A STUDY ON CHINA'S MAIN RIVER ABOUT WATER SCARCITY, CLIMATE CHANGE, AND HOW CITIES ARE RESPONDING.

Zhou Mingwu 1*, Aiman Al-Odaini 1

1 Lincoln University College, Petaling Jaya, Malaysia.

*Corresponding author: Zhou Mingwu, Lincoln University College, Petaling Jaya, Malaysia.

ABSTRACT

There are three rivers in China that have an effect on the country's economy and society: the Yangtze, the Yellow, and the Mekong. The continuation of these businesses is contingent upon the existence of these waterways. However, river systems and the people who use them are under a great deal of stress as a result of conditions such as climate change and a scarcity of water. Already, these river systems are seeing the pressure that this demand is putting on them. Within the context of China's main river basins, this research analyses water shortage, climatic variability, and adaptive responses within urban contexts with a focus on China. This method takes a comprehensive look at the factors that contribute to water shortage. According to the findings of this research, the availability of water is being altered as a result of increasing temperatures, changing patterns of precipitation, and harsh drought seasons. Already, the effects of climate change are exerting a great deal of pressure on ecosystems and societies that are already very fragile. Because urbanisation has resulted in an increase in the demand for water, cities have been forced to devise innovative strategies to deal with water shortages. Following the publication of the results, communities are increasing the amount of wastewater that they recycle, increasing the efficiency with which they use water in agriculture and industry, and implementing integrated water resource management strategies. The actions described here are carried out by the local government. This is only one of many different ways that things may be done right now. One of the goals of this study is to make a contribution to the ongoing conversations. The findings suggest that the future of China's rivers is an issue of relevance on a national, regional, and global scale, regardless of the viewpoint that is taken into consideration.

Keywords: River Systems, National, Regional, Global Scale, Recycle.

INTRODUCTION

The Yangtze, Yellow, and Mekong rivers have been very important to China's economic, cultural, and social growth throughout its history. These rivers are some of the most important in China. These rivers are very important for the country's growth and safety since they offer water for numerous uses, such as farming, making things, generating electricity, and urban populations. This is because they have a lot of water that may be used for numerous things. The effects of climate change and water shortages are putting more and more river systems in danger. This

danger has been becoming greater over the last several decades. The interaction between these two things has led to this hazard. The water supply has gone down because of things like rising temperatures, changing rainfall patterns, and repeated droughts. There are several reasons why this happened. The frequency of floods and the melting of glaciers have made people even more worried about hydrological conditions. This has made it a lot worse. The problem that has come up because of quick industrialisation and urbanisation is far worse than the one that was there previously. This is because cities that are developing need a lot of water for things like infrastructure, businesses, and homes. The unequal distribution of resources between rural and urban regions, as well as between upstream and downstream locales, has caused environmental damage and water contamination since there is more competition for limited resources. These bad outcomes are because there isn't enough of everything. The main reason for these bad results is that competition for limited resources is becoming stronger (Ali et al., 2020). China has become a significant participant in talks on climate resilience, water security, and sustainable development throughout the world. This may be because of the problems mentioned above. A lot of nations are having these talks. Several American localities have begun taking adaptive steps. Two ways that have been employed to build "sponge city" programs that can handle climate change are integrated water resource management and recycling of wastewater. Also, plans have been made to start things. The socioeconomic position of the neighbourhood, the money available, and the rules for running the programs all affect how effectively they function. This still continues, even though there are efforts on a national and regional level to encourage efficiency, conservation, and new technology. This statement is still accurate even if these regulations are in place. This study can look at how water shortages, climate change, and strategies for cities to adapt to them affect China's main rivers (Han et al., 2021).

BACKGROUND OF THE STUDY

The Yangtze and Yellow Rivers are two of China's most important river basins. They are now dealing with a serious water scarcity that is harming many areas of the economy. Climate change is making droughts worse, making rainfall patterns less predictable, and making surface water less available. The increase in demand for water has also been tremendous due to the expansion of cities and the population. Many cities are at danger of running out of water because of both natural catastrophes and more people using it. This is not good for either the planet's ecological balance or its socioeconomic stability (Li et al., 2021). Because of this, Chinese communities have had to modify the way they do things to match the changing situations. Some of the strategies that fall under this category are: the Sponge City Program, which aims to make cities more resilient and capture more rainwater; the South-to-North Water Diversion, which aims to move water from one place to another; and stronger groundwater regulation policies to stop people from taking too much groundwater. These flexible solutions show how our understanding of the important relationship between water scarcity and urban sustainability is growing (Huang et al., 2024). It is important to look at the link between water shortages and how cities are responding in order to ensure water security, urban resilience, and sustainable

development in the face of climate change. This is because cities respond differently when there isn't enough water. This kind of research not only reveals the adaption strategies now used but also underscores the need for long-term transformation. It's important to think about both of these things (Li et al., 2023).

PURPOSE OF THE RESEARCH

This research seeks to investigate the reactions of densely populated areas situated along China's main rivers to water shortage by analysing the correlation between the two. The researchers can concentrate on Chinese towns located near waterways to get greater accuracy. Climate change and increased urbanisation are making water stress worse. This research attempts to look into how these things affect urban policies, adaption measures, and sustainable water management practices. This information is what led to this inquiry. The goal of this study is to figure out where resilience-building programs could require some adjustments. The project also aims to discover innovative approaches and assess the efficacy of solutions at the local level. To accomplish this objective, investigate the relationship among the different components. The ultimate aim of this project is to provide significant insights that may guide political and operational choices to secure a sustainable water supply for metropolitan areas in the future. This is the end of the research.

LITERATURE REVIEW

One of the most important social and environmental problems can face today is the growing lack of water. This is especially true in countries where cities are growing quickly and businesses are becoming more important. This is particularly true in places where water is hard to get by right now. Pollution, climate change, and unsustainable extraction techniques are just a few of the reasons that are putting China's most vital river systems at danger of becoming extinct. These river systems are very important for many kinds of urban, industrial, and agricultural activities. Experts say that climate change, which includes changes in rainfall patterns and higher temperatures, has made water shortages much worse. This has made river ecosystems even more stressed. Ecosystems in rivers are more stressed than they were ten years ago. The main reason for this stress is that there are more water shortages than there used to be. Because people, businesses, and infrastructure in these cities depend on a steady supply of water, they are particularly vulnerable to floods (Wang & Morris, 2025). According to earlier studies, cities are already putting adaptation plans into action. The findings of the research corroborate this perspective. Some of the things on this list include new technologies, conservation methods, public awareness campaigns, better water management systems, and stricter rules for governance. But this is not a complete list. Resilience frameworks for cities show how important these three components are. They show that effective responses involve not just changes to infrastructure but also cooperation across institutions and changes to policies during implementation (Wang & Morris, 2025).

RESEARCH QUESTIONS

What is the impact of water scarcity on the urban sector?

RESEARCH METHODOLOGY

Research Design: The SPSS version 25 to do the quantitative data analysis. The direction and intensity of the statistical association were determined using the 95% confidence interval and odds ratio. At $p < 0.05$, the researchers established a criteria that was considered statistically significant. The data's essential features were extracted using a descriptive analysis. When analysing data transformed by computing tools for statistical analysis or data collected from surveys, polls, or questionnaires, quantitative methods are often used.

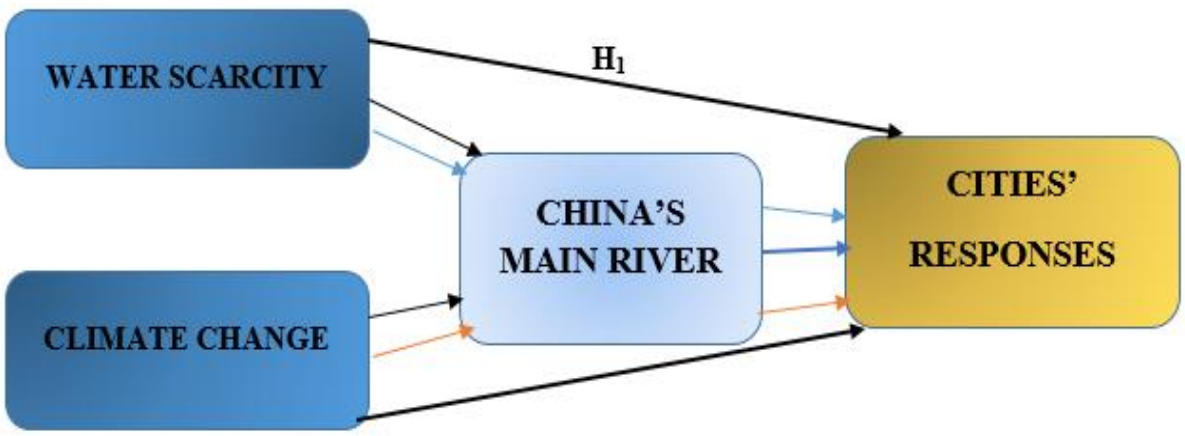
Sampling: Research participants filled out questionnaires to provide information for the research. Data collection for the study was done using questionnaires. A sample size of 1,463 was determined using the Rao-soft algorithm. Of the 1600 surveys sent out, 1557 were returned; 57 were not included because they were missing information. The study ultimately made use of 1500 questionnaires.

Data and measurement: The research relied heavily on a questionnaire survey—either a one-to-correspondence survey or a Google Form—to compile its data. The survey included two parts: (A) a section asking participants to identify themselves according to their preferred method of contact (online and offline), and (B) a section asking them to rate various variables using a 5-point Likert scale. Many other sources, most of which could be accessible online, provided the secondary data.

Statistical Software: With the help of SPSS 25 and MS-Excel, they ran the statistical analysis.

Statistical tools: A descriptive analysis was carried out to get an understanding of the underlying structure of the data. A descriptive analysis to get to the bottom of the data's essential features. ANOVA and factor analysis to check for validity.

CONCEPTUAL FRAMEWORK



RESULTS

Factor Analysis: Factor Analysis (FA) finds widespread usage in the process of confirming the underlying component structure of a collection of measurement items. It is thought that elements that cannot be seen directly impact the scores of the variables that have been examined. Among the methods that rely on models is accuracy analysis (FA). The main focus of this research is on establishing relationships between visible events, their hidden causes, and measurement errors. The Kaiser-Meyer-Olkin (KMO) Method may be used to determine whether the data is suitable for factor analysis. Both the overall model and each individual model variable are tested for adequate sampling. By using statistical methods, may measure how much common variance there may be among several variables. Factor analysis is often more appropriate for data sets with smaller percentages. The output of KMO is an integer between 0 and 1. If the KMO value is between 0.8 and 1, it means that the sampling was sufficient. If the KMO is less than 0.6, it means that the sample was insufficient and corrective action is needed. May use the best judgement here; 0.5 has been used as an example by various writers, thus the range is 0.5–0.6. The partial correlations are much larger than the overall correlations when the KMO is near to 0. To reiterate, significant correlations significantly impede component analysis. The following are the acceptance criteria set by Kaiser:

Declining from 0.050 to 0.059.

0.60-0.69 points lower than typical

Range often seen in middle school: 0.70 to 0.79.

A quality point value ranging from 0.80 to 0.89 is required.

Astounded at the range of 0.90 to 1.00.

Table 1. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Method.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.870
Bartlett's Test of Sphericity	Approx. Chi-Square	3252.968
	df	190
	Sig.	.000

Applying Bartlett's Test of Sphericity provided further confirmation of the correlation matrices' overall significance. The sample adequacy value according to Kaiser-Meyer-Olkin is 0.870. A p-value of 0.00 was discovered by researchers using Bartlett's sphericity test. The correlation matrix was shown to not be a correlation matrix by a significant test result from Bartlett's sphericity test.

INDEPENDENT VARIABLE

Water Scarcity: Water shortage happens when there is more demand for freshwater in a region than there is availability. This situation puts stress on ecosystems, people, and businesses. Not only is there a lack of water, but there are also problems with access, quality, and equitable distribution. The major river basins in China are suffering from a severe water scarcity that is caused by a number of things, including climate change, pollution, and floods caused by people. This is making a lot of folks scared right now. Physical water scarcity happens when rivers, lakes, and aquifers can't provide people enough water to meet their needs. This deficit is usually made worse by things like decreased rain, glaciers melting, and droughts that happen every so often. Economic water scarcity, on the other hand, happens when water that is accessible is not being exploited to its maximum potential because of problems with infrastructure, governance, or finances. This might happen even if there is water available. Even if there is a lot of water available, this type of scarcity might still arise (McGuire, 2025). This is the case for the reasons already indicated. It has a direct effect on how cities make their water management rules, use technology, and set up systems to make sure their water supply is safe, keep the economy going, and protect ecosystems. The lack of water is the key thing that affects how cities deal with present and future problems. This study analyses the subject by using the scarcity of available water as the independent variable (Wang et al., 2022).

DEPENDENT VARIABLE

Cities' Responses: Urban centres are essential for addressing the issues of water shortages, especially in China's most populated and industrialised areas, which are situated in the primary river basins. A good illustration of this is China. The situation in China is a good illustration of this. This is particularly true when taking into account the many cities in China. This research examines the notion of "cities are responding" as a dependent variable. The term "water management" refers to the many ways that cities govern the use of limited water supplies and adapt to changing weather patterns. Cities have taken a number of steps to solve the issue (Wu, 2025). Community-based, policy-driven, technology, and infrastructure-based efforts are all part of this group of techniques. To reduce their reliance on conventional freshwater sources and make the most of their resources, several municipalities have worked on technological projects like recycling wastewater, desalination, and installing innovative water management systems. They want to rely less on these sources, therefore they do this. One way to fix the infrastructure issue is to build "sponge cities," which would make cities better able to soak up rain, lower the danger of flooding, and replenish groundwater supplies (Zhang et al., 2025).

Relationship between Water Scarcity and Cities' Responses: There is an obvious and changing link between city life and water limitations. Communities need to change how they do things to make sure they have a stable water supply and stable economies. Residents take action when there isn't enough water. The main problem is that there isn't enough water. Water shortages, pollution, and unfair distribution are putting a lot of stress on the big cities in China's

river basins. Tensions in the city have been increasing because of this necessity. These strategies make it simpler to gather and store water. In this case, changing policies is a crucial way to respond. Because there isn't enough water, governments need to make rules to restrict how much water industry uses, raise the price of water, and control pollution to make the water better (Li, 2021). Things that happen in places where water is limited tend to be big, use a lot of resources, and happen quickly. There are a number of things that affect how well these reactions work. The socioeconomic situation, the money that is available, and the administrative skills of each city are all taken into consideration. The communities' responses are similar to what they found, which suggests that a lack of water is the main cause. These two concepts show that not having enough water is more than simply a problem; it can lead to new ideas, new regulations, and cities that grow in a way that lasts. One concern is that there isn't enough water (Zhang, 2023). In response to the above discussion, the researcher has offered the following hypothesis to examine the correlation between Water Scarcity and Cities' Responses.

"H_{01}: There is no significant relationship between Water Scarcity and Cities' Responses."

"H_1: There is a significant relationship between Water Scarcity and Cities' Responses."

Table 2. H1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	39588.620	643	5624.417	1069.687	.000
Within Groups	492.770	856	5.258		
Total	40081.390	1499			

This investigation yields remarkable results. The F value is 1069.687, attaining significance with a p-value of .000, which is below the .05 alpha threshold. This signifies the "H_1: There is a significant relationship between Water Scarcity and Cities' Responses" is accepted and the null hypothesis is rejected."

DISCUSSION

Cities in vast river basins are having a lot of problems since China's weather is so unpredictable and water demand is going up. One likely reason for this problem is that people have been using a lot more water in the last several years. The study's results show that how quickly individuals can get water has a big effect on how they behave to various circumstances. After this paragraph, there is a summary of the possible conclusions that may be made from the study. A curve, as opposed to a straight line, may more effectively depict the relationship between scarcity and urban responses. This is a truer picture of how the couple's relationship really is. This scenario has come about because there is no apparent link between the two things. Scarcity is definitely one of the things that affects how cities work, and it is definitely one of those

things. The severity of the situation determines how urgent it is and how much each community can do to help with water shortages. The severity of the problem determines the kind and quantity of this data. Thinking about this helps us understand the several things that have caused the situation are in now. People who live in places where rivers are badly affected, like the Yellow River basin, have taken steps that are more thorough and quicker than those who live in places where water supplies are usually stable or predictable. The present water deficit has hurt a number of river basins, but the Yellow River basin is the most well-known. A lot of people are suffering due of this lack, which has lately spread to neighbouring river basins. A lot of regions are now feeling the effects of this. The technological adaptation process that occurs when resources are scarce is a key aspect of this link. Because there is a greater need for fresh water, there has been a big rise in the building of sponge city infrastructure, recycling systems, and rainwater collection. The reason for this is because there is an increasing demand for water. This includes making sponge towns as well. When it comes to this, consistency is really important. They need to pay close attention to this problem. In the end, the debate reveals that cities have to do something because of water shortages, and the steps they take depend on the kind, level of severity, and effectiveness of those steps. Because of this, it's evident that need to use scarcity as an opportunity to come up with new ideas and modify laws so that can be better prepared for climate change that doesn't go away. The purpose of the quest is to achieve sustainable development.

CONCLUSION

This research indicates that cities along China's major river basins have had to change since they don't have enough water. The figures show that urban innovation depends on scarcity. This implies that cities need to take legal, physical, and technical actions to keep their water supply safe. Climate change, urbanisation, and industrial demand are making it harder to find adequate water. So, cities need to make plans for whole systems that meet both their short-term demands and their long-term goals for environmental sustainability. The main point is that water shortage is not an independent variable. Instead, it is influenced by many other factors, such as how unpredictable the weather is, how well the government works, how easy it is to get money, and the overall state of the economy. One method to show this is by how the conclusion is presented. Municipalities with strong administrative structures and access to modern technology are more capable of implementing successful solutions, including wastewater recycling, sponge city initiatives, and legislative reforms. The reason for this is that these cities are more likely to be able to put these ideas into action. Cities with little resources find it harder to respond to disasters effectively. This is why resilience levels are different in different areas. The lack of water should be regarded as a big environmental concern that needs big changes in how cities are planned, run, and how new technologies are used. Water shortages are a big challenge for the environment. Water shortage is one of the most important environmental issues face today. To make sure that China's cities can adapt, endure, and bounce back from ongoing hydrological and climatic challenges, it is important to construct robust infrastructure, encourage regional collaboration, and create established institutional frameworks. Three things

are needed. This technique is necessary to make sure that these elements can still be there in China's cities in the future.

REFERENCES

1. Ali, T., Huang, J., J. Wang & Xie, W. (2020). Global Footprints on Water and Land Resources through China's Food Trade, Global Food Security.
2. Han, H., Xia, S., & Jiang, Y. (2021). Challenging Issues over Sustainable Water Management in Coastal Area from China. Journal of Coastal Research, 83.
3. Huang, Z., Yuan, X., Ji, P., Sun, S., & Leng, G. (2024). Shifts in trends and correlation of water scarcity and productivity over China. Journal of Hydrology.
4. Li, R., Zhu, G., Lu, S., Sang, L., Meng, G., Chen, L., Jiao, Y., & Wang, Q. (2023). Effects of urbanization on the water cycle in the Shiyang River basin: based on a stable isotope method. Hydrology and Earth System Sciences.
5. Li, Q., Wang, F., Yu, Y., Huang, Z., Li, M., & Guan, Y. (2021). Comprehensive performance evaluation of LID practices for the sponge city construction: A case study in Guangxi, China.
6. McGuire, R. (2025). 'All the birds returned': How a Chinese project led the way in water and soil conservation.
7. Wang, R. & Morris, J. (2025). The policy supports, economic incentives and the adoption of agricultural water-saving technology in China.
8. Wang, J., Li, R., et al. (2022). Spatiotemporal variation of household water consumption and coping strategies in water-stressed city of arid and semiarid Northwest China. Frontiers in Environmental Science.
9. Wu, Z. (2025). Coordination between flood prevention capacity and urbanization under climate change in the Yangtze River Economic Belt, China.
10. Zhang, Y., Yin, Y., Zhang, X., & Yin, M. (2025). Local and indirect water scarcity risks under climate change in the Yellow River Basin: A virtual water flow perspective.
11. Zhang, X. (2023). Upgrading urban water storage system: Achieving water conservation, power generation, carbon reduction, and water quality enhancement.