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Examining the social consequences of extreme weather: the outcomes of the 1946/1947 winter in upland Wales, UK

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Abstract Extreme forms of weather are predicted to become more frequent experiences in the future. However, the hardest event to mitigate against is the unexpected. In the UK, the occurrence of winter snowfall is difficult to predict, highly variable, both spatially and temporally and predicted to become less common in the future. This paper examines the consequences of the severe winter of 1946/1947 at the local scale through a Welsh case study of Cwm Tywi, a community of upland sheep farms. This community had shown great resilience during the snowiest winter on record in comparison with other, more urban communities, but the inhabitants eventually abandoned their homes because of the emotional distress caused by the loss of a large proportion of the livestock. In addition to the severity of the snow, perceptions of the extreme nature of this event and the community's ability to mitigate as a result of rurality, self-sufficiency and remoteness are investigated through the analysis of interviews, oral histories, and other documentary accounts. This case study provides an insight into the complexity of understanding vulnerability, adaptation and resilience, which are temporally and spatially specific.

1 Introduction

Extreme weather is by its very nature rare, challenging to forecast and difficult to model. Whilst extensive research has been undertaken to determine present and future consequences of climate change, the identification of extremes remains problematic. Since Manabe and Wetherald's first climate model (Manabe and Wetherald 1967), global models have continually been improved. Current models predict extreme meteorological conditions to "become more frequent, more widespread and/or intense during the 21st century" (IPCC 2007: 17). However, the spatial and temporal extent of these occurrences are difficult

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to determine, as such the value of examining extreme weather and its consequences in the near and distant past has increasingly been recognised (e.g. Alexander et al. 2009).

It is difficult to adapt and mitigate for the unexpected, particularly as a population's unfamiliarity with extreme weather will increase their vulnerability to it e.g. being unaccustomed to snow and ice. For example, December 17th, 2009 brought a prolonged period of low temperatures and (comparatively) large amounts of snow to the United Kingdom (max. 57 cm of lying snow, reported from Westgate, County Durham on 7th January) (Met Office 2010a, b). The duration and severity of the low temperatures resulted in the coldest winter since 1978–1979 (Eden 2010a), with the mean January temperature for most of the UK ranging from 2.5 to 3.0°C below the 1971–2000 norm (Eden 2010b). The population was unprepared for this period of extreme weather, and this led to special news reports being transmitted, sporting fixtures being cancelled (Guardian 2010) and guides produced to inform people on how to cope with the snow (e.g. BBC News 07/10/2010a, b). This recent example of unfamiliar and prolonged weather conditions illustrates the way in which rarity (i.e. extremeness) is pivotal to the perception of the level of risk present.

The consequences of extreme weather may be different for each individual, depending on a number of factors, which are all informed by cultural and historical experiences. This view is echoed by climatologists, such as Hulme, who suggests the use of climate change "as a magnifying glass and a mirror" (2009: 362), as opposed to considering it as explicitly physical and global. There is a need for local case studies that examine complexities which are not apparent on a larger scale. Additionally, Mauelshagen and Pfister (2010) propose that case studies from the nineteenth and twentieth centuries should provide the most useful insights into social responses to climate variability, as they include a greater variety of sources of information than earlier periods.

In this paper, we examine a small-scale example from the uplands of Wales, UK, during the winter of 1947, using an in-depth narrative to explore the social consequences of an extreme weather event. Cwm Tywi (the upper Towy valley) provides an excellent opportunity to focus on four key themes: i.) perceptions of extreme events among the community of Cwm Tywi; ii.) the way in which the community has experienced these events; iii.) the factors influencing personal adaptability and vulnerability and finally iv.) institutional response to the event . We conclude by discussing this case study and future similar meteorological conditions in terms of the wider concepts of vulnerability, adaptability and resilience (see Table 1 for definitions).

Table 1 A glossary defining some key terms as the authors intend them to be interpreted in the context of this paper

Term	Definition
Adaptability	The ability of an individual, group or community to adjust in response to severe wintry weather or its effects, to moderate harm or take advantage of opportunities.
Resilience	The ability of an individual, group or community to resist, absorb, accommodate and recover from the effects of severe wintry weather.
Vulnerability	The degree to which an individual, group or community is susceptible to, and unable to cope with, adverse effects of severe wintry weather.

2 The snow of 1947

The winter of 1946–1947 was extreme in many areas around the world (Namias 1947). In the USA, for example, low-temperature records were broken for January in Kansas, it was the coldest February in Florida since 1895, and March snowfall records were broken in states such as Virginia and West Virginia (Seamon 1947).

In the UK, a severe snow storm tracked across the country during mid January 1947, with snowfall every day somewhere in the United Kingdom from 22nd January to the 17th March; a total of 55 days (Met Office 2007). The prolonged period of cold weather was the result of a slow-moving area of low pressure near the Channel Islands and high pressure over Scandinavia, Greenland and Iceland, which maintained a very cold, mostly easterly or north-easterly, flow across Europe and into the British Isles; it resulted in one of the coldest winters in recent times (see Table 2), the snowiest winter (Booth 2007; Shellard 1968) and coldest February[1] on record. This led to a nationwide coal crisis, resulting in electricity cuts and reduced industrial production (Burroughs 1997). The atmospheric depression which arrived from the southeast on the 10th of March 1947 initially deposited additional snow before turning to rain, with the subsequent rise in temperatures causing widespread flooding across many catchments in southern and central England (Howorth et al. 1948) (see Fig. 1). Floods resulting from snowmelt were also recorded across much of Europe (Spain, Poland, Germany and the Czech Republic) during the spring of 1947.

Much has been written about the meteorological conditions of 1947 and its societal implications. For example, it is argued that this severe winter caused the UK to lose its independent role as a world power and was an indirect cause of the Cold War (Kaiser 1974).[2] The extreme conditions capture the imagination, particularly following the relatively severe winter of 2009–10, and are described in a number of popular accounts (e.g. McCaskill and Hudson 2006). However, whilst considerable meteorological research was published immediately after the winter of 1947 (e.g. Namias 1947; Seamon 1947) and some recent papers have taken a retrospective look at the period (e.g. Booth 2007), there is limited academic literature pertaining to the social consequences of this winter. This is especially notable for the rural areas of the UK, such as the remote uplands of Wales.

2.1 Socio economic context

The post-World War II period was one of turmoil in the UK. In 1945, a Labour government came into power, with the country in a state of military and economic weakness (Marr 2007). Rationing was still in operation and was, in fact, more stringent because of the nation's wartime debts. As a dietary indicator, total fat consumption at 33% in 1947 was 6% lower than before the war (Barker and Osmond 1986). Nevertheless, the annual mortality and

[1] having a mean of −1.9°C. From Mean HadCET Data, 1659–2011, Monthly ranked HadCET mean (Parker et al. 1992). These data can be found at http://www.metoffice.gov.uk/hadobs/hadcet/mly_cet_mean_sort.txt

[2] Kaiser (1974) argues that the 1947 snow was one of the ingredients of an enormous coincidence which resulted in the Truman Doctrine. This is because the fuel crisis in the UK, worsened by the weather conditions, diminished the country's position as a world leader and economic strength, requiring the relinquishment of its control over Greece and Turkey. It was feared that this would lead to civil wars and a Communist takeover, eventually resulting in Soviet domination in Europe, the Middle East and Asia. The USA, through the Truman Doctrine, decided to apply its power and resources in Europe and the Near East to counteract Soviet power, and this began the confrontation which resulted in the Cold War.

Table 2 The ten coldest winters in Wales and the UK, 1910–1999[a]

	UK		Wales	
Rank	Winter	Mean (°C)	Winter	Mean (°C)
1	1962–63	−0.18	1962–63	−0.33
2	1946–47	0.87	1946–47	1.12
3	1978–79	1.17	1916–17	1.19
4	1939–40	1.25	1978–79	1.64
5	1916–17	1.37	1939–40	1.78
6	1928–29	1.53	1928–29	1.95
7	1940–41	1.82	1940–41	2.33
8	1950–51	2.03	1950–51	2.71
9	1941–42	2.08	1981–82	2.72
10	1981–82	2.12	1984–85	2.73

[a] Winter = December–February. Data used are for Mean Temperature from http://www.metoffice.gov.uk/climate/uk/datasets/

infant mortality rates improved after the war (Ibid.), and a post-war 'baby boom' increased the birth-rate to 20.7 per thousand in 1947 (Marwick 1990). Furthermore, the demand on agricultural land increased dramatically, with the area of arable land in the UK having doubled during the war (mostly for potatoes and wheat) (Marr 2007).

In Wales, agriculture and farming incomes improved quickly, with the number of tractors reaching 13,652 in 1946 compared with 1,932 in 1938 (Davies 1990).[3] The focus of agricultural production in Wales also changed (1939–46), with a decrease in the number of sheep in all but the highest altitude areas and an increase in the area of arable land (Borchert 1948). Unemployment in post-war Wales was much lower than during the pre-war era, as many people moved across the English border to work during the war and returning soldiers also settled in England. Furthermore, the population's health in Wales reflected the general UK trend, in that it was generally better as a consequence of a fairer rationing system and newly-introduced welfare schemes, such as family allowance in 1945 (Ibid.). Therefore, Wales and the UK were in a state of economic, cultural and agricultural change immediately after the war.

2.2 Study area

The vast majority of agricultural land in Wales is classified as disadvantaged or severely disadvantaged[4] (Welsh Assembly Government). Despite the moderating influence of the Atlantic Ocean, these less-favourable conditions of production make the farming communities of Wales extremely susceptible to weather extremes.

For Welsh agricultural communities, such as Cwm Tywi in mid Wales (Fig. 2), the climate and the annual cycle of weather are important to their farming success (exemplified in studies such as Taylor 1965). Cwm Tywi begins at the source of the River Towy

[3] Note that Wales' population increased from 2,593,332 (1931) to 2,596,850 (1951) (National Statistics 2001).
[4] These are current land classifications for Less Favoured Areas (LFA) according to both natural limitations to farming (e.g. climate, location, landscape) and socio economic considerations.

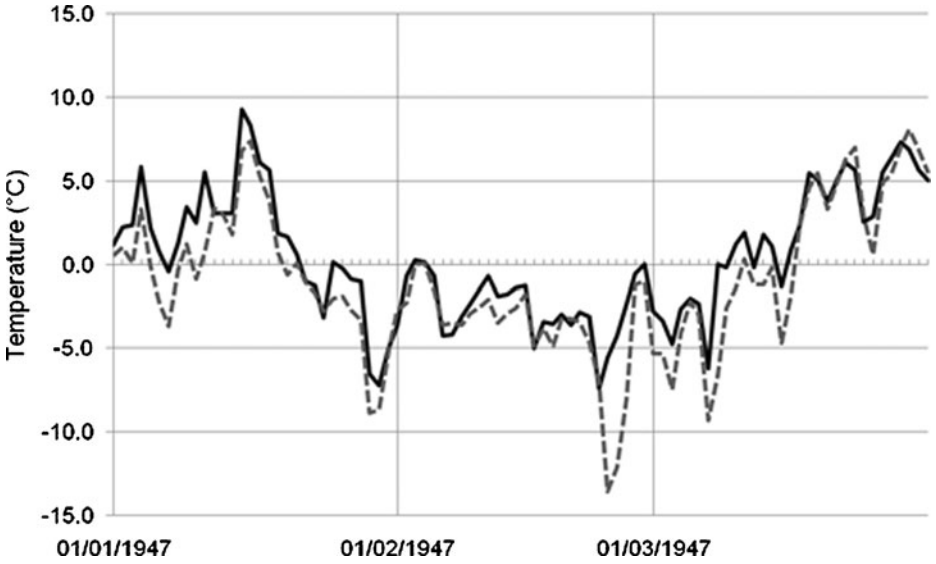

Fig. 1 Temperature during January–March 1947. Dashed line is the minimum Central England Temperature (CET) (Parker et a. 1992). Solid line is the average minimum temperature of selected stations within Wales (Aberystwyth: Corporation Yard, Tenby Priory, Haverfordwest, Rhyl and Colwyn Bay) (UK Meteorological Office 2006)

(52°15′11.08″N, 003°45′16.16″W OSGB36 Lat/Lon), which meanders down through the valley and forms the border of the counties of Ceredigion and Powys. It is a part of the Cambrian Mountains, an area otherwise known as the 'Green Desert of Wales', a description reflecting its emptiness (Howells, 2005). Today, the valley's lower reaches are flooded as part of the Llyn Brianne Reservoir and the area is densely planted with coniferous trees, being primarily owned by the Forestry Commission. However, in 1946, the valley landscape was very different; sustaining seven families in traditional open upland sheep farming. The sheep were their livelihoods and a system of labour exchange was employed during important farming events (i.e. when workers from neighbouring farms and from far afield went to work on a farm during a key agricultural event, such as shearing), the chapel (Soar-y-mynydd, up to 15 miles away) and the small town of Tregaron (approximately 10 miles away) ensured social interactions despite the community's remoteness.

Cwm Tywi can be perceived as a 'vulnerable community' because of its remoteness and high dependency on agriculture in a challenging environmental context. Furthermore, Cwm Tywi illustrates a community completely transformed by a period of extreme weather; the valley was progressively abandoned as each family vacated their farmstead following the severe winter of 1947.[5] The 1947 snow is perceived to be, by former residents of Cwm Tywi, the main reason for its desertion. As such Cwm Tywi provides an excellent example in observing the internal processes which highlight the resilience or vulnerability of a sector of society during the stress of extreme weather.

[5] The first farm, Nant-Neuadd, was vacated in 1947. The last farm, Dolgoch, was vacated in 1967. During that period, the family at Dolgoch experienced the departure of the families of Y Fanog (pre-1950), Tywi Fechan (1950), Nant-ystalwyn (1955), Bron-yr-Helm (1956) and Nantyrhwch (1960) (Jones 2007).

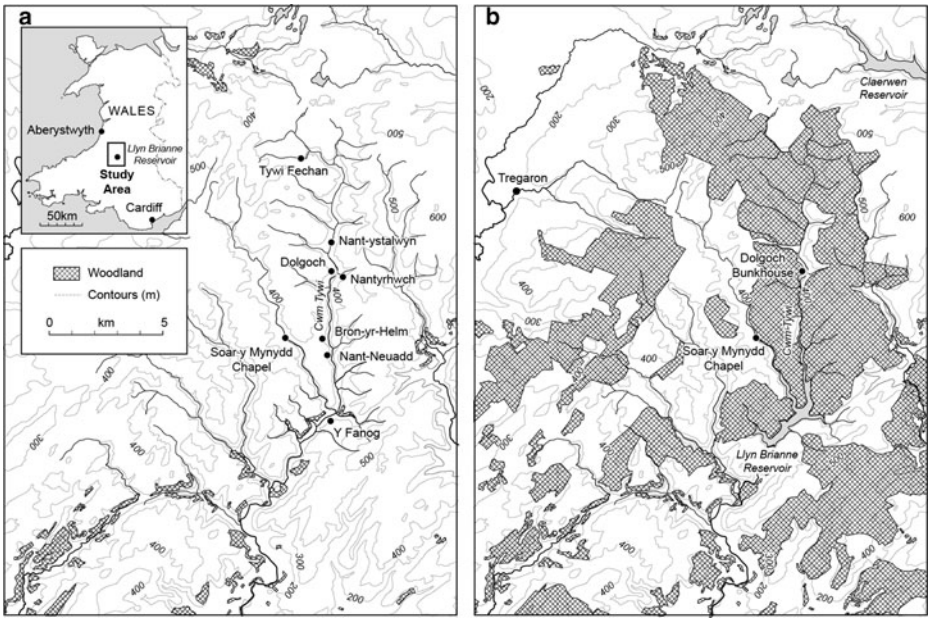

Fig. 2 Maps of the study area of Cwm Tywi. Map a) is derived from the 1931–1935 Land Utilisation Survey of Britain, showing the locations of the seven farmhouses. Map b) shows the area at present

3 Methods and approach

In order to understand the relationships between the residents of this part of upland Wales and the outcomes of the meteorological conditions of the 1947 snows, a variety of documentary sources have been investigated. Compared with extensive investigations on social responses to climate variability in other regions such as North America and Eastern Europe (e.g. Endfield et al. 2004; Pfister and Brázdil 1999) and indeed elsewhere in the British Isles (e.g. Parry 1981), the potential of documentary sources in Wales has remained largely untapped (Macdonald et al. 2010). Documentary sources include newspapers and personal collections such as diaries, memoirs and correspondence (both published and unpublished). It was decided to concentrate on one newspaper, the weekly *Welsh Gazette*. A complete collection of its publications, from 1899 to 1964, is available on microfilm at the National Library of Wales (NLW), Aberystwyth. This newspaper contains reports in both English and Welsh and includes a large amount of local-interest content. The large collection of archival texts used, which include diaries, poems and memoirs, have been donated to national archives, such as the NLW, however some are only accessible through family consent. Requests for the anonymity of authors of non-published documents have been met, and noted in the footnote reference.

Because of the relatively recent timing of the 1947 snow, a number of individuals in the region are still able to recall this period in their lives; “There are many people alive today whose memory [of] every hour of this [1947] storm is painfully etched, because of its severity and hardship” (Howells 2005: 66–67). The inclusion of semi-structured primary

interviews enables us to collect direct answers to specific questions which are difficult to glean from documentary accounts, such as emotions and retrospective perspectives. Primary interviews with surviving family members and those in the surrounding area were conducted, many of whom were either children or young adults in 1947. Primary interviewees have been anonymised. A large proportion of the interviews were conducted in Welsh, as is the case for many of the secondary radio and television programmes which augment the analysis of primary interviews.

Secondary interviews were viewed and transcribed at the National Library of Wales (NLW), which holds the National Screen and Sound Archive of Wales, and the BBC archives in Cardiff. These are interviews previously broadcast on radio and television programmes which were not conducted by the authors. These interviews were conducted for a variety of broadcasts and by different interviewers. Consequently, the interview questions were not asked specifically for this research, but inadvertently include relevant information. The broadcast dates of these programmes range from 1947 (for official radio announcements and eyewitness accounts during the snow) until 1997. Additionally, a more recent resource is the digital story, 'The Valley by Bryn Hughes', and its transcript which is part of the on-line NLW project, 'From Warfare to Welfare, 1939–1959'. The project is a collection of digital stories which were created by secondary school children (age 11–16) and youth organizations, and combine narrations with photographs or documents.

Archival material and interviews present information as a personalised source of material, which reflects the memories of an individual in a specific place and time. Personal sources enrich newspaper accounts and official documents by providing individual experiences, but are much scarcer because of their personal nature. Whereas official documentation may only provide an overview of the general effects of adverse weather, personal accounts can, in addition, provide memories and thoughts which may reflect a community perspective or a personal one. Oral histories, for example, are a recognised method for uncovering 'hidden histories', giving a voice to the previously unheard individual (Riley and Harvey 2007). Bringing additional narratives to the fore, whether spoken, written, or published, can only add to our understanding of that history.

The contents of the documentary sources and interview transcripts were coded manually. This method was chosen in order to retain an overview and familiarity with the data, which may be lost by more rapid electronic approaches. Where quotations have been translated from Welsh into English, this has been noted. All translations not by C. A. Jones have been otherwise acknowledged.

4 Results and analysis

The various sources identified above were used to investigate the effects of the severe winter of 1947 on the inhabitants of Cwm Tywi. From the analysis of primary and secondary accounts a number of themes can be identified which are explored below.

4.1 Perceptions of extreme events

The people of Cwm Tywi were prepared for the winter of 1947. This is a result of their perception of a comparatively high probability of heavy snowfall occurrence which led to a desire to be prepared for each winter. This is explained by Mrs. Davies in an interview held in the NLW.

> **Mrs. Davies:** … You made sure now, if you went to fetch linen, you didn't think of going to the shop to fetch it, you went to the drawer in the house to fetch it. You made sure they were there already. Well the same for groceries then. Cart went about once a month. But now the winter comes and you had to make sure you had flour—until mid April at the least. And everything. You made sure, box of tea. Fifty. If possible, about 50 to a hundred of sugar. Enough over the winter. And the pigs put in the loft. And we didn't go down from Cwm Tywi especially to fetch meat … for Sunday. Maybe fetch them on Tuesday. It was just as acceptable.
> **Dafydd** (interviewer): And you kill a pig at the beginning of winter then?
> **Mrs. Davies:** Yes, beginning of winter, before the beginning of the rough weather.[6] (Translation)

A similar view was provided by Bryn Hughes, from the same county of Ceredigion, in his digital story, "Perhaps you'd think there was a problem then, that we'd starve, but everyone had enough food. Everyone had stocked up. That was the way food was kept in those days: there was a room in every house, a cold room"[7] (Translated from Welsh as a part of the digital story production). This exemplifies the way in which an increased perception of the probability of occurrence of snow can lead to a greater awareness of the need to mitigate the effects.

The frequency and severity of snowfall in Wales is greatest within the uplands (Met Office 2009). As such, the perception of the probability of the occurrence of snow is more acute in these areas. Being more accustomed to experiencing regular snowfall, the desire and general ability of residents to mitigate the effects is greater. In addition, the individual perception of rarity would depend on the person's age, i.e. whether they lived through many similar extreme periods.

During the 1940s, there were five severe winter months (months with mean temperatures less than 2.0°C), compared with only two in the 1930s (see Table 3). Two very severe winter months (months with mean temperatures less than 0°C) were had in the 1940s, namely January 1940 and February 1947, conditions which had not been experienced in the previous three decades (see Table 4), with 1939–40, 1940–41 and 1946–47 ranking 5th, 7th and 2nd, respectively, Table 2 shows the ten coldest winters in Wales during the period 1910–1999. The severity of the first two winters (1939–40 and 1940–41) was poorly reported at the time as a result of wartime censorship, the British government being careful not to inform enemies of any weaknesses. From a keyword search of 'The Times' newspaper's digital archive, the word "weather" was only included an average of 1116 times per year during 1940–1942, compared with a total wartime (1939–1945) average of 1483 and pre-war (1925–1938) average of 4700 times per year.[8] Although the public may not have been as dependent on newspapers for weather forecasts during the wartime period, local areas experiencing harsh weather may not have been aware of similar, or fairer, conditions nationwide. The areas most likely to have experienced the worst conditions

[6] Davies (c.1960–70s) Mrs Davies of Cartref, Pontrhydfendigaid: Memories of Soar y Mynydd. National Library of Wales Screen and Sound Archive, Copy RM 6303 Disc 2 62

[7] Hughes B (2009) The Valley. From Warfare to Welfare 1939–1959. Created by Cadw Sŵn Theatre Company. Recorded 7 June 2009. http://www.myglyw.org.uk/index.php?id=3863&L=0. Accessed 10 August 2010

[8] This deficit would also incorporate the lack of wartime weather forecasts. During a state of emergency no newspaper was allowed to carry weather forecasts (Air Ministry 1954). The restrictions were removed on the 8th of May, 1945, with the first forecast in the Times appearing on the following day: The Times (09/05/1945) Weather News Again. Forecast to-day: Warm and thundery

Table 3 The distribution of severe winter months for each decade, 1910–1999[a]

	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s
UK	3	3	4	6	7	6	6	6	2
Wales	3	3	2	5	3	4	2	5	1

[a] 'Severe winter months' are taken here to be months with an average temperature of less than 2.0°C. Data used are for Mean Temperature from http://www.metoffice.gov.uk/climate/uk/datasets/

during the previous winters were the uplands, whereas the lowlands may have been comparatively unaware without experiencing these cold snaps directly. And although cold, the war years were not as snowy; 1947 being the snowiest on record in the UK[9] (Shellard 1968).

Similarly, an improved awareness of the probability of the occurrence of severe wintry weather may also be the result of memory. Attempting to characterise memory is challenging. Some research has been undertaken by Tobin and Montz (1994) in relation to flood memory, but little has been undertaken in relation to the memory of weather severity. Eden (2008) wrote that "once a [weather] phenomenon has reached 2 years old it seems to fall out of the human memory bank" (Eden 2008: 4). The length of memory within upland regions, such as Cwm Tywi, could be much longer for a number of reasons. "When people talk about the weather, one of the topics that is discussed most frequently is memory of past extreme weather events" (Harley 2003: 115). The 'memory' of a period of extreme weather may live in the minds of Welsh farmers for longer. Storytelling is an important part of Welsh culture, described as 'an organic part of the joy of everyday conversation' (Gwyndaf 1992: 225) which would help to keep the experiences of earlier extreme winters alive. Furthermore, a farmer's memory of everyday weather would be in stark contrast to that of an indoor city worker, insulated from the experiences of seasonal change (Hitchings 2010), a result of a farmer's close proximity and dependency on the weather. For these reasons, the residents of Cwm Tywi's enhanced memory of pre-1947 wintry winters may have given them the perception of a higher probability of the occurrence of snow.

4.2 Experiencing severe events

The severity of any event significantly increases the consequences. The severity is informally defined according to its risk of major damage, serious social disruption and loss of human life (WMO, 2004). The snow of 1947 was unprecedented; being the snowiest on record (Shellard 1968). Even the cries of "I've seen it worse than this" (referring to 1895) by an elderly man on the uplands of mid Wales were muted by 1947 (Howells 2005: 67). This same sentiment is echoed by Mrs. Davies:

> **Dafydd**: How was it in winter when there were winter storms and things?
> **Mrs Davies**: Well [um…], now 1896 was a hard winter. About two Sundays were without a service at Soar [y Mynydd Chapel] … but there were many more [Sundays] in 47.

[9] According to the most number of days with snow depth of 6 cm or more at selected stations, as calculated by Shellard (1968)

Table 4 The distribution of very severe winter months for each decade, 1910–1999[a]

	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s
UK	0	0	0	4	1	2	1	1	0
Wales	0	0	0	2	1	2	0	1	0

[a] 'Very severe winter months' are taken here to be months with an average temperature of less than 0°C. Data used are for Mean Temperature from http://www.metoffice.gov.uk/climate/uk/datasets/

Dafydd: That's the biggest storm you remember?
Mrs Davies: Oh yes. 47 and 1814 was the biggest they remembered before that.[10] (Translation)

This sentiment is taken even further by a BBC reporter, who believed there could never be such a bad winter again, "When your grandchildren complain about the weather, 'Huh, my dear boy or girl. What are you grumbling about? This is nothing compared with the winter of nineteen hundred and forty-seven'."[11]

The risk of loss of human life and financial damage caused directly by snow is smaller than other extreme occurrences such as droughts and floods. For example, not a single snowstorm which was not associated with floods and/or high winds is included in the list of USA Billion Dollar Weather Disasters for 1980–2009 (National Climatic Data Center 2009). This is, presumably, especially so in the UK and Wales as a result of the relative temperate nature of their weather and climate. Apart from the potential flooding resulting from snowmelt such as in 1783/84 (Brázdil et al. 2010), the factor which increases the severity of snow, according to the definition of severe, is serious social disruption. Cliff Michelmore, a BBC presenter, recalls this disruption, "What German bombers had failed to do in wartime, the weather was going to succeed in doing in peacetime. It just about shut down the whole country."[12]

As Mrs. Davies mentioned in the interview above, many Sunday services at Soar y Mynydd Chapel were cancelled. Although this may not seem a significant misfortune, such gatherings were integral to the social fabric of such an isolated community. The snow began to fall when the residents were on their way home from this social centre, and according to the memoirs of one resident they never thought, upon seeing fine snow falling, that they were going to be closed in for 10 weeks.[13]

The small town of Tregaron provided the residents with most of their needs, with regards to shopping and larger social events. This was, now, unavailable to them. Social interaction may still have been maintained within short walking distances; however, in the case of Cwm Tywi, social connections were severed for almost the whole of January to March, 1947.

[10] Davies (c.1960–70s) Mrs Davies of Cartref, Pontrhydfendigaid: Memories of Soar y Mynydd. National Library of Wales Screen and Sound Archive, Copy RM 6303 Disc 2 62
[11] Included as a clip in: BBC Archives, Cardiff. A Year to Remember: 1: 1947. Audio recording, duration 027m00s. BBC Radio 2 Broadcast date 10 November 1996. SCN 644/96 FT 3650. The original broadcast was a Children's Hour episode on World Affairs presented by Commander Stephen King Hall. Broadcast date 25 March 1947. BBC Sound Archive reference 9LL0008826.
[12] Presenter's recollection of 1947 in 1996: BBC Archives, Cardiff. A Year to Remember: 1: 1947. Audio recording, duration 027m00s. BBC Radio 2 Broadcast date 10 November 1996. SCN 644/96 FT 3650
[13] Anonymous (1976) Personal Memoirs. Unpublished. [anonymised upon the request of the family]

Furthermore, the system of '*cyfnewid*', which was a form of labour exchange between farmers from a large area, was temporarily broken after 1947 as a result of the smaller sheep stock numbers:

> "There was a large stock in Dolgoch before 1947. Yes yes. … In 1946, 44, 45. 85 men were shearing in Dolgoch. In 1947, 10 were shearing. … But only neighbours were there shearing in 1947. Only the neighbours. There was no point."[14]
> (Translation)

The indirect social effects of the snow lasted for much longer than expected. The snow had killed over 80% of the sheep at Dolgoch, leaving only a small number to be sheared in the following summer. The shearing was not the usual large social gathering of people from a large area, but rather a comparatively small congregation from a smaller local catchment area. The duration and intensity of the social disruption, according to the definition of 'severe', defines the snow of 1947 as one of great severity. An ability to mitigate the effects would be required in order to reduce the consequences of such severe weather.

4.3 Factors influencing personal adaptability and vulnerability

There are numerous factors that made the winter of 1947 so severe and which either increased the people of Cwm Tywi's ability to mitigate its severity (i.e. the serious social disruption) or exacerbate the situation. These are explored below and where possible comparisons drawn with other communities in Wales experiencing the same extreme weather.

4.3.1 Agricultural marginality

The main source of income for the Cwm Tywi families was from agriculture, in the form of upland sheep farming. The yearly cycle of agriculture dealt a fatal blow to British farmers in 1946–47 as the weather during the summer of 1946 was wet, notably so in August and September, exacerbating shortages of food and fodder.[15] Many farms had insufficient supplies for even a mild winter, and much of that was of poor quality (Howells 2005). According to one interviewee, "Not a lot of farming went on because I tell you the 1946 summer was so bad … so wet. If I remember correctly, there were four cows a pony and a mare in the Dolgoch house [inaudible] Dad sold the cows to men to go off for the winter – he had no food".[16] (Translation).

Even with a greater awareness of the likelihood of severe weather and a desire to mitigate the effects, their ability to do this was impeded by the inferior harvest yield of the preceding summer. This was a widespread problem, as one woman from the same county of Ceredigion complains in her diary, "We tried to sell two cows in the mart but the price was too bad: plenty of livestock for sale because of a shortage of fodder"[17] (Translation). Therefore, local neighbouring farms could not help one another by sharing animal feed, the resulting death of livestock caused additional distress to the community.

[14] Anonymous Interviewee 1 (2009) Primary interview conducted by C.A. Jones 02-03-2009
[15] Welsh Gazette (30/01/1947) Transport Grant for Hill Farmers. Aberystwyth Chronicle and West Wales Advertiser
[16] Anonymous Interviewee 1 (2009) Primary interview conducted by C.A. Jones 02-03-2009
[17] 25th February 1947: Williams E (1947) Personal weather diaries, Dolau, Pentre Bach, Lampeter, Wales. Unpublished

It was estimated at the time that a total of 4 million sheep and lambs had died in the UK (Martin 2010). The sheep in the upland hills and moors accounted for approximately 75% of the total losses (Ibid.), and thousands were lost in Cwm Tywi. In a neighbouring village, over 500 sheep were found under a drift across the River Teifi, which were "as flat as pennies" as a result of the weight of the snow (Arch 2005: 66) (Translation). Whilst the loss of these sheep represents a short-term loss, the long-term effects were explained by a former resident of Cwm Tywi. As a result of the open nature of hill farming, sheep need to be bred in their place. Sheep bought from the lowlands would be unsuitable. Therefore, upland sheep stocks had to be re-built from the surviving sheep. Consequently, not a single ewe was sold from the Dolgoch farm until 1952.[18]

4.3.2 Self-sufficiency

As indicated, the Cwm Tywi residents prepared thoroughly for each winter. This made them self-sufficient and reduced their dependency on transport in the case of meat and bread. This is also evident in other areas, for example Eirlys Jones, of North Wales, describes the effect of the post-war introduction of the rationing of bread units, which included all bread, flour and flour confectionary, and lasted from 1946 to 1948. "Up until bread was rationed nearly everyone baked and aired in the large oven. It was a very difficult thing to ration the average of a sack of wheat flour to last, so everyone got used to buying the bread".[19] (Translation). When the snow and isolation came, it made people like Eirlys vulnerable, as they were unprepared for such a requirement, reducing their self-sufficiency and increasing their vulnerability to the snow. Some, who had been accustomed to buying bread, had to resort to making their own once again, as was true of David Jones' farming family at Esgerdawe, near Llandeilo (to the south-west of Cwm Tywi), "The wind abated today and the sun came out—but the drifts remain.—Liza walked to Rhydcymerau today for yeast—fail[sic] to get bread" (Evans 2009: 41). This farmstead was close enough to walk through the snow to the nearest village of Rhydcymerau, however the rations were not considered to be enough. This is noted, once again, by David Jones, "… we had pancakes for tea today—the first now for the last 3 or 4 years—ever since the quality of flour became poor. The quality has improved,—but the present ration allowed us is hardly sufficient—every crust and crumb is devoured. For the first time we get to know what scarcity of bread means" (Evans 2009: 41).Therefore, preparing for the winter by stocking up on flour would be much more difficult and explains why, given the opportunity, even farming families abandoned the custom of bread-making for the convenience of buying bread from the local shop. In comparison, Cwm Tywi never adopted this extent of dependency upon shops because of the isolated nature of the community.[20]

Furthermore, electricity and telephone networks had not yet reached outlying areas such as Cwm Tywi. Without a dependency on operational over-head power and phone lines, the essential daily running of a household was not affected greatly by the snow. This differs from other areas of the UK which had already received electricity and

[18] Anonymous Interviewee 1 (2009) Primary interview conducted by C.A. Jones 02-03-2009

[19] Jones E (1997) Cofio Eira 1947. Fferm a Thyddyn 20:26–27

[20] For instance, 30 loaves of bread were baked for the shearing of 1943 in the old brick oven of Dolgoch. The isolation was also why the milk from Dolgoch's cows could not be sold and was for their own consumption, as it was not feasible to transport it to the nearest town on a daily basis. Bread is of a similar, perishable nature. The commute to Tregaron was not made regularly, hence they would make their own loaves as opposed to buying bread from shops (letter by Pat Walters in Jones 2007).

become dependent upon it. Power was cut to domestic homes for 5 h a day[21] and cut completely to industry[22] throughout much of the UK during the winter of 1947. There are accounts of English urban mothers struggling to complete household chores within the allocated time.[23] Rationing of electricity was a result of low coal stocks which was attributable to the adverse weather.[24] One self-sufficient village in Ceredigion had a generator in the village shop which supplied enough electricity for the shop and up to 6 other houses.[25] Alternatives to coal were used in some other upland areas to heat the houses, "We burnt all of the wood that was around the farmyard and barns and in the end we had to burn the piano. It wasn't of much worth, being all warped, but it made excellent fuel!" (Jones 1989: 157) (Translation).

A resource that was affected throughout the country was water. Many springs and most household water systems were frozen. One lady recalls, "To stop these pipes freezing we discovered from other neighbours that they got up in the night and pulled the chain to keep the water circulating so we did the same".[26] It has been argued that it was the winter of 1947 which "gave the water wheel its pension" (Arch 2005: 67) (Translation) as it failed to perform its usual tasks, such as milling, because the water was frozen and the wheel unable to turn. In the following October, Charles Arch's family bought an oil engine, and a tradition was lost (Ibid.).

4.3.3 Remoteness

Cwm Tywi was completely isolated during the snow. Each farmhouse in Cwm Tywi was up to 4 km from the next, and the valley over 10 km from the nearest town (Tregaron). A resident shepherd of the area said that such remoteness is only lonely for people who were born elsewhere, and that the loneliest place ever is London.[27] However, the snow of 1947 created extreme conditions never experienced before by the inhabitants of this remote valley, and for such a long period of time. Some occupants hardly saw any friends or family for days and weeks at a time. This loneliness filled Margaret Jones of Dolgoch's days during this period. Her only son was down in the lowlands with his grandparents, separated from his mother for 3 months. Her husband and the servant were out on the mountains looking for sheep for most of the day, leading to diary entries detailing in depth her sense of isolation:

[21] From 10th February 1947 in the Southeast, Midlands, Northwest and London (Robertson 1987: 88), and from 13th February 1947 in the remaining areas of the UK (The Times, 13/02/1947 p. 4: Coal A "Major Military Operation"). The cuts in domestic electricity continued until May 5th, 1947 (The Times, 05/05/1947 p. 8: Heating restrictions in force to-day), replaced by summer space-heating restrictions.

[22] Government electricity cuts to industry began on 20th January, 1947, and were progressively lifted from 24th February, 1947, onwards (Robertson 1987).

[23] e.g. Edna Foxon from Upton. On: BBC Archives, Cardiff. The Weather Show (1997). Video recording, duration 04m00s. Broadcast date 11 February 1997. LPR U856D/71

[24] This was the stance taken by the Government at the time. Robertson (1987) provides a detailed account of the circumstances that led to coal shortages in the UK. To summarise, there were low coal stocks and electricity cuts before the snow, as early as October 1946, in consequence to the Second World War. However, the adverse weather conditions exacerbated the situation.

[25] Anonymous Interviewee 2 (2009) Primary interview conducted by C.A. Jones 26-10-2009

[26] Doris Graham from Martock. On: BBC Archives, Cardiff. The Weather Show (1997). Video recording, duration 04m00s. Broadcast date 11 February 1997. LPR U856D/71

[27] John in: Nantllwyd (1987) John, Glyn, Alun, Dafydd, Shanco, Nansi: Bois Nantllwyd. Commentary: W.J. Gruffydd and John Nantllwyd. HTV Cymru production for S4C. 4693, Programme 08. National Library of Wales Screen and Sound Archive

> "Saturday, 1 February 1947. Cold day. Snowing at first but thawing a little. … John up the hills in morning. Also Dick in afternoon. Very quiet all day. Would be so glad to see anybody calling to have a chat. … Finding it a great loss without water in house."
> "Saturday, 8 February … So fed up with everything & finding it so lonely & time dragging so much."
> "Thursday, 6 March … Plight of sheep very serious & scores found dead & dying every day. A very heavy fall of snow during the storm & the largest drifts ever seen in living memory. John & Dick up the hills together today digging sheep from under drifts."[28]

These diary entries of monotonous loneliness continue throughout this period of severe weather. A particularly telling sentence comes from an interview with the son of Margaret Jones 'the 1947 winter was nearly too much for Mum, you see'[29] (Translation).

4.4 Institutional responses

Having just come out of a gruelling Second World War, the post-wartime shortage of steel and money in general[30] meant that no new snow ploughs were brought in to clear the roads, as would be expected, and that much of the snow-clearing had to be done by hand. This exacerbated the situation of the population of the lowlands. However, the timing of the snow gave some relief in the form of foreign soldiers, still resident after the war. They were soldiers who were under orders from the War Agricultural Executive Committee[31] and were a fully equipped, able and organised military group, unlike any other in the country. These additional workers helped with the country's response to the severe weather, improving the road conditions and reducing the effects of the high dependency on transport for bread. However, tensions rose between nationalities as accusations of idleness and unwillingness to help were reported of those "who were only too willing to receive the hospitality of this country".[32] Some Italian ex-prisoners-of-war retaliated in the press by defending their work, stating that "without our help … many homes [in Borth] would have been without milk".[33] Helicopters were used to drop fodder for stranded animals on some hilltops, but the stock of Cwm Tywi farmers were not lucky enough to receive this help.

A disaster fund of £4,575,000 was partly allocated to assist hill farmers who suffered heavy sheep losses, in the form of the Agriculture (Emergency Payments) Bill. This enabled subsidy payments for hill sheep in 1948 to 1951 to be made on the basis of 1946 flock numbers.[34] A north Wales hill-farmer, Simon Jones, expresses his thanks for the kind financial help, but stresses "The financial loss was only one thing—the sheep mean more to a shepherd than only money. I heard … the best shepherd on the Berwyn [mountains, in north-east Wales] … saying that he'd rather die than see another winter like it. … the effect of that harsh winter lay on us farmers for many years. It was mostly in the mind. Some fear that it would happen again" (Jones 1989: 148–161) (Translation). Moreover, the financial assistance appears to have been inadequate for some as a man from the village of Llanddewi Brefi, not far from Cwm Tywi, committed suicide, allegedly because of the snow of 1947 (Howells 2005: 68).

[28] Jones M (1947) Personal diary (unpublished), Dolgoch, Tregaron, Wales
[29] Anonymous Interviewee 1 (2009) Primary interview conducted by C.A. Jones 02-03-2009
[30] Ceredigion County Council (1947) Snow Clearing, 1947. County Council Deposits: Highways. Ceredigion Archives, CDC/HI/2/8
[31] Welsh Gazette (20/03/1947) The Italians at Borth. Aberystwyth Chronicle and West Wales Advertiser
[32] Welsh Gazette (10/04/1947) The Snow Bill. Aberystwyth Chronicle and West Wales Advertiser
[33] Welsh Gazette (20/03/1947) The Italians at Borth. Aberystwyth Chronicle and West Wales Advertiser
[34] The Times (1947) Government aid for farmers: £4,575,000 set aside: 7 May 1947

5 Discussion and conclusion

Michaelowa (2001) states that the 'stabilising factors' of English agriculture during climatic extremes in the early 18th century were agricultural diversification, agrarian innovation and improved infrastructure. The residents of Cwm Tywi too had many, differing, factors in their favour during 1947. They had the benefit of a perception of a high probability of occurrence of snow and hence a desire to prepare for and mitigate the effects of a harsh winter. Associated with this preparedness, they were self-sufficient in terms of food, especially bread which was a major problem for the people in the lowlands, and also had a low dependency on transport. In hindsight, the fact that electricity had not been introduced to their homes meant that they did not feel the effects when supply was halted because of coal shortages, nor were they affected by the subsequent fuel crisis that caused problems elsewhere (Burroughs 1997). This remote community was well-prepared through being accustomed to austere living conditions and the harsh climate so characteristic of the Welsh uplands.

The first factor which was not in their favour was agriculture, their main source of income, as it is extremely weather-dependent. The previous wet harvest had impeded their efforts for preparation and led to an even greater loss in stock numbers. Secondly, their remoteness led to a complete breakdown in social interaction. Lastly was its magnitude; the snowiest winter and coldest February on record would stretch even the best preparatory measures. These were the main factors which contributed to the substantial consequences of the 1947 snow to the community of the upper Tywi valley.

The farmers of Cwm Tywi, like other upland farmers, did receive some monetary compensation for the loss of their sheep. However, the aid given must have been insufficient, since it is difficult to assign a financial value to the farmers' emotional state and, as it is argued that it was the utter devastation of 1947 which caused the eventual abandonment of the valley (Jones 2007). The emotional consequences of recent agricultural disasters, such as the foot and mouth epidemic in the UK, are much better understood and investigated (e.g. Bailey et al. 2003; Convery et al. 2005). Furthermore, it has been shown how precarious the agricultural system is when disrupted, leading to large scale and catastrophic consequences (Law 2006). When the opportunity arose to leave their Cwm Tywi homes, in the form of an offer by the Forestry Commission to buy the land, the first family left in 1947 and the remaining six families followed; the last in 1967. As such, the snow of 1947 triggered a series of events which changed the valley's landscape and community forever. The heavy snowfall across much of the UK during December 2009 to January 2010 provides some insights into the challenges that comparable conditions would have in the present day. After being caught out by the snow of February 2009, local authorities were prepared and kept large stocks of grit. However, the severity of this period was high, being the coldest winter since 1978–1979 (Eden 2010a), and personal preparations were low. This resulted in severe consequences, causing major damage, serious social disruption and loss of human life (which is the definition of a severe meteorological event; WMO, 2004). Indeed, there were reports of all three factors during the snowfall of 2009–10.

It is proposed that the perception of the rarity of extreme weather is related to an individual's memory. If the type of weather is very rare within a person's lifetime, there is a perception of a low probability of it occurring. Strauss and Orlove (2003) discuss how our complex lives influence the way that we are affected by weather and climate, creating both forms of vulnerability and capacities to mitigate against extremes. We are able to recall the past and anticipate the future (Strauss and Orlove 2003). It is this individual anticipation which is of key relevance, and is essentially a person's perception of the probability of the

weather's occurrence. The UK Climate Projections (UKCP09) indicate higher temperatures in Wales and therefore less frequent snowfall, as well as more frequency of extreme weather, such as summer droughts and winter flooding (UKCP 2009). It may be assumed from the projections that both personal and community preparation and mitigation efforts will be reduced for snowy weather. Its rarity, under the definition of 'extreme weather', may be the very factor which increases its future consequences. A reduction in the perceived frequency of severe snowfall may result in a lower degree of weather severity being considered as extreme, leading to consequences of equal or greater severity when a snowfall of comparable magnitude occurs.

As climate change exerts changes in meteorological conditions over time, new regions will come under threat of extreme conditions (e.g. Beniston 2008), and other regions and weather classified as extreme may become more frequent and will subsequently require re-classification as severe, or vice versa. After an initial period of transition, certain (currently perceived as extreme) forms of weather may become the seasonal expectation.

The proportion of the population of Wales, and other developed countries, solely dependent on agriculture has reduced, as mechanisation and the size of farms increased following the 1947 Agriculture Act (Murdoch 2006: 116). Many of the upland areas, following 1947, were fenced and many farms now try to house their stock in sheds during the lambing season. However, the resilience of farm animals, the importance of the preceding harvest and, hence, the livelihoods of farmers remains fairly constant. Communities may even be more vulnerable, as there has been a decrease in the average age of stock since the beginning of the twentieth century, through a reduction in the number of wethers (4 to 6 year old castrated rams) and an increase in the number of ewes and lambs which are, at times, more weather-sensitive (Taylor 1965).

This paper provides an insight into what could be perceived as a 'vulnerable community', as a result of its remoteness and high dependency on agriculture, during a meteorologically challenging period. Cwm Tywi provides an excellent example in order to observe the internal processes which highlight the resilience or vulnerability of a sector of society. It is fair to say that the community of Cwm Tywi was relatively resilient and it was the severity of the snowfall and resultant emotional distress which were the dominant causal factors in the abandonment of the Cwm Tywi valley. However generalisation is not the aim, as a universally-applicable picture of social vulnerability to climate is not to be expected (Pfister 2010). Each country, community and individual is different, and each extreme meteorological period is temporally sensitive. We call for further in-depth analysis of a variety of local communities and individuals situations which differ spatially, culturally and historically for a range of extreme weather conditions and individual events over a wide temporal scale. Only then will we begin to decipher the complexity which lies at the heart of understanding vulnerability, adaptation and resilience.

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