North Asian International Research Journal of Sciences, Engineering & I.T.

IRJIF. I.F. : 3.821

ISSN: 2454-7514 Vol. 7, Issue-12 December -2021

Index Copernicus Value: 52.88 DOI NUMBER: 10.5948/2454-7514.2021.00008.9 Thomson Reuters ID: S-8304-2016

A Peer Reviewed Refereed Journal

DRIVING PUBLIC UNDERSTANDING OF URBAN DRAINAGE SYSTEMS

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INTRODUCTION

Urban flooding is a result of inflow water in urban areas exceeding the speed of which the drainage system or the natural soil could carry them away. This could be caused by heavy rainfall or an overflow of rivers. When new development is added or modified, the existing path for water flow is disturbed. This means an effective system made up of channels, streets, and pipes must be in fast growing cities.

The increase in population density drives the demand of development which increase the need of more efficient and complex drainage system network. However, the performance of the drainage is only looked at when they fail. Many are oblivious about the level of vulnerability and an accumulation of risks will result in catastrophic event.

Cities such as London has many historical infrastructures, of which many of their drainage systems are aging. According to British laws, the private landowners are responsible for the drainage system under their privately own land, and water suppliers look after the everything under public lanes. However, the current mind set around providing efficient drainage is passive – which is doing the minimal to prevent fine or legal dispute, in comparison to an active approach – making active upgrades to prevent it causing damages in the first place. The passive behaviour is a result of availability and accessibility of the information, hence public often rely on the insurance company to provide risk measures and pay to provide a sense of security.

The aim of this project is to drive public understanding of the urban drainage system in order to gain support in improving the urban drainage resilience. This result in active participation for public to raise voice to the policy makers. To convey the message, I will be using data visualisation to create straightforward, easy to access and reliable information.

To answer achieve the final goal the following questions will be addressed:

i) What are the economic and social factors associated with urban flooding?

ii) What are the current implementations around improving urban drainage and how are they assessed?

iii) What is the missing gap?

iv) What are the most important factors that create an effective outlook to convey messages to the public?

v) How is python been developed to produce the desire design?

vi) What are the expected outcomes of the product?

The objective is to use existing database gathered from officials and authorised companies to provide real world reflection on the urban drainage system performance. The preliminary data will be based in London, United Kingdom, however the same tool can be used to further assess data from other cities.

LITERATURE REVIEW

Urbanization and the Increase of Extreme Climate

Historically, urbanisation increase the removal of natural soil and increase the ratio of impermeable grounds. Now, the demand is still increasing within highly in global significant cities, which drives the modification of existing network causes an increasing complexity in drainage network. As the National Academy of Science (2019) stated: ‘Flood problems reflect the history of a city and generally increase with urbanisation’. This had been due to drainage systems and flood defences were built to fit the past demand, but not design for the future. Not only does the existing network have to take greater volume of flow, they were also poorly maintained which causes leaking, clogging, etc.

In addition, due to the economic growth that business trades near ports have bought to many areas, flood prone areas were in high demand resulting in a concentration of development. Where economic activity is high, people were attracted to the area for opportunities, and this promotes expansion of the city as the affordability of the suburb becomes attractive. An example was the population in Outer London had expanded 250% in the last 100 years as central London housing price grew. (ONS – Office for National Statistics)

On top of the increase in demand and density, cities also face an increase in rainfall and number of extreme climates. As a research conducted by Tim Osborn and Douglas Maraun at the University of East Anglia, the contribution of rainfall in the UK was 7% annually around 1910, had increased to 12% in 2007 – just less than 100 years.

ECONOMIC AND SOCIAL IMPACT OF URBAN FLOODING

It is estimated by the Parliamentary Office of Science and Technology (2007) 80,000 homes were at risk and it is costing £270 million a year in England and Wales recovering from the damages. The estimated value could be largely underestimated. This is due to the disruptions cause – such as transport and personal property damages, were difficult to measure (Hammond et al., 2015). On top of what was mentioned, issues such as contamination, energy and water provision, temporary and long-term change of housing not only result in economic loses but also great social damages.

The prediction of future winter rainfall will increase by 20-30% by 2080, which is 200-300% greater increase to the previous 100 years of UK history. London infrastructure is also listed as high risk due to aging buildings and network. (CDP, 2019)

CURRENT CHALLENGES ON URBAN FLOODING

Flood Impact Assessments were a prerequisite for actions to be taken. Usually they were carried out in local or national governments' interest to allocate resources, and for insurance companies to value assets. Techniques for conducting the assessments varies depending on the availability of data and access to resources (Messner et al. 2007).

There are many flood predictions and warnings that's reported by officials such as the UK government. Flood maps were updated every few hours and it can be easily accessed through the internet or text messages. However, the challenge lies within the process of quantifying the 'flood resilience' which includes social, economic, institutional, infrastructure, and community capital factors (Hammond et al., 2015). [Summaries examples of flood resilience methods]

The vagueness in making direct connection between investment in urban drainage systems and apparent benefits, created a major resistance from the decision makers to implement proposal of flood prevention structures (Herath and Wijesekera, 2019). This results in design that only covers the minimum requirement given the short term monetary gain.

Decision makers were often elected by the genenral public through aligning targets and goals that they hope to achieve within the elected term. However, the cost of implementation is immediate, but the benefits could not be quantified during within the election period (Herath and Wijesekera, 2019). The fear of being critised by the public, policy makers would priorities other sectors of improvement such as healthcare and education.

A fundamental difference between infrustructure resilience and other areas were the use of probability. The interpretation of probabilities and consequences varies in the community. Often than not probability is considered as a fixed-term event and the public have the tendency of thinking it might not happen to them in the 'language of probability'(Stevens, 2012). This misunderstanding created false security about the current status of system (Herath and Wijesekera, 2019).

RAISING PUBLIC AWARENESS

In a study improving water management options in Las Vegas, it was argued that public awareness of the issue and consequences have direct correlation between potential solutions and system changes (Stave, 2003). Driving public involvement requires: public awareness, public education, and public participation.

The world bank partenered with GFDRR (Global Flood Disaster Reduction and Recovery) in 2012 published a guidance to build the fundation of flood risk management. The guidance emphasised what Stave (2003) had argued a decade before, and it had highlighted the the measures of assessing vulnerability of people and settlements. Policy makers should be kept up to date with the continous changing flood models thake takes into account of climate change and the condition of the 'defence system' (Stevens, 2012). In order to aid decision making, understanding the probability of hazard and associated consequence must be addressed; then the actions taken upon those risks would be supported (Stevens, 2012).

However, communication between academic research to the general public does not come without challenges. There have been a substantial amount of information exchanged in the media which can be intepreated in different ways. Often than not the information is re-written through digital environment (e.g. online applications, software, or games) to the public than directly from the researcher (McInerny et al., 2014). This could be due to the complexity in the language that many scientific publications contain (Condit, 2004), and the ready accessible platform that those digital platform already provide.

USE OF VISUALIZATION IN DECISION MAKING

To bridge the gap between researchers, public, and policy makers, the use of data vidualisation has great potential in the age of rapid computational advancement (UNDRR, 2019).

Prior to data based visualization, mapping of a 'system dynamics model' on water distribution was developed to analyze the management issues and provide direct overview of the thought processes to the policy makers (Stave, 2003). The same model is then used for public outreach. However, the complexity remain relatively high and reamined a barrier to many, the distribution of the graphic was limited, and the product does not allo continous updates.

Now, with an abundance of available data we can iterate through data frequently and display them in an easily accessible way. Arguably, information presented from factual data would be reliable and the public would be more willing to absorb the key ideas (Gatto, 2015). However, due to the errors in extracting relevant data, and the existing cognitive biases – where figures were interpreted in a way that shows their perception to the data, the practice could result in a negative impact on decision making (Ellis and Dix, 2015). In the digital ages, where there is an increasing public scrutiny and ease of spreading false information, such practice would suppress scientific reputation and the affect the level of public engagement (McInerny et al., 2014).

For information to carry reliability, visualisations must contain traceable sources where it can be validated. Depending on local policies, the distributor could hold responsible for the accuracy of the information depending on its severalty of consequences, which means the effectiveness of the visualisation could vary between regions. In addition, a common understanding that visualisations are only representations of data that have been filtered and visually encoded to convey a story is important for public to make informed decisions (McInerny et al., 2014).

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