Societies Facing Hydrological Extremes: The Case of Urban Supplies in France (Middle Ages to Late Eighteenth Century)

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Societies Facing Hydrological Extremes: The Case of Urban Supplies in France (Middle Ages to end of Eighteenth century)*

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Abstract

This article aims to study a relatively overlooked subject: extreme hydrometeorological events, their effects on urban supplies of primary commodities, and the ways in which urban societies used to deal with them. The analysis focuses on French cities and spans a period from the Middle Ages to late eighteenth century. It studies the reactions of urban societies to supply issues, due to either hydrological excesses or deficits provoked by floods or droughts. The analysis shows that populations and urban authorities developed different kinds of adaptive strategies, especially to further social stability.

Keywords

Flood, drought, food, supply, town, risk, social reactions, France, Ancien Régime.

Résumé

Cet article s'intéresse aux événements hydrométéorologiques extrêmes sous l'angle jusqu'ici peu étudié de l'approvisionnement urbain des sociétés qui ont à y faire face. L'analyse se concentre sur

des villes françaises du Moyen Âge à la fin du XVIII^e siècle. L'article montre les réactions des sociétés urbaines lors de problèmes d'approvisionnement en raison d'excès ou de déficits hydrologiques. De ce fait, il souligne que les aléas hydrométéorologiques extrêmes ont pu entraîner des soucis d'approvisionnement des villes (alimentaire, en sel, en bois, etc.), conduisant à des formes d'adaptation par les populations et les autorités urbaines au nom, notamment, de la stabilité sociale.
Mots clés
Inondation, sécheresse, alimentation, approvisionnement, ville, risque, réactions des sociétés, France, Ancien Régime.

Early in 1784, severe floods affected France and Western Europe.[1] Louis XVI provided the victims with 3 million French *livres* and other measures were taken, such as rebuilding the destroyed bridges. Such an exceptional help was aimed at avoiding social troubles in the event of disruption to urban supplies. The event gave rise to what can probably be described as the first visit of a head of state to the scene of a disaster, immortalized in an engraving.[2]

This paper deals with extreme hydrometeorological events, their effects on supplies to cities, and the reactions of urban societies to supply problems. It focuses on hydrological excesses and deficits. From a hydrological point of view, drought is defined as a water deficit affecting surface water and groundwater,[3] whereas flood is defined as a temporary excess of water covering areas that are not submerged in normal times.[4] In this article, the word "flood" covers events caused by both streams and rivers. Of course, both phenomena are more complex to determine, and the relevant literature shows that both floods and droughts have social and political components. Depending on the historical period, societies define and apprehend differently what they regard as "droughts" and "floods", either in terms of economic damage or social repercussion.[5] We have chosen not to study other meteorological hazards (such as long periods of frost) in this article, even though they might have consequences on supplies.

[1] Rudolf BRÁZDIL, Gaston R. DEMARÉE, Mathias DEUTSCH et al., "European Floods during the Winter 1783-1784: Scenarios of an Extreme Event during the 'Little Ice Age'", *Theoretical and Applied Climatology*, vol. 100 (2010), pp. 163-89.

[2] Bibliothèque Nationale de France (BNF), Département des Estampes et photographies, QB-1 (1784-12), folio reproduced in Jérémy DESARTHE, *Le Temps des saisons. Climat, événements extrêmes et sociétés dans l'Ouest de la France (XVI^e-XIX^e siècles)* (Paris, 2013), p. 257.

[3] Donald A. WILHITE, "Drought as a Natural Hazard", in Donald A. WILHITE (ed.), *Drought: A Global Assessment*, vol. 1 (London, 2000), pp. 3-18; Vincent DUBREUIL, "Un risque climatique à géographie variable : la sécheresse", in Denis LAMARRE (ed.), *Les Risques climatiques* (Paris, 2005), pp. 147-74; Benjamin LLOYD-HUGHES, "The Impracticality of a Universal Drought Definition", *Theoretical and Applied Climatology*, vol. 117 (2014), pp. 607-11.

[4] Rudolf BRÁZDIL, Zbigniew W. KUNDZEWICZ, Gerardo BENITO, "Historical Hydrology for Studying Flood Risk in Europe", *Hydrological Sciences Journal*, vol. 51, no. 5 (2006), pp. 739-64.

[5] Stéphane CASTONGUAY, "The Production of Flood as Natural Catastrophe: Extreme Event and the Construction of Vulnerability in the Drainage Basin of the St Francis River (Quebec), Mid-Nineteenth to Mid-Twentieth Century", *Environmental History*, vol. 12, no. 4 (2007), pp. 820-44; Bettina LANGE, Ian HOLMAN, John P. BLOOMFIELD, "A Framework for a Joint Hydro-Meteorological-Social Analysis of Drought", *Science of Total Environment*, vol. 578 (2017), pp. 297-306; Alexis METZGER, James LINTON (eds), *Quand les eaux montent. Mise en patrimoine des crues et des inondations* (Paris, 2018); Anne RIVIÈRE-HONEGGER, Jean-Paul BRAVARD (eds), *La pénurie d'eau, donnée naturelle ou question sociale*, *Géocarrefour*, vol. 80, no. 4 (2005) and vol. 81, no. 1 (2006), https://journals.openedition.org/geocarrefour/1234, accessed on 11 December 2019; Nicolas JACOB-ROUSSEAU, "Water Diversions, Environmental Impacts and Social Conflicts: The Contribution of Quantitative Archives to the History of Hydraulics. French Cases (Nineteenth Century)", *Water History*, vol. 7 (2015), pp. 101-29.

The analysis focuses on French cities located on rivers and spans a period from the Middle Ages to the late eighteenth century. Several reasons explain our choice: 1) supplies to these cities were vulnerable to hydrometeorological extremes; 2) few geohistorians and historical climatologists have investigated the effects of drought or flood on urban supply; 3) supply to maritime cities has already been studied;[6] 4) throughout the period studied here, there continued to be an opposition between the city and the countryside in terms of supply;[7] 5) cities represented a large consumer base; 6) from the end of the Middle Ages onwards, an inflation of urban legislation appears to have ensured urban supply.[8] We excluded the nineteenth and twentieth centuries from our study, due to the major social transformations undergone by cities and political regimes during this period. The supplies studied include primary commodities (cereals/flour/bread, meat, salt, wood, wine, etc.) used by the populations from the fourteenth to the eighteenth centuries.

This study intersects a number of different historiographies: climate, risks and disasters, food supply and public supply policies. In France, there is a long tradition of studies focusing on food and urban supply and many are still ongoing.[9] Coexisting within the same water territories ("*territoires de l'eau*"),[10] hydrometeorological hazards have been the topic of many studies, both in climate history and the geohistory of risks.[11] Of course, the links between either climate variability or meteorological events and food have been of great interest to researchers in the fields of economics, urban history, and food history.[12] However, there has been no specific research on the links between hydrometeorological extremes and the history of supply so far.

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[6] Caroline LE MAO, Philippe MEYZIE, *L'Approvisionnement des villes portuaires en Europe du XVI^e siècle à nos jours* (Paris, 2015).

[7] Massimo MONTANARI, *La Faim et l'abondance. Histoire de l'alimentation en Europe* (Paris, 1995), pp. 105-06.

[8] Alexis WILKIN, "Organiser l'approvisionnement urbain : gestion des flux alimentaires, régulation des espaces d'échanges. Quelques réflexions en guise de conclusion", in Alexis WILKIN, Arnaud KNAEPEN, Christophe LOIR (eds), *Approvisionner la ville. Flux alimentaires et circulations urbaines du Moyen Âge au XIX^e siècle* (Bruxelles, 2018), p. 193.

[9] Without any claim to exhaustiveness, see: Robert PHILIPPE, "Une opération pilote : l'étude du ravitaillement de Paris au temps de Lavoisier", *Annales. Economies, Sociétés, Civilisations*, vol. 16, no. 3 (1961), pp. 564-68; Louis STOUFF, *Ravitaillement et alimentation en Provence au XIV^e et XV^e siècles* (Paris, 1970); Bartolomé BENNASSAR, Joseph GOY, "Contribution à l'histoire de la consommation alimentaire du XIV^e au XIX^e siècle", *Annales. Economies, Sociétés, Civilisations*, vol. 30, nos 2-3 (1975), pp. 421-23; Guilhem FERRAND, Sandrine LAVAUD (eds), *L'Approvisionnement des villes de l'Europe occidentale au Moyen Âge et aux Temps Modernes*, (Auch, 1985); Reynald ABAD, *Le Grand marché. L'approvisionnement alimentaire de Paris sous l'Ancien Régime* (Paris, 2002); Steven KAPLAN, *Provisioning Paris. Merchant and Millers in the Grain and Flour Trade during the Eighteenth Century* (Ithaca/London, 1984); Steven KAPLAN, *Les Ventres de Paris. Pouvoir et approvisionnement dans la France d'Ancien Régime* (Paris, 1988); Steven KAPLAN, *Raisonner sur les blés. Essais sur les lumières économiques* (Paris, 2017); Alexis WILKIN, Arnaud KNAEPEN, Christophe LOIR (eds), *Approvisionner la ville*….

[10] Stéphane GHIOTTI, *Les Territoires de l'eau. Gestion et développement en France* (Paris, 2007).

[11] See Christian PFISTER, Rolf WEINGARTNER, Jürg LUTERBACHER, "Hydrological Winter Droughts over the Last 450 Years in the Upper Rhine Basin: A Methodological Approach", *Hydrological Sciences Journal*, vol. 51, no. 5 (2006), pp. 966-85; Gwyneth A. COLE, Terry J. MARSH, *The Impact of Climate Change on Severe Droughts. Major Droughts in England and Wales from 1800 and Evidence of Impact* (Bristol, 2006); Emmanuel GARNIER, "Bassesses extraordinaires et grandes chaleurs. 500 ans de sécheresses et de chaleurs en France et dans les pays limitrophes", *La Houille Blanche*, vol. 4 (2010), pp. 26-42; Georges PICHARD, Émeline ROUCAUTE, "Sept siècles d'histoire hydroclimatique du Rhône d'Orange à la mer (1300-2000). Climat, crues, inondations", *Méditerranée*, vol. 123 (2014), Special Issue; Emmanuel GARNIER "A Historic Experience for a Strengthened Resilience. European Societies in Front of Hydro-Meteors, Sixteenth to Twentieth Centuries", in Philippe QUEVAUVILLER (ed.), *Hydrometeorological Hazards. Sciences and Policies*, vol. 1 (New York, 2014), pp. 3-26.

[12] For example, John TITOW, "Evidence of Weather in the Account Rolls of the Bishopric of Winchester, 1209-1350", *The Economic History Review*, vol. 12 (1960), pp. 360-407; John TITOW, "Le climat à travers les rôles de

This study aims to highlight the supply difficulties faced by urban societies confronted with floods and droughts. Here, we will consider urban areas as "open and interconnected systems co-evolving with their natural environment (including the climate system), whose various components, which affect the materiality of buildings, urban environments and functions, as well as the political and socioeconomic dimensions of the urban area (including institutions, actors, and communities living together), interact to create 'urban facts'".[13] Nevertheless, while focusing on hydrometeorological extremes, we underline that the administrative tools of public power are not only due to flood and drought management but also to numerous causes such as meteorological disturbances, wars, epidemics, and commercial crises.

The first section tackles the effects of hydrometeorological extremes on urban supply, such as spoiled commodities, the disruption of urban supply circuits, and damaged infrastructures. The second and last section examines the reactions of urban societies to urban supply problems caused by flood or drought, in terms of humanitarian aid, food distribution, legislation, and preventive measures.

The Effects of Extreme Hydrometeorological Events on Urban Supply

Extreme hydrometeorological events have a variety of effects on the urban supply of primary commodities. During the Ancien Régime, supplies to cities located on the coast depended mostly on rivers, and this also applied to Paris.[14] Although rivers were sources of profit for the nearby populations, they could also make them vulnerable.[15]

To begin with, hydrometeorological extremes can harm crops, affect fields and fruit trees, kill livestock, ruin wood stocks in the rivers, and interrupt the use of water mills. In our chosen period, extremes of the kind could also lead to urban supply issues because of an upstream lack of grains, meat, fruit and vegetables, or because of a disruption of activities, such as water mills brought to a standstill and inaccessible fisheries, either due to flood or drought.[16] For instance, on 19 April 1783, the court in Larche, located in the Corrèze region, drew up a report following the

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comptabilité de l'évêché de Winchester (1350-1450)", *Annales. Economies, Sociétés, Civilisations*, vol. 25, no. 2 (1970), pp. 312-50; Chantal CAMENISCH, *Endlose Kälte. Witterungsverlauf und Getreidepreise in den Burgundischen Niederlanden im 15. Jahrhundert* (Basel, 2015); Karin BECKER, Vincent MORINIAUX, Martine TABEAUD (eds), *L'alimentation et le temps qu'il fait* (Paris, 2015).

[13] "[…] des systèmes ouverts et interconnectés qui coévoluent avec leur environnement naturel (y compris le système climatique) et dont les diverses composantes, qui touchent aussi bien à la matérialité du bâti, au cadre de vie et aux fonctions urbaines qu'à la dimension politique et socioéconomique de l'urbain (y compris les institutions, les jeux d'acteurs, aux communautés et au vivre ensemble) interagissent pour constituer le 'fait' urbain" (cited by Béatrice QUENAULT, "La résurgence/convergence du triptyque 'catastrophe-résilience-adaptation' pour [re]penser la 'fabrique urbaine' face aux risques climatiques", *Développement durable et territoires*, vol. 5, no. 3 [2014], https://journals.openedition.org/developpementdurable/10683, accessed on 11 December 2019.

[14] Steven KAPLAN, *Les Ventres de Paris…*, p. 128.

[15] Jean-Marc Antoine and Bertrand Desailly see this as a "river tropism" which concerns all cities (Jean-Marc ANTOINE, Bertrand DESAILLY, "Villes et inondations dans le Sud-Ouest de la France, de l'époque moderne au milieu du XX^{e} siècle", in Helga-Jane SCARWELL, Guillaume SCHMITT, Pierre-Gil SALVADOR [eds], *Urbanisme et inondation: outils de réconciliation et de valorisation* [Villeneuve d'Ascq, 2017], pp. 39-74). See also Martin BOUDOU, Benjamin DANIÈRE, Michel LANG, "Assessing Changes on Urban Flood Vulnerability through Mapping Land Use from Historical Information", *Hydrology and Earth System Sciences*, vol. 12 (2016), pp. 161-73.

[16] Reynald ABAD, *La Conjuration contre les carpes. Enquête sur les origines du décret de dessèchement des étangs du 14 frimaire an II* (Paris, 2006), pp. 13-53; Michel LE MENÉ, *Les campagnes angevines à la fin du Moyen Âge (vers 1350 – vers1530). Étude économique* (Nantes, 1982).

damage caused by the flooding of the river Vézère that occurred on 6-7 March: "wheat covered in an infinite number of places with fine and burning sands that severely damaged the standing crops […]".[17] During the Ancien Régime, cereals and bread were a cornerstone of social peace and safe markets.[18] According to Patrick Rambourg,[19] in normal conditions, a city like Paris was full of food, salt, wine, wood, etc. The French capital and the other cities used to provide important resources that enabled the common people to find what they needed for their survival, while the richest could perfect the gastronomic diversity of their table. Indeed, even if they were socially heterogeneous, urban societies were all concerned about food security, as much as about a supply that answered both their expectations and needs.[20]

Moreover, floods and droughts could lead to the disruption of urban supply circuits, either due to issues with transport network or to damaged infrastructure: flooded roads, the impossibility of river navigation, destroyed bridges and dried-up locks. For instance, at the beginning of November 1488, a flood of the Loire rendered impassable a great number of roads leading to Nantes, along with streets and alleys in the town itself. Rather than causing real damage, heavy deposits left by the floodwaters prevented carts and people from circulating.[21] In cases of serious material damage, the consequences for transport networks and urban supply circuits would last longer. During the night of 26-27 November 1770, a flash flood of the river Sèvre washed away part of the Rousseau Bridge, which eventually collapsed during the afternoon of the 28th. The ruined bridge "intercept[ed] one of the most important public crossing points", since the roads to Retz, La Rochelle, and part of Poitou intersected in the vicinity of this bridge.[22] It was a real disaster for trade and food supply, especially for the cities of Nantes and Paris, and also for the provinces of Brittany and Normandy. Indeed, livestock traders, who came in large numbers from the fairs of Lower Poitou, had no other road to supply Brittany, Normandy and Paris.[23] In this unfortunate situation, the city council of Nantes decided that a "temporary" ferry (that in the event lasted for more than six years) had to be set up to "give passage to passengers, animals and carts".[24] Moreover, when such a long disruption of urban supply circuits happened without any fallback solution, a shortage of primary commodities such as food, wine, wood, and salt could occur. In 1547 a severe drought affected western France. Between May and November, there was almost no rain, to the extent that the lack of rainfall quickly led to a hydrological drought. Southern Brittany, Anjou, Poitou, and Touraine were particularly affected. The Loire and its tributaries partially dried up. As a result, the water level decreased to the point that the river became "non-navigable, in such a way that there were no merchants who could haggle in Nantes, and bring other goods such as

[17] "[Nous] avons trouvé dans la paroisse de Saint Pantaléon […] les bleds couvers en une infinité d'endroits de sables fins et brulans qui ont fort endommagé la récolte qui est sur pied." Departmental Archives of Corrèze, Fonds de la judication de Larche, B 1456, fol. 2.

[18] Isabelle PARMENTIER, "Les marchés et les pratiques alimentaires en ville, du Moyen Âge au XIXe siècle : remarques introductives", in Alexis WILKIN, Arnaud KNAEPEN, Christophe LOIR (eds), *Approvisionner la ville…*, pp. 7-12; Steven KAPLAN, *Le meilleur pain du monde. Les boulangers de Paris au XVIIIe siècle* (Paris, 1996).

[19] Patrick RAMBOURG, "Bien manger dans le Paris de la fin du Moyen Âge : de la nécessaire nourriture à la bonne nourriture", in Alexis WILKIN, Arnaud KNAEPEN, Christophe LOIR (eds), *Approvisionner la ville…*, pp. 53-65.

[20] Ibid.; Massimo MONTANARI, *La faim et l'abondance…*, p. 133.

[21] Municipal Archives of Nantes (MAN), DD 324, piece n° 1, fol. 1.

[22] "…intercepte un passage public des plus importants", MAN, DD 141, piece n° 22.

[23] Departmental Archives of Loire-Atlantique (DALA), C 372, piece n° 94.

[24] "…donner passage aux voyageurs, aux animaux et aux voitures", DALA, C 372, piece n° 93.

wheat, and others".[25] The supply difficulties were such that granaries and shops in Nantes were poorly stocked. As shown by Monique Bourin,[26] transportation difficulties meant that the subsistence crisis could not be "solved through exchange".

While urban supplies could be interrupted by hydrometeorologically extreme conditions or damage, the latter could also lead to an increase in commodity prices. As Meschinet de Richemond and Reghezza[27] have pointed out, material damage was likely to produce structural damage that, in a third phase, could result in functional damage. As roads became impassable, the cost of transport to supply cities tended to skyrocket. Indeed, carts either had to be diverted to longer routes, or required more animals, men, and time. In turn, extreme conditions caused an increase in the price of basic foodstuffs, delays in reaching markets, as well as social pressures and stress. During the winter of 1524, the "milk-like rainy weather" ("*le lait tempts de pluye*") made roads muddy and rivers difficult to navigate. In Metz, this led to problems with the salt supply. They quickly caused a price surge, as prices multiplied six-fold during the season. This episode resulted in widespread unrest ("*grant murmure*") in the city and the surrounding plains. In order to restore social peace, the urban government was obliged to open its salt granaries and cap prices.[28] The same applied to grain and wood distributions, as both were affected by hydrometeorological extremes. Everyone needed wood all year round, but the commodity was a difficult one to store because of the risk of fire. For this reason, wood supplies often required a "last-minute" delivery by land or water.

During the Ancien Régime period, in order to reduce the risks linked to wood supply problems, abandoned islands such as the Île des Javiaux or the Île Louviers, in Paris, served as wood depots despite being prone to river flooding. Even though the latter were very close to the centre of Paris, wood supplies would take a long time, remain fragile and vulnerable, as the winters of 1783-85 exemplify.[29] From the end of the Middle Ages onwards, such recurrent vulnerability prompted cities in France, England, and the Holy Roman Empire to take exclusive control of salt, wood, and grain flows and stocks.[30]

Furthermore, during the Ancien Régime, the disruption of urban supply circuits could lead to a fall in tax revenues. Indeed, when commodities entered the gates of a city, they were subject to taxes and duties. Wine was particularly impacted, as it enjoyed a high social and fiscal value. According to Sandrine Lavaux,[31] at the end of the Middle Ages, more than 75% of the tax revenues of Bordeaux depended on wine taxes. At the end of the Ancien Régime period, the levy on

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[25] "…non navigable en sorte quil ny avoit aucun marchant damont, qui peult venir querir à Nantes et amener autres marchandises comme du bledz et autres", MAN, CC 384, dossier 6, piece n° 13.

[26] Monique BOURIN, John DRENDEL, François MENANT (eds), *Les Disettes dans la conjoncture de 1300 en Méditerranée occidentale. Actes du colloque de Rome, 27-28 février 2004* (Rome, 2011).

[27] Nancy MESCHINET DE RICHEMOND, Magali REGHEZZA, "La gestion du risque en France : contre ou avec le territoire ?", *Annales de géographie*, vol. 673 (2010), pp. 248-67.

[28] Charles BRUNEAU (ed.), *La Chronique de Philippe de Vigneulles*, t. 4 (Metz, 1927-1933), pp. 495-96.

[29] Jean BOISSIÈRE, "La grande disette de bois à Paris des années 1783-1785", in Charles HIGOUNET (ed.), *L'Approvisionnement des villes de l'Europe occidentale au Moyen Âge et aux Temps modernes, Actes des 5e Journées Internationales d'Histoire de l'Abbaye de Flaran, 16-18 septembre 1983, Valence-sur-Baïse* (Bière, 1985), pp. 237-42.

[30] John BOHSTEDT, *The Politics of Provisions. Food Riots, Moral Economy and Market Transition in England, c. 1550-1850* (Farnham, 2010), pp. 80-82; Bernard CHEVALIER, "Aux origines de la ferme. Les villes et le monopole d'approvisionnement des greniers à sel (fin XIVe-milieu XVIe siècle)", in Jean-Claude HOCQUET (ed.), *Le Roi, le marchand et le sel, Actes de la table ronde "L'Impôt du sel en Europe, XIIIe-XVIIIe siècle", Saline royale d'Arc-et-Senans, 23-25 septembre 1986* (Lille, 1987), pp. 133-49; Franz IRSIGLER, "L'approvisionnement des villes de l'Allemagne occidentale jusqu'au XVIe siècle", in Charles HIGOUNET (ed.), *L'Approvisionnement des villes de l'Europe occidentale…*, p. 129.

[31] Sandrine LAVAUX, *Bordeaux et le vin au Moyen Âge. Essor d'une civilisation* (Bordeaux, 2003), p. 178.

beverages (wine, cider, beer and other beverages) amounted to 75% of the municipal budget of the city of Chartres.[32]

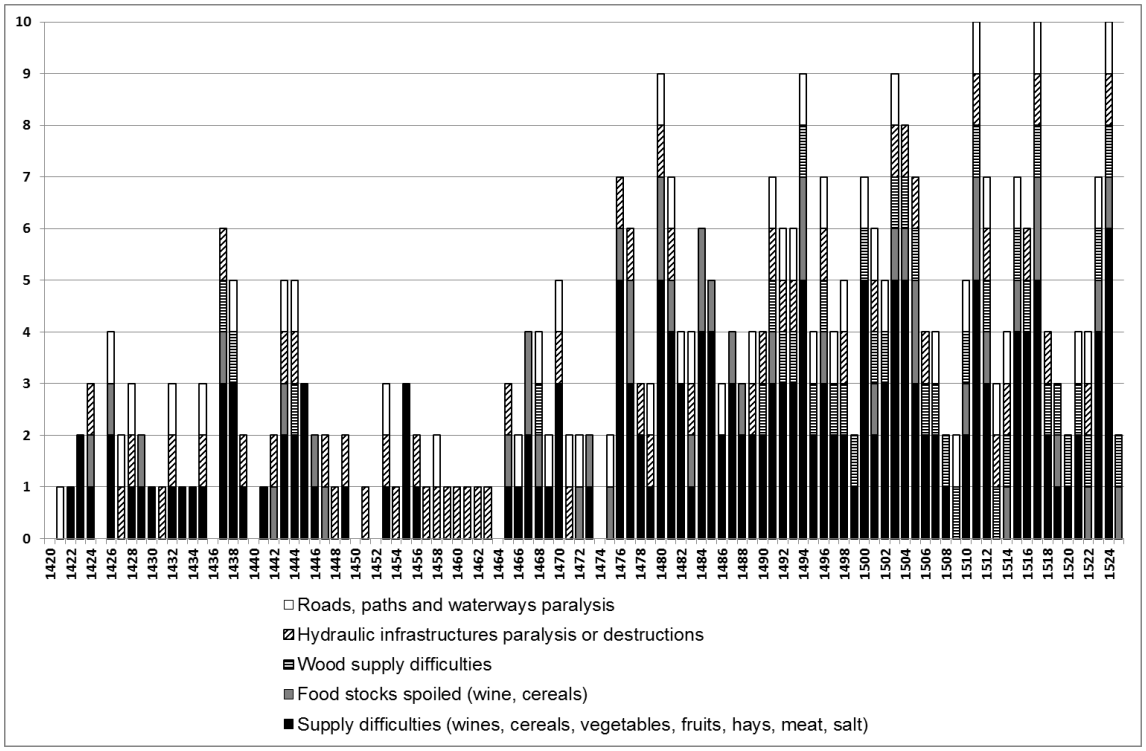

Figure 1. Supply difficulties caused by hydrometeorological extremes in Metz (1420-1525).[33] Graph from Litzenburger (see note 37).

In these conditions, urban supply issues could temporarily result in lower incomes for cities affected by hydrometeorological events. Finally, droughts and floods could disrupt urban supply to the point of affecting social, political, and food security. The need for security in modern times was crucial, especially in Paris.[34] Scarcity sometimes resulted in social disturbances[35] such as "whispering" ("*murmures*"), riots,[36] thefts, and unemployment.

[32] Benoît GARNOT, "Administrer une ville au XVIII[e] siècle : Chartes", *Histoire, économie et société,* vol. 7, no. 2 (1988), pp. 178-79.

[33] The index shows for each year, and cumulatively, the supply difficulties of the city at different times of the year. Each item appearing in the categories "Food stocks spoiled (wines, cereals)" and "Supply difficulties (wines, cereals, vegetables, fruits, hays, meat, salt)" is accounted separately. For example, wine and cereals were both spoiled in 1467, while the supply of six out of seven commodities was difficult in 1524.

[34] Steven KAPLAN, *Le Complot de famine. Histoire d'une rumeur au XVIII[e] siècle* (Paris, 1982); Steven KAPLAN, *Les Ventres de Paris…*; Vincent MILLIOT, *L'Admirable police. Tenir Paris au siècle des Lumières* (Paris, 2016).

[35] For example, Emmanuel LE ROY LADURIE, "L'historien face à l'histoire climatique et à l'attitude des autorités en cas de conjoncture 'climatico-périlleuse'", in René FAVIER (ed.), *Les pouvoirs publics face aux risques naturels dans l'histoire* (Grenoble, 2002), pp. 13-29.

[36] Jérémy DESARTHE, "Le devoir de mémoire comme outil de résilience ? Les sociétés urbaines face aux inondations dans l'ouest de la France (XVI[e]-XX[e] siècles)", in *Actes du colloque "Renforcer la résilience au changement climatique des villes : du diagnostic spatialisé aux mesures d'adaptation", 7-8 juillet 2011, Université Paul Verlaine* (Metz, 2011), p. 13.

Taking the example of Metz,[37] figure 1 shows the main effects (spoiled food stocks, paralysed roads and waterways, damaged infrastructures…) of hydrometeorological extremes on the urban supply of the city from 1420 to 1525.

New urban functions appeared in response to the increased risk of damage and vulnerability, thus making it possible to study the means implemented by both societies and municipal authorities in order to cope with the urban supply difficulties caused by hydrometeorological extremes.

Urban Food Supply Management during Hydrometeorological Extremes

To deal with supply problems resulting from floods and droughts, the urban societies and authorities – mainly municipalities – implemented a variety of means. As anthropologists Sandrine Revet and Julien Langumier note: "making humanitarianism a management principle"[38] is not something that happens by itself. To manage a supply crisis either caused by a flood or by a drought means, first, to manage a social situation deemed to be politically operative. Defining the issues targeted by the political authorities is, above all, a cultural act. Each society defines the issues resulting from a crisis in its own way and thus determines the sectors to be acted upon. For the Ancien Régime period, we identified at least three types of reaction, which represent different kinds of adaptability: 1) relieving populations through the distribution of commodities such as bread, wheat, and wine; 2) resorting to legislation; 3) adopting alternative solutions and precautionary measures. These actions reveal the social organization of urban supply management during hydrometeorological extremes. They show that reactions from municipal officials and urban authorities are decisive. Thus, in April 1784, the lieutenant-general of police in Rennes specified: "The primary duty of the administrators of a large city is, generally, to provide for the subsistence of the inhabitants, this being a sacred duty when it comes to bread which is of primary necessity for everyone, and almost the only food for the poor."[39]

The first reaction we will focus on is "relief", i.e. charitable food distribution. Historical documents often mention private actions to assist victims facing floods or droughts. In 1296 and 1325, the river Seine flooded. The bridge connecting the Île de la Cité to the rest of the city of Paris collapsed. According to the chronicler Guillaume de Nangis, for several days, anonymous "boatmen" supplied the isolated island with bread.[40] However, in the present case, some questions remain: was the involvement of both the boatmen and the other economic actors on the river voluntary or compulsory? Did the involvement happen under duress, inducement, or through a natural support system? When food distribution came either from relatives or the urban elite, the charitable nature of the action was clear. It was then a question of showing one's presence, and behaving according to one's family status or social rank.[41] It was also a matter of fulfilling one's

[37] Laurent LITZENBURGER, "Les risques climatiques à Metz à la fin du Moyen Âge", in Jean SOUMAGNE (ed.), *Nature et composition urbaine* (Paris, 2013), pp. 49-62, esp. pp. 54-55.

[38] "…un humanitarisme converti en principe de gestion", Sandrine REVET, Julien LANGUMIER (eds), *Le Gouvernement des catastrophes* (Paris, 2013), p. 13.

[39] "Le premier devoir des administrateurs d'une grande ville est de pourvoir en général à la subsistance des habitants, ce devoir sacré lorsqu'il s'agit du pain qui est de première nécessité pour tout le monde et presque la seule nourriture des pauvres". Municipal Archives of Rennes, HH 184.

[40] Guillaume DE NANGIS, *Chronique latine de Guillaume de Nangis et de ses continuateurs* (Paris, 1843).

[41] Théo BLANCHARD, "Les inondations de 1733 et 1740 à Grenoble : L'évolution de la résilience dans l'après catastrophe", *Environnement Urbain / Urban Environment*, vol. 2 (2008), pp. 73-89.

religious duty, and acting according to theological values.[42] For example, in Caen, during the flood of February 1784, notables donated to the city's hospital, thus allowing its administrators to buy enough bread to feed the 700 residents staying there.[43] It should be noted that such assistance could favour certain categories of people, or areas, over others. In Metz, in the fifteenth and sixteenth centuries, distribution was only organized for the very poor. The rest of the population had to pay (at great expense) to access municipal stocks. Furthermore, disaster policies slowly emerged during the Middle Ages and the Renaissance.

A significant shift took place towards the end of the fifteenth century, and in particular during the sixteenth century.[44] Local authorities seriously began to make emergency relief to victims a part of their remit. In the city of Tours, for example, municipal accounts and records of deliberations make it possible to trace the activity of the municipality faced with the flooding of the Loire and Cher rivers back to the beginning of the fifteenth century. Thus, when the flooded rivers burst their banks in November 1520, the municipal authority explicitly decided to take charge of the food difficulties facing the victims by organizing requests in the parishes, in order to collect enough money to arrange the baking of a large quantity of bread. The latter was distributed to all those who had taken refuge within the city walls. This type of action then became systematic. And yet, the definition of humanitarian emergency in a situation of natural disaster is very recent indeed. It developed gradually, in parallel with what is known as the welfare revolution. Due to an evolution in thinking about poverty at the beginning of the sixteenth century, public welfare was transferred from the ecclesiastical sphere to the local political sphere.[45] Giovanni Botero was one of the first political thinkers to define public welfare even more broadly. In his *Della ragione di stato*,[46] first published in Italian in 1589, he listed floods among a particular category of events that he called "public disasters", and added that it was compulsory for a prince to take responsibility for these. Botero went as far as taking advantage of the disaster, turning it into an opportunity for a good ruler to win the love of his people by showing his compassion, thus opening the door to a completely new political tradition of disaster and emergency relief.

In the Ancien Régime period, especially from the fourteenth to the fifteenth centuries, urban supply was a focus of legislative inflation in France[47] and Europe.[48] Both administrative and legal texts became more and more restrictive. They aimed to ensure a good urban supply throughout the year, even during times of shortage. In terms of legislation, the goal for French medieval and early modern cities was to ensure a steady flow of commodities that were as cheap, varied, and high quality as possible.[49] The most frequent regulations pertaining to urban supply problems concerned the price and weight of bread, the purchased amounts (e.g. flour for bakers), and exportation. Municipal legislation about the weight of bread and the quantity of goods varied in times of crisis and high prices. The main goals were to reduce the risks of private hoarding, speculation, and

[42] Emmanuel GARNIER, "La ville face aux caprices du fleuve. L'exemple normand XVI^{e}-XVIII^{e} siècle", *Histoire urbaine*, vol. 18, no. 1 (2007), pp. 41-60.

[43] Ibid.

[44] Thomas LABBÉ, *Les Catastrophes naturelles au Moyen Âge* (Paris, 2017).

[45] Jean Pierre GUTTON, "Aux origines d'un ministère de l'Assistance et de la Santé dans la France de l'Ancien Régime", in Jean-Louis HAROUEL (ed.), *Histoire du droit social – Mélanges en hommage à Jean Imbert* (Paris, 1989), pp. 277-86.

[46] Giovanni BOTERO, *Della ragione di stato libri dieci* (Venezia, 1598), esp. pp. 42-43.

[47] Alexis WILKIN, "Organiser l'approvisionnement urbain…", p. 193.

[48] Guido ALFANI, Cormac Ó GRADA, *Famine in European History* (Cambridge, 2017); Carl GUNNAR PERSSON, *Grain Markets in Europe 1500-1900: Integration and Deregulation* (Cambridge, 1999).

[49] Alexis WILKIN, "Organiser l'approvisionnement urbain…", p. 192.

corporatist advantage,[50] and to enable more people to access basic food and commodities. For instance, in Paris, the maximum amount a baker could buy per market day was normally of two *muids* of grain, or one *muid* of flour.[51] However, the authorities were quite tolerant with this legislation.

The urban authorities also borrowed money to buy and have cereals delivered at lower prices, and they took measures to preserve local stores of grain. Between 1419 and 1422, because of frequent flooding of the river Clain in Poitiers, a series of poor harvests led to a food crisis. The cereal supplies were running out. Consequently, the urban administration of Poitiers made every effort to ensure that the city's markets were supplied as a priority. Encouraged by provincial authorities, the export of wheat was prohibited from both the city and the province.[52] In the same way, at the end of the 1460s and the beginning of the 1470s, the duke of Brittany forbade the export of wheat out of the province in order to preserve a local supply as much as possible.[53] The efficiency of supply politics relied as much on shared moral, cultural, and economic norms as on the structures and dynamics of power.[54]

Finally, it seems that urban authorities adopted alternative solutions and precautionary measures. In France, the historical reports of preventive measures are rare. However, we can still highlight different forms of intervention. One of the anticipatory solutions offered by urban societies facing supply problems due to hydrometeorological extremes was to produce a greater quantity, or procure supplies elsewhere in terms of geography, once the risk was detected. From the end of the Middle Ages, municipal authorities started to consider urban supply issues. In Tours, when a flood threatened the city, authorities asked bakers to make as much bread as possible, in anticipation of the potential difficulties in flour supply and foodstuff distribution. Similarly in 1740, a flood threatened Grenoble. According to Denis Coeur, bakers had to make a huge number of bread loaves and bake them "before the ovens [were] all flooded or the wood [ran] out". In these conditions, from 25-28 October, he estimated the quantity of bread produced by the nineteen bakers to have been 2,559 French *livres* of white bread and 3,056 French *livres* of brown bread.[55] Moreover, during droughts and floods, bakers were ordered to go elsewhere in order to grind grains. Such a situation could entitle them to a compensation. In 1785, a significant drought occurred in France.[56] The situation took a political turn when flour prices started to skyrocket at the markets, and "whispers" began. The high cost of flour not only impacted the scarcity of produce but also the measures taken. In some cities, such as in Alençon, the municipal authorities resorted to increasing the bread price in order to compensate the bakers who had to grind their wheat in mills unaffected by the low water levels.[57] At the request of the Brittany Intendant, the King's Council granted an exceptional subsidy of 200,000 pounds for the purchase of wheat.

As mentioned briefly below, supply problems could stem from a disruption of activities caused by a hydrometeorological extreme. Whenever water mills were down because of a lack or excess of water, the use of either horse-drawn mills for industries, or human labour, became

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[50] Steven KAPLAN, Philippe MINARD (eds), *La France, malade du corporatisme ? XVIII^e^-XX^e^ siècles* (Paris, 2004).

[51] Steven KAPLAN, *Les Ventres de Paris…*, pp. 388-89.

[52] René FAVREAU, *La Ville de Poitiers à la fin du Moyen Âge, une capitale régionale* (2 vols, Poitiers, 1978).

[53] DALA, B 7, fol. 136.

[54] John BOHSTEDT, *The Politics of Provisions…*, p. 268.

[55] Denis COEUR, *La Plaine de Grenoble face aux inondations. Genèse d'une politique publique du XVII^e^ au XX^e^ siècle* (Paris, 2008), p. 55.

[56] Jérémy DESARTHE, *Le Temps des saisons…*, pp. 115-19.

[57] Municipal Archives of Alençon, 2HH.

alternative solutions. In December 1794 and January 1795 in the city of Douai, water mills stopped because of the hydrometeorological conditions. In order to avoid a flour crisis, the municipality forced the National Guard to take turns to rotate mills by hand.[58] Moreover, from the fifteenth century onwards, the construction of large municipal granaries in cities became part of the supply crisis prevention and improved the anticipation of such dramatic events. When a food crisis occurred, the religious authorities also reacted in order to avoid more severe conditions. For example, they could give permission to eat dairy products (such as milk, butter, and cheese) during Lent. This would enable populations to survive and reduce the risk of starvation. In 1457 and 1501, the Bishop of Metz issued such an authorization to the population of his diocese.[59] In 1506, the Duke of Lorraine René II directly obtained the permission from Pope Julius II.[60] In addition to these steps taken by the authorities, the people themselves searched for solutions, such as the use of oatmeal as a substitute for wheat. The development of alternative and precautionary measures provided neither solutions to achieve specific goals nor specific decisions to reduce vulnerability. However, they were part of the anticipation and prevention of crises and helped to reduce the economic and financial impact of urban supply problems.

During the Ancien Régime, the management of urban supply problems mainly rested on municipal authorities. Their interventions rested on three main types of reactions, namely legislation, prevention, and relief. From the fourteenth to the eighteenth centuries, the various reactions to the urban supply problems studied here were largely guided by the goal of preserving social peace.

Conclusion

This article has shown some of the ways in which hydrological extremes impacted urban food supplies. During the Ancien Régime, in France, droughts and floods were hydrological, climatic, and social realities faced by individuals and public authorities, either in the short or medium term. At times of food shortage, the general interest was not always targeted. Indeed, the political authorities involved, as well as the way in which private interests managed to make their way into legislation, play a certain role.[61] However, urban territories were able to withstand shocks and rebuild after a hydro-socio-environmental crisis that disturbed the supply of primary commodities. The various actors adapted to these difficulties from time to time. Assistance was also provided, first by private individuals, and then by the authorities.

Several case studies presented in this article predate the French Revolution. It is not necessary to discuss the role played by climate factors in its outbreak. However, we can point out that at the end of the eighteenth century, hydrological extremes still made urban populations very vulnerable to food shortages. In addition to these "natural" triggers, the authors suggest that in general this period was as difficult in terms of food "as any previous time (with the possible exception of the eleventh century) […]. We find ourselves, on the contrary, faced with widespread discomfort, a state of permanent under-nourishment which is, so to speak, 'assimilated'

[58] Municipal Archives of Douai, D^1 2, p. 379.

[59] Bibliothèque Multimedia Intercommunale Épinal-Golbey, Ms. 131, *Chronique de Praillon* (1323-1498 n.s.), fol. 340 (1457). Lorédan LARCHEY (ed.), *Journal de Jehan Aubrion, bourgeois de Metz, avec sa continuation par Pierre Aubrion (1465-1512)*, F. Blanc (Metz, 1857 [1st ed., Metz, 1501]), pp. 433-34.

[60] A copy can be found in the Departmental Archives of Meurthe-et-Moselle (AD 54, B. 456, fol. 197, n° 3).

[61] Alexis WILKIN, "Organiser l'approvisionnement urbain…", p. 199.

(physiologically and culturally) to a normal life condition".[62] Furthermore, it goes without saying that, to use the words of Emmanuel Le Roy Ladurie, an extreme hydrological event is only one of a multitude of other factors contributing to the origin of a crisis.[63]

Several disasters in history have led to changes in legislation, especially regarding risk prevention and protection.[64] It remains to be seen whether periods particularly marked by excesses, and hydrological extremes, have been accompanied by changes in political and social reactions against food shortages. Thus, while this work provides a synthesis, a perspective that focused on a particular city, a river or a watershed, using a microhistorical approach, might allow these possible links to be discussed.[65]

Urbanization rates have grown strongly since the nineteenth century and urban food models have become the norm.[66] Nevertheless, the vulnerabilities of urban societies to their food supply are still significant. Food distribution for the deprived inhabitants during extreme events was a constant throughout the past, and still is today. As Magali Reghezza mentioned in her thesis on the vulnerability of the metropolis of Paris to the hundred-year flood: "The first concern of managers is the supply of water and foodstuffs in the capital."[67] Providing supplies can be difficult in the event of distribution grid and network shutdowns – and fuel shortages – while power cuts make it difficult to preserve or cook food. Though the vulnerabilities have changed in nature, they are still present.

[62] Massimo MONTANARI, *La Faim et l'abondance…*, p. 176. « [comme elles ne l'ont peut être jamais été (à l'exception peut-être du XIe siècle) […] Nous nous trouvons au contraire devant un malaise diffus, un état de sous-alimentation permanente qui est pour ainsi dire « assimilé » (au plan physiologique et culturel) comme une condition normale de la vie".

[63] Emmanuel LE ROY LADURIE, "Du déterminisme climatique en histoire", in Martine TABEAUD (ed.), *Réchauffement climatique : un carbone qui sent le soufre*, Special Issue of the *Bulletin de l'Association des Géographes Français*, vol. 90, no. 1 (2013), pp. 5-11.

[64] René FAVIER (ed.), *Les Pouvoirs publics face aux risques naturels dans l'histoire* (Grenoble, 2002).

[65] For a discussion of *microhistory*, see Carlo GINZBURG, Carlo PONI, "La micro-histoire", *Le Débat*, vol. 10, no. 17 (1981), pp. 133-36.

[66] Massimo MONTANARI, *La Faim et l'abondance…*, p. 214.

[67] Magali REGHEZZA, *Réflexions autour de la vulnérabilité métropolitaine : la métropole parisienne face au risque de crue centennale*, Doctoral dissertation, University of Nanterre – Paris X, 2006, pp. 107, 110.