Gong and Alrehaili *Int. J. Dis. Manag. (2023) 5:2, pp 181-192*
DOI: https://doi.org/10.24815/ijdm.v5i3.28854

International Journal of Disaster Management
E-ISSN: 2527-4341 P-ISSN: 2808-439X

RESEARCH ARTICLE Open Access

Flood Preparedness in United Kingdom and China: A Comparison Study Focusing on Social and Economic Factors

Ruishan Gong[1], Naif R Alrehaili[2]

[1] Institute for Risk and Disaster Reduction, University College London (UCL), United Kingdom.
***Corresponding author:** ruishan.gong.21@ucl.ac.uk

Received 04 April 2022; *Received in Revised Form* 25 February 2023; *Accepted* 26 February 2023

Abstract

The paper aims to explore the social and economic factors influencing the flood preparedness of Zhengzhou, China and Leeds, United Kingdom residents. As one of the chosen areas, Zhengzhou experienced a terrible flood with an inaccurate weather forecast and little pre-flood preparedness in July 2021. On the other hand, Leeds has a long history of frequent floods. Wetter winters and stormy weather caused by climate change led to increased floods in Leeds. The consistent seasonal floods keep damaging residents and their properties, leading to economic losses. The authors conducted semi-structured interviews with residents who experienced floods in Zhengzhou and Leeds. Comparative parameters included economic and social, as these factors are hugely different in the study areas. The results showed that factors like education influence the households' flood preparedness; likewise, economic factors like disposable income also affect the willingness of residents to spend on flood preparedness. Furthermore, the results revealed that with proactive flood management, both communities progressed in minimizing the post-adverse effects of floods.

Keywords: flood, preparedness, economic, social, Factors, Zhengzhou, Leeds.

Introduction

Preparedness for floods is not only the responsibility of the governments and communities but also the responsibility of individuals. When discussing flood preparedness, the term resilience stands out. According to UNISDER (2009) resilience refers to the ability of a system, community or individuals exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and efficient manner. According to Klein et al. (2003) maintaining and enhancing the adaption capacity is the main goal of resilience. Chan and Liao (2022) believe that there are mainly two harms that flood will cause to communities – risk harm and outcome harm. Risk harm is identified as increasing the local community's vulnerability and diminishing human well-being, whereas outcome harm is pernicious and should only be exercised in extreme situations., and Nola (2019) state that flood impacts include damaging economic and social. Generally, theorists have widely agreed that disaster risk reduction policies and strategies such as floods should consider the environment, which includes social and economic factors (Alexander, 2000; Weichselgartner & Obersteiner, 2002). In other words, the disaster risk reduction approach is socio-economically divergent based on the hazard's location.

This paper aims to explore the social and economic factors influencing individuals' predisposition to floods in both Leeds, UK, and Zhengzhou, China. In this study, Hofstede's six-dimensional model: power distance, uncertainty avoidance, individualism, masculinity, long-term orientation, and indulgence, is employed to examine the effect of social factors on individuals' preparedness for floods. On the other hand, this study explores the national GDP and household income as economic factors that affect individuals' preparedness for floods in both cities.

Leeds and Zhengzhou have been suffering from different levels of frequent flood events for various reasons in recent years. Hence, it is necessary for the residents to react correctly to the flood signals. So, the authors seek to explore the difference in how residents react to flood signals in two different countries with the influence of social and economic factors. The main aim is accomplished by exploring the following four research objectives:

- The social factors affecting the residents' flood preparedness in Leeds.
- The social factors affecting the residents' flood preparedness in Zhengzhou.
- The economic factors affecting the residents' flood preparedness in Leeds.
- The economic factors affecting the residents' flood preparedness in Zhengzhou.

Two cities are chosen as the study areas for a comparative study: Leeds, United Kingdom and Zhengzhou, China. Leeds experiences frequent floods that most likely will cause economic losses and would be improbable to cause an increase in the death toll. On the other hand, Zhengzhou experienced the strongest flood disaster in 2021 in the last thirty years. Therefore, the residents' flood preparedness is worth exploring.

Study Areas

Zhengzhou and Leeds were chosen due to geographical similarities and their governmental flood management schemes which address shared issues such as each city's drainage systems. Both cities' surface water drainage systems have contributed negatively to flooding (GuyCarpenter 2022). Highly frequent and intensive storms in Leeds and Zhengzhou cause more widespread sewer flooding and floods from both rivers and drainage systems in the cities (Shu & Finlayson, 2018).

Leeds, United Kingdom

Leeds is a bustling city at the heart of West Yorkshire, in the north of England. The traditional infrastructure has long relied on its links to the waterways, the Leeds and Liverpool canals and, more importantly, the river Aire. Despite Leads' reliance on water-based commercial transportation decreasing over the years, in its current state, the Aire still finds itself a profitable asset to Leads' localised economy through areas such as the Aire and Calder navigation.

Historically, Leeds has had a long history of fluvial and surface water flooding. Within the last 20 years, the city has seen a concerning increase in the frequency of large-scale flooding. MET Office statistics highlight a 12% increase in rainfall during winter compared to the last 60 years, a potential contributing factor to the infamous 2015 Storm Eva flood event. According to local rainfall data from July 2019 onwards, Leeds rainfall has been above the East and Northeast England average. Six months on from July 2019 occurred, Leeds significant flood event, Storm Ciara.

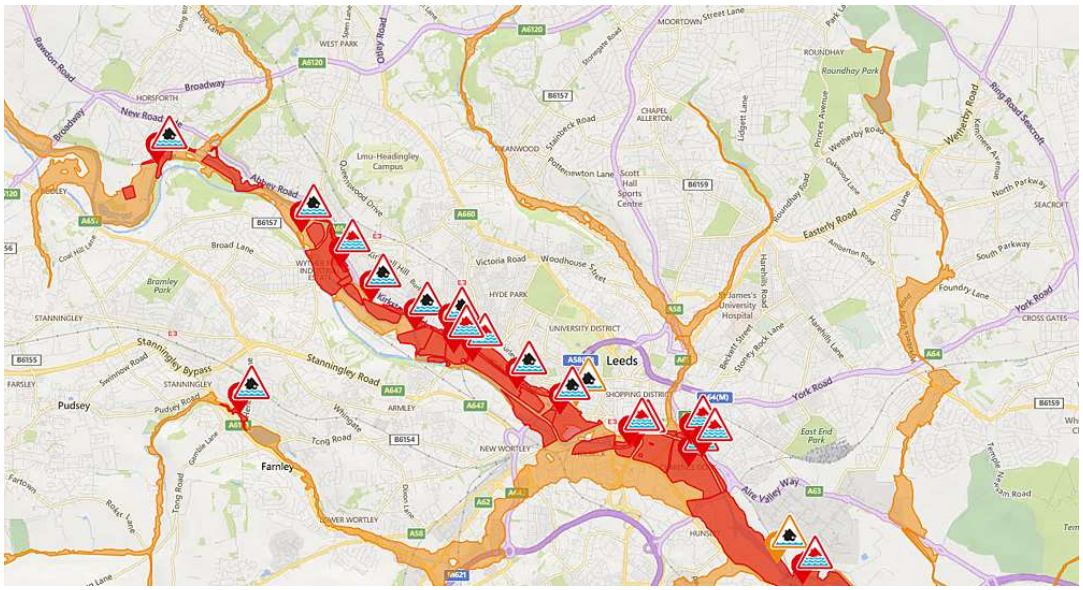

Figure 1. A map showing the flood warnings (marked in red) which are in place in Leeds. Source: The UK Environment Agency.

The resultant economic damage prompted a large-scale response which aimed to build on Leeds' already active flood management plans. In December 2010, the 'Aire Catchment Flood Management Plan' was introduced, outlining short-term goals alongside planned management over the next 50 to 100 years. Leeds' next and most significant plan is the 'Leeds Flood Alleviation Scheme', with phase 1 having begun in October 2017 and phase 2 currently taking place with an aim to be completed by Autumn 2023. Key features include moveable weirs (the first in the UK), flood defence walls, embankments, and flow control structures. The scheme aims to reduce the risk of flooding to a 0.5% chance in any given year, including a climate change allowance.

Zhengzhou, China

Zhengzhou is the capital city of the Henan province, therefore being the central metropolis through which many of the region's key service lines run. The city is situated along the bank of the Huang He, also known as the Yellow River. The Yellow River is particularly notorious due to its penchant for disastrous flooding, with Zhengzhou flood events in the region dating back as far as 1886. In 2021, the city was again the victim of catastrophic weather conditions, believed to have been amplified as a result of climate change. According to rainfall data from the 20th of July, 201.9mm of rainfall fell in Zhengzhou during the hour of 5:00 pm alone. When totalling the rest of the day's collective rainfall, it measures 644.6mm, setting the national record for rainfall. Using meteorological data from between 1981 and 2010 shows the city averages an annual rainfall of 640.9mm.

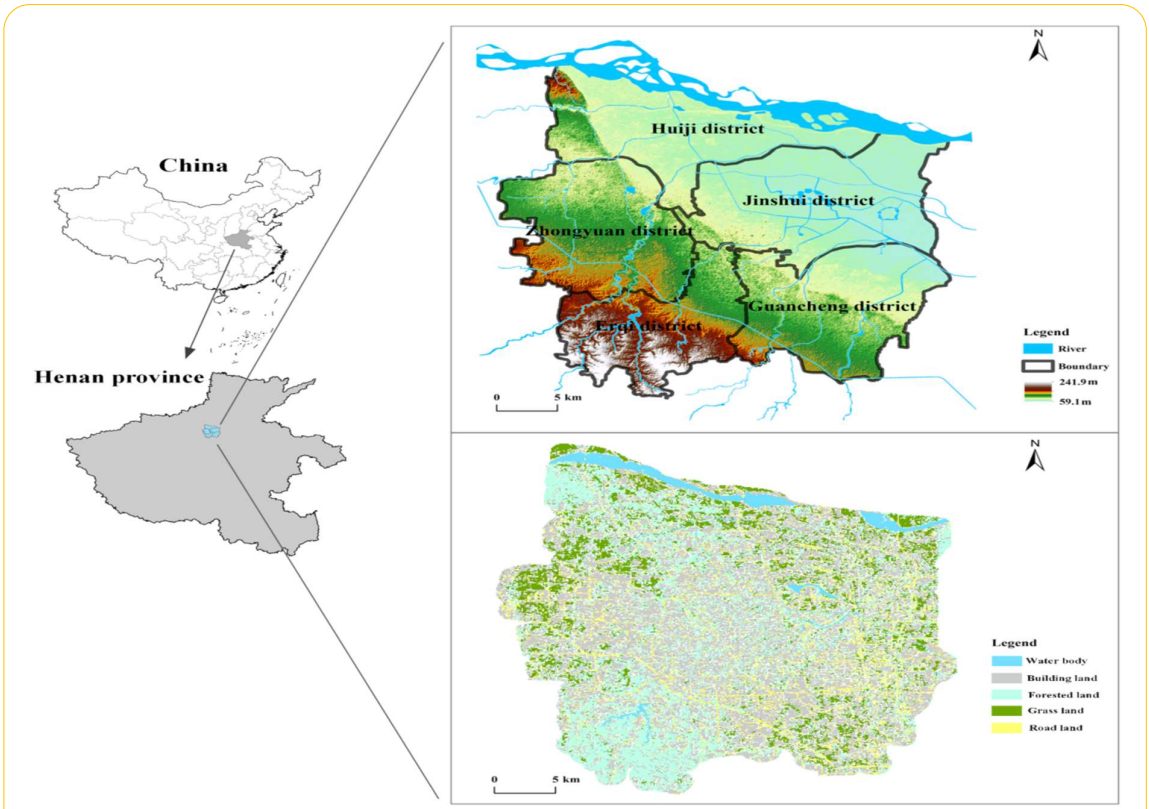

Figure 2. Overview of the study area of Zhengzhou, China. Source: Wu et al., 2022.

The rainfall and subsequent flooding damaged crucial infrastructure and led to the loss of life. Zhengzhou experienced an electracy shot, a water supply cut and other consequent instant damages after the flood happened. According to the evaluation of the Chinese government's post-disaster report (2021) there were 14,786,000 people influenced by the flood event, 398 people died or went missing, and 120,060,000,000 yuan

(Chinese currency) directly economic losses. Zhengzhou's subway system attracted the bulk of media attention as it became thoroughly overwhelmed, responsible for many lost lives. With an expectation of climate change to continue the moisture loading of tropical storms, Chinese government officials have begun to reform the current regulations (Emergency Response Law, Flood Control Law, Work Safety Law and Flood Control Regulations). The immediate response has been to work on rehabilitating the city, its infrastructure, and its citizens with the '14th Five-Year Plan' aiming to reduce flood risk in the long term.

Role of Economic Factors in Flood Preparedness

Economic factors are often the cornerstone of flood preparedness. The correlation between high overall GDP measurements within a city can influence the subsequent level of funding the city receives for creating disaster prevention infrastructure and plans. Leeds and Zhengzhou share many similarities with respect to geography, metropolitan status, and infrastructure, amongst others, but crucially, they differ on GDP measurements in a significant way. Both cities' local council/state management shares a common goal in flood prevention; they differ in their operation and execution of plans, which can be partly attributed to economic factors. According to government statistics, Leeds is the UK's fastest-growing city. Even though the gross national GDP in China is way higher than the United Kingdom, the GDP per capita is not very ideal in China in comparison to the data from the United Kingdom (Data for the United Kingdom, China | Data 2022). Furthermore, according to China Internet Watch (2021) Zhengzhou ranked 15th among China's most developed cities' list; under the circumstance of unevenly distributed economic power in a developing country – China, the rank presents the comparably weak economic power of residents in Zhengzhou. With a larger GDP, Leeds risks suffering more damage to key segments of its economic generation due to a large majority of its revenue.

Figure 3. Gross GDP, GDP per capita comparison in China and UK (source: Data.worldbank.org, 2022).

Additionally, the Gini index below can better reflect the inequality of two countries – China and the United Kingdom (Top Chinese Cities by GDP Ranking in 2020 2022). Usually, the higher the Gini coefficient is, the greater

the inequality is for the area. As presented in figure 2, the Gini coefficient indicator decreased in China from 2010 to 2018, which is a favourable implication as the household's income is more equal. Therefore, people from different economic backgrounds would feel more comfortable spending their disposable income on flood preparedness or using their economic power to act towards flood disasters. In comparison, the Gini index in the UK had been relatively stable from 2003 to 2018, which means the percentage of the resident's disposable income is maintained at a relevantly stable level. However, in terms of flood preparedness, the percentage of residents' disposable income remains similar, which implies that the willingness to put money into flood preparedness might be at the same level in the past few years unless there is a drastic increase in flood occurrences in Leeds.

Figure 4. Gini index Comparison in China and United Kingdom (source: Data.worldbank.org, 2022).

Role of Social Factors in Flood Preparedness

Social factors are an integral contributing factor to flood preparedness and can shape items such as response time and disaster preparation, amongst others. Both cities have shared social factors but unique issues that impact each city individually. For example, although Leeds' population is slightly below the national average in pupils achieving grades in Maths and English, at a percentage of 69.9%, Leeds has a large, educated workforce.

Academists suggest that there is a correlation between flood preparedness and education. The knowledge and application of advanced technologies support the most effective way to prepare for disaster and minimise its negative effects (Majd et al. 2019). Leeds' working population with high-level qualifications is 46.7%, which is higher than the national average of 43.0%. The working-age population with no formal qualifications is also significantly lower than the national average at 4.2% compared to the national 6.6%. Also, 74.7% of the population

has access to an internet connection of 30+ Mbps. These factors contribute positively to a population's flood preparedness action, and the study's primary research findings reinforce this further. Whilst in Zhengzhou, Kobayashi and Porter (2022) imply that lacking laws and regulations in the flood hazards areas and floodplains is one of the main reasons that flash floods often occur in this place. Additionally, Kobayashi and Porter (2022) mentioned a similar thing in their article; even though China employs a highly competitive education system and provides a sufficient number of flood-related professionals, the changing technologies need constant updates and extra training, which the current Chinese education system is lacking.

When it comes to the perspective of culture, it is worth mentioning Hofstede's model, which measures culture from six dimensions: power distance, uncertainty avoidance, individualism, masculinity, long-term orientation, and indulgence. Gerard Hendrik Hofstede is a social psychologist; the application of Hofstede's culture model allows us to identify similar cultural traits and diagnose the differences. Figure 3 presents the estimated index number between China and the United Kingdom (Compare countries - Hofstede Insights 2022).

In relation to flood/disaster preparedness and reaction, it can be said there are areas worthy of discussion within Hofstede's model, the most significant being individualism and indulgence. An individualist society is built with greater importance upon personal goals than a collectivist approach that promotes unity and cohesive group functionality. According to Alberici (2022) with the long history of collectivism, the culture tends to put people in a group instead of prioritising individual needs, and individualistic rewards like personal recognition are deemed inappropriate thought.

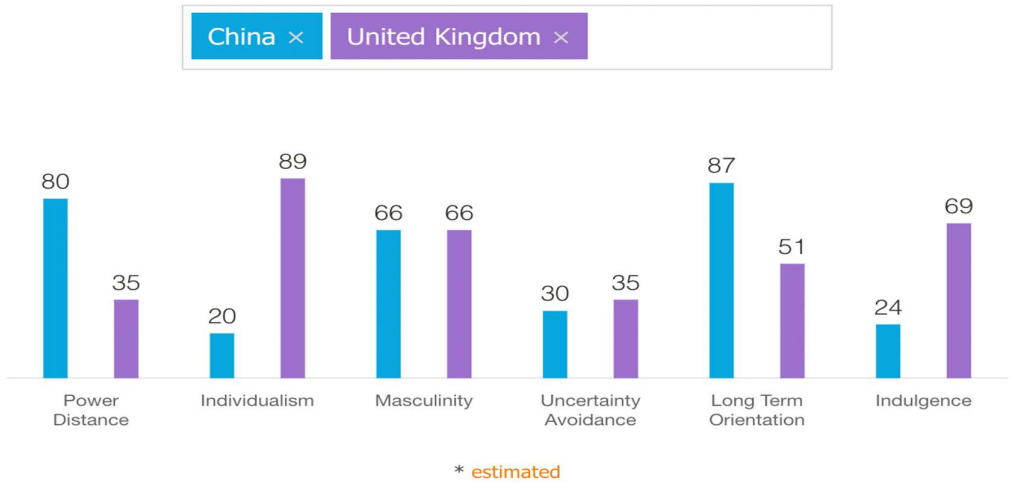

Figure 5. Hofstede's culture dimension indexes, China, and the United Kingdom (source: Hofstede Insights, 2022).

This paper assumes that without a general command, residents might tend to stay and wait for the order and act in a group instead of preparing for their benefit when disasters come. However, there are also hints that the younger generation in China supports democratisation and fights against transitional social rules. This means that the younger generation in China, especially Zhengzhou, might act more positively and efficiently when disasters occur. There is also the factor of indulgence, valuing the satisfaction of human needs and desires instead of withholding these views in alignment with societal norms. Given the disparity between the United Kingdom's measurement in these areas compared to China, there could be a lot to be said when directing these factors against flood preparedness and reaction that may warrant further investigation. The United Kingdom presents a weak impulse control towards things, and people tend to realise their desires more than act restricted by rules and regulations. Therefore, a flexible plan will be more suitable for UK residents, especially after they receive the

signals of disasters such as emergency evacuation, leaving enough space for them to plan out what the next move will be a more efficient way to help mitigate the disaster risks.

Methods

Semi-structured interviews were employed to identify and evaluate how social and economic factors influence flood preparedness in both Leeds and Zhengzhou communities. These two factors were further divided into four strata of data as the study was conducted in study communities. According to the study area, participants were asked the following two key questions:

- Participants of Leeds:
  - How the social factors affect the residents' flood preparedness in Leeds?
  - How the economic factors affect the residents' flood preparedness in Leeds?
- Participants of Zhengzhou:
  - How the social factors affect the residents' flood preparedness in Zhengzhou?
  - How the economic factors affect the residents' flood preparedness in Zhengzhou?

Semi-structured interviews were a series of dialogues that were carried on between the authors and the participants; the interview was quite flexible, thus helping better explore participants' views and delving deeply into participants' perspectives. In addition, the authors were clearly aware that flood disaster-related memories are often quite sensitive; it takes significant courage for participants to open up and reminisce about the sentimental scenes. Therefore, semi-structured interviews helped the authors better guide participants to provide valuable answers.

The semi-structured interviews were conducted through zoom calls, and all participants knew the recording function was turned on. Online voice calls better supported asynchronous communication; it extended the access for the authors to reach out to the populations based in Zhengzhou, China. Apart from this, phone interviews provided time and budget flexibility for interviewees and interviewers, which converted the time zone problem into a doable task (Opdenakker, 2006).

Nine participants were invited to this study as they all meet the following requirements: 1) 18 years old or older; 2) mandarin or English speakers; 3) agree to the participation consent and 4) living in the flood-prone areas in Leeds and Zhengzhou for a long term. The participants were selected by the snowball sampling method, which meant one participant recommended another until there were sufficient participants for the study. Meanwhile, the authors intentionally opted for participants of different ages and economic backgrounds to enrich the collected answers.

The application of snowball sampling methods helped the authors reach out to both Leeds and Zhengzhou participants for the study. As a result, four participants were from Zhengzhou; they luckily survived the 2021 Zhengzhou flood disaster and embraced the rich experiences of years of flood issues. Furthermore, since they were mandarin speakers, it allowed them to express their attitudes and perspectives with the most appropriate words; therefore, the authors decided to carry the conversation in their mother language – mandarin and translated the draft into English for analysis. While for Leeds, five participants were chosen who have been residing in a flood-prone area for over a decade, as they were English speakers, and the interviews were conducted in English. Afterwards, the drafts were exported from Zoom recordings for analysis. As soon as the interviews were recorded, they were transcribed for coding and analysing data. Transcriptions were read several times in order to extract common themes. The content analysis method was adopted to reach the results.

Results

How Social Factors Influence Zhengzhou and Leeds Residents

A frequent topic of discussion that organically dominated the conversation was education which varied in its content between Leeds and Zhengzhou residents. In Leeds, the discussion was about the reliance of independent teachings such as finding information by one's own choice rather than being part of the school curriculum. This

belief was reciprocated by each of the five Leeds based participants. For example, interviewee (3) discussed the impact that studying geography had on their outlook toward flooding; from selecting geography for further study over history, they were able to develop their knowledge and show an interest in Leeds based flood policies. In contrast, Zhengzhou residents discussed how following the 2021 flood, the national education system was improved to include compulsory fundamental teachings surrounding how to prepare for a flood, what to do during a flood and how to deal with the aftermath. For example, interviewee (4) stated that "before the flood, these teachings were mostly for primary and middle school students but are now much more popular following the flood".

When discussing masculinity and feminism as features of social influence regarding flood preparedness, it was clear that the UK has less defined patriarchal influence and carries more of a sense of equality between genders. For example, interviewee (1) stated that "it would have been my mum being the one to make the decisions and choices, but my dad would have more of a final say", whereas interviewee (2) stated that because of their one-parent household, the bulk of the decision making would be left up to their mother. This contributed to the thought process that both genders appear to have an equal say, but males could be more likely to be the ones to make the decision. These results would be somewhat inconclusive or require a bigger sample size to validate which viewpoint is more representative. When considering Zhengzhou, as interviewees (3) and (4) state, Zhengzhou residents follow a more patriarchal or traditional societal structure which inevitably leads to the males handling the decision-making while females trust and stand by the decisions made.

In regard to the view of the individual or group, it appears that both cities and their societies would act as a group or show collaboration when responding to a flood event – the caveat being that, according to the views of the Leeds based interviewees, they would be more reluctant to extend that collaboration further than their household especially if it involved spending money. When compared to Zhengzhou, the overall culture is founded on community and collaboration as "it is more like a Chinese tradition", as an interviewee (1) stated. Therefore, when asked if they would be happier to spend money to help their community and act with collaborative intentions, the interviewees answered positively, with interviewee (2) stating, "after the flood event, we would all help our neighbours with the recovery and share supplies with each other".

Uncertainty avoidance was also discussed where there was a difference in reaction to a flood event, as shown by the responses of the Leeds and Zhengzhou residents. For example, Leeds residents were shown to be more likely to leave a reaction until "the last second", as noted by Interviewees (1) and (5). This leaves a sense of ambiguity regarding the importance placed upon disaster preparation and response, which could support the argument that independent education on flood events is the more likely form of education rather than being part of a school curriculum. In contrast, in Zhengzhou, the residents instead present their attitudes towards these events as "going with the flow", which would rely on acting when needed. This is also supportive of the inclusiveness and communal collaboration from the decision to act being reliant on when it is necessary to do so.

Factors such as local medical and health conditions and local government supporting policies were also brought up by interviewees. For example, with the NHS public services, Leeds residents are more willing to risk the emergency scenarios as lowkey they implied that "we will possibly have government support if there are serious economic damages to most households" and "living with free NHS services make me and my family less worried about the actual physical body damages". In contrast, interviewees from Zhengzhou mentioned that they tend to care more about things they would physically lose as they can only acquire "basic guarantees" from the government.

How Economic Factors Influence Zhengzhou and Leeds Residents

Leeds' national gross GDP was discussed with interviewees and was shown to be at a low level, which contrasts with the GDP per capita at a high level. When asked how this would factor into flood preparedness, interviewees discussed the idea of the positive impact of Leeds' growing economy. They discussed their childhood experiences

with flooding and how Leeds' development has allowed a budget for flood-related schemes – specifically the 'Leeds Flood Alleviation Scheme', which would not have been possible 15 years ago. The interviewees also discussed how important the high level of GDP per capita is on a flood response, as it allows the family members to pre-emptively defend their property or create defence structures through financial means if possible. As interviewees (3) and (1) stated, the importance of residential finance allows for disaster-related insurance, which can be the difference between landing comfortably or falling apart in the aftermath of a disaster.

However, in the discussion about disposable income and residents' willingness to spend money on general disaster preparedness, Leeds interviewees revealed that they are less willing to make expenditures in flood preparation, as the interviewee (4) mentioned that "I believe that the basic support should be provided by the amount of high-level tax that I submitted every month". With a high-level tax and social welfare system, Leeds interviewees expressed that they are more willing to put their income into self-indulgent and prefer to "live in the moment". Additionally, floods are more frequently happened in Leeds in the past few years, and flood disasters most likely come after mild storms and only cause basic damages to public infrastructures instead of directly influencing the households. Therefore, it is not hard to understand that Leeds interviewees who have been through different flood events are less likely to treat flood disasters seriously and prepare for the worst cases.

Zhengzhou's national gross GDP was also discussed with interviewees and was shown to be at a high level, which also contrasts with the GDP per capita, which is at a low level. However, with the development of the economy in China, residents' happiness in the general living conditions is rising, and they can afford better quality committees conformably. However, the issue is that with little knowledge about weather changes and emergency resilience, residents are not consciously aware of the city structure and the city water management system. As interviewee (2) mentioned that "I never knew it (the Zhengzhou July 2021 flood) would be the worse". Interviewees from Zhengzhou implied that the flood in July 2021 was totally out of their expectations. Even now, some interviewees are still unaware of the total losses and the economic damage level that the city has been through. Interviewees were shocked when they were informed in the interviews that the total losses for the 2021 July flood event were around 120 billion pounds.

Additionally, by gathering all the information from interviews with participants, the authors noticed that household income inequality is quite important and indirectly influences the participants' answers similarly. For example, in Zhengzhou, interviewees (1) and (3) both work to gain stable income or have stable financial resources from external help like parents. They also indicated that they would consider integrating disaster preparedness into their future lives as they gradually realised the importance of it. However, the remaining participants from Zhengzhou seemingly have a tight monthly budget. Even if they are aware of the disasters, they will choose to risk it as they cannot afford the appropriate equipment comfortably. In contrast, it is a similar situation in Leeds; interviewee (2) mentioned that from a not-too-affluent background, even with better knowledge in this area than others, the actions that he could take are quite limited. Other interviewees (1) and (4) motioned less about the cost of coping with the disaster signals.

Discussion

From the primary research sources, we can see that the frequency of flooding is drastically increasing as a result of climate change. Climate change has a list of catastrophic results ranging from droughts to typhoons which China experiences both, and the UK is beginning to experience. This trajectory is set to keep increasing, with the average global temperature predicted to rise by 1.5 degrees Celsius by 2050, which carries disastrous consequences for the planet. Leeds' flood frequency has increased, with two major flood events occurring in the last ten years, whereas Zhengzhou experienced record-setting rainfall, equal to the annual average, within a day.

The historical analysis reviewed has suggested that there are levels of vulnerability and exposure that improve the chances of a flood event occurring, and each of these has been witnessed at differing levels within Leeds and

Zhengzhou. Primarily prompted by harsh weather conditions, Zhengzhou experience a monsoon season in which a deluge of water downpours at an extreme rate. All these factors influence flood preparedness by having a guaranteed weather event that will occur with evidence of when throughout the year.

The study mainly focused on social and economic factors using established theory to prompt research; to expand upon this, the social factors consider the Hofstede model, which discusses six key cultural dimensions, and the economic factors consider the Gini index, amongst other elements such as GDP. The Gini index measures the distribution of income to determine financial equality, which can be a crucial indicator of flood/disaster response, given that money is a practical resource for combating disaster events. These two factors were selected due to the prevalence of established theory that determines factors behind flood preparedness on an individual level and a governmental level. As flood preparedness and subsequent risk reduction require much collaboration between the relevant parties, this deeply considers economic and social factors, as the decisions often need to consider the affected communities.

The study's results indicated room for improvement outside of developing more advanced flood infrastructure, focusing more on the individual. This study found that educational backgrounds are vastly crucial for both study areas, and the authors assumed that better disaster preparedness education could help minimise the vulnerability of disaster losses. Apart from this, the study also found out that even though Leeds is a more developed city, residents could have more disposable income for emergencies like disasters. However, with the Gini index maintained at the same level for the past years, people feel less comfortable letting part of their savings go into disaster preparedness, even those living in the most flood-prone areas in Leeds. The radical difference from what is expected should be reflected and improved in the future. At the same time, the interviews between the authors and participants in Zhengzhou presented those residents in this area are experiencing significant economic development in the last decade and are more comfortable with their current economic power. However, with little knowledge about flood and emergency responses, they likely care less about flood preparedness and will not calculate emergency response costs as part of their life necessities.

The result of this study goes along with Alexander's (2013) opinion that the latent vulnerability issues should be understood and addressed with the improvement of the socio-economic system towards flood preparedness. The very nature of flooding is one fraught with high-level unpredictability and meteorological uncertainty. However, the dominant factors to influence this are not entirely from the devastating fluvial power of rushing water but societal elements such as "corruption, negligence, maximization of profit and the structural weaknesses of the global socio-economic system". Given the results of our primary research, there are also considerations toward other elements beyond social and economic, which adds to the challenge of achieving a disaster plan, prevention scheme, clean-up, or even seeking humanitarian aid. Both Leeds and Zhengzhou were fortunate enough to have the resources to tackle the aftermath of the flooding. However, countries lacking in resources with less than favorable political reputations may refuse help or have their requests refused.

Conclusions

In conclusion, in terms of Hofstede's model of social factors, the study concluded that the primary source of flood awareness within Leeds' study participants was independently sourced information or inadvertently obtained through the education system through studying geography. Since geography is optional and is a choice alongside history, it is not a reliable source of flood preparedness information. In contrast, within Zhengzhou, following the 2021 flood, extracurricular activity and educational courses have been integrated into the national education system, predominantly within primary and middle schools.

The study also concluded that Leeds' gender responsibility was equally shared, with males more likely to make the decisions. This is expanded upon within Zhengzhou as females are likelier to listen to males' opinions and trust their decisions. In addition, the Leeds households' interviewees were shown to be more likely to act together

when a flood event was to happen, which is reciprocated within Zhengzhou residences as this philosophy of collaboration is more like "Chinese tradition". Finally, Leeds residents were shown to leave reacting to a flood til the last available second, whereas Zhengzhou residents were more aligned with "going with the flow" and reacting when needed.

Regarding economic factors, the study concluded that Leeds' national gross GDP was measured at 'low', but the GDP per capita was measured at 'high'. Leeds measures as 'low' within the Gini index but stable in the last 15 years. Leeds also has a 'medium' level of disposable income and measures as 'medium' in the comfortability of spending money toward flood preparedness. In contrast, Zhengzhou's national gross GDP was measured as 'high', but the GDP per capita was measured as 'low'. Within the Gini index, Zhengzhou measures as 'high' but going down in the previous ten years. Zhengzhou also has a 'medium' level of disposable income, which has been on the rise; however, the comfortability to spend money on flood preparedness is 'low'.

Recommendations

Based on the results and discussion of the study, some recommendations emerged. From a social perspective, there are many ways to improve flood preparedness. Firstly, public education is necessary through various means, such as providing leaflets, infographics, physical and digital advertisements, or holding a Disaster Preparedness Day/Memorial Day to inform and remember past events and their subsequent loss of infrastructure and life. This education is necessary as there is a lack of understanding about flood responses, such as how to defend yourself or your property pre-emptively. This would also be feasible in a city such as Leeds, where there are screens in a central part known as 'Millennium Square', where events, news and advertisements are naturally shown and digested by the public. In contrast, a Memorial Day would be informative and empathetic in Zhengzhou due to the flood event being the most catastrophic in the city and China's history. It would also be necessary to educate those most vulnerable to a flooding event, such as businesses of residential areas on the fringe of flood-prone areas or those who may have issues escaping a flood event, like the elderly or disabled.

From the perspective of the economy, new tools and advanced infrastructures should be introduced to society with a tight focus on flood prevention before flood events are triggered. Leeds' 2017 flood alleviation scheme is an excellent example of this, with the aims being set at preventing and limiting the damage of future large-scale flooding events like the one in 2015 at the hands of Storm Ciara. However, this would also suggest that more funding is necessary as, without the money, the flood defences cannot be implemented successfully or be developed to the point where the city would be future proofed against the rising challenge of floods. This would also tie into the importance of instilling a sense of financial responsibility and consciousness on an individual level, such as investing in private insurance policies or putting money aside for a 'rainy day fund' - which is more than understated when flooding is considered.

Acknowledgements

The study was approved and supported by the Institute for Risk and Disaster Reduction (IRDR) at University College London (UCL), which provided logistical and informational support. We are especially thankful to our colleagues who contributed to the study's improvement through their feedback, comments, and suggestions.

References

Alberici, C. (2022). China in respect to Hofstede's Cultural dimensions model, lesson 10, viewed 21 August 2022, from https://sites.psu.edu/global/2016/10/29/china-in-respect-to-hofstedes-cultural-dimensions-model-lesson-10/.

Alexander, D., & Alexander, D. E. (2000). Confronting catastrophe: new perspectives on natural disasters. Oxford University Press, USA.

Alexander, D. E. (2013). Resilience and disaster risk reduction: an etymological journey, Natural Hazards and Earth System Sciences 13, 2707–2716, https://doi.org/10.5194/nhess-13-2707-2013.

Chan, J. and Liao, K. (2022). The normative dimensions of flood risk management: Two types of flood harm, Journal of Flood Risk Management 15(2).

Data.worldbank.org. (2022) Data for United Kingdom, China | Data, viewed 27 August 2022, from https://data.worldbank.org/?locations=GB-CN.

Data.worldbank.org. (2022). Gini index - United Kingdom, China | Data, viewed 27 August 2022, from https://data.worldbank.org/indicator/SI.POV.GINI?end=2019&locations=GB-CN&start=2003.

GuyCarpenter. (2022). Post Event Report: Henan Flood, July 17-21. viewed 12 July 2022, from https://www.guycarp.com/insights/2021/07/post-event-report-henan-flood-july-17-21.html.

Hofstede Insights. (2022). Compare countries - Hofstede Insights, viewed 20 August 2022, from https://www.hofstede-insights.com/fi/product/compare-countries/.

Klein, R., Nicholls, R. & Thomalla, F. (2003). Resilience to natural hazards: How useful is this concept?, Global Environmental Change Part B: Environmental Hazards 5(1-2), 35-45.

Kobayashi, Y. & Porter, J. (2022). Flood Risk Management in the People's Republic of China: Learning to Live with Flood Risk, Asian Development Bank. viewed 20 August 2022, from https://www.adb.org/publications/flood-risk-management-peoples-republic-china-learning-live-flood-risk.

Majd, P., Torani, S., Maroufi, S., Dowlati, M. & Sheikhi, R. (2019). The importance of education on disasters and emergencies, Journal of Education and Health Promotion 8(1), 85.

Mitrović, V., O'Mathúna, D. & Nola, I. (2019). Ethics and Floods: A Systematic Review. Disaster Medicine and Public Health Preparedness 13(4), 817-82.

Opdenakker, R. (2006). Advantages and Disadvantages of Four Interview Techniques in Qualitative Research, Forum Qualitative social Research 7(4).

Robinson, S. (2022). Interview Sampling by Beverly Peters, viewed 26 July 2022, from https://aea365.org/blog/interview-sampling-by-beverly peters/#:~:text=Evaluators%20use%20different%20sampling%20techniques,often%20use%20is%20snowball%20sampling.

Shu, L. & Finlayson, B. (2018). Flood management on the lower Yellow River: hydrological and geomorphological perspectives. Sedimentary Geology 85(1-4), 285-296.

Weichselgartner, J., & Obersteiner, M. (2002). Knowing sufficient and applying more: challenges in hazards management. Global Environmental Change Part B: Environmental Hazards 4(2), 73-77.

Wu, Z., Xue, W., Xu, H., Yan, D., Wang, H., & Qi, W. (2022). Urban Flood Risk Assessment in Zhengzhou, China, Based on a D-Number-Improved Analytic Hierarchy Process and a Self-Organizing Map Algorithm. Remote Sensing, 14(19), 4777.