

# A CRITICAL SYNTHESIS OF THE INDIRECT TANGIBLE IMPACTS OF FLOODING ON HOUSEHOLDS

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The impact of flooding on households has been witnessed by an increasing number of UK residents in the last decade. Previous studies in the UK and internationally have identified a wide variety of economic, social and environmental impacts both tangible and intangible, usually during the flood alleviation appraisal stage at Governmental level. The tangible impacts of flooding on households are both direct and indirect in nature. Direct impacts are the impacts caused to buildings and their contents as a result of physical contact of flood water on properties, whereas the indirect impacts occur as a further consequence of the flood and the disruptions of economic and social activities. Most previous studies have focussed on the direct tangible impact of flooding on households largely due to the fact that there are difficulties in accounting for indirect and non-monetary impacts of flooding on households and because this is usually a low priority in the post-disaster recovery effort. This review seeks to identify in detail the indirect tangible impacts of flooding on households, towards contributing to a wider understanding of the tangible impacts of flooding on householders at the individual property level. The review highlights that the indirect tangible impacts have the potential to affect wider communities rather than the flooded households alone, therefore making these indirect impacts an important consideration when considering the true impact of flooding. The review also revealed that since most of the indirect impacts are not insurable, the bulk of the indirect tangible costs of flooding are borne by householders. These findings indicate that there is a need for further research towards improving the assessment of these indirect tangible impacts for the purpose of developing a comprehensive flood mitigation appraisal tool to be used at property level.

Keywords: direct impacts, flood, households, indirect impacts, tangible impact.

## INTRODUCTION

Flooding has long been recognised as one of the World's most damaging and costly natural hazards (Zevenbergen and Gersonius, 2007). It is increasingly accepted that flood events are likely to become more frequent and severe in the future, as a result of climate change and sea level rise (Evans *et al.*, 2004, Parker *et al.*, 2005, Environment Agency, 2007; Pitt, 2008), together with land use changes and urban development. However, determining the precise effects of these changes remains difficult in practical terms. In the UK, flood management policy has traditionally favoured technological solutions to hazard reduction and focussed primarily on the construction of hard-engineered defences. Brown and Damery (2002) argued that the long-term

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sustainability of flood defences should be questioned in the light of climate change and floodplain development pressures.

Following a series of destructive floods across parts of England and Wales (2000, 2002, 2004, 2005, 2007, 2009 and 2010) flood risk management in the UK has undergone a series of radical reviews (Institution of Civil Engineers Learning to Live with Rivers, 2001; DEFRA Making Space for Water, 2005; and the Foresight Project Future Flooding, 2004). These reviews have proposed less reliance on hard engineering solutions such as flood defence and a move towards adaptation and resilience to flood risk. Evans *et al* (2004) stressed that there is a need for a conceptual shift in which flood risk management relies less on Government intervention and more on an acceptance of individual responsibility; and for individuals to accept responsibility for managing flood risk at property level, there is a need for full understanding of the impacts of flooding on households in terms of both the tangible and intangible impacts.

The tangible impacts are those that can be assessed in monetary terms, while the intangible impacts are those that cannot readily be valued but can be described in qualitative or quantitative terms such as health effect (Tapsell *et al.*, 2002, Environment Agency and DEFRA, 2004, Proverbs and Soetanto, 2004). The tangible impact of flooding can further be categorised into direct and indirect impacts (Messner and Meyer, 2005). Direct tangible impact of flooding covers all varieties of damage which relate to the physical contact of flood water with damageable property, such as damage to building fabrics. The indirect tangible impacts are those caused by disruption of physical, social and economic linkages of the economy. Typical examples are the loss of economic production due to destroyed facilities; lack of energy and telecommunication supplies; and the interruption of supply with intermediary goods.

Assessing direct tangible impacts has received greater attention in the aftermath of flood events as these are more apparent and relatively easy to quantify. Quantifying the indirect impact of floods on households has always been more elusive and problematic in post-flood appraisal due to the fact that these indirect impacts are more difficult to encapsulate. Nevertheless, the tangible impacts of flooding on the society still dominate the decision making around flood alleviation / mitigation investments (Environmental Agency, 2010), but with little or no attention paid to the indirect tangible impacts, at the household level and possibly at the community level. The inference of this is that the true benefits of flood alleviation measures cannot be established without considering the indirect tangible impact of flooding on households. This explains why the take up of property level flood adaptation is still low among the floodplain residents. Based on this gap in the knowledge base, this review is primarily concerned with exploring the indirect tangible impacts of flooding on households based on an extensive review and synthesis of extant literature. The paper discusses the tangible impacts of flooding on households and identifies the indirect tangible impacts of flooding. It then discusses the assessment of the indirect tangible impacts of flooding and concludes by stressing the need for further research in the area of quantifying the indirect tangible impacts of flooding.

## **TANGIBLE IMPACTS OF FLOODING ON HOUSEHOLDS**

The most visible and obvious impact of floods upon households is the physical damage to contents and the fabric of the building, these are termed direct impacts, which may or may not result in financial loss to the homeowner, such impacts are;

physical damage to building, cost of replacing damage contents. However, there are other more indirect impacts, which are often overlooked (Green *et al.* 1983 cited in Messner *et al.*, 2007). These indirect losses are generally associated with disruption to the 'normal' course and quality of life and include such issues as increase in travel costs due to living in an alternative accommodation, loss of income and loss of utility supplies.

The actual economic impacts of flooding on households are damage generated by a specific flood event, and these represent a driving force that stimulates politicians to strengthen flood policy measures following the occurrence of flood event. Ahern *et al* (2005) argued that the impacts of flood on health, livelihood, and infrastructures vary between populations for reasons relating to population vulnerability and the type of flood event. The tangible flood impacts can arise from almost any source of flooding, including tidal, fluvial as well as from surface water runoff and ground water and combinations of these sources. To keep to the theme of this paper, only the indirect tangible impacts of flooding on households are explored in detail in the subsequent sections.

## **INDIRECT TANGIBLE IMPACTS OF FLOODING ON HOUSEHOLDS**

Indirect tangible impacts (ITI) of flooding comprise damage, which occurs as a further consequence of the flood and the disruptions of economic and social activities. This damage can affect households who may not have been affected directly by the flood. Examples might include the loss of economic production due to destroyed facilities, lack of energy and telecommunication supplies, financial loss, potential for increased insurance premiums, and short-term loss of house values, particularly if homeowners decide to sell their properties immediately or soon after the flood event.

Indirect impacts can also occur as a result of tax increase or payment of levy. A typical example is the recent flood event in Australia (2011), it where was reported that the Australian Government has decided to levy every households \$5 (Australian dollars) in order to finance the recovery process. Other examples are the loss of time and profit due to traffic disruptions (Watts, 2009/2010), disturbance of markets after floods (e.g. higher prices for food), reduced productivity with the consequence of decreased competitiveness of selected economic sectors or regions and the disadvantages connected with reduced market and public services. For instance, the summer 2007 flood event affected many parts of the UK and caused damages of approximately £674 million to important national infrastructure. The floods also caused substantial disruption to the operation of many essential services (Chatterton *et al.*, 2010).

The indirect impacts of flooding on households are outlined below and discussed in the subsequent sections:

- Disruption of daily life and normal activities (such as damage to communications networks)
- Increase travel costs
- Financial loss / loss of income
- Increase in insurance premiums / loss of no claim bonus
- Potential for reduction in property values
- Loss of utility supplies (e.g. electricity)

### **Disruption to daily life and normal activities**

Research suggests that disruption to family life is the most difficult aspect of flooding to deal with (ABI and NFF, 2004). The prime function of investment in flood defence measures and the management of flood risk and floodplains are to protect people, property and precious environments from the damage and disruption that floods can bring. Tapsell *et al* (2002) found that disruption to daily life was one of the main issues raised by flood affected householders. Many were said to have been very upset at the loss of treasured possessions and the disruption of their daily routines.

Further, flooding has a potential to reduce spending power or to impose financial loss on households. If it is necessary to relocate during a flood and subsequent restoration then housing costs can amount to a substantial expense that may often be covered by insurance for those victims who are insured. However extra transport costs, and increased living expenses resulting from the inaccessibility of the normal amenities of home are harder to quantify and will probably be borne by the flood victim. Some households and businesses are not insured or underinsured. An informal survey in Lewes, Sussex UK showed that 15% of residents were underinsured by £5,000 to £20,000 (Kenney *et al.*, 2006). Thereby when they are faced with flood event, they will have to bear the costs of complete restoration of their properties.

### **Increase travel costs**

The occurrence of a flood event have a serious impact on the transport network (Arkell and Darch, 2006). A research on transport network reliability and resilience to disasters demonstrates that a disruption to a particular section of road network can have a degrees of disruption throughout (Sakakibaral *et al.*, 2004). The implication of this is that other regions within the vicinity of the flood area may be affected. In the specific case of flooding, the disruption can affect large continuous areas of the street networks. The impact of this on households is an increase in travel costs.

For example, during the 2009 flood event in Cockermonth UK, six bridges were reported to have been washed away by flood water (Watts, 2009/2010). The loss of bridges meant that people had to find alternative routes to get to their destinations (such as work, school, and shops). It was reported that the alternative routes could add as much as 55 miles per journey on a daily basis for some residents, which equates to approximately extra travel costs of £8.25 per trip (assuming a conservative assessment of 15p per mile). This had a massive impact on the already strain resources of local businesses and households in general.

### **Potential for an increase in insurance premiums / loss of no claim bonus**

Floods account for approximately one third of economic losses Worldwide from all natural disasters, but only about 10% of economic insured losses because, in many markets, flood cover is conservative or unavailable (Kenney *et al.*, 2006). In the UK, flood insurance is offered as part of the household domestic insurance policy and is provided entirely by the private insurance market. Wordsworth *et al* (2005) found that several major insurers had started to link flood risk to postal codes and many have started to set premiums on that basis. According to the ABI, currently where the level of flood risk is known, insurers are increasing premiums to more accurately reflect the risk (Thurston *et al.*, 2008). This is somewhat contrary to the state of affair in the past decade where a premium rising is normally as a result of direct effect of claiming under the insurance policy.

Of course, not everyone is insured, and those who claim under their insurance policy may face an increase in premiums (Thieken *et al.*, 2006) or refusal of renewal (Elliott and Leggett, 2002). Mitchell (2006) raised his concern that, despite the ABI's assurances, in areas of flood risk, securing adequate insurance cover is becoming increasingly difficult. In contrast to Mitchell's concern, Lamond (2008) found that the variation in insurance premium rates for low, moderate and significant risk areas was not significant. Further, Lamond and Proverbs (2009), in their survey of the flood insurance market from the consumer's point of view found that availability of insurance is still strong in both at-risk and previously flooded locations, and this was attributed to the competitive nature of the UK insurance market and households shopping around to gain cover. It can be concluded that there is no significant difference in the long run average premium charged for flood insurance whether properties are at risk or not, though, a minority of flooded households may experience large increases, and others may lose their no claim bonus thereby experience some increase in their premium.

### **Potential for reduction in property values**

A flood event in a particular region / area may adversely affect the value of a residential property, depending on the local property and the particular property in question. (Wordsworth *et al.*, 2003) showed that this may typically involve a temporary discounted value of some 12%, but depends very much on the individual circumstances of the property. (Wordsworth *et al.*, 2005) found that the ability to obtain buildings insurance cover, and the nature of any conditions attached, will be key determinants of value and saleability of a particular property which is located in a floodplain area.

Inevitably, houses in the worst category, are those where no defence improvements are planned, such households may face the situation that insurance cover is withdrawn or maintained at a penalising premium rate (Elliott and Leggett, 2002), thereby severely restricting the ability to sell such property (Lamond, 2008), because it would either be expensive to obtain cover for such properties or may be practically impossible to obtain cover.

The results of RICS Foundation commissioned research showed that a recent flood event adversely affects the value of a residential property, though the degree of discounting is not consistent between valuers, and depends on their personal perceptions of the local residential property market and the particular property in question (RICS Foundation, 2004). Further, (Samwinga *et al.*, 2004) reported that homeowners interviewed expressed concern regarding the potential reduction in property values due to flooding. However, Lamond (2008) concluded that in most cases there is no long term loss of property value due to flooding in the UK, the loss of value may appear to be temporary in nature (i.e. immediately after the flooding). These will only affect homeowners who decide to sell their properties immediately after a flood event or who may want to borrow money against the property. Studies have shown that flood event can trigger temporary property value loss. Further, the loss of value can be a paper rather than actual loss, however, it is still widely believe that there is a potential for discounting value of floodplain properties, this is as a result of negative effect of media coverage or report as part of post flood recovery phase.

### **Loss of utility supplies (e.g. electricity)**

It was reported that the summer 2007 flood event caused damages of about £674 million to important national infrastructure and the operation of essential services.

Total damage costs were greatest, in order of magnitude, for water supplies and treatment, roads, electricity supply, agriculture and schools (Chatterton *et al.*, 2010). For example 140,000 houses were without clean water for up to 17 days in Gloucester during the summer 2007 flood event in the UK. In the electricity sector, supply companies borne only 6 per cent of total costs whereas consumers incurred 94 per cent of total economic costs due to loss of value associated with disruption of supply. For instance, approximately 40,000 addresses were temporarily without power in Carlisle in 2005 flood event (Cabinet Office, 2010), further, 42,000 homes were reported to have been without power in Gloucester for up to 24 hours in 2007 flood event. The greatest estimated cost for power utilities is associated with the impact of deprived supply to customers and losses incurred due to restriction in the value derived from using power, over and above the price normally paid for it. The loss of these important and essential amenities increases the stress and disruption of flood event on households. However, these indirect tangible impacts of flooding on households require assessment of costs for the adoption of effective flood mitigation or preventative measures.

## **ASSESSMENT OF THE INDIRECT IMPACTS OF FLOODING**

(Penning-Rowesell and Chatterton, 1977) produced a Manual of assessment Techniques which provided detailed synthetic stage-damage curves for both residential and commercial property in the UK. These data are used extensively to assess flood damage and provide an essential input into cost benefit analyses of flood mitigation options. The data have been revised over the years and are available in (Penning-Rowesell *et al.*, 2010). However, the set up of the stage-damage curves does not include data on the indirect tangible impacts / losses.

Conceivably, assessing the actual impact of a flood event by only considering tangible flood damages, i.e. direct tangible losses by using the stage-damage curves, would usually not give fair and accurate assessment. It would probably arrive at misleading messages to policy makers about the true impact and consequences of a flood event on households. It could be argued that the intention of economic analysis through the use of stage-damage curves as part of a flood loss assessment is to assess the deviation from likely economic activity as a result of the flood, not to take into account the financial losses to individual or communities. For instance, insurance companies mainly interested in the direct tangible impacts / losses of flooding and their relation to the total insured value of the damaged object, while, householders on the other hands are more interested in the indirect tangible impacts of flooding as in most cases these impacts are not covered under the household's insurance policies.

Traditionally, indirect impacts/losses, essentially due to disruption caused by the flooding rather than the 'direct' effects of floodwaters, have been estimated as a fixed proportion of direct impacts/losses. That is they too; rely on stage-damage curves of direct damage. The study by (Parker *et al.*, 1987) and (Penning-Rowesell *et al.*, 2005) provide a detailed review of method and new insights for estimating indirect economic losses, however, these methods only examine the national indirect economic impacts/losses. It was concluded in Penning-Rowesell *et al* (2005) that the national significance of indirect impacts of flooding is small, this is attributed to the fact that the trade lost by the affected premises simply forms extra income for those located elsewhere, thereby showing little or no effect on the national economy.

While, this can be true when considering the indirect impacts of flooding on the national economy, it is not true when considering the impacts on households and

communities because the extra expenses brought about by the flood event in most cases cannot be transferred to other people or through insurance policies. It is against this backdrop that it is suggested that there is a greater need to develop an assessment method which specifically considers the indirect impacts of flooding at property-level.

## CONCLUSIONS

The occurrence of a flood event brings about a range of tangible and intangible impacts. The results of a thorough review of the literature related to the tangible impact of floods on households indicated that both direct and indirect impacts of flooding are of utmost importance in the assessment of the full impacts of floods on households. However, it transpires that only the direct impacts are normally considered when assessing the impact of a flood event, while the indirect impacts are given little or no attention. Nevertheless, these indirect impacts are as important as the direct impacts particularly to homeowners.

The review highlights that the indirect tangible impacts have the potential to affect wider communities rather than the flooded households alone, therefore making these indirect impacts an important factor when assessing the impacts of flooding on households. Further, these impacts are being underestimated during the post-flood disaster recovery stage because they are more difficult to quantify. The research challenge based on these findings is that there is therefore a need for further research towards improving the assessment of these indirect tangible impacts for the purpose of developing a comprehensive flood mitigation measure appraisal tool to be used at property levels.

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