

# MATERIAL RESPONSES TO NATURAL HAZARDS IN 16<sup>TH</sup> AND 17<sup>TH</sup> CENTURIES: CASES FROM PRE-SENT-DAY SLOVENIA AND ITS SURROUNDINGS

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## **Abstract**

Material responses to natural hazards threatening agricultural land and dwellings in princely seigneuries and urban settlements included cooperation between central agencies, regional and local level – in some cases leading to efficient measures. Examples of reactions of provincial estates, non-princely seigneuries and neighbours are also given. Historical knowledge contributed to risk mitigation. Artificial interventions in landscape due to flood hazard affected also flood safe locations.

**Key words:** natural disaster, environmental history, Early Modern Period, Slovenia, Carniola, Styria, Carinthia, Inner Austria, archival sources

## **STVARNI ODZIVI NA NARAVNE NESREČE V 16. IN 17. STOLETJU: PRIMERI Z OZEMLJA DANAŠNJE SLOVENIJE IN NJENE OKOLICE**

### **Izvleček**

Stvarni odgovori na naravne nesreče, ki so ogrožale kmetijska zemljišča in bivališča v deželno knežjih gospostvih in urbanih naseljih, so vključevali sodelovanje centralnih organov, regionalne in lokalne ravni. V nekaterih primerih so omogočili učinkovite ukrepe. Navajam tudi primere odzivov deželnih stanov, nedeželno knežjih gospostev in sosedov. Poznavanje zgodovine je prispevalo k zmanjševanju tveganja. S poplavami povezani človeški posegi v pokrajino so spreminjali tudi poplavno varna območja.

**Ključne besede:** naravne nesreče, okoljska zgodovina, zgodnji novi vek, Slovenija, Kranjska, Štajerska, Koroška, Notranja Avstrija, arhivski viri

## I INTRODUCTION

‘Disasters /.../ have two historical trajectories, one “natural” and the other societal. They are “historical” in the sense that both forces change over time’ (Bankoff, 2007, p. 104).

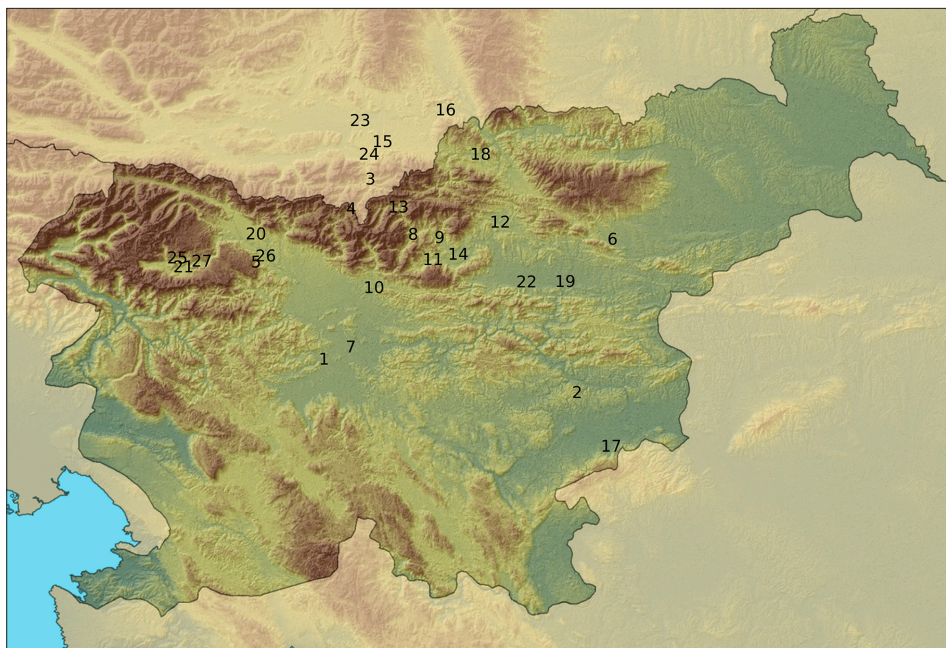
The article concentrates on the period from mid 1560s to the late 17<sup>th</sup> century. In the observed timeframe, great majority of people here lived on the countryside as tenants of various seigneuries. The state and transformation of cultural landscape as results of interrelated ever changing natural conditions and processes on the one hand, and varying human interventions on the other hand were often much different from the present ones. The braided rivers, for instance, heavily transformed during the further course of history, must already in the observed timeframe be interpreted as socio-natural sites, although human interventions were in general not comparable with the ones from industrial period (Winiwarter et al., 2013).

The main emphasis is placed on case studies (Fig. 1) from the territory which was at that time part of three provinces belonging to the Inner Austrian group – Carniola, Styria and Carinthia (Spreitzhofer et al., 1988). Inner Austria had its own central agencies in its capital Graz. Whereas court’s treasuries in Vienna were responsible for the Inner Austrian territory until 1564 (Inventar ..., 1951), the court’s treasury and the Lower Austrian court’s treasury were founded in Graz in that year (Spreitzhofer et al., 1988; Vilfan, 1996). The majority of archival sources of central agencies from the period 1564–1625, used in this article, are preserved in the chronological series from the collection *Archive of the Inner Austrian court’s treasury* in Styrian provincial archives, thus they are results of operation of the court’s treasury in Graz, not of the Lower Austrian court’s treasury situated there (Puschnig, 1959). Division of work between both court’s treasuries in Graz changed more than once until 1625 when they were united into the Inner Austrian court’s treasury. These court’s treasuries were responsible for princely property until the end of the observed period (Spreitzhofer et al., 1988), which suggests that they were actively involved in material responses to natural hazards and disasters.

On the provincial level, two parallel but partly overlapping administrative systems co-existed, the princely one and the one of the Estates of each province. Central authorities from Graz cooperated with the princely ones. In the observed timeframe and in the observed provinces, *Viztums* were officials administrating the princely property on the province level or at least on the level of a very considerable part of the province as in the case of Styria. One of the most important fields for which Estates of the provinces were competent and which is important for this article was the administration of taxes from non-princely seigneuries based on revenues from land in possession of tenants (Spreitzhofer et al., 1988; Vilfan, 1996; Golec, 2011), thus they were also actively involved in material reactions to natural disasters.

By analysing archival sources from the archives of the court’s treasury in Graz, the Inner Austrian court’s treasury, the Estates of the provinces of Carniola and Styria, the *Viztum* of Carniola and selected seigneuries, the article, firstly, provides a new basic insight in the administrative as well as not formally organized material responses to natural hazards within the specified timeframe and area, and secondly, discusses artificial interventions into environment related to natural hazards with an emphasis on floods. Within the cultural landscape, the article focuses on agricultural land and banks of watercourses.

Figure 1: Important locations for understanding the case studies. For easier orientation, state boundaries are represented in their present-day outline. Background: Relief map of Slovenia  
 Slika 1: Lokacije, pomembne za razumevanje študij primerov. Za enostavnejšo orientacijo so prikazane današnje državne meje. Ozadje: Relief map of Slovenia



1 Kozarje; 2 Primož, Osredok pri Hubajnici, Dolge, Gornje Impolje, Dolnje Impolje, Dolnje Orle; 3 Eisenkappel/Železna Kapla; 4 Jezerski vrh/Seebergsattel; 5 Kropa; 6 Slovenske Konjice; 7 Mala vas, Stožice; 8 Luče ob Savinji; 9 Ljubno ob Savinji; 10 Kamnik; 11 Gornji Grad; 12 Šoštanj; 13 Solčava; 14 Pobrežje; 15 Gösselsdorf/Goselna vas; 16 Schwabegg/Žvabek; 17 Kostanjevica na Krki; 18 Ravne na Koroškem; 19 Celje; 20 Nova vas, Dvorska vas; 21 Savica, Brod; 22 Šešče, Vrbje, Spodnje Roje; 23 Stein/Kamen, Seidendorf/Ždinja vas, Piskertschach/Piskrče; 24 Winkel/Kot; 25 Studor; 26 Otoče, Globoko; 27 Nomenj

## 2 FROM CENTRAL AUTHORITIES TO LOCAL RELIEF: BASIC LEVELS OF MATERIAL RESPONSES TO NATURAL DISASTERS

### 2.1 The levels of Inner Austria and its provinces

Environmental historian Christian Pfister (2009) divides activities during and after a natural disaster into phases of emergency, damage compensation and reconstruction. According to him ‘under the ancient régime, local officials waited for instructions from the prince and his cabinet in the wake of a disaster’ (pp. 25–26) and only later, e.g. in the late

18<sup>th</sup> century when the initiative of the local level increased, ‘local officials reported their observations to higher levels of administration and made recommendations on how best to manage the emergency phase’ (p. 26). In the damage-compensation phase ‘disaster-stricken communities usually received some support from the territorial ruler or his surrogate’ (p. 27). The provinces could reduce or free the disaster-stricken population from taxes (Pfister, 2002a) and it was for instance typical for reconstruction following disastrous floods, the phase succeeding the emergency and damage compensation, that prior to the 19<sup>th</sup> century adaptation and flood risk mitigation were matters of local communities in the Western Europe (Pfister, 2009). On the observed territory, the system functioned in a slightly different way. According to the following case studies, central agencies took very important final decisions in the phases of damage compensation and reconstruction, but before that they had received the information from the local level, they had checked it and had asked for advice at the regional, mainly provincial level.

The instructions from 1498 already ordered the provincial administrator of princely property (*Viztum*) in Carniola to provide a report on damage, caused by natural disasters to the land in possession of tenants from **princely seigneuries**, to the central agency existing at that time (Žontar, 1966). How did the information from princely seigneuries reach the central authorities in the 16<sup>th</sup> and 17<sup>th</sup> centuries? The example of princely tenants from the small seignury of Kozarje, spatially concentrated mainly in the village Kozarje (Fig. 1; no. 1) from the late 16<sup>th</sup> century is representative of many similar cases. **First**, the court in Graz in Styria, at that time the capital of Inner Austria, received a letter written by tenants or on behalf of them, e.g. by a person with pledge right on the affected princely seignury. In the case of Kozarje, it says that severe winter and cold weather in 1586, the subsequent frost but most of all hailstorms in 1588 caused great damage to cereals and fruits to eight princely tenants there which turned them to poverty and caused ‘severe famine’. The letter was written not earlier than in 1589. Tenants asked for release from their debts caused by taxes and dues from years 1586 to 1588. The letter did not forget to stress also that they lived close to the city of Ljubljana, the provincial capital, where their compulsory labour presented a source of workforce for the administrator of the princely possession (*Viztum*) (ARS, 1589). Taking into account the fact that the purpose of such documents was releasing of burdens, many such sources present the devastation in an exaggerated way. Comparison of preserved draft and final version of a record from 1654 on damage caused to agricultural land and forest by fluvial erosion and deposition can demonstrate it. According to the (impartial or already exaggerated?) draft, up to five days had formerly been needed to plough the devastated fields and 112 carts of hay had been cut on destroyed meadows, what turned to many days of ploughing and many hundreds of carts in the final version (ARS, 1654a, b, d). Thus, **second**, trying not to be misled, the court’s treasury ordered the provincial administrator of the princely property to provide a report on the situation containing also the advice, what the adequate measures would be for the central authority to take in the case of Kozarje; it dates from March 6, 1589. **Third**, the *Viztum* answered confirming the truthfulness of causes for the existing poverty announced by tenants. He suggested releasing them from debts in taxes and dues at least for the year 1588 if not for all the three years they had asked for, or for two of them. To

increase the possibility for his proposal to be accepted, he also emphasized that the occasional compulsory labour of these tenants in Ljubljana or in freight transport reduced the expenditures for workforce (ARS, 1589) – one of the factors which could lead to potential untruths in his report. **Fourth**, on April 22, 1589, the court's treasury from Graz decided to release these tenants from the whole tax and dues for 1588 (ARS, 1589).

The central agency thus took into account the potentially reliable advice from the regional level. The procedure took a couple of months, thus it was completed relatively quickly, which was not always the case. For instance, the letter from the princely seignury of Teriška vas/Ruckenstein was sent to Graz before August 25, 1570, stating that fields of 29 listed tenants in eight settlements, e.g. Primož, Osredok pri Hubajnici, Dolge, Gornje Impolje, Dolnje Impolje and Dolnje Orle (Fig. 1; no. 2), were entirely devastated by a hailstorm in the same year. It immediately followed the previous food shortage, thus the tenants would not subsist there unless they were released from taxes for 1570. The order to the provincial administrator of princely property to inform the central agency on the actual circumstances and to propose the adequate measures was written in Graz on August 29. Almost half a year later, before January 30, 1571, the seignury sent a reminder to the court's treasury in Graz that as far as it knew the case was still not solved and on February 4, the central agency issued a reminder to the provincial *Viztum* as they were still waiting for his report (ARS, 1570–1571). The field work had by that time already been carried out – not by *Viztum* himself, but by a nobleman from the vicinity whom *Viztum* had ordered to conduct it. His report to *Viztum*, dated November 16, 1570, more or less confirmed the statements of the seignury of Teriška vas/Ruckenstein. Due to the previous food shortage, the majority of tenants stricken by hail in 1570 already had to borrow, buy or beg for seed for 1570 harvest; also the seignury helped them with release from dues and with seeds.

In 1570, hail destroyed the majority of those cereals with high grain volume weight and grapes to tenants listed by the seignury as well as to two nearby hides in Prevoje. In the villages Gornje Impolje, Dolnje Impolje and Dolnje Orle harvest of cereals with high grain volume weight and grapes was completely destroyed. *Viztum* sent his report to the court's treasury only on September 8, 1571. He proposed to help the affected tenants with a tax release and reduced dues, especially for those whose crops were entirely destroyed. However, he stated that according to the trustworthy information he had received, the main reason for the poverty of these tenants was extremely low wine and must prices paid to the tenants by former seignorial economic officials. The *Viztum* did not know whether this was also the case with the economic official of the time but he proposed to make sure that such exploitation would not continue. On November 19, 1571, the court's treasury proposed the prince to reject the tax release due to the usury of seignorial economic officials as well as to force the noblewoman with pledge rights on this princely seignury to pay the debts in taxes instead of the tenants and to make sure that the usury of economic officials would not continue. Five days later, more than a year and a quarter after the beginning of the procedure, the prince rejected the tax release and ordered the mentioned noblewoman to make sure that the usurious wine prices would not continue (StLA, 1571).

Recommendations from provincial level were thus not always respected by central authorities as demonstrated even more clearly by an application for a three-year tax

release of burghers from the alpine market town of Kappel/Kapla (now Eisenkappel/Železna Kapla) (Fig. 1; no. 3). The subsequent letter from Graz to the agency of the provincial administrator of princely property and, in this case, also to the representative of the office between the prince and the Estates of the province (*Landeshauptmannschafft*; on this agency, see Spreitzhofer et al., 1988) dates from April 11, 1572. The involvement of the instance between the prince and the Estates is here probably the consequence of the reported fact that burghers of Kappel/Kapla had unsuccessfully tried at first to receive aid from the Estates of the province. The *Viztum* who inspected the situation there and a representative of the office between the prince and the Estates recommended a two year tax release (a year less than the burghers had asked for) because of damage caused by water due to abundant precipitation and harvest failure(s). To increase the possibility of a favourable answer, they emphasized that this market town was also in charge of repair works on a section of the important Alpine route over the Jezerski vrh/Seebergsattel Pass (Fig. 1; no. 4). At that time, it was in very bad condition thus the investment of traffic-related incomes of the market town would not make the repair works possible. The tax release would lead also to improved traffic infrastructure, what would have broader beneficial economic consequences. The central agency proposed prince to reject this tax release but stated that he could per chance allocate another kind of relief to the burghers of this market town. Considering the finances of the state, this solution could not only be beneficial in this case but would also discourage similar applications for tax releases in the future. On December 21, 1572, the prince ordered the court's treasury to reject the tax release in order to avoid other similar cases but ordered the court's treasury to impose on the provincial *Viztum* to deliver this market town the relief of 50 Gulden in each of the two following years. This sum corresponded to about a quarter of the taxes paid by burghers of this market town in two years (StLA, 1572a, b). Further research will be needed to prove, whether this case in reality had any broader impact.

In the case of a disastrous flood in Kropa (Fig. 1; no. 5) in the autumn of 1625, there is clear evidence that after the measures recommended by provincial *Viztum* were rejected in Graz, he was ordered to propose a more acceptable solution (StLA, 1626). Kropa, situated in a narrow valley, was in the 17<sup>th</sup> century very important center of iron extraction and forging, many devices were driven by waterwheels (Valvasor, 1689). The provincial *Viztum* ordered the visitation of the devastated Kropa. It confirmed the truthfulness of the report which had arrived from Kropa to Graz stating that 'the smithies, charcoal sheds, road[s?], squares, ore, charcoal, wood and others' needed for iron extraction and forging as well as 'houses, fields, gardens, bridges and mills' were so much swept away or devastated that it was impossible to recognize, where they had been situated. As means of damage compensation the *Viztum* supported the proposal from the application sent from Kropa to Graz to allow a tax free sale of as many nails as 500 horses could carry. The recommendation was rejected in Graz but the provincial *Viztum* was ordered again to propose an acceptable solution. It was a flood relief of 200 Gulden, a half of it for the local church whose dues collected from people in possession of ecclesiastical pieces of land disappeared because the plots were annihilated by erosion and deposition, the other half for the blacksmiths. According to the estimation it only amounted to less than a third

of sum of taxes for trading in nails which 500 horses could carry and the court's treasury was not against the new proposal from provincial level (StLA, 1626).

Also **non-princely seigneuries** could apply for tax releases due to natural disasters. In February 1654, the provincial diet of Carniola confirmed a considerable tax release of 200 Gulden to a seignery due to the damage caused by hail (ARS, 1654c). In some cases, detailed lists of devastated holdings were added. This is most probably the reason why a source listing more than 40 tenants possessing vineyards subservient to three small ecclesiastical seigneuries with seignorial seats in the parish of Konjice (now Slovenske Konjice) (parish seat Fig. 1; no. 6) who were affected by hailstorm in 1700 is preserved in the archives of the provincial Estates. Its reliability is suspicious, it is not based on inspection of affected territory but on questioning the affected. The landlord listed there for how much the 1700 wine harvest of each of those tenants exceeded the tithe and dues, for 13 tenants the source says that it did not exceed them at all, also the amount of harvested seignorial wine is mentioned. Shares of destroyed cereals are not listed although the source mentions that also they were severely stricken (StLA, 1701).

The application to the Estates of the province of Carniola from 1654 for tax reductions for tenants from various seigneuries due to fluvial erosion and deposition at villages Mala vas and Stožice (Fig. 1; no. 7) calls for inspection of circumstances (ARS, 1654a, d) thus at least in some cases visitations were carried out before the answer was provided. Further investigation of tax reductions and relief involving the Estates of provinces will be needed.

## 2. 2 Seigneuries, help among neighbours and relatives

If we move further towards the local level, **seigneuries** were important actors in material responses to natural disasters. In some cases detailed reports on such disasters or increased environmental dynamics of less than disastrous extent are preserved in their archives, e.g. the report of seignorial official on flood in the Upper Savinja Valley in late autumn 1625 whose addressee was the bishop of Ljubljana as important landlord there. The official, who had just returned from the flooded area, reported that snow cover formed in the mountains as well as in the valleys in late November or in early December; a rainy interval followed, so that there were up to 12 successive days of precipitation. It rained incessantly at least in the night and the day before the report was written. In the administrative unit of Luče (almost corresponding to the present-day municipality; central village Fig. 1; no. 8), all the paths along the Savinja River were washed away. In Ljubno (Fig. 1; no. 9), the new bridge and two dams were destroyed, one of the dams was entirely washed away. The source describes in detail the damage caused to the new bridge across the Savinja River on an important way from Kamnik (Fig. 1; no. 10) via Gornji Grad (Fig. 1; no. 11) towards Šoštanj (Fig. 1; no. 12), where the river severely stroke the pillars and caused collapse of one of the arches. The source reveals also the awareness of the fact that damage was not caused only by water but also by wood and other material carried by the swollen river. The main emphasis is thus placed on infrastructure but even here the report is evidently not exhaustive. For instance, there were about 120 isolated farmsteads on the

slopes above Luče, according to a source from 1581 about every fourth of them possessed a small mill on an nearby alpine brook but no such damage is reported in the source in question. From the great majority of those mills no dues were paid to the seignury which could be the reason why they are not mentioned in the report (Zwitter, 2013; 2014a).

There is evidence that **seigneuries took a variety of measures** to help tenants after natural disasters and also less destructive adverse nature-induced events. Seigneuries e.g. (a) allowed a temporary or permanent reduction of tenants' burdens (cf. Pfister, 2002a) – those delivered annually and/or occasional ones (Zwitter, 2014b; 2015). Seigneuries (b) permitted intensification of land use in limited parts of forests or pastures in order to compensate for the flood-inflicted damage and also (c) ordered works in stream beds (see below). On the one hand, there is evidence that a seignury (d) cared for attachment of extant agricultural land of an abandoned holding to another farm which was severely damaged by fluvial lateral erosion in order to improve its economic situation (Zwitter, 2014b). On the other hand, seigneuries (e) cared for incorporation of agricultural land that remained from the former farms abandoned due to natural disasters (e.g. floods) to the existing holdings, e.g. of remnants of three out of nine hides in Otoče in the 15<sup>th</sup> century (Fig. 1; no. 26) which were subservient to the seignury of Radovljica or of the only field that after the flood remained of one out of three hides of the same seignury in the nearby village Globoko. Some seigneuries (f) enabled a different, more favourable form of dues, e.g. pecuniary ones instead of dues in agricultural products of tenants from four or five hides subservient to the same seignury in Otoče in the 15<sup>th</sup> century – in four cases explicitly as adaptation to flood-inflicted damage (ARS, 1498). Alpine farmsteads in the seignury of Gornji Grad (seigneurial seat Fig. 1; no. 11) delivered barley instead of rye in 1602 (Zwitter, 2014a). Both species do not tolerate the same hazards equally and they are exposed to weather in different parts of the year. E.g., barley has a very short growing season, rye, if autumn-sown, is among all cereals most prone to damage by long-lasting snow cover (Pfister, 1984). As mentioned, seigneuries (g) were often involved in correspondence with higher authorities applying for tax reductions. Seigneuries (h) influenced on adaptation to conditions after a disaster and on the vulnerability also through court rulings (Zwitter, 2014b). In some seigneuries, (i) tenants in severe economic difficulties, potentially caused by natural disasters, were allowed to pawn a part of their farms for a limited period, e.g. for up to three years (ARS, 1571), which, in general, improved subsistence possibilities by borrowing money or property without a long-term deterioration of economic situation of holdings. On the territory of isolated farmsteads above Solčava (Fig. 1; no. 13), an area where impartibility of farms was a rule, the seignury (j) allowed a tenant to sell a third of the isolated farm in 1627 after the hailstorm had devastated it (Zwitter, 2013). Seigneuries (k) served as important creditors of tenants at least in terms of tolerating accumulation of tenants' arrears (Zwitter, 2015), and (l) some tenants were forgiven a part of their debts by the seignury due to natural disasters (Zwitter, 2014b).

Exceptionally, landlord (m) provided a relief that was not expected to be returned. Seigneuries thus occasionally helped already in the emergency phase. So, the landlord approved the application for the famine relief in cereals (rye) – which was not expected to be returned – for a drought stricken family of his severely ill tenant from Pobrežje or its hilly southern



surroundings (Fig. 1; no. 14). Tenant's wife provided an application to the landlord stating that extreme summer heat and drought as well as hoar frost in autumn caused very severe harvest failure of cereals, cabbage and turnips on their holding and in its surroundings in 1669 (it is not clear if in the previous years as well). She stated that they were dependent on relief received from neighbours and relatives (NŠAL, 1670; localisation based on comparison with NŠAL, 1723). Comparison with other sources reveals that husband's severe illness contributed to the positive answer (NŠAL, 1579). Due to the closeness of seigneurial seat, the listed arguments are most probably real although the entire economic effects of severely adverse natural conditions on this holding could be reported in an exaggerated way. In the case that not a single but consecutive harvest failures are mentioned, the information corresponds with the documented crop failures in the region of Solčava (Fig. 1; no. 13) in the second half of 1660s caused by frost (Zwitter, 2015). Further investigations will be needed to prove whether the fact that this landlord was a bishop contributed to the positive answer.

Ties between people in areas affected by natural disasters strengthened and multiplied. The aid was usually a combination of institutionalized and not formally organized one. On the **local level** it comprised e.g. relief campaigns organized by church or various kinds of help provided by relatives, neighbours and other locals (Pfister, 2002a; 2002b; 2009). It is typical that the source from Pobrežje documents that neighbours and relatives were the first to help, higher institutional levels were only activated when help between relatives, neighbours and other villagers did not suffice (cf. Pfister, 2002b). Results, referring to the time from the late 19<sup>th</sup> century on but in many aspects relevant for our topic, stress that main motives for this first help, activated already during the emergency phase and continuing throughout the forthcoming phases, were compassion, religious grounds and also awareness that a household could reckon on help if it also offered it. This awareness played an important role although former disputes could be overcome due to a disaster in a considerable number of cases (Makarovič, 1979). Also credit networks existed in the countryside in the observed timeframe (Zwitter, 2015).

### 3 ACTIVE HUMAN INTERVENTIONS IN THE ENVIRONMENT RELATED TO NATURAL DISASTERS

Despite the importance of religious interpretation of God punishing human sins by disasters, preventive measures taken were 'more than just religious observances'. Devastation caused by natural disasters presented an incentive to think of risk mitigation or even prevention during reconstruction (Pfister, 2009, p. 27). Whereas the previous chapter focused on institutionalized as well as not formally organized ways of relief, this one concentrates on artificial interventions in the environment related to natural hazards as far as they are reported in the listed sources. Most of them refer to flood hazard. Learning in the case of natural disasters 'is geared either toward prevention of or adaptation to catastrophes' (Pfister, 2009, p. 20). In this chapter, we will go step by step from riverscapes towards areas distant from watercourses but severely impacted by artificial interventions related to natural disasters.

### 3.1 Riverbeds

The awareness that regular **stream cleaning activities** contribute to risk mitigation was at least partially present. The brook Suha/Sucha rises in the Alps to the north-east of Eisenkappel/Železna Kapla. Due to seepage into the ground, there used to be no surface flow in the final part of its bed close to Gösselsdorf/Goselna vas prior to the recent regulation (Fig. 1; no. 15). However, when its water level rose, the surface water flow lengthened and the debris from this flooding caused e.g. abandonment of a meadow in possession of a tenant from Gösselsdorf/Goselna vas as recorded in mid 1660s. At that time, the seignury of Eberndorf/Dobrla vas cared for cleaning up the creek bed of the Suha/Sucha. Details were not reported, but removal of a fence reaching into stream bed thus increasing flood risk could be a part thereof. The seignury of Eberndorf/Dobrla vas also warned the seignury of Sonnegg/Ženek to clean its part of the bed by compulsory labour of tenants to mitigate flood risk. Not far from there, villagers from Schwabegg/Žvabek (Fig. 1; no. 16) were obliged to clean up the bed of another brook or mill race every year as reported by the source from 1664/65 (Zwitter, 2014b & author's fieldwork in 2015).

One of the measures of stabilizing the river banks in the observed timeframe was **reforestation** (Pfister, 2009). The town Kostanjevica (now Kostanjevica na Krki) (Fig. 1; no. 17), situated on a low island within the floodplain of the Krka River (Komac, Natek, Zorn, 2008) offers an example of afforestation and further measures to prevent fluvial erosion. The island was considerably narrowed by lateral erosion between the 17<sup>th</sup> and early 19<sup>th</sup> century. From 1691 a record is available, not only mentioning erosion of river banks but also ordering its prevention. Every burgher had to plant ten poplars and willows, which were not allowed to be cut for heating, no tree was permitted to be cut for charcoal and it was prohibited to dig holes for fishing (Golec, 2014). The ordinance thus reveals not only understanding of bank-protective role of roots and prescribes to plant appropriate tree species for moist soils but proves also the awareness of anthropogenic stimulation of erosion by digging the holes.

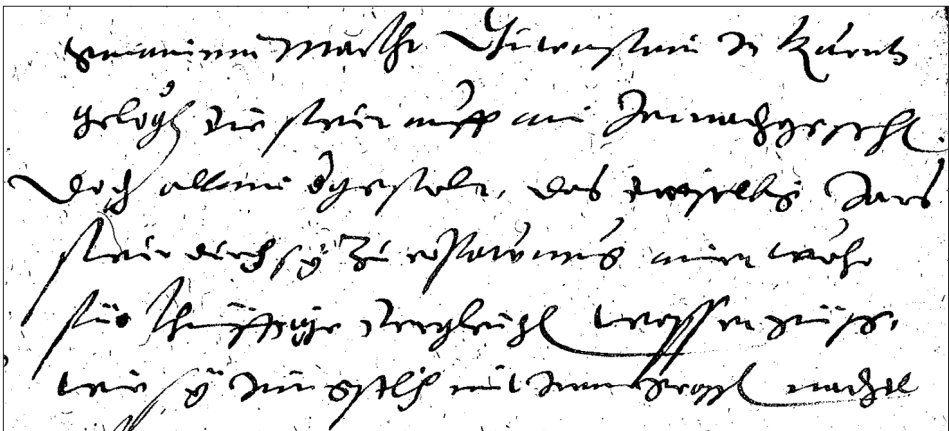
**Building of wooden constructions** to protect river banks or erection of dams in rivers or streams was another way of mitigating the risk of lateral erosion (Pfister, 2002b). Traditional constructions from wood, stone and some iron elements added for stability are at present recognized as good, sustainable practices of water management and of impeding slope processes. Their building is promoted (Repnik Mah et al., 2013). We shall realize that very similar constructions have already been built in the 16<sup>th</sup> century.

The market town of Guštanj (now Ravne na Koroškem) (Fig. 1; no. 18) is situated in an alpine valley near the Meža River. On the slopes above the urban settlement, made of impermeable bedrock, there have been extensive permanent forest clearings. Additionally, temporary clearings existed there in the observed timeframe due to the presence of swidden cultivation. These are some of the factors causing floods in the market town (Komac, Natek, Zorn, 2008; swidden cultivation: Makarovič, 1982; Zwitter, 2014a). In the late 1560s or in the early 1570s, this princely market town was stricken by flood, the burghers asked the Inner Austrian court to release them from their debts in taxes. According to the previously discussed procedure, the court's treasury ordered *Viztum* in May 1572 to provide a

report containing also the advice which measures to take. By accident, *Viztum* had already personally visited the affected territory in 1571. In his report to the central agency from November 1573, he suggested releasing the burghers from tax for at least one year but only on condition that they invested the capital saved by tax release into the riverbed, probably by stabilizing the banks, so that a future flood would not cause a repeated devastation. The court accepted this suggestion and on November 25, 1573, a one-year tax release was issued on the aforementioned condition (Fig. 2; StLA, 1573; translation that it refers to the banks by comparison of StLA, 1588, and Franz, 1998). Such preventive measures from the 16<sup>th</sup> century are interesting in a Middle European context; it has been stressed for the Ill River close to Strasbourg, that contemporaries had already clearly connected its regulation in 1531 with prevention of future damage (Schenk, 2012).

*Figure 2: A section from the source confirming tax release for Guštanj (Ravne na Koroškem) on condition that preventive works in the riverbed are carried out (StLA, 1573)*

*Slika 2: Izsek iz vira, ki potrjuje davčno olajšavo za Guštanj (Ravne na Koroškem) pod pogojem, da bodo izvedli dela v strugi vodotoka (StLA, 1573)*



The town of Celje (Fig. 1; no. 19) is situated in the floodplain, there are confluences of the Savinja and the Ložnica as well as the Savinja and the Voglajna rivers in the immediate vicinity (Fig. 3). In the course of centuries, the urban area was often stricken by floods (Komac, Natek, Zorn, 2008). At least in a part of the observed timeframe, mill dams increased the flood risk as reported for the 1651 flood. In the centuries preceding the observed period, at least from the late 15<sup>th</sup> century on, works in the river are known to have been carried out (Orožen, 1971; Bizjak, 2014).

Riverbed of the Savinja shifted towards the Ložnica creek above their confluence upstream from the town Celje in the second half of 1580s (Fig. 3). Consequently, only a very narrow belt divided the two streams. Contemporaries realised a serious risk that the majority of water from the Savinja would find its way into the riverbed of the Ložnica, severely increasing the flood threat to the main road, the nearby common land and the town castle. It

would cause also other devastation. The commission whose part was also the official of the administrator of princely property called for the necessary erection of constructions on two locations of severe lateral erosion to strengthen the banks and prevent the progression of the Savinja (*Sann Fluss* in Fig. 3) towards the Ložnica (*Bach Losniz* in Fig. 3). They stated that one of the two had to be particularly strong, built from oak timber (StLA, 1588). Wood of some oak species belongs to the best choices for such constructions due to its slow decomposition and resistance to fungi (Repnik Mah et al., 2013). The commission proposed the strengthening of the latter construction by timber framework filled with stones. Official of the *Viztum* recommended to build another timber skeleton filled with stones for strengthening the bend of the river near the castle (*Schloss* in Fig. 3). The commission also called for people skilled in protection against fluvial erosion to inspect this area but due to the severe risk of the Savinja reaching the Ložnica soon, they were afraid that this commission would arrive too late. On December 20, 1588, the court decided not to wait. It allowed to cut the requested oaks in the princely forest near Celje; during the tree felling caution had to be taken to make the least possible damage to forest and game (StLA, 1588). However, the risk was mitigated but the Savinja River was not tamed in the observed timeframe. For instance, disastrous flood in August 1651 destroyed a small section of town wall and eroded an extensive area of town's common; works to mitigate the risk were ordered (Orožen, 1971). If not earlier, the swollen river caused damage there again in 1656. It harmed the so called old construction considerably and lateral erosion appeared at another site where it had not represented a problem before. The *Viztum* stated that four new skeletons would have to be

*Figure 3: The hydrological situation near Celje in 1780s provides a basic context to interpret the situation in 1580s despite the naturally and socially caused changes in the meantime (Slovenia ..., 1763–1787, 5, section 193)*

*Slika 3: Hidrografske razmere v bližini Celja v 80. letih 18. st. predstavljajo osnovo za razumevanje dogajanja v 80. letih 16. st. navzlic naravno in družbeno povzročenim spremembam v vmesnem času (Slovenija ..., 1763–1787, 5, sekcija 193)*



erected there and that only oaks were appropriate for such constructions. The court's treasury agreed with it and ordered to take the oaks from the princely forest again (StLA, 1656).

Due to high population density, the issues of natural disasters affecting urban areas are different from those in the countryside (Bankoff, 2007). However, mitigation or prevention of lateral erosion by stabilizing river banks were not characteristic only for urban areas. In 1558, a new renter of the seignury of Bled was installed, who was given a list of ordinances (Wallner, 1889). Accompanied by specified persons he had to inspect the damage caused by lateral erosion of watercourses in two villages, most probably Nova vas and Dvorska vas (Fig. 1; no. 20) but per chance the information refers to Savica and Brod (Fig. 1; no. 21). He was obliged to enable the affected tenants to gain some uncultivated land and intensify its land use as compensation for the agricultural land devastated by fluvial erosion but he was at the same time obliged to order these tenants to strengthen the river banks to prevent future lateral erosion there (Innstruction ..., 1558).

In some cases **artificial channels were dug** to mitigate flood risk at a certain site, which could have downstream effects. The rural and urban areas in the Lower Savinja Valley at the end of the 17<sup>th</sup> or at the beginning of the 18<sup>th</sup> century offer examples of both. The Savinja River near Šešče and the neighbouring villages to the east (Fig. 1; no. 22) was a braided river (Slovenia ..., 1763–1787, 5, map of the section 174). At that time, its riverbed moved northwards there, towards some villages and the main road, thus artificial channels were dug, e.g. near the mentioned village, shortening the riverbed. This measure mitigated lateral movement of the river, but on the other hand, the straighter bed caused disputes over accelerated erosion downstream as the contemporaries perceived it. Another artificial channel was dug for the lowest course of the Ložnica in 1690s. Some bushes which had formerly grown on the path of this new channel were foreseen to serve as material to strengthen the embankments (Orožen, 1971) – a common sort of raw material for such constructions at that time (Winiwarter et al., 2013). Similarly, a channel was dug to change the course of the Sava River not far from the village Mala vas near Ljubljana (Fig. 1; no. 7) in 1707 but due to the dispute it is not yet clear whether the water was redirected to it or not (ARS, 1707).

### 3. 2 Agricultural land, forests and settlements

In the wake of a hailstorm and heavy rain having caused disastrous flood, tenants of St. Lambrecht's abbey in Upper Styria asked their landlord to apply at the provincial Estates for tax release, so they would be able to subsist there and **turn the devastated agricultural land again into fruitful area**. They stated that the disaster not only destroyed their crops in fields, but it also devastated a lot of agricultural land. It swept away a very considerable extent of fields and meadows, some of them were covered with debris and years of work would be needed to make the land suitable for cropping again (StLA, 1611). Despite the possible exaggerations, the source proves that in certain cases, definitely more frequently than shown in the preserved written sources, such adaptive interventions were also carried out, e.g. by removing the unproductive debris which covered fertile land. However, it was certainly often not the case. For instance, a source

from 1707 says that former meadows – partly eroded and partly covered with debris by the Sava River not far from Mala vas (Fig. 1; no. 7) and the neighbouring villages to the west – were abandoned and overgrown by bush (ARS, 1707).

Investigation of **local knowledge about natural hazard adaptation and mitigation** belongs to desiderata of environmental history (Schenk, 2014). The lawsuit between the village communities of Stein/Kamen, Seidendorf/Ždinja vas and Piskertschach/Piskrče (Fig. 1; no. 23), situated above the Drava River in Jauntal/Podjuna, over enclosing the common land reveals preventive importance of local long-term knowledge. The ruling from July 1615 observed local knowledge emphasizing the importance of taking into account decades old historical experience of problems caused to animal husbandry, when a year of extreme drought was followed by a year of extreme flood, in order to mitigate the forthcoming vulnerability related to droughts and floods. Both extreme weather conditions destroyed grass on the common of Stein/Kamen, both natural hazards also threatened the common of Seidendorf/Ždinja vas, thus it was essential for both villages to have access to the common of the neighbouring Piskertschach/Piskrče, where on the one hand, there were water springs mitigating the drought threat, and on the other hand, this common was situated higher, thus the flooding Drava River did not reach it. The ruling from 1615 made sure that the communities from these three villages were allowed to graze the animals on all the three commons. However, every village community had to keep or restore the good quality of grassy pastures it was in possession of – by uprooting the thistle, thorny bushes and coniferous trees. This task represented the largest burden to the village Piskertschach/Piskrče because their common was the most overgrown by thornbush, spruce, fir and pine trees. Additionally, since there was wetland, this village was ordered to dig drainage ditches. The fact that the common of Piskertschach/Piskrče was the most overgrown one proves that by ordering its clearing and draining the seignury wanted to assure larger extent of productive land than needed in most years to prevent lack of fodder as a consequence of extreme drought or flood event (Zwitter, 2014b).

It was common to **compensate the agricultural land devastated by lateral erosion by intensifying the use of some previously uncultivated land** – forest or pasture. As revealed already by the aforementioned lawsuit, flood damage caused also artificial interventions and environmental change in parts of cultural landscape away from the flood area. Sources from the seignury of Eberndorf/Dobrla vas reveal conversion of forest or pasture into fields at the village Winkel/Kot in Jauntal/Podjuna due to fluvial erosion (Fig. 1; no. 24) (Zwitter, 2014b). The ordinance of the deputies of the bishop of Brixen/Bressanone in Tyrol as landlord of the seignury of Bled from 1558 contains the same instruction for tenants from the already mentioned two villages, most probably Nova vas and Dvorska vas (Fig. 1; no. 20) or, due to the already mentioned uncertainty, maybe from Savica and Brod (Fig. 1; no. 21) (Innstruction ..., 1558). A land register of the seignury of Radovljica from 1579 ordered such compensation of flood damage for two farmers from the village Studor (Fig. 1; no. 25) after the village community had confirmed the truthfulness of the devastation. The seignury stressed that the extent of the new clearings would have to correspond with the extent of the lost agricultural land which the affected tenants had possessed and also boundary stones would have to be erected in order to

prevent uncontrolled further clearing or other disputes. The dues, tithe and taxes of the flood-stricken tenants would thus not be reduced (ARS, 1579).

However, the extent of forests and pastures and the geopolitical situation did not allow to take such measures everywhere. According to the same source, the seignury of Radovljica at the same time reacted to river-induced damage to the tenants from the village Otoče situated near a bend of the Sava River (Fig. 1; no. 26) only by releasing them from a considerable part of dues in cereals and by noting that also their pecuniary dues and their taxes would in the course of time have to be reduced because the river was causing further damage and hardly anything was left from two of the eight farms from this seignury there (ARS, 1579). Moreover, the inclination to this kind of intensification of land use also varied in time within the same seignury and considering tenants from the same settlements. The land register of the same seignury from 1498 proves that the compensation of flood damage to a tenant in Studor (Fig. 1; no. 25) was not carried out by allowing such an intensification of land use but, instead, by reduction of tenant's dues (ARS, 1498). At the village Savica, situated near the bend of the Sava Bohinjka River (Fig. 1; no. 21), 17 out of 33 holdings of tenants who delivered the tithe to the seignury of Radovljica were deprived from very considerable extent of arable land devastated partly by lateral erosion and partly by deposition during floods. The devastation took place at unspecified occasions before the land register was written in 1579. In some cases it caused abandonment of a half of the fields from which the tithe was collected by the seignury of Radovljica. The extent of two holdings in the nearby village Nomenj (Fig. 1; no. 27) was also reduced during floods, leaving to one of them only roughly one third of the fields (ARS, 1579).

Changing of riverbed's position was due to geomorphic factors, weather and climate characteristic for many sections of rivers in the middle and lower course. It was also the case with the Sava River to the north of Ljubljana, e.g. near the villages Stožice and Mala vas (Fig. 1; no. 7). Despite it, there were many factors promoting land use in parts of some floodplains, which was for that time intensive. Such factors were the influx of nutrients where deposition of nutrient-rich mud was the prevailing process during flood events, vicinity of potable water, possible income and transport possibilities provided by the adjacent river (Winiwarter et al., 2013).

However, the environment has been changing considerably since the medieval colonisation. The Sava River was not navigable near the villages Mala vas and Stožice in the late Middle Ages (Kosi, 1998) and also not in the 17<sup>th</sup> century (Valvasor, 1689). It was a braided river (Slovenia ..., 1763–1787, 2 & 4, maps of sections 177, 190). In this area, sources from mid-17<sup>th</sup> century reveal fluvial erosion and deposition of sand and pebbles on fertile land, e.g. on fields and meadows (ARS, 1654a, b, d). Therefore, there is clear evidence that increased soil fertility was not the case here. Land use became inappropriate due to the changing location of riverbed which posed increased threat not only to agricultural land but also to villages. Extensive floods lasted there for five to six days every spring according to data from the second half of the 18<sup>th</sup> century which surely does not correspond entirely with conditions a century and a quarter earlier (Slovenia ..., 1763–1787, 4). According to the source from 1654, the river in previous decades devastated very considerable parts of

holdings in possession of 19 tenants from Mala vas and Stožice. It was destructing parts of arable land, meadows, common land and bush, in some places by erosion, in others by deposition. The extent of affected fields is not expressed in precise units but up to five days were reported to have formerly been needed to plough the devastated land. According to the same source, more than a hundred carts of hay had been harvested from the devastated meadows. The bush and the common where trees for timber had been cut were reported to have been damaged. The source says that most of 19 listed tenants from the villages Mala vas and Stožice will have to abandon their houses because the riverbed moved too close to them (ARS, 1654b, d).

Another source from the mid-18<sup>th</sup> century proves that this statement was truthful – these **villages were displaced to flood safe locations** (Fig. 4). At that time, two meadows, each of them a part of another holding from Stožice, were called ‘*Na starem selische*’ meaning ‘On the site of the former homestead’ (ARS, about 1750a), thus at least some of the sites of former homesteads in the floodplain were used as meadows. It is also

*Figure 4: The flood safe location of the old farmstead in the now urbanized village Mala vas on the terrace is not a result of a cautious selection of settlement area, taking into account long-term environmental change already in the Middle Ages. It is a consequence of historical adaptation in the forthcoming centuries. After the artificial transformation of the riverscape, e.g. the channelisation, the former floodplain below the village is not threatened any more, not even by a 500-year flood (for present flood hazard see Environmental atlas ..., 2014). (photo: Ž. Zwitter, 2014)*

*Slika 4: Poplavno varna lega stare kmetije v dandanes urbanizirani Mali vasi na terasi ni rezultat pazljive srednjeveške izbire prostora za naselje, ki bi upoštevala dolgoročne okoljske spremembe. Je posledica historične prilagoditve v sledečih stoletjih. Po umetnem preoblikovanju rečne pokrajine (regulaciji) nekdanja poplavna ravnica danes ne šteje več med ogrožene niti zaradi poplav s 500-letno povratno dobo (o današnji poplavni nevarnosti gl. Environmental atlas ..., 2014). (foto: Ž. Zwitter, 2014)*





explicitly reported for Stožice in the same source that some of the homesteads had to be displaced due to fluvial dynamics but the homesteads of villagers persisting on old locations were threatened (ARS, about 1750a). The fact that the village was formerly located below the terrace and its present-day location is a consequence of fluvial dynamics is preserved also in local tradition, at least in the case of Stožice (Škerl, 1987) but it was not known before this investigation whether it was true or false and when it had happened. By the mid-18<sup>th</sup> century, the Sava River also entirely eroded a big meadow in possession of a tenant from Mala vas. This meadow had been called ‘*vass*’ (ARS, about 1750b), ‘The village’ – evidence that by the mid-18<sup>th</sup> century the riverbed moved or extended to the location where at least some homesteads from the village Mala vas were previously standing.

There are also other examples of villages in the observed timeframe displaced to safe, higher locations due to fluvial dynamics, e.g. Vrbje and Spodnje Roje (Fig. 1; no. 22) in the Lower Savinja Valley at the end of the 17<sup>th</sup> or at the beginning of the 18<sup>th</sup> century (Orožen, 1971).

## 4 CONCLUSIONS

In Inner Austria, central authorities, especially the (Inner Austrian) court’s treasury played an important role in material responses to natural disasters in 16<sup>th</sup> and 17<sup>th</sup> centuries. They checked the information received from local level at regional, mainly provincial level, and asked the latter also to propose adequate measures for central authorities. It made possible potentially highly efficient measures, e.g. to approve relief for damage compensation only on condition that preventive measures would be taken. However, proposals from regional level were in some cases accepted, in others they were rejected leading either to decisions without further consultations with regional level or to repeated ordering provincial administration to propose acceptable measures. Duration of such procedures varied but, characteristic of that time, it did not allow a reaction in the emergency phase at least for short-lived emergencies. Regarding non-princely seigneuries, provincial Estates were involved in responses to natural disasters.

Seigneuries not only reduced or accustomed tenants’ burdens, they could also allow tenants to pawn or sell parts of their holdings in order to improve their economic situation, seigneuries attached or incorporated abandoned holdings to the remaining ones, seigneuries functioned as tenants’ creditors, forgave a part of tenants’ debts, at least exceptionally they even approved the relief to affected tenants and did not expect them to return it. They were involved in responses to natural disasters also through court rulings. Seigneuries thus influenced on adaptation to conditions after natural disasters and similar less destructive events, but they were in some cases also actively involved in risk mitigation. They could be involved in all three phases of activities during and after a natural disaster – emergency, damage compensation and reconstruction. It is important to stress that not all the listed measures were taken in every seignury.

Mentioned institutions only reacted when help of relatives and neighbours did not suffice. There were many institutionalized and not formally organized measures which could be taken but the effectiveness of the whole system is yet to be assessed.

Artificial interventions in cultural landscapes related to floods took place on the one hand in riverbeds and on the threatened lands, e.g. by cleaning up riverbeds, strengthening river banks with wooden skeletons filled with stone or through reforestation as well as by digging new channel to divert a section of a river or a creek into it. On the other hand, artificial interventions also affected flood safe environments, e.g. by clearing forest to compensate for lost agricultural land or by displacement of villages.

Local traditions in the Early Modern Period in some cases included knowledge of historical natural disasters as well as an enviable rate of awareness how important it was to take such data into account during decision-making process in order to reduce vulnerability to future extreme nature-induced events.

*(Translated by the author)*

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## **STVARNI ODZIVI NA NARAVNE NESREČE V 16. IN 17. STOLETJU: PRIMERI Z OZEMLJA DANAŠNJE SLOVENIJE IN NJENE OKOLICE**

### **Povzetek**

Članek obravnava stvarne ukrepe, povezane z naravnimi nesrečami na Kranjskem, Koroškem in Štajerskem v 16. in 17. st. Metodološko predstavlja analizo primarnih pisnih virov iz arhivov graške dvorne komore, notranjeavstrijske dvorne komore, vicedomskega urada za Kranjsko, kranjskih in štajerskih deželnih stanov ter izbranih zemljiških gospostev. Sinteza temelji na rezultatih študij primerov. Razprava po eni strani nudi temeljni vpogled v stvarne ukrepe, povezane z naravnimi nesrečami, po drugi strani pa obravnava človeške posege v okolje, ki so bili povezani s poplavno nevarnostjo in dejanskimi poplavami. Znotraj kulturne pokrajine se osredotočam na kmetijska zemljišča in naselja.

V deželnoknežjih gospostvih, mestih in trgih je prošnja za pomoč po naravni nesreči, npr. za davčno olajšavo, z lokalnega nivoja potovala neposredno na sedež notranjeavstrijskih centralnih uradov v štajerskem Gradcu. Pred odgovorom pošiljatelju na lokalni nivo je (notranjeavstrijska) dvorna komora kot centralni organ, pristojen za deželnoknežje premoženje, iz Gradca naslovila dopis na regionalnega predstavnika – vicedoma, ki je bil pristojen za deželnoknežje premoženje v deželi ali v njenem obsežnem delu. Vicedom je moral v Gradec poslati svoje poročilo o naravni nesreči, s čimer si je dvorna komora zagotovila zanesljivejše informacije od tistih, ki jih je prejela s strani prizadetih. Poleg tega je moral vicedom dvorni komori predlagati ustrezne ukrepe. Takšen postopek je omogočal učinkovito ukrepanje, denimo davčni spregled v času sanacije po poplavih, a le pod pogojem, da bodo tako prihranjena sredstva vložili v sanacijo struge vodotoka, kar so leta 1573 določili od poplav prizadetemu trgu Guštanj (Ravne na Koroškem). Poudariti je potrebno, da so v Gradcu le občasno udeležili ukrepe, ki jih je priporočil vicedom. V nekaterih primerih so ravnali po svoji presoji, v nekaterih drugih pa so vicedomov predlog ocenili kot neustrezne in ga pozvali, naj predlaga novo, sprejemljivo rešitev. Trajanje takšnih postopkov ni bilo enotno, vendar pa vsaj v primeru tistih naravnih nesreč, kjer so izredne razmere kratkotrajne, ni omogočalo ukrepanja že v času trajanja naravne nesreče. V nedeželnoknežjih gospostvih so bili v ukrepanje po naravnih nesrečah vpleteni deželni stanovi.

Zemljiška gospostva niso ukrepala le tako, da so (a) po naravni nesreči zmanjšala podložniška bremena ali (b) spremenila obliko dajatev v ugodnejšo. Med nadaljnje gosposčinske ukrepe so sodila dovoljenja, da so podložniki (c) zastavili ali (d) prodali del podložne posestne enote, da bi izboljšali svoj gospodarski položaj, gospostva so (e) ohranjene dele kmetij, ki so propadle zaradi naravnih nesreč, priključila preostalim kmetijam in obratno – (f) obstoječa kmetijska zemljišča opuščenege posestva je gospostvo priključilo kmetiji, ki je ostala naseljena, čeprav so ji naravni dogodki uničili obsežen del kmetijskih zemljišč. Zemljiška gospostva so poleg tega (g) dovoljevala urejanje nadomestnih obdelovalnih zemljišč namesto tistih, ki so jih uničile poplave, in sicer z intenzifikacijo rabe tal na ozemlju gozdov ali pašnikov, in (h) odrejala sanacijo strug vodotokov. Gospostva so bila vpletena v odzive na naravne nesreče tudi (i) prek razsodb patrimonialnih sodišč. Poleg tega so (j) podložnike kreditirala, zaradi naravne nesreče so (k) podložnikom lahko odpisala del dajatev, v izjemnih primerih so (l) podložnikom namenila tudi brezplačno pomoč, ki je ni bilo potrebno vrniti. V kontekstu naravnih nesreč so bila vključena tudi v (m) dopisovanje z nadrejenimi organi. Zemljiška gospostva so torej vplivala na prilagajanje razmeram po naravnih nesrečah, v nekaterih primerih pa je njihova dejavnost vplivala tudi na zmanjševanje tveganja. Zemljiška gospostva so lahko sodelovala v vseh treh stopnjah ukrepanja po naravni nesreči – v času izrednih razmer, nadomestila škode in obnove. Vendar v vseh gospostvih niso izvajali vseh navedenih ukrepov, v različnih delih istega gospostva so lahko hkrati ukrepali na različne načine, tudi znotraj istega gospostva so v istem kraju lahko ob različnem času ukrepali različno – denimo enkrat z odpisom podložniških dajatev, drugič z dovoljenjem za ureditev nadomestnih zemljišč po poplavih.

Navedene ustanove so se vključile v odzive na naravne nesreče, kadar pomoč sosedov in sorodnikov ni zadoščala. Obstajali so raznovrstni institucionalno in neformalno

organizirani ukrepi, ki jih je bilo mogoče uvesti, vendar pa stopnja raziskav še ne omogoča ocene učinkovitosti celotnega sistema.

S poplavami povezani posegi v pokrajino so po eni strani potekali v strugah vodotokov in na poplavno ogroženih območjih, po drugi strani pa tudi v poplavno varnih legah. Strugam so utrjevali bregove z gradnjami iz lesa in kamna – tako so pri poplavno ogroženem Celju v 80. letih 16. st. skušali preprečiti prelitje Savinje v strugo Ložnice – ali s pogozdovanjem. Poleg tega so kopali umetne struge, da bi vanje preusmerili vodotoke, in odstranjevali med poplavami odloženo nerodovitno plavje. Blizu Ljubljane so tako leta 1707 izkopali kanal, da bi vanj preusmerili Savo. Na poplavno varnih lokacijah so okoljske razmere spreminjali denimo z urejanjem nadomestnih obdelovalnih zemljišč ali s prestavitvijo vasi. Spreminjanje savske struge je med sredino 17. in sredino 18. st. zahtevalo prestavitev večine domačij Stožic in Male vasi na višji, poplavno varni mesti. Kjer je nekdaj stala Mala vas, je sredi 18. st. tekla Sava, nekdanja zemljišča dela stoženskih domačij pa so tedaj uporabljali kot majhne travnike.

Zgodnjenovoveško lokalno znanje v nekaterih primerih ni vsebovalo le poznavanja naravnih nesreč v preteklosti, ampak tudi zavidljivo stopnjo zavedanja, da je za zmanjšanje ranljivosti v tedanjem času in v prihodnosti pri načrtovanju pomembno upoštevati te podatke. Razsodba v sporu glede ograjevanja gmajn med tremi podjunskimi vasmi iz leta 1615 je upoštevala pričevanja, ki so trdila, da mora paša ostati nerazmejena, saj je historična izkušnja leta z izredno sušo, ki mu je sledilo leto z izrednimi poplavami, dokazala, da je to za lokalno živinorejo zaradi škode, ki sta jo oba dogodka povzročila travi, ključnega pomena. Ena od treh gmajn je namreč ležala više, tako da je niso dosegle dravske poplave, hkrati pa so ravno na njej ležali izviri, ki so zmanjševali tudi nevarnost suše. Največja zaraščenost te gmajne med vsemi dokazuje, da so bile tamkajšnje pašne obremenitve v običajnih letih zmerne. Z rzsodbo, da jo je potrebno očistiti trnovega grmovja, smrek, borov in jelk (z vidika živinoreje neproduktivne in moteče rastline!), hkrati pa izboljšati kakovost pašnika še z izkopom drenažnih jarkov v močvirju, je gospodarstvo ukazalo, da je tam potrebno vzdrževati obsežnejše pašnike, kot so bili potrebni v običajnih letih, da bi zmanjšali okoljsko ranljivost tamkajšnje živinoreje v sušnih poletjih in ob poplavih.