

**The Irish famine of
1740–1741: causes
and effects**

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The Irish famine of 1740–1741: causes and effects

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Abstract

This paper advances the current debate on causes and effects of famines. Since Sen's food entitlement decline theory emerged in the 1980's, climate and environmental factors are widely excluded in famine analysis. Studying the causation and the processes of famines as well as the adaptations to it before the 20th century will enhance modern famine theories and lead to a rethinking of the role of climate/environmental aspects in current research.

In our case study, the "Famine Vulnerability Analysis Model" (FVAM) serves as an explanatory model and will open up new perspectives on famines. Special emphasis will be put on the Europe-wide crises of 1740–1741, with a focus on the famine of the "great frost" in Ireland. The interaction of demographic, political, economic and environmental aspects is characteristic in this famine.

1 Introduction

Despite agricultural, political, social and technological developments over past times the world food problem is one of the greatest challenges of today's societies (Wisner et al., 2004, p. 127).

Wolde-Mariam (1984, p. 9) describes famine as a "general hunger affecting large numbers of people in rural areas as a consequence of the non-availability of food for a relatively long time". Wolde-Mariam's definition of famine disregards two aspects: firstly, famines also occur in the urban framework. Secondly, people can also be driven into famine even if general food availability exists. Considering the previously mentioned criticism Ó Gráda (2009, p. 4) states that a "famine refers to a shortage of food or purchasing power that leads directly to excess mortality from starvation or hunger-induced diseases". Even though Ó Gráda's definition includes important aspects of famine the elements of time and space are missing. Taking all definitions of famine into account, we define famine "as an extreme scarcity of food or a drop in exchange

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entitlements in a certain region over a multi-year period that threatens the way of life of the already-vulnerable resident population and frequently leads to a higher mortality rate” (Engler, 2012a, p. 159).

What causes a famine and how people adapt to them still seem to be the most significant subjects in famine research. Several theories, such as the Neo-Malthusian, the Food Availability Decline (FAD) and the Food Entitlement Decline (FED) theories, try to answer the posed questions. Since the Sahelian famines of the Mid 1980s the FED theory of Amartya Sen (1981) is widely accepted in scientific research to explain the causes of a famine. It focuses on food entitlements of the population, i.e. the social conditions for food distribution, and not on its alleged availability. According to Sen (1984, p. 497) “entitlement refers to the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces”. What Sen emphasises in his case studies (Bengal 1943, Ethiopia 1972–1974 and Bangladesh 1974) is the fact that during a famine only certain segments of the population suffer or die from hunger, while others have plenty of food. Thus he illustrates the disadvantages of the poor.

In contrast to Sen, whose theory excludes environmental and climatic aspects on a general basis, we consider environmental and climatic drivers as possible causes for famines, which should be further re-included into modern famine theories. Variations of seasonal temperature, humidity, precipitation, solar radiation as well as atmospheric CO₂ concentration and soil condition are some of the most relevant variables affecting agricultural production (Reilly, 1999; Rötter and van de Geijn, 1999; Xoplaki et al., 2001). They directly determine the size and quality of the harvest, the spreading and aggravation of epidemics and indirectly influence the occurrence of hunger and famine. The biophysical impact factors of Pfister and Brázdil represent this relation (Pfister and Brázdil, 2006).

The limitations in Sen’s theory may be related to the narrow space and time framework of his case studies. Recent famines accompanied by long-lasting droughts at the Horn of Africa (Feed the Future, 2011) renewed the debate on the connection between

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climate (environment) and famine. Here, we will expand the focus on this discussion by analysing an earlier famine in Ireland 1739–1740. Even though Ireland is famine-wise best known for its “Great Famine”, occurring in between 1845–1852 (Kinealy, 2006), it has been continuously struck by many famines since 900 AD (Crawford, 1993). Many of those famines were caused by a combination of socio-environmental factors (Crawford, 1993). We will put an emphasis on the famine of the great frost of 1740–1741.

The paper is organised as follows. Section 2 focuses on the methodology of the FVAM. We study the crises of 1740–1741 and its impacts on Europe in Sect. 3. The Irish famine of 1740–1741 will then be analysed in a holistic manner in Sect. 4. In this section, we will put an emphasis on the socio-environmental characteristics of the famine. We show the climate conditions in Ireland during 1739 to 1741 by using the temperature and precipitation reconstruction from Luterbacher et al. (2004, 2007), Xoplaki et al. (2005) and Pauling et al. (2006).

2 Methodology

The FVAM is a heuristic tool, suitable to describe and analyse diverse famine conditions. It is built on existing vulnerability concepts by Birkmann (2006), Bohle (2001), Füssel (2007), Pahl (2006) and Turner II et al. (2003) and adds new dimensions, for instance an analysis of the pre-famine phase, to them. Concerning the development of this analysis model, the following two features seemed most desirable and were considered in the FVAM: the model has to be complex enough to explain the entire famine context, nevertheless it also has to be a practicable research tool in terms of its applicability to varying historic contexts.

The most important improvement and strength compared to earlier models is that the FVAM allows a detailed evaluation of the situation before a famine and its early stages. Pre-famine vulnerability studies people’s livelihood, before the initial drivers start affecting them (Engler, 2012a). In contrast, the focus of most other models is fully on the impacts of a famine and the subsequent coping strategies (Engler, 2012b).

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Based on an evaluation of the literature on famines that occurred globally between 1315 and 2012 we distinguish four phases: first, pre-famine vulnerability; the second phase is characterised by the initial driver such as climate, failures of political crisis management and other social or environmental circumstances such as wars or microbial shocks. Coping capacities/strategies and direct impacts on a group or society are major subjects of phase three. The adaptations to famine crises build the forth phase. Major processes such as migration or learning-processes belong to the adaptation phase, but also link this phase to others (Engler, 2012b). These connections and feedback-loops amongst the phases make the FVAM a complex tool of analysis (Fig. 1).

In order to apply the FVAM to historical contexts such as the Irish famine of 1740–1741 the data pool needs to feature a wide range of sources. First, the existing interdisciplinary literature on Irish and famine history is studied in detail. Second, we collected and analysed archival materials, including local Irish newspapers, letters, books, diaries, official records, etc. of this period to scrutinise the social and environmental situation in Ireland before and during the famine. Third, we compile statistics about burials and marriages as well as reconstructing grain prices. Fourth, we reconstruct and interpret the climatic conditions of 1740–1741 because of their importance for the occurrence and further dispersion of the famine.

3 1740 – a crisis struck Europe

Considering 1740–1741 as a solely Irish crisis would create a false impression of the situation. In fact, it was a crisis of European scale that hit most parts of the continent. The stresses in 1740 were manifold: firstly, harsh climate conditions were experienced in large parts of Europe (Fig. 2).

At the end of 1739 and the beginning of 1740 very low temperatures were felt in Europe. In central and Eastern Europe the temperatures were 3–4 degrees lower compared to the reference period of 1961–1990. Most parts of southern Europe and the

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whole northwest also experienced lower temperatures (Fig. 2; upper left panel). In spring 1740, low temperatures persisted (Fig. 2; upper right panel). In June, July and August 1740 Ireland, Great Britain, France, Germany, the Czech Republic, Poland and the southern parts of Scandinavia still experienced temperatures, which were between 0.8 and 2.4 °C lower than normal (Fig. 2; lower left panel). Autumn 1740 was again characterised by below average temperatures (Fig. 2; lower right panel). Overall, 1740 was the coldest year of the 18th century (Mauelshagen, 2010, p. 67).

Secondly, as a consequence of bad harvests, increasing grain prices severely affected many European regions (Abel, 1974, p. 179 ff.). Between 1735 and 1740, grain prices in Berlin, Hamburg and Augsburg rose between 160 and 280 per cent (Abel, 1974, p. 181). For the same period the prices also rose in other European regions (Table 1). The prices for breadstuff at the Danish Sound Passages rose between three and five times (Abel, 1974, p. 180 f.).

Thirdly, a great mortality wave hit Europe. John D. Post (1984, p. 1) summarised “that climatic variability touched off concurrent epidemics of less fearful diseases which proved capable of producing European mortality waves”. For Post (1984, p. 3) the rising prices of grain and fodder between 1739 and 1741 indirectly influenced the relation between climate and mortality and acted as an intensifier. Even though 1740 and 1741 were tough years in various regions in Europe, the population of Ireland was greatly affected by the great frost, which started at the end of 1739 (see also Sect. 4: coping capacity and direct impacts). Table one refers to this indirect connection and gives examples from several European countries.

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4.1 Vulnerability in pre-famine Ireland

It is important to study the Irish famine of 1740–1741 in a holistic view. The reactions and adaptations to this famine as well as the migration patterns to America that were

further strengthened during and after it helps to better understand the processes of the “Great Irish Famine” of 1845 and out-migration from Ireland in its aftermath.

According to the model that is applied in this study (see also Sect. 2), our analysis of pre-famine vulnerability is based on an evaluation of 34 social and environmental indicators (Table 2). Compared with the theoretical portrayal of the FVAM, some of the indicators have been slightly modified (Engler, 2012a,b). The evaluation of single indicators is based on the interpretation of historical documents and the existing literature on Irish history. Our evaluation works with a simple three-value index, ranging from -1 to $+1$: 0 means that an indicator is considered to influence vulnerability neither positively nor negatively, whereas 1 indicates that a given indicator is considered to have severing and -1 to have mitigating effects on famine vulnerability. Historical evidence is sometimes sparse and incomplete and, therefore, does not allow an unambiguous evaluation of certain indicators. In such cases, the respective indicator will be marked with the sign \emptyset , and it will not be counted in our overall assessment. We use the same sign for indicators that do not apply to the respective historical context, in our case: Ireland in the first half of the eighteenth century. Although the FVAM is composed by factors of vulnerability that we consider to be generally relevant and applicable to any historical case, there are exceptions from this rule requiring modifications of our model. In case all indicators allow evaluation, the sum total of our pre-famine vulnerability assessment ranges from -34 to $+34$. Given this full range, we suggest provisional distinction between five types of famine vulnerability: a highly resilient¹ society (-34 to -20), a resilient society (-19 to -6), a society in danger (-5 to 5), a vulnerable society (6 to 19) and a highly vulnerable society (20 to 34). Future case studies and their comparison will prove if this distinction requires any adjustments. However, it must be stressed that our indexation does not allow any relative or comparative assessment among indicators, in other words: indicators are not weighted against each other. Nevertheless,

¹ According to Füssel (2007) “resilience focuses on the ability of the system to maintain its basic functions and return to the original state after a perturbation”. Therefore resilience can be seen as the compliment of vulnerability.

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in concrete contexts, some may be more important than others, such as the indicator group “agriculture” for the analysis of rural societies. Therefore, calculating a sum total from our indices does not lead to a precise quantitative assessment and, therefore, requires some caution when used for comparison. The evaluation of the Irish famine of 1740–1741 is listed in Table 2. The number in the bracket represents the value of the specific indicators.

4.1.1 Population

Before we go into issues such as social discrimination, poverty, social disparities and the resulting vulnerability for food security, we will first reconstruct the population size of Ireland in 1740–1741. This is a necessary aspect before analysing the famine-affected people.

Eighteenth century numbers of the total population of Ireland can only be estimated. According to an “Abstract of Protestant and Popish Families” the population size of Ireland in 1732 was 2 million. In 1754 hearth-money was collected and the population size was around 2.4 million (Connell, 1946, p. 113). Basing on these census Daultrey et al. (1981, p. 624) add further statistical approximation. Their result was that the population size in 1744 was between 1.9 and 2.23 million (Daultrey et al. cited in Mokyr and Ó Gráda, 1984, p. 475). It is safe to conclude that the population size before the cutting impact of the famine (Sect. 4.3) has to be somewhere between 2.0 and 2.4 million. Possibly this is even a low approximation. Certainly, around 70 per cent of the Irish population were Roman Catholics (McCracken, 1986, p. 37).

If we now change our focus to a smaller scale, the disparities between the rural and urban population becomes obvious. Around 1740 Ireland “was predominately rural” (McCracken, 1986, p. 31). In 1725, only 12.5% of the population lived in cities (McCracken, 1986, p. 31). Dublin was the biggest city with a population of around 150 000, while Cork was the second biggest city with an estimated population of 40 000 (Lloyd, 1732, p. 3; Warburton et al., 1818, p. 457). The next biggest city was Belfast in the North.

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Generally, the famine was not only a rural or an urban phenomenon. In fact, it affected both comparably. The prevailing social inequalities, the religious discriminations and the great poverty lead to this vulnerability and further raised food insecurity. A contemporary witness from Cork describes some of these differences: “There is in no kingdom greater inequality than in Ireland: one class of great property who live excessively sumptuous: the second and more numerous class hurting their fortunes by the imitation of the first – the third in extreme poverty” (cited in O’Brien, 1918, p. 23). From a social standpoint there were even more dependencies (jobs, landownership, etc.), which affected the vulnerability of famine of big parts of the Irish population.

All in all, segments of the Irish population had low “exchange entitlements” (see Sect. 1), which made them vulnerable for the upcoming famine. In the context of the FVAM the vulnerability of the “population” indicator group is +3.

4.1.2 Policy

The vulnerability of political systems corresponding institutions and structures are in the centre of this indicator group. Nowadays, “good governance” is an aim of (most) political systems worldwide and is characterised by a balanced planning culture. That means that state, economy and civil society should be integrated in all questions and problems of strategic planning (Benz et al., 2007). Even though it is not possible to transfer this modern planning culture to historic processes, the term originates from the old British political-philosophical discourse of “Good Government”. Therefore, some parts of the “good governance” concept, such as participation or repression of certain parts of the society, are of significance for historic political processes.

Since the 16th century Ireland was under the control of the English kingdom, which was mostly protestant. The so-called “plantations” were regions in Ireland, which were annexed and colonised by English and Scottish settlers in the course of the 16th and 17th century. Primarily, these were areas in the North of Ireland (Ulster), but they also existed in the Southwest and in the centre of the island (Cruise O’Brien and Cruise O’Brien, 1985, p. 61 ff.). These external political as well as religious influences provoked

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social conflicts and increased the vulnerability in the context of food scarcities and famines. From a religious perspective, Roman Catholics, who represented by far the biggest population group (Sect. 4.1.1), were completely excluded from political actions by the (English-) protestant minority. Between 1728 and 1793 the Roman Catholics were strictly banned from all governmental duties and did not have a passive nor an active voting right (McCracken, 1986, p. 37; Smyth, 2006, p. 417). This increased their vulnerability immense, especially in the field of agriculture and food production, because decision on export and imports, price cutting strategies, etc. were made by individuals, who were not interested in the needs of the rural, Roman Catholic population.

In addition to the discrimination of the Roman Catholics through the “Penal Laws” (Cruise O’Brien and Cruise O’Brien, 1985, p. 77 ff.), other laws complicated the operation process of certain economic sectors and raised the vulnerability of those, who were involved. For example, the woollen-manufacture got into distress, because of the numerous production-limiting laws. As a consequence, 20 000 employees emigrated to seek for better chances abroad (O’Brien, 1918, p. 181 ff.).

In the field of health, care/relief and education, Ireland lacked the basic structures to strengthen the populations’ resilience against the impacts of a famine. At the beginning of the 18th century Irelands health system just started to constitute. Predominantly, these services were based on charitable private investments to treat the sick and poor (Harvey, 2007, p. 4). The already established voluntary hospitals and infirmaries were commonly located in Dublin (Pringle, 2012, p. 2). In addition to the missing health system, a relief system was generally absent in 1740–1741. In the context of famine, we define a relief system as “an organised form of food aid from private actors or public institutions, ready to answer the demands of the specific crisis”. Nation-wide charitable actors – with the exception of the church – or a political welfare system did not exist, referring to contemporary witnesses Stephens (1746, p. 3 ff.) and Prior (1741, p. 2 ff.). In some cities private actors or institutions helped and started some kind of poor relief in real scarce times during, but not before the famine. These local activities were normally unique or short-term. The city of Cashel was one of the exceptions

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to the rule and started a city-wide food relief, right at the start of the first symptoms of famine: “The great charity of this little town [Cashel] has brought above a thousand poor together, who are fed every day in the most regular manner of any I hear in any town in the kingdom; [. . .] I wish all the towns in the kingdom wou’d take pattern” (George Faulkner, The Dublin Journal, 1741).

After the famine of 1740–1741 the need for a widespread health and relief system was more obvious to the government, urban administrations and the civil society, which triggered some changes.

Nowadays, according to the “World food Summit” education is considered as one of the crucial factors to reach the aim of food security. The “Food and Agricultural Organization of the United Nations” (FAO, 2007) also highlights the importance of education and human capital for a decreased vulnerability against famines. Furthermore, the FAO (2005, p. 4, cited in FAO, 2007) states that the “lack of education undermines productivity, employability and earning capacity, leading directly to poverty and hunger”. Around 1740 great educational disparities were established in the kingdom of Ireland. Really striking was the high illiteracy rate, which limited the spreading of education in many fields, such as new cultivation methods, corn imports or market price developments. Thus, regions with a high illiteracy rate were highly vulnerable. High illiteracy rates, Irish as a spoken language, the Catholic religion and non-existing communication paths correlate positively (Smyth, 2006, p. 406 ff.). Therefore, the illiteracy rate was, compared to other parts in Ireland, rather low in today’s Northern Ireland (between 40 and 60 per cent) and Dublin (under 40 per cent). In west and southwest Ireland the illiteracy rate was over 80 per cent (Smyth, 2006, p. 412).

In addition to all other negative political aspects, the whiff of war with Spain and France lay over the kingdom and the military expenses rose, even in times of famine (Magennis, 2000, p. 32 ff.).

Overall the index value of this indicator group is +7.

4.1.3 Economy

The importance of economic factors to defining pre-famine vulnerability hardly needs to be emphasised. Our indicator group includes market behaviour, labour markets and other financial aspects. Therefore, dealing with the economy is of major importance in the context of pre-famine vulnerability and its subsequent processes. It can further harm the individual as well as the whole state finances and lead to increased poverty. In times of regional or state-wide supply shortfalls state finances normally acted as a financial cushion.

The first great disadvantage of Ireland at the beginning of the 18th century was the isolated geographical position in terms of market integration. In times of globalisation an isolated geographical position is not a problem anymore, but back in the early 18th century all exports and imports in Ireland relied entirely on ship transport. Even though the Dutch Republic and England were great trading nations due to their mercantile marine, the isolation of Ireland exposed this country even more. Especially the bad weather (e.g. frozen harbours) and piracy worsened the situation in Ireland. Additionally it took a long time to get goods in phases of urgency (1740–1741). Therefore even in times of peace the trade market was challenging for individual merchants or the state of Ireland. The problematic state of foreign affairs worsened this tense situation.

Ireland also lacked well-functioning infrastructures to mitigate the effects of unfavourable market regulations in times of food crises.

“Good infrastructure is essential for food security to ensure low food prices and efficient markets that can respond to changes in demand. Infrastructure reduces the costs of transporting produce and inputs (such as fertiliser), and food storage. It allows information transfer between producers and markets, and gives farmers access to new technologies” (Parliamentary Office of Science and Technology, 2006, p. 2).

The importance of infrastructures for food production and transportation was as high in 1740–1741 as it is today. In 1740–1741, Prior (1741, p. 2 ff.) directly referred to the absence of public granaries (Powell, 1757), although Collet rightly points out that

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availability not always equals accessibility (Collet, 2010). For the distribution of goods the road situation was of major importance. The reports of the contemporary witnesses diverge on this topic, probably because the road quality varied significantly from one part of the country to another. While the roads in and around Dublin were in good shape, road conditions deteriorated with shrinking size and relevance of other cities (Smyth, 2006, p. 413). Though a broad network of waterways in Ireland existed, this could hardly compensate for the missing inter-city routes. All centres of commerce (Belfast, Cork and Dublin) were situated at the oceans, and sailing against the flowing path of rivers to the sea was very demanding.

Another economic factor worsening the situation were limitations on exports and imports due to taxes. For example Irish merchants had to pay taxes on exports to England, which lowered their profits, while exports from England to Ireland were more or less tax-free. Thus did trade reflect the unequal power relations between England and Ireland. Irish exports to many other European countries, e.g. Spain, were entirely prohibited (O'Brien, 1918, p. 244 ff.). Also the trade embargoes by specific cities inside Ireland harmed other regions and the market as a whole. Cork and Belfast were only two examples for this particular behaviour. Cork mostly stopped incoming ships from America, and Belfast stopped all ships in their harbour as soon as food shortages became discernible (The Belfast News Letter, 1740).

The French economic historian Ernest Labrousse, in his seminal study of Ancient Regime-type crises, described the cyclical effects of food crises: bad harvest led to general recessions causing mid-term effects on markets for other than agricultural products and labour markets: harvest failure led to higher food prices; higher food prices reduced the spending capacity of large parts of the population. Even in cities with excellent market networks, the relative expenses of citizens for basic supplies went up significantly, which meant they had less to spend on other produce. As a result, the demand for manufactured products and services declined reducing the income of employees in these sectors or even unemployment. Labour markets were also directly affected by harvest failures due to declining demands for wagedworkers in the countryside. In Ireland, these

impacts of food crises, which were effective more or less everywhere in pre-industrial Europe, were aggravated in Ireland by the structure of the food market and the deficiencies of the transport infrastructures (as described above).

Though the Irish labour markets were relatively stable before the famine – there were (nearly) no reports on problems with high unemployment rates prior to 1740 –, they lacked resilience to Labrousse-type crises. Already shorter after the first impacts of the climatic extreme conditions began to show, the unemployment rate in the towns and in their hinterlands went up.

This index value of this group is +4.

4.1.4 Agriculture and environment/climate

Prior to mid 18th century, agriculture was the dominant economic sector in all countries all over Europe. This fact was mostly disregarded in the course of the debate of (neo-) Malthusian and Food Entitlement Decline theories since the 1980s. Agriculture is strongly influenced by environmental (climate, etc.) conditions. The weather and climate conditions during the growth period of the main staple foods is in the centre of the consideration. Febvre describes the role of plants as foods for agricultural societies, mainly referring to the medieval and early modern ages as follows: “En d’autres termes, pour connaître l’action du climat sur l’homme, il faut d’abord connaître l’action du climat sur le milieu naturel dans lequel l’homme vit” (Febvre, 1949, p. 151 f.). The indicator groups “agriculture” and “environment/climate” are deeply interwoven in our case study and are thus analysed together.

Agriculture plays a major role in Irish history (Ó Gráda, 1990), which is influenced by specific climate conditions. Due to the geographical position, influenced by the North Atlantic Drift, Ireland normally has a climate of relatively mild winters and cool summers (Goodale et al., 1998). Concerning precipitation Ireland shows large regional differences between the western and the eastern parts of the island. “For sites at sea level, annual precipitation ranged from more than 2000 mm in the west to less than 800 mm in the east” (Goodale et al., 1998, p. 41). Compared to these “average” Irish

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climate conditions, years with extreme weather events lead to food scarcities in various segments of the society. Ireland was often hit by famines, which were primarily caused by extreme climates. The year 1739–1741 was one of those years (see Sect. 3 and initial driver). Weather observations of agrarian societies and their collective memory, which they developed for extreme situation, play an important role in the context of choosing the right adaptations and strengthen their resilience.

Referring to the population in Ireland two structural circumstances seem to be most important. First: owing to the life expectancy of around 35 yr of the Irish in 1740 (Schellekens, 1996, p. 29), which is slightly lower than in continental Europe and England, the climate perception was very limited. The three decades prior to the famine were characterised by relatively mild winters (Rutty, 1770, p. 78), what nearly equals a full generation shift – referring to the average Irish life expectancy (Schellekens, 1996, p. 29). Dickson (1997, p. 21) already assumed that this experience “perhaps lulled people into a sense of false security as regards their food supply”. Therefore, the Irish population in 1740 was not prepared for such a cold winter and the subsequent harvest failures. Second: the high illiteracy rate counteracted against a multi-generational, collective famine memory. In earlier centuries, historical writings about extreme weather events, climate developments and famines were only accessible for small segments of the society. Indeed, a lot of Irish newspapers reported on those events and linked them to expected harvest outcomes in rural areas (The Dublin Gazette, 1740a), but they did not reflect on previous famines (such as 1728–1729). In rural areas, such reports were, at best, indirectly communicated by the clergy. Newspapers were primarily printed and read in cities. Overall, many aspects point in the direction that the Irish population of 1740–1741 did not have a decent memory of disasters – contrary to the situation after the far-reaching experience of the “Great Famine” of 1845–1852 (Kinealy, 2006).

Looking at the state of the primary sector of economy will disclose some of the problems of the “socio-environmental system” in Ireland. All society processes were bound to the crop cycle. Even in agricultural societies today this seems to be true. Since the potato made its way over the Atlantic Ocean, it became one of the two main

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staple foods in Ireland (the other one being oat) prior to and in 1740 (Salaman, 1985, p. 252). Simultaneously, this monoculture-type cultivation increased the vulnerability of the Irish society for potato and oat specific climate and environmental impacts. In addition to the diversification in agriculture, the cultivation techniques were also vital. They not only refer to the infrastructure of agriculture, but also to the agricultural knowledge and cultivation method. As it was mentioned before, many Irish lived on agriculture outcomes, but two problems emerged thereof: first, appropriate storages for excessive corn of good harvests were missing (Powell, 1757). Second, the farmers did not use the tillage system efficiently enough. “It is certain that the tillage of the kingdom does not bear a sufficient proportion to the wants of the inhabitants” (Powell, 1757, p. 6). Furthermore, the close relationship between nature and culture becomes obvious by examine the woodland clearance in 1740. The fast woodland clearance in Ireland, due to shipbuilding, construction of army material and increasing cultivation areas, was exploitative to the nature (Smyth, 2006, p. 101) and entailed certain aftermaths. Suddenly decreasing woodland areas had negative effects for both domestic animals and plants. On the one hand many animals died because of habitat destruction. On the other hand the quality of soils declined and soil erosion was enabled.

The fishing industry also faced major difficulties. Due to some research and contemporary witnesses reports, the former abundance of fish stock in the Irish Sea not seemed to be a good source any more. According to Lecky (1913, p. 340) “the wasteful system of trailing nets, however, which was illegal in France, had been introduced into the Irish fisheries about 1738, and the destruction they caused among the seaweed and among the spawn is believed to have been the cause of the decline of the fisheries.” This situation forced many traditional coastal towns into a shrinking situation, both economically and demographically. Overall, the indexation value of the FVAM for “agriculture” and “environment/climate” as an indicator group is +7.

By summing up all these different indicators Ireland equals an indexation value of 22 out of 32 applicable indicators from the FVAM. This means that most parts of Ireland were highly vulnerable to famine impacts prior to the period of the famine 1740–1741.

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Therefore Ireland was bound to the vicious circle of famine (Fig. 1). “To give particular dates as the occasions of famine years is, to some extent, to create a wrong impression of the Irish situation, the truth being that the country lived in a chronic state approaching famine, and that the particular years which are mentioned by historians as famine years were simply the years in which the chronic symptoms became acute” (O’Brien, 1918, p. 102).

4.2 Initiating driver

As discussed in the previous sub-section, Ireland had been on the brink of a famine for several years. However, the extreme winter of 1739/1740 and the still too dry spring seem to have caused the situation to tip. “For several days past we have had here very cold weather, but Sunday and yesterday, most excessive cold, with hail and snow, and not three hours of continued rain since the beginning of November, which causes as great scarcity of water as in the midst of summer, so that there is no getting corn ground at our water mills” (The Dublin Gazette, 1740b).

The records of purely qualitative weather descriptions from archives need to be verified using quantitative data. We use the seasonal temperature and precipitation reconstructions by Luterbacher et al. (2004) and Pauling et al. (2006) for Ireland. In Fig. 3 we present seasonal climate diagrams for temperature and precipitation for the early 18th century (1710–1739), the 30 yr prior to the famine. A solid red vertical line marks the average values for the late 20th century (1961–1990 reference period) and blue dashed lines mark the famine years of 1740–1741. The pre-famine situation seems to have been roughly comparable to the situation in the late 20th century (Fig. 3). The autumn of 1739 was already slightly cooler than normal (1 °C). The winter of 1739/1740 was even cooler (about 2 °C) and much drier (–30 % of precipitation) than the previous years. Contemporary witnesses also noted the unusually cold weather, as can be seen from newspaper reports like the following, printed in the Dublin Gazette in January 1740: “The frost continues most severe and intense, so that there are tables and forms on the Liffey and selling liquors, and it’s said they intend to roast an Ox on it. The

thermometer is four degrees lower and colder since our last, and is now 7–9 degrees colder than ever has been known” (The Dublin Gazette, 1740c) (Fig. 3).

The dry winter and spring of 1739/1740 had a huge influence on crop yields for the following year as the saplings withered: the influence of detrimental weather on plant life, especially of plants growing only one year, is much higher during the beginning of the vegetation period than later in the same year.

Luterbacher et al. (2002) argue, that possibly a stable high-pressure ridge over the eastern Atlantic was dominating mid- and upper tropospheric circulation flow. The corresponding low-pressure systems extended from the Canadian Archipelago down to Labrador and to the Black Sea. The ridge over the eastern Atlantic led to stable high-pressure conditions over the British Isles including Ireland. Cold air during winter and early spring mostly flows around ice-shielded Greenland. Therefore, it seems that stationary atmospheric circulation patterns during winter and spring 1740 significantly conditioned sea surface temperatures and marine boundaries along the European Atlantic coasts and influenced also the conditions over Ireland. Briffa and Jones (2006) suggest also the development of a persistent, cold blocking high over central Europe, which reached unusually far west. This suggests that cyclonic activity was restricted to Iceland and parts of the Mediterranean regions (Figs. 4 and 5).

While the spring of 1740 still remained slightly too dry, over the following seasons precipitation returned to normal levels. Still, temperatures remained too cold till spring 1741. In October 1740 the Dublin Gazette reported: “We hear from Belfast, that there has been for these several days last past, the coldest weather and the greatest fall of snow and sleet, that hath been known in that part of the world at this time of the year; the snow was so deep on the road between that place and Ballymena, that a person coming from thence with a horse, was in much danger of perishing, he often sunk out of sight in the snow and was oblig’d to turn back again” (The Dublin Gazette, 1740d).

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4.3 Coping capacity and direct impacts

In the context of the FVAM the phase of coping capacity/strategies and direct impacts consist of consecutive feedback loops, which are characterised by consecutive responses to one another. After the climate, as the main initial driver, started to affect the socio-environmental system in Ireland in 1739 the potato crop failed (Salaman, 1985, p. 604; Smith, 1774a, p. 229 f.). With the failure of the potato, the prices of all eatable goods on the markets increased. In April 1740 George Faulkner The Dublin Journal noted: “There is now as great scarcity of provision in this city [Dublin] as ever known, and it is much to be feared all over this kingdom, every kind of food being at vast high prices, which is owing to the great drought we have had ever since last Christmas, there not having been one day’s rain. During that time forty thousand sheep have died in Connaught within these two months” (George Faulkner, The Dublin Journal, 1740a).

Although wheat was not the primary nutrition source for the Irish population, its increasing price on the Dublin market also represents the price situation of other edibles. In September 1739, prior to the harvest failure, the price for one quarter of wheat was one pound and ten Schillings. With the ongoing strong frost conditions and the failing potato, demand for wheat and other crops rose as well as the prices for these goods (Fig. 6). The drought that followed the winter frost in spring 1740 exacerbated the food shortage. At the peak of the famine, the price for one quarter of wheat was more than three pounds, almost three times the price paid in September 1739. The prices for other agricultural products increased by similar percentages.

Ireland was an export-orientated country for food products, but in times of crises this changed in certain economic sectors. For obvious reasons of supply, the exports of live cattle, oatmeal, etc. were cut drastically. Nevertheless, some important goods for nutrition were exported in high amounts, regardless of the scarce food situation, for example: butter, beef, barley and malt (O’Brien, 1918, p. 122 and 222).

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In 1740–1741, hake was also exported in masses (Smith, 1774a, p. 196 ff. and 267 f.). Some counties, such as Waterford, also spent shares of their money for luxury commodities such as tobacco, wine, etc.

In the course of the crisis, as a coping strategy, many poor changed their eating habits. These changes were two-fold: less and different. “Less” is obvious; “different” means that diets would include “famine foods” (Ó Gráda, 2009, p. 73 ff.). Nutrient content became more important than taste. Even sour milk, nettles, charnock and foul potatoes were consumed (Dickson, 1997, p. 26). Less and unhealthy food often harmed the immune system of individuals and made them more vulnerable to diseases. Not surprisingly, the death rate was greatest among the poor. George Faulkner The Dublin Journal reported: “Here is an uncommon mortality among the poor people, by fevers and fluxes, owing, no doubt, in a great measure to their poor living” (George Faulkner, The Dublin Journal, 1740b). In March 1741, Rutty (1770, p. 85) also wrote, how the “dysentery raged greatly” among the most exposed segments of the Dublin population. At its peak dysentery caused 21 deaths in a single week, “though it was less mortal than in the country” (Rutty, 1770, p. 85).

Besides “famine foods”, other forms of desperation occurred. Some Dubliners began rioting and looting: “Last Saturday in the evening, Sunday and yesterday, we had very great tumults, occasioned by the great dearness of bread, meal, &c. Several bakers shops were broke open, and their goods sold at a low price to the poor; great damages have been done on this occasion, many persons being wounded and some killed” (George Faulkner, The Dublin Journal, 1740c).

Similar incidents occurred in other places. In his account of the famine Dickson describes that the “atmosphere in the towns” was “more explosive” (Dickson, 1997, p. 26) than in the countryside. As food theft became more common, the number of prisoners rose and punishment for such crimes was severed. As a reaction to jails overcrowding in the kingdom of Ireland some of the prisoners were deported to North America (McDonnell, 1992). Clearly, these so-called “transportees” were forced migrants to the “New World”.

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Together with such measures, some private and public relief programs were established. The following charity actions were reported from the small town of Cashel, in the county of Tipperary: “Every Sunday, Tuesday and Thursday, they [the poor] are served with excellent soup well seasoned with spice and herbs, and thickened with oat meal; every other day, they have stirabout well prepared, for to every hogshead of water there is allowed half a barrel of meal, 12 pound of butter, a peck of salt, a quarter of a pound of pepper; each grown person, gets three pins at each mess, and every young body, half as much, which serves most of them for two good meals; this contribution is wholly confined to the town” (George Faulkner, The Dublin Journal, 1741).

In Dublin a hundred poor were fed for free at the university on a daily basis (George Faulkner, The Dublin Journal, 1740d). Furthermore, in the peak periods of the famine, the workhouse served around 34 000 poor during a week (George Faulkner, The Dublin Journal, 1740e). Huge problems were posed by increasing unemployment in the towns. As is typical for pre-industrial subsistence crises, at some point the famine turned into a general economic depression, which showed in a diminished demand for labour (McCracken, 1986, p. 33). Many Irishmen tried to escape unemployment through short-term labour migration. Most of them went to England to work as seasonal harvesters or to find a job in big cities such as London.

Even though coping strategies were activated, the fatality ratio was unusually high. 13 per cent died in the famine of the Great Frost of 1740–1741, compared to 12 per cent during the “Great Irish Famine” in the nineteenth century (Ó Gráda, 2009, p. 23 f.). The death ratio is not the only demographic aspect similar to the Great Famine. According to some studies the ratio of the population moving within Ireland or leaving the country during the famine of 1740–1741 was just as high as it was in 1845–1852 (see section adaptation phase). In our opinion, the reasons for these painful consequences are best explained by the high pre-famine vulnerability we have diagnosed in a previous section of this article (Sect. 4.1).

4.4 Adaptation phase

Before an affected individual or society can adapt to a famine, a learning process needs to be set in motion. We assume that there is a certain learning process threshold describing the point when individuals or societies start to adapt (Engler, 2012b).

5 Statistically the mortality rate, the emigration rate and the financial instability of the famine-affected societies seem to be sensible indicators to define this threshold (Engler, 2012a).

After crossing this learning process threshold the adaptation phase sets in during or after the famine. Smit et al. (2000, p. 225) define adaptation as follows: “Adaptation refers to adjustment in ecological-social-economic systems in response to actual or expected climate stimuli, their effects or impacts.” Adaptations during and after a famine are mostly made on an individual or micro scale. “Migration as a sustainable adaptation strategy” (Mayer, 2011, p. 1) is very important in this context. On a local level we consider migration as an adaptation of last resort, meaning that migration will be chosen after all other strategies are fathomed. What we exclude from our understanding of migration as an adaptation of last resort is the debate on consecutive and automatic subsiding migration processes.

Due to the great migration streams connected with other Irish famines, for example in 1728–1729 and 1845–1852, we will take a closer look at this particular form of adaptation. Migration is a complex phenomenon and has various foci. The climmigration.dat – a database, which comprises a great amount of climate migration cases – of the BMBF research project “Climates of Migration – Climate Change and Environmental Migration in a Historical Perspective” describes these diverse foci. The first focus of migration is bound to the cause of migration. Migration can be caused by specific reasons, such as war, religious persecution, political failure, climatic drivers, etc.

25 In this paper we will only deal with the so-called climate migration. As the “Bundeszentrale für politische Bildung” (BpB), an organisation of the German “Federal Ministry of the Interior”, rightly points out there is no “internationally recognised definition

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for the phenomenon of climate-induced migration” (BpB, 2012, p. 1). Hence, a central aim of this paper is to provide a working definition for the process of climate migration. Climate migration is a specific type of the so-called environmental migration. Therefore climate migration needs to be differentiated from other forms of environmental migration by the driver of the movement. On the one hand this form of migration may arise because of short-term weather changing phenomena, such as heat waves, droughts, extreme rainfall and frost. On the other hand long-term processes like sea-level rise and desertification may also cause climate migration. The varieties of climate migrations and of migration in general are of internal, i.e. remaining within state borders, as well as external (emigration) nature. Thus, before analysing climate migration, a distinction between migration and a general mobility of people has to be made (Smyth, 2006, p. 390).

The affected group or society represents the second focus of migration. In 1740–1741 it is possible to distinguish between three major migration groups in Ireland, relating to the region of origin, the social class and the religion. First, there was generally a high movement among the affected people in need all over the island. The so-called Ulster-Scots from the northern parts of Ireland were the second big group of migrants. Third, a lot of Protestants and Presbyterians migrated. All these different groups were forced to leave Ireland because of the bad living conditions, which were strongly connected to the climate and the resulting famine (Fitzgerald and Lambkin, 2008; Dickson, 1997; Cullen, 1981; Wokeck, 1989, 2003; O’Brien, 1918; Stevenson, 1920).

The third focus refers to the time scale. Migration can be temporary or permanently/definitive. Temporary migration, in the sense of moving away due to scarcity of food and coming back after the distress is over, is counted as coping. The previously mentioned labour migrants are one example in this context. All migrations that last longer belong to adaptation methods. Generally, these migrations are bound to a change of the residential location. This act clearly marks a permanent or long-lasting migration.

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The range of migration marks the fourth focus. Migration can be internal or external. Even though most of the migration remained within the boundaries of the island (internal), emigration (external) did already occur in 1740–1741 (Dickson, 1997, p. 69). The internal migration practice in Ireland in those days was characterised by huge rural-urban migrations. Calamitous conditions in the countryside were the cause for this movement as well as the faith for a better life in the urban framework. This hope was bound to the market integration of the towns. The movement of some members of the family of a local farmer called Lucas of Corofin to Ennis is a symbol for this migration process (Ó Dálaigh, 1995, p. 49). As regards the poor Dickson (1997, p. 69) generally states that “most of their wanderings contained within the island”. Most likely this is related to the high costs for the emigration journey. One example for the emigration process during this famine is the path to the New England states and Pennsylvania. It was an already existing relationship because of the trade between both regions and Ireland (George Faulkner, *The Dublin Journal*, 1729; *The Dublin Gazette*, 1740e). A great number of Irish people emigrated to Philadelphia and therewith following their ancestors and friends who migrated in 1728–1729. In her case study, comparing 1730 and 1740, Wokeck (1989, p. 140) states that the immigration rate to Philadelphia (Pennsylvania) rose by 500 %. In 1740, an estimated 1000 Irishmen and women took this path over the Atlantic Ocean (Wokeck, 2003). In the North of Ireland, “the emigrants leaving Belfast and Derry for America were not fewer than twelve thousand annually” in times of the famine (Stevenson, 1920, p. 240). The emigration rate in the famine of 1740–1741 could have been even greater, but “mostly Irishmen (were) too poor to pay for the transatlantic passage” (Wokeck, 1989, p. 139). Other circumstances, like the impeding war against Spain, further increased the risk of a transatlantic emigration.

The scale of migration characterises the fifth focus. All in all the Irish famine of 1740–1741 is characterised by a high migration rate. Fitzgerald and Lambkin consider 1741 as a “migration landmark” year (Fitzgerald and Lambkin, 2008, chapter 13). Smyth even assumes that the migration rate in 1741 was as high as it was during the Great Irish Famine of 1845–1852 (Smyth, 2006 cited in Fitzgerald and Lambkin, 2008, p. 120).

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Although his estimates may be a bit high and cannot be verified clearly, they can be taken as an indicator for a high migration rate. Cullen also suggests a lot of migrations in his case study, concluding that most of the reduced tax amount of 1/3 in Sligo and Kerry was due to out-migration and not to deaths (Cullen, 1981, p. 90 f.). As official records of migration are missing for 1740–1741 there are no exact figures on the number of emigrants.

After the famine of 1740–1741 adaptations were also initiated on an administrative level. To avoid or diminish further food shortages the enlargement of state granaries was claimed (Powell, 1757, p. 3 ff.). Thomas Prior wrote: “The best course to guard against scarcity, is to encourage farmers to raise large quantities of corn yearly, that the redundancy of plentiful crops may be sufficient to answer the deficiencies of bad ones. And this can no other ways be done, than by affording them a constant and reasonable price for the quantities of corn they shall raise. [...] It will easily occur to every one, that granaries under proper regulations would answer all those intentions” (Prior, 1741, p. 3).

As it was mentioned in the section “coping capacity and direct impacts” a lot of diseases, like the smallpox, the flu and severe fevers spread during the famine. Consequently a lot of cities started or improved their health systems. For example the city of Cork, with the help of charitable members of the musical society, erected a medical facility, in which ten physicians and four surgeons attended the poor three hours every day (Smith, 1774b, p. 390 f.). “Some years above 2000” were medicated there (Smith, 1774b, p. 391). Still, because of the virtual absence of nation-wide adaptations on an administrative level, Ireland stayed in the recurring vicious circle of famine for more than 110 yr.

5 Conclusions

We have argued that environmental/climatic aspects need to be included more in the debate on causes of famine. Accepting Sen's FED theory on a general basis will lead to "half knowledge" of famine processes and their developments.

We have verified this demand by analysing the crisis of 1740–1741, with a special focus on the Irish famine of those days. In 1740–1741 frosty temperatures struck vast areas in Europe (section three) and frequently lead to harvest failures, drastically increasing grain prices, diseases and deaths.

Ireland cultivated on a monoculture-type basis, leaning heavily on potatoes and oat. This self-imposed limitation increased the vulnerability of climate or environmentally induced harvest failures of those two staple foods. In 1740–1741, the destruction of the potato harvest led to high purchasing prices of food. The increase of wheat prices on Dublin markets by around 300 per cent of (before) famine standards represents this situation.

This and other factors, such as missing corn storages, a non-existing health and relief system, etc. caused many to emigrate, to sicken or die. The extraordinary high scales of emigration and death rates (section coping capacity and direct impacts) are percentage-wise comparable to statistics of the "Great Irish Famine" of 1845–1852.

Considering famines as a complex interaction of social and environmental factors will enhance the understanding of those impacts. Recent famines in Eastern African countries, such as Ethiopia, Somalia and Kenya, support this statement. Therefore, mitigating the shocking outcomes of famines is only achievable by working on social as well as environmental strategies.

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Table 1. Development of grain prices and mortality in different European countries 1735–1744 (adapted table from Post, 1995, p. 246).

State	Increase in grain prices from 1737–1738 to 1740–1741 (in %)	Increase in mortality from 1735–1739 to 1740–1742 (in %)
Low Countries	77	22.3
Denmark	71.4	10.1
Finland	67.1	51.8
Sweden	60	22.7
Ireland	56.7	25.3
Scotland	52.9	21.1
Germany	47.9	3.9
Norway	44.1	81
Italy	37.2	10.4
France	35.7	24.5
Austria	33.7	1.9
England	32.9	23.4
Switzerland	30.7	17

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Table 2. Assessment of pre-famine indicators of vulnerability for the Irish Famine of 1740–1741: Bracketed numbers represent the index value according to our assessment of single indicators.

Social Vulnerability (SV)	Population
	1.Social Classes (1)
	2.Marginalisation or inequality (1)
	3.Exchange Entitlements (1)
	4.Dependence structure (1)
	5.Population Size (0)
	6.Urbanisation ratio (0)
	7.Fresh water accessibility (–1)
	Policy
	8.Political systems (1)
	9.Relief systems (1)
	10.Education systems (1)
	11.Power struggles (internal or external) (1)
	12.Health system (1)
	13.Legal structure (1)
	14.National Borders (Ø)
	15.Governance structure (1)
	Economy
	16.Financial structure (Ø)
	17.Tax-structure (1)
	18.Economic opportunity (1)
	19.Market integration (1)
	20.Labour market situation (1)
21.Infrastructure (1)	
22.Grain prices or prices of staple foods (0)	
Agriculture	
23.Agricultural diversification (1)	
24.Agricultural techniques (1)	
25.Famine history and memory (0)	
26.Diversity of species (1)	
Environmental Vulnerability (EV)	Environment/Climate
	27.Geographical position (–1)
	28.The population's perception of climate (1)
	29.Temperature conditions (1)
	30.Precipitation conditions (1)
	31.Mean temperature during the growth period of staple crops (1)
	32.Mean precipitation during the growth period of staple crops (1)
	33.Influence of other forcings (1)
	34.Fresh water availability (–1)



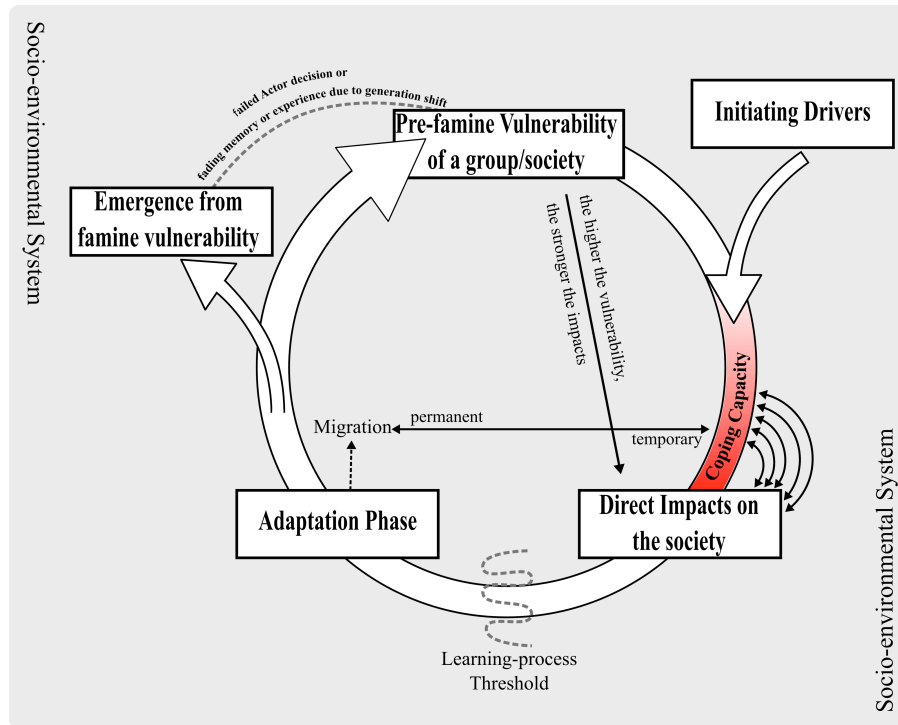


Fig. 1. Famine Vulnerability Analysis Model (Engler, 2012a, p. 161).

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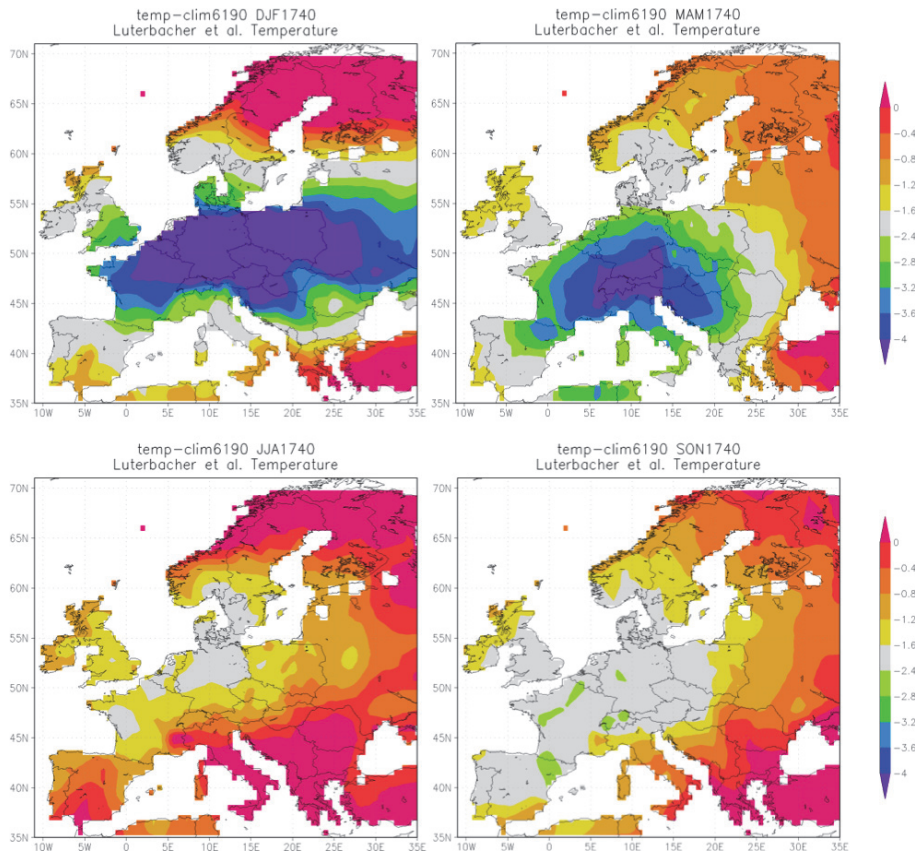


Fig. 2. Temperature anomaly (with respect to the 1961–1990 reference period) for the December to February average (upper left panel), March to May average (upper right panel), June to August average (lower left panel) and September to November average (lower right panel) 1740, is taken from the reconstruction of Luterbacher et al. (2004) and Xoplaki et al. (2005). The figure was plotted using the KNMI Climate Explorer.

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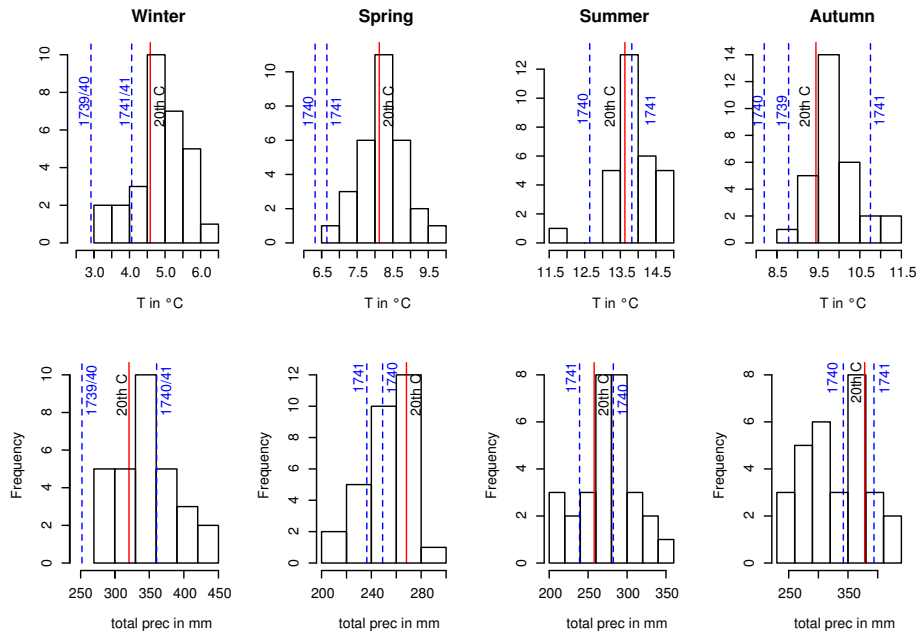


Fig. 3. Seasonal climate diagrams for Ireland (averaged over land only grid cells 51°N – 56°N , 11°W – 5°W). The histograms show temperatures (top) and seasonal precipitation (1710–1739). Solid red lines mark 1961–1990 averages; dashed blue lines denote values for seasons during the famine, years marked adjacent. Data from Luterbacher et al. (2004), Xoplaki et al. (2005) and Pauling et al. (2006)

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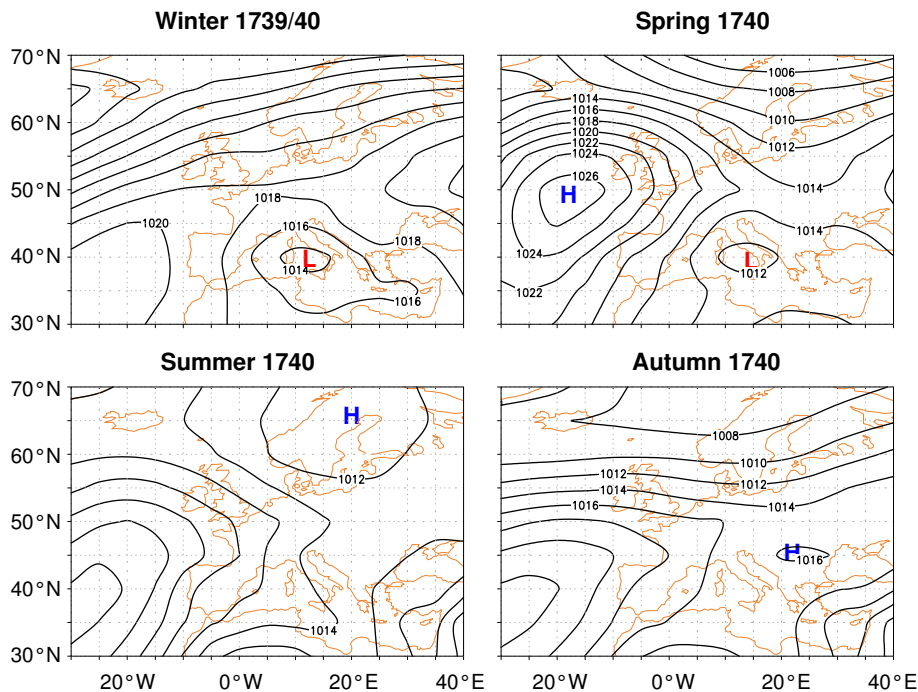


Fig. 4. Seasonal averages of sea level pressure in 1740. During spring a strong blocking high West of the British Isles lead to cold air advection from the North. Data from Luterbacher et al. (2002).

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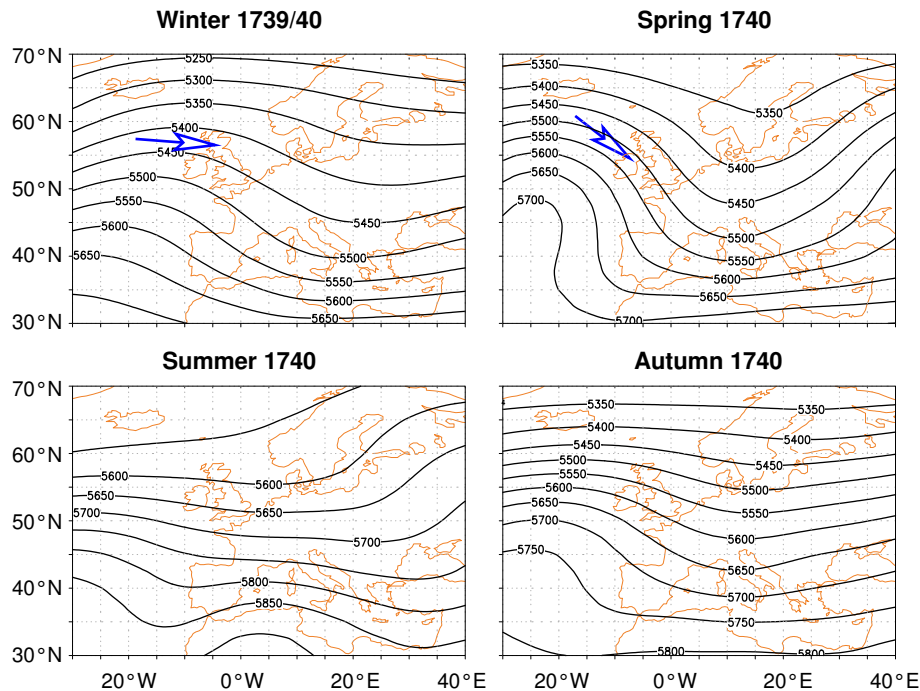


Fig. 5. Seasonal averages of geopotential height at 500 hPa during 1740. From a zonal flow during winter 1739/1740 (blue arrow) synoptic situation changed to meridional flow in spring, advecting cold air from the North. Data from Luterbacher et al. (2002).

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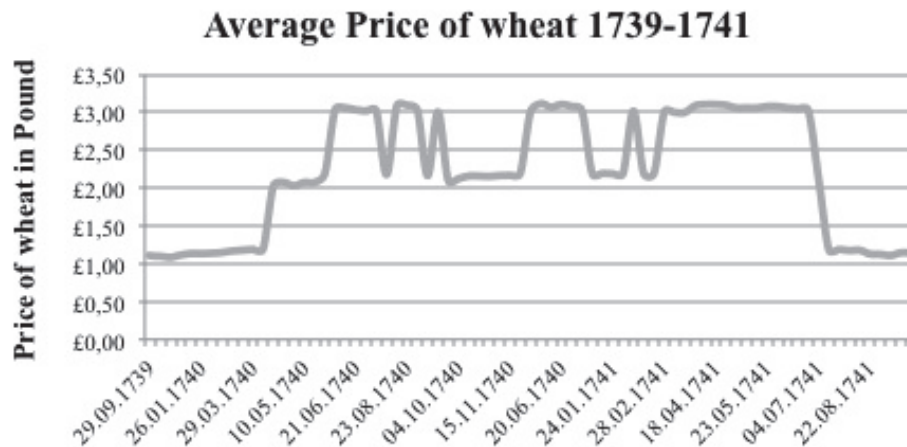


Fig. 6. Average price of wheat (one quarter = 40 stone) (Data: George Faulkner, The Dublin Journal).

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