men do so.

Researchers Hou et al. (2017) examined farmers' perceptions of drought severity over the past decade in 9 provinces of China. The results show that more than half of the respondents (52%) were aware of the increase in drought from 2003 to 2012. Only 3% of respondents did not express their attitude and 17% indicated a decreasing trend. The respondents were farmers from both arid regions and flood regions. According to the results, almost twice as many farmers from arid regions perceived the severity of drought for the period 2003 to 2012 than those from flood regions. In terms of drought responses, more than half of the farmers have adopted water-saving technologies, with the largest number (31%) adopting surface pipes. Twice as many farmers from drought counties (70%) as from flood counties (34.5%) adopted these technologies.

Another survey was conducted to investigate the relationship between perceptions of water security and disaster risk in Xingguang Village, Chongqing. Due to the scarcity of water resources, most residents (84.6%) rely on rainwater as their main source of water, despite its poor quality. However, only

one-third of the population is aware that they live in a high disaster risk area. Nevertheless, research results found an association between perceptions of water scarcity and perceptions of disaster risk, and also confirmed that previous disaster experience and use of medication for chronic diseases cause higher perceptions of disaster risk, while socio-demographic factors were not confirmed in this regard (Ho et al. 2019).

A study by Fan et al. (2019) looks at the perceptions of water scarcity among rural farmers in Minqin County, Gansu Province, across three irrigation districts. According to the results, farmers' perception of both surface and groundwater scarcity is significant, and the perception of water scarcity positively influences the adaptation strategies. Willingness to take action for production risks such as land productivity, grain yield and vegetation proved highly significant, while perception of natural risks did not show a significant effect. Interaction capacity also had a positive effect on taking the adaptation measures related to water scarcity.

Perception of water ecosystems importance

Recently, a study has also emerged that looks at the perception of aquatic ecosystems. Thus, this research project may represent another potential type of research that will highlight how people view the environment from a more holistic perspective.

Study by Hua and Chen (2019) explores people's satisfaction with the quality of urban ecosystem services in Guangzhou. It showed that all respondents considered them very important, but local residents were less satisfied with them than non-local residents. However, all respondents, regardless of hukou status, identified the enhancement of water purification as the most important ecosystem service item.

Khan et al. (2021) examine residents' preferences and their valuation of river ecosystem services based on their willingness to pay for improvements to these services. The results of the study showed both urban and rural residents care about water for their daily life. The mean value on a 7-point scale (1 — most important, 7 — least important) was 2.08 and 2.10 respectively. Residents also rated agricultural and industrial water, weather management in Yangsha Lake, vegetation restoration, biodiversity conservation and ecological protection of the lower reaches as important ecological attributes. According to the analysis results, river water quality has the highest marginal use value. In contrast, recreational conditions have the lowest marginal use value.

Water perception and health

Most of the studies mentioned in the previous sections touch on health issues in some way, as poor quality water poses a health risk. However, there are also studies whose primary focus is on water and health.

A study by Jiang et al. (2020) examined the impact of perceptions of environmental risks (air, water pollution, domestic waste) on the physical and mental health of migrant workers. According to Abdulbari (2017), migrant workers routinely use well water for cooking, showering and cleaning instead of tap water. Jiang et al. (2020) asked research participants to indicate on a 6-point Likert scale (0 — no pollution at all, 5 — extremely severe) how severe they considered various types of pollution in their environment. For the perception of water pollution, the mean came out to be 2.86. It was found that the higher the perception of environmental risks, the better their physical and mental health. It also appeared that perceptions of water pollution were linked to physical health in men but not in women. This could be justified by the fact that female migrant workers come from poor backgrounds and feel a greater economic burden than men — they have to feed their families and ignore the environmental risks that the work entails.

Yamashita et al. (2020) show a link between perceptions of environmental pollution and mental health. The authors used the health module of this survey which included perceived pollution. The results of the study showed that types of perceived environmental pollution, including air, water and noise, have different impacts on mental health in middle-aged and elderly populations. The study provides an impetus for further empirical research to confirm the findings and also highlights the importance of studying environmental risk perceptions.

Perception of reclaimed water

An important research topic is the perception of reclaimed water. It is the possibility of recycling and the search for renewable resources that represent promising ways to alleviate the environmental crisis. This issue is also related to trust in government and scientific experts who are in charge of the technological processes leading to water recycling.

Gu et al. (2015) conducted research in Tianjin focusing on the perception and acceptability of reclaimed water by city residents. The results of the survey show that the residents are aware of the limitations of water resources. Their knowledge is worse in case of where their water comes from or which industries are most water intensive. Furthermore, public awareness of the need to conserve water is also relatively low. Reclaimed water is currently used by 54% of the population. The public is willing to use reclaimed water but not for domestic and drinking purposes. According to the results, Tianjin residents with higher education and income are more likely to agree to use reclaimed water.

Study by Chen et al. (2015) reflected knowledge, perceptions and risk identification related to the use of reclaimed water. Respondents agreed with its use, but except for drinking purposes. Public awareness proved to be poor, with only

24% of respondents knowing Beijing's water supplies, or even only 3% of respondents were aware which sectors in the city consume the most water. The results also showed that stakeholders strongly support the treatment of water resources and the use of reclaimed water, but are also aware of the risks involved. Thus, it became apparent that the government does not sufficiently inform the public about the benefits of reclaimed water. Demographic factors such as older age, higher income and education have been shown to increase respondents' awareness of the water resource and their knowledge of water resources in Beijing. However, gender did not prove to be significant in the results.

Research by Zhu et al. (2017) looks at the perception of reclaimed water in Shandong Province. The results of the questionnaire survey show that respondents lack awareness of the status of water resources, for example, only 9.15% of them are aware of the serious water shortage. They showed a negative attitude regarding the use of reclaimed water mainly for drinking purposes. However, it was confirmed that reclaimed water is mostly accepted by the elderly people and people with higher education. Therefore, authors suggest that people with higher education and income — the so-called a priori group — should spread awareness about the use of reclaimed water. Regarding the perceived price of reclaimed water, 73% of respondents suggested that the price of reclaimed water should be 20% to 30% of the price of tap water. It showed that 63% of respondents were aware of the benefits of using reclaimed water, but only 31% of them used such water at home.

Li et al. (2021a, b) focused their study on the attention people pay to reclaimed water. The researchers analysed the text data of Weibo users over a period of 6 years in 34 administrative regions. The results of the study show that people in economically developed areas pay significantly more attention to reclaimed water than those in underdeveloped areas. The study also concluded that most people have a positive attitude towards reclaimed water and are aware of the ecological properties and usefulness of reclaimed water. As far as avoidance of reclaimed water is concerned, fear and disgust figure most prominently. People are particularly sceptical about the safety of recycled water. This is mainly due to a lack of trust in reclaimed water treatment technology and regulatory measures.

Perception of desalinated water

With the development of technology, there are opportunities for the use of other types of water. An example is desalinated water. The task of current research is to determine public attitudes towards this alternative.

Article by Lili et al. (2021) investigates residents' attitudes towards the use of desalinated water using the theory of planned behaviour in Qingdao city, Shandong Province. The main barriers to the use of desalinated water by urban residents were found to be its reduced availability and lack of knowledge — many respondents believed that this water does not meet national water quality standards and is harmful. Another major problem is the high costs associated with its production, which is reflected in its high final price. The authors conclude that community support as well as government and media promotion are needed to increase citizens' acceptance of desalinated water. For this reason, the government should develop an appropriate pricing mechanism for desalinated water and work on its own development of key technologies for its production. The results showed that attitude, subjective norm and perceived behaviour control (PBC) have a positive effect on desalination water use behaviour. However, no significant relationship was found between a positive attitude towards desalinated water and an increase in PBC.

Perception of bottled water

Another category concerns the perception of bottled water, which is not given as much attention as the perception of tap water. This topic is thus open for further research.

The study by Guo et al. (2021) investigated the potential environmental risks perceived by consumers when purchasing bottled water online. The research was conducted in six cities in China through questionnaires to people who frequently buy bottled water online. The results show that consumers were aware that bottled water is safer than tap water, which increased their motivation to purchase it. Perceived risk of water contamination was found to have the most significant effect on attitude, followed by subjective norm and perceived behavioural control. The primary criterion for choosing bottled water was its quality. Knowing the source of the water was also essential for the respondents, it increased their subjective attitude towards bottled water. It has also been found that consumers highly trust Nongfu Spring bottled water brand, mainly because it presents itself as pure natural water with the slogan "we do not produce water, we are the porters of nature".

Perceptions of glacier changes and impacts on water resources

Snow, glaciers and permafrost in mountains have traditionally been a very important source of water in arid and semi-arid regions. Especially in arid areas, people depend on these "water towers" (Viviroli et al. 2007). Climate change is dramatically affecting them, which will have an impact on water availability and food security (Immerzeel et al. 2010). A number of studies show a retreating trend for Chinese glaciers (Cai et al. 2021; Chen et al. 2016; Ding et al. 2006;

Zhang et al. 2022). It is also important to focus on residents' perceptions of these changes.

A study by Deng et al. (2012) investigated how residents perceive climate change in the Ürümqi and Aksu river basins, where glacier mass is decreasing, resulting in increased runoff in these areas. Although water supplies in these basins are increased, the increasing demand for water poses sustainability problems. The results of the study showed that most respondents' estimates of climate and cryosphere (frozen water on land) change are consistent with objective scientific measurements. When asked about the rate of glacier melt, 64.2% of respondents in the Ürümqi Basin chose "increase" and 23.9% chose "slow down". In the Aksu River Basin, 67% of respondents chose "increase" and 11.8% "decrease". However, in both basins, there is still a group of respondents who have doubts or lacked knowledge about glacier melt rates. People prefer adaptation measures set by the government, the perception of the urgency of individual participation in changes leading to environmental protection is still insufficient.

Tvinnereim et al. (2017) conducted research in Chengdu and Xi'an, focusing on perceptions of climate change, where respondents were asked to mention associations that came to mind. Glacier melt and sea level rise is one of the identified themes with high prevalence. Citizens associate glacier melt and sea level rise with global warming. Associations with glaciers were reported by younger respondents and more men than women.

Zhu et al. (2018) investigated residents' perceptions and adaptations to climate-related glacier changes in the Heihe River Basin in northwest China. Glacier melt occurs mainly in the eastern part of the upper region. Results showed that residents who lived closest to the glacier were best able to identify glacier changes. For 85.6% of respondents, television programmes were the primary source of information. Analysis of the results showed that 13.8% of the respondents still did not understand the changes on the glacier. Although the majority of the population was convinced that glacier changes will bring damage and negative consequences to society and future generations, respondents had incorrect judgements about the indirect effects of glacier retreat on agriculture, natural disasters and the ecological environment.

Limitations of research

Limits of this study

This research is limited by specific keywords that allow a certain number of studies to be found. More keywords could be suggested to potentially expand the research set to include more studies. Another option for extending the study is to use other databases to search for articles.

Limits of analysed studies

The research results presented for individual studies may be influenced by a number of factors. Many studies have been published in open access journals, which publish a huge number of articles in each issue and the review process takes place in a very short period of time. In the past, some publishers have been criticised for this approach. We can find articles where the authors seem to be based on the same research sample, although they claim that the study area is different. An example is recorded in Table 2. Similar findings confirm the need for further research and literature reviews on the topic.

Discussion

Trends in water perception

The studies examined showed great signs of divergence. Each focused on a specific problem within the perception of water pollution and was conducted in a different area. Due to the lack of studies in each specific research area, it is problematic to provide a summary for the perception of water-related phenomena. However, when summarising the results from the surveys, specific trends in residents' perceptions of water pollution were identified.

These include demographic characteristics. The studies confirmed that people with higher incomes and education perceive water-related problems and risks as more serious (Wang et al. 2019; Du et al. 2017) and the water to be of lower quality (Bi et al. 2010). In terms of satisfaction with water quality, older people and female respondents were more satisfied (Wang et al. 2019; Bi et al. 2010). While one study shows that men mention environmental issues as more important than other issues more than women (Aregay et al. 2016), results from other studies suggest that women have lower risk tolerance (Du et al. 2017), or are more willing to pay for environmental improvements (Zhang 2011). However, more studies show that women are willing to take more actions leading to water conservation (Pan et al. 2020; Tong et al. 2017).

Furthermore, studies also mention that awareness of these issues is insufficient and needs to be improved by changing the government's communication strategy and focusing especially on targeted groups (less educated, more financially vulnerable, people living in rural areas). The media and social media influence perceptions of environmental issues and can increase individuals' willingness to act or lead to behavioural change or collective action (Tu et al. 2019). Some of the studies reviewed revealed a lack of awareness among residents about water-related issues and safety, especially when it came to poor areas (Zhou et al.

Table 2 Comparison of the research sample and study area of two studies

Authors	Hou et al. (2020a)	Hou et al. (2020b)
Title	The effect of recycled water information disclosure on public acceptance of recycled water – Evidence from residents of Xi'an, China	Impacts of regional water shortage information disclosure on public acceptance of recycled water – evidences from China's urban residents
Study area	Xi'an	Six regions — the provinces of Gansu, Shaanxi, Fujian, Hunan, Guangxi and Beijing City
Sample description	The survey was conducted in January 2020, and 621 valid samples were recovered, excluding respondents who did not complete the survey and whose survey duration was less than half of the median of the total survey duration. Finally, 616 valid questionnaires were obtained, with the valid questionnaire rate being 94.8% Among the 616 subjects, there are 306 males (49.7%) and 310 females (50.3%). Their ages are between 18 and 76, with an average age of 35, which reflects the features of China's population. In addition, 30% of the subjects are employed by companies, 26.8% are students, 16% are employees of administration departments, 12.2% are retired, 7.2% are freelancers and 7.8% are from other industries; this ensures the social-demographic diversity of the subjects	Six hundred and sixteen valid questionnaires were obtained, and the valid questionnaire rate is 94.8%. Among the 616 subjects, males account for 306 (49.7%) and females account for 310 (50.3%). Their ages are between 18 and 76 years, with an average age of 35 years, which indicates the features of China's population. In addition, 30% of the subjects are staff members of companies, 26.8% are students, 16% are workers in administration departments, 12.2% are retired, 7.2% are freelancers and 7.8% are from other industries; thus, the sociodemographic diversity of the subjects was ensured

2011). On the other hand, urban residents who have more information about the environment, consider water quality a more serious problem (Bi et al. 2010). Studies continue to call for the need to raise awareness of environmental risks (Chen and Zhou 2020).

The Chinese population is experiencing a change in preferences. While there was significant economic growth in the 1990s (Lee 2005), after 2000, studies start to show that people prefer environmental protection (Bi et al. 2010). There have been studies that have tracked the change in residents' perceptions of water over a 10-year period. Some concluded that public awareness of water quality is improving (Du et al. 2018; Yue et al. 2017). Other studies showed pessimistic views of water quantity in the river basin (Zhou and Akiyama 2018) or increased risk perception of drinking water pollution (Li et al. 2021a, b).

Regarding the perception of reclaimed water and desalinated water, residents demonstrated a lack of knowledge (Gu et al. 2015; Lili et al. 2021) while peoples' education (Gu et al. 2015; Chen et al. 2015; Zhu et al. 2017), income (Chen et al. 2015) and higher age (Zhu et al. 2017) significantly influence its acceptance. As for reclaimed water, the public is willing to use it but not for drinking purposes (Gu et al. 2015; Chen et al. 2015; Zhu et al. 2017). There is a need for greater promotion of the use of these types of water in order to increase its acceptance among all segments of society (Lili et al. 2021).

Perceptions of water-related risks have shown a wide diversity of results across studies. While one study reported that people with direct experience of pollution have the lowest accuracy rate and underestimate the risks the most (Chen et al. 2017), another study claims that people who live closer to industrial facilities have greater awareness of risks (Yao et al. 2018). However, the occurrence of disasters associated with polluted water has led to an increased perception of risk among local residents (Liu et al. 2010).

Several studies have shown residents' health concerns associated with polluted water (Yu et al. (2021), or the common incidence of diarrhoea (Chen et al. 2012). An analysis of the situation a decade ago showed that people from poor urban areas lack information about health risks (Zhou et al. 2011). Perceptions of health risks fundamentally reduce public satisfaction (Yu et al. 2021).

Implications for policy

The results of water perception surveys are of great importance for policy makers, as they show the ability of the population to understand water issues and assess risks, as well as their attitudes towards accepting measures aimed at protecting water resources.

Clarifying the underlying determinants of public perception enables the development of targeted policies and information campaigns. Gender differences highlight the

opportunity to tailor information campaigns to different genders (Tong et al. 2017). Although women are more active in water management and prevention against water scarcity, they are often excluded from decision-making at the local level, which could be changed in the future (Su et al. 2017). Furthermore, targeting populations with lower education is important. Attention should also be paid to residents with direct experience of pollution to ensure they do not underestimate the risks (Chen et al. 2017).

The use of reclaimed water is an important means of combating water scarcity. In this context, there is a need to ensure that the population becomes more familiar with water recycling, including for domestic use (Gu et al. 2015). Important data from foreign psychological research can also be used to guide educational activities (Nemeroff et al. 2020; Rozin et al. 2015). The application of behavioural insights will lead to an awareness campaign that uses understanding of residents' emotions.

Another important area is to improve communication strategies about water-related risks and water scarcity. In addition to the use of media, official government communication channels need to be engaged (Zhou et al. 2011). Social networks are also an important means of disseminating information (Tang et al. 2013), especially in areas with high environmental risks (Chen and Zhou 2020).

Research on water perceptions can also help shape policies that lead to increased trust in government by identifying determinants of such distrust (Zhen et al. 2018, 2019a, b) and recognising disputes between residents and government (Hu et al. 2014). Government also gains valuable information from research on residents' willingness to pay for ecosystem improvements. Environmental policies can be set to reflect residents' value orientation (Pan et al. 2020).

Public participation and interest in environmental activities in China has been shown to be low. This is justified by a lack of awareness among residents, reduced opportunity to express opinion, but also lack of enthusiasm (Xue et al. 2020). Strategies need to be found to increase interest in addressing environmental issues among the wider public. Further studies can contribute to approaching this path.

Conclusion

China suffers from a serious water shortage. Polluted and contaminated water causes serious diseases such as cholera, diarrhoea, dysentery or polio, and also threatens food safety and agricultural production, posing additional health risks. Increasing public awareness of these threats and rising living standards are leading to changes in people's preferences. While economic growth used to be a priority, current studies indicate that people are placing more emphasis on environmental protection.

Although there are a large number of natural science studies that examine the quality of China's water resources and the extent of pollution, efforts to understand public perceptions of water have not attracted as much attention among researchers. The first surveys of public attitudes towards the environment were not conducted in China until the 1990s. This interdisciplinary area of research, which touches on environmental studies, environmental policy, environmental psychology and public health, is crucial for policy makers, facing environmental problems and preventing health risks. Sustainable development in China has its own specific socio-political framework. The role of the public in facing environmental problems is set in the context of a transitional society that is gradually moving towards a more liberal system. Public awareness has been influenced by a series of environmental protests and the development of NGOs that have drawn attention to serious environmental disasters and their consequences.

This systematic review identified 54 studies published in journals indexed on the Web of Science that address water perceptions in China. Studies meeting the selection criteria were divided into ten main research areas. Studies related to perceptions of water quality, tap water and water conservation were the most represented, providing an opportunity for comparison between similar studies examined. The results showed that water pollution is reaching the public, but people with lower education and income as well as people living in poorer areas still have less information and knowledge, which affects their underestimation of the risks. Acceptance of the risk associated with tap water is decreasing among the population. People also do not trust questionable brands of bottled water and risk of water contamination was found to have the most significant effect on purchase attitude. Regarding water conservation, women are the most active in this respect, although they are excluded from decision-making at municipal level. Research on perceptions of water scarcity has been carried out mainly among farmers who have been facing a long-term shortage of water for irrigation. In the future, it would be interesting to explore this issue among urban dwellers as well. The review was followed by studies on the perception of reclaimed and desalinated water, which provided useful advice for promoting these types of water. Some studies examined perceptions of aquatic ecosystems. Water quality was shown to be of greater value to residents than recreational conditions. However, more research is needed to assess residents' perceptions of ecosystems. Few studies have addressed perceptions of glacier changes and impacts on water resources. Although residents are aware of glacier melt, they still do not understand all the implications. The impact of pollution on human health is obvious. Studies examining the impact of perceptions of pollution on health, particularly mental health, are also beginning to emerge. However, further empirical research is needed in this area.

The results of the studies show that awareness of water quality among Chinese people is increasing, but there are still gaps in the perception of health risks and ways to contribute to the efficient use of water resources. Further social science research is needed to problematise issues related to water perceptions and to describe the mechanisms that influence people's attitudes towards environmental issues.

The developing interdisciplinary research on perceptions of environmental problems provides opportunities for further research. Changes in people's preferences open up the research question of how willing people are to reduce economic growth in order to improve the environment. In the context of climate change and dramatic water scarcity, further research on perceptions and acceptance of reclaimed water is needed. Future research could focus on the impact of educational campaigns on increasing acceptance of reclaimed water. In this regard, it is also suggested to use behavioural insights such as framing and other strategies that could support information campaigns and rational persuasion. In the area of risk research, there is a need to continue to find out whether people underestimate risks and whether the government communicates risks in appropriate ways. Given China's large size, attention also needs to be paid to regions that have not been surveyed. In addition, many of the studies that have been carried out were conducted several years ago and the results are outdated. All of these facts call for further research to understand human perceptions of environmental problems and to inform environmental policies that can save the environment and human lives.

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Declarations

Conflict of interest The author declares no competing interests.

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