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Monetary Assessment of Damage to Residential and Commercial Properties during Flooding in the United Kingdom

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Abstract

Recent flooding events in the United Kingdom have raised concerns that rapid climate change is pivotal to increasing flood frequency and magnitude. The fiscal assessment of flood destruction is becoming a significant priority, and evaluating flood hazardsis vital for flood economics in the United Kingdom. Subsequently, this paper qualitatively investigates the recent UK flood damage costs i.e. predominantly commercial and residential property destruction by incorporating a novel methodology, i.e. Flood Cost Evaluating Device. This approach, estimates damage costs of commercial and residential contents against an amalgamation of centimetre and metre scales. Implications of the methodology provide more precise damage costs, which emphasise potential climate change impacts on current and future generations. Evaluations for UK property costs are found to be circa £1.4 billion per year with > 6 million properties at flood risk. However, present UK property damage costs represent only 0.1% of national GDP, showing it to be insignificant on a national scale. However, it results in significant losses e.g. housing, commercial building, industry, etc., which has an inevitable and major fiscal impact on local economies in both short and long term, and ultimately will have an increasing effect on the national economy.

***Keywords**:* Flooding, residential and commercial properties, destruction costs, flood cost assessment device, United Kingdom.

Introduction

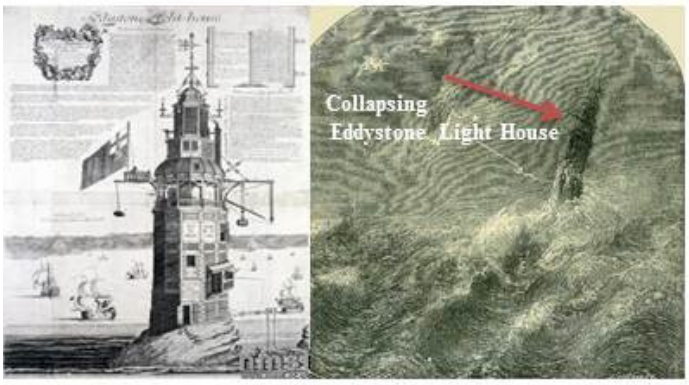
Natural disasters have increased considerably in recent years[1-3]. Many monetary sectors and regions are vulnerable to increasing disasters like floods. The average annual fiscal loss due to natural hazards over the world has been evaluated at £33 billion[4]. Whilst, research on economics of flooding in the United Kingdom has increased significantly after the 2007 severe flood destruction in England. A series of flooding events in between 2007 and 2013 across the United Kingdom illustrated the intensity of destruction power of natural disasters, particularly floods. These episodes caused major fiscal damage in England and Wales: less in Northern Ireland and Scotland. However, the most significant example in the history is the Lynmouth flood, which caused 34 deaths in England[5].

Consequently, this paper seeks to evaluate residential homes and commercial properties destruction costs associated with recent flooding in the United Kingdom. Accordingly, this study has measured both tangible and intangible components for commercial and residential buildings. Therefore, this study is centrally focused on property damage costs with the intention of finding actual costs. This includes study context, methodologies and data collection followed by an analysis of results and consequences. It also examines the impacts of destruction costs on both national and local economies. Conclusions are drawn and recommendations made regarding the true costs of property damage to the UK economy in recent years.

Study Area: The UK is an Island nation positioned in Western Europe and consists of four executive regions: England, Wales, Scotland and Northern Ireland (figure-1)[6]. The total area is 243,610 km2m[7] and population is 62.74 million[8]. Moreover, the UK is increasingly vulnerable to impacts of flooding and extreme weather events in recent times. However, changing climate scenarios are the primary reason for this situation. From out of 28 million properties, more than 6 million are at flood risk across the UK[9]. Furthermore, while in England and Wales one in 6 properties[10] are at flood risk, the figure falls to one in 22 in Scotland[11]. Therefore, this work evaluates the economic impact of UK property damage during recent flooding and develops a flood cost methodology for assessing damage costs. In addition, this research also analyses the abovementioned destruction costs impact on GDP as well as local economies.

Source: British, HM and Revenue and Customs[12]
Figure-1
United Kingdom with major regions

Background: Flooding: Floods are a great threat to the United Kingdom economy with more than 1.85 million properties and approximately 190,000 commercial properties at risk in England and Wales. Additionally, over 6 million people are at greater risk because of anticipated and unanticipated flooding[13]. High numbers of fatalities is uncommon in the United Kingdom excluding the1703 hurricane (figure-2 and 3)[14] and 1952 Lynmouth flood events[15.] Furthermore, 1953 North Sea floods struck the England and caused massive destruction to 24,000 residential properties[16]; while in April 1998 heavy rain hit the Midlands causing major flooding with about 4,200 houses as well as many commercial services affected, costing £350 million[17]. Furthermore, in 2000 major floods affected England and Wales and caused >£1billionof damage with about 10,000 houses affected[18].



Source: Henry Winstanley, and Derham, William,

Figures-2 and 3.
Eddystone Light house before and during Hurricane in 1703 in Devon, England

In 2007 summer floods (figure-4) in England, turned into a nationwide catastrophe and was established as one of the costliest flooding event on record causing £3.5 billion as damage costs[21]. In this figure, £3 billion of the damage came inthe housing sector. Moreover, 2012 floods (figure-5) across the UK, cost the national economy *circa* £600 million [22]. However, recent research reveals that, flooding in the UK will be worse due to the anthropogenic induced climate change over the next century [23-25.]

UK GDP and Trends: The United Kingdom is the world's 6th largest economy with a 2012 GDP of £1.6 trillion[28]and represents 4% to the global economy. In 3rd quarter of 2013, GDP grewby 0.8% and it is higher than the 2nd quarter growth rate and fastest growth rate for last three years[29]. The service sector plays a vital role in contributing a major percentage (75%) of total GDP. The main segments within service are, distribution, hotels and restaurants and particularly tourism etc[30.]However, since 2007, the UK economy has faced fluctuations (table-1) for various reasons; flooding being one of the majorreasons[31]. Meanwhile, 2007 flood damage costs significantly distressed the UK economy and suppressed the 0.4% growth rate[32]. Accordingly, analyses were undertaken of the residential and commercial properties destruction costs by flooding events, as well as the impact of these events on national GDP and local economies.

Source: British Geological Survey[26]

Figure-4
2007 summer floods in England

Source: BBC, 2012[27]

Figure-5
2012 Flooding in Scotland

Table-1
UK GDP

Year	UK GDP In Trillions (£)
2007	1.8
2011	1.6
2012	1.6
2013	1.7 (Estimated)
2050	5.6 (Estimated)

Source: World, Bank[33]and PWC, 2013[34]

Methodology

There are many methodologies for estimating flood impacts in the world particularly for monetary assessment. In those, some strategies established to work on unit loss models and some are developed to estimate the sectorial assessment[35] and others are standardized engineering models[36]. However, the UK and Australia have introduced comprehensive procedures for estimating physical and intangible losses[37]. Accordingly, most of the countries have developed analogous strategies for damage estimates[38]. Moreover, all aforementioned nations have appliedequivalent approaches for flood damage assessment i.e. unit loss method[39]. Based on various research results, it is clear that most of the countries like UK, Japan, and Australia have developed standardised methods for fiscal assessment of flood destruction costs[40]. However, there is no precise methodology for assessing property damage costs in the modern era in the United Kingdom. Accordingly, a novel methodology has established new parameters to estimate true costs of property damage during flood events across the UK.

Systematic description of novel methodology: The novel methodology qualitatively estimates and is applied as a new tool for evaluating flood costs, particularly for residential and commercial properties in the United Kingdom. It was motivated by the FEMAS, USA flood cost tool. This new approach (figure-6) is applied to UK flood destruction costs for propertiesand this preliminary study focuses on total damage costs of residential and commercial properties during recent floods.

Flood Cost assessment constructed on this newly established device. It has been developed using an incorporation of cm and m flooding levels to classify the intensity of flood water levels, designated by colour codes on a horizontal scale. If water levels reach between 2 and 5 cm into properties, there is not too much destruction (excluding bungalows), but if flood waters reach between 0.5 and 1.5 metres significant damage to assets include construction, structural and fittings, for example, furniture and household equipment (figure-7). Replacement costs for carpets, refrigerators, sofas, beds, electrical equipment and decoration are generally higher than those assets lost. This assessment method analytically scrutinises property damage costs to residential and commercial structure costs.

Data: Until 2007, total flood damage costseven in severe flood events, were not recorded either digitally or manually by any United Kingdom government departments or private agencies. Therefore, there is no chance to test the reliability or accuracy of flood loss data. However, since 2007, the Met Office and Environment Agency have collected complete data regarding flood destruction statistics along with other disasters. In addition, British Insurers also updates the data systematically about commercial and residential properties. An official damage assessment expert group visits every damage location to estimate the magnitude of losses and then offers initial evaluations for flood destruction costs. Consequently, in most disasters and some dominions now it is now possible to systematically compare preliminary damage estimates with true costs. Accordingly, data was acquired from the Environment Agency, British Geological Survey, British Insurance Agency and Parliamentary reports. Derived results were compared with published national reports to offer new damage estimates.

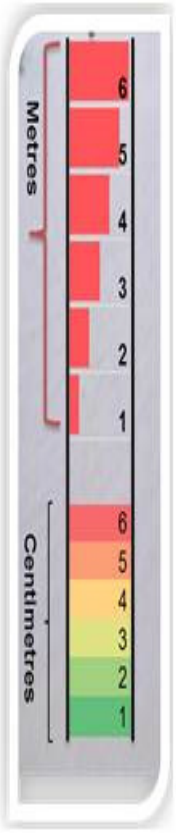


Figure-6
Flooding Cost Assessing Device

This new method used market values for each component and followed a systematic approach to obtain flood damage costs, the process being underpinned by a mathematical derivation as follows.

$$\left(\frac{Min.Flood\ Damage\ Costs + Max.Flood\ Damage\ Costs}{2}\right)X \quad (No.of\ Damaged\ Properties) \qquad (1)$$

Results and Discussion

The derived formula was considered alongside minimum and maximum costs for various items and scenarios as shown in table two.

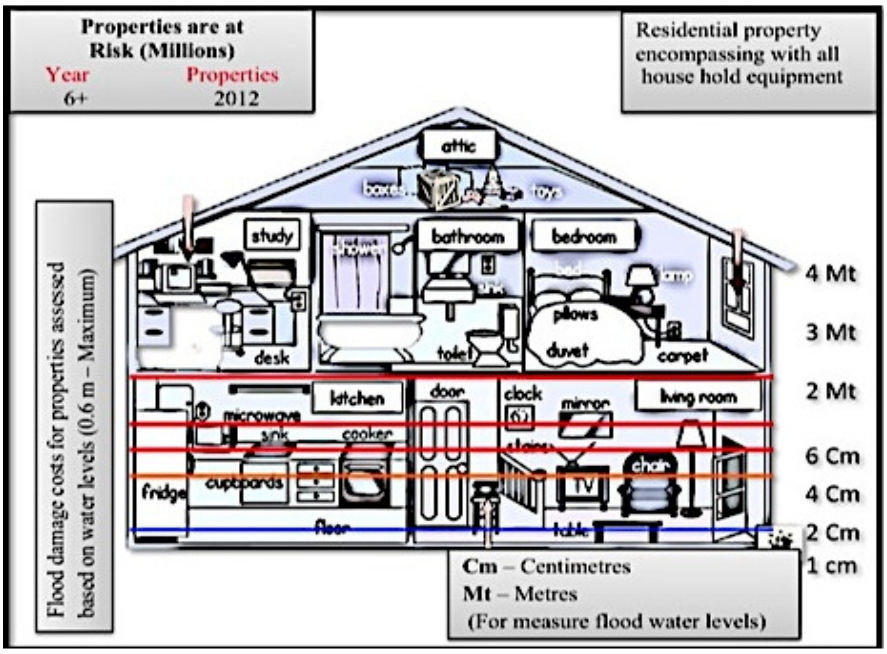


Figure-7
Residential property and Assessment of Flood Damage

Table-2
Flood Damage Valuations for Residential and Commercial properties

Flood Damage Cost per property	Damage Costs for Residential and Commercial properties (Minimum to Maximum)
Carpet\Wooden Floor	£1,500 to £3,000
Electrical Appliances	£2,500 to £5,000
Doors and Windows	£1,500 to £4,000
Living\ Dinning\ Kitchen\ Bed room Furniture\ Infra structure	£9,000 to £ 23,000
Personal Items	£2,000 to £3,500
Cleaning and Repairs	£4,000 to £6,000
Others	£2,500 to £3,000

Table 2 shows how diverse the costs are for resendential and commerical properties and how difficult it can be to estimate flood damage costs per house/building/infrstructure. These values have been set from minimum to maximum costs for a particular item, i.e £2,500 (minimum) to £23,000 (Maximum). From table-2, summing the total maximum (£47,500) and minimum values (£23,000) enables the derivation of an average damage cost per property, which can be factored for the total number of properties at risk. This is currently estimated at 6 million and flood damge costs for properties are compared with and are different from ABI (Association of British Insurers) results,which are between £20,000 and £40,000 for single property.If floods affect the whole United Kingdom at once, the cumulative costs for properties are £211 billion.

$$\left(\frac{£23{,}000 + £47{,}500}{2}\right) X\ 6000000 = £211\ billion \qquad (2)$$

However, approximately (on average) 40,000 properties (0.6%) are affecting by (major/minor) floods every year, which means UK annual average damage costs for properties are £1.4 billion.

$$\left(\frac{£23{,}000 + £47{,}500}{2}\right) X\ 40000 = £1.4\ billion \qquad (3)$$

Damage costs/losses were evaluated for only residential and commercial properties; Indirect and secondary impact costs were not included in this assessment.

Destruction Costs Impact on GDP and Local Economies: Results have shown that UK property destruction costs are £1.4 billion, but this is a fraction of the UK GDP (which is currently £1.6 trillion). Furthermore, whilst the range of costs according to ABI is between £20,000 and £40,000, this research shows them to be underestimated by between £3000 and £7,500 per property, resulting in a total £210 million underestimation of damage costs. Although, flood damages represent only 0.1% of the national GDP, they are significant to local economies[1] and will continue to suffer for longer periods. Consequently, UK property destruction costs have fiscal impacts on local economies but do not have the same effect on the national

economy. However, major infrastructure damages, e.g. bridges, fatalities and environmental degradation linked with flooding events are not included and these could have a more significant effect on national GDP. Future work will look into these aspects.

Conclusion

This paper described the on-going development of a mechanism/tool to allow assessment of residential and commercial properties damage costs during United Kingdom flooding events. It was established using a combination of cm and m scales with distinct coloured bands representing codes for flood water level intensities. Comparatively simple to use, the underlying methodology has been mathematically based and refined. It was shown that annual average UK damage costs to properties during flooding events are £1.4 billion. These significantly affect local economies but do not have the same proportional national impact. Research indicated that original estimates had been underestimated and the new approximations provide a more realistic assessment. Based on aforementioned research, property damage costs do not currently adversely affect GDP, but if flood risk planning and protection measures are not improved, socio-economic costs will significantly affect national GDP over next 100 years.

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