A retrospective approach to managing cultural heritage in a changing climate

By Nina Kjølsen Jernæs & Maja Granberg

There is a global focus on climate change and climate adaptation for our common cultural heritage. In Norway (the focus of this article), as in many other countries, the climate is predicted to be milder and wetter, including an increasing number of floods and avalanches.[1] This will challenge the preservation of heritage assets on a national level. Natural decay is well known; however, we can expect to witness an increasing speed of degradation. The present and future extreme weather conditions will negatively impact the built heritage. Thus, the demands for thorough regular maintenance and long-term adaptation strategies are crucial. Therefore, it is necessary to revise relevant tools for cultural heritage management.

Over time, people worldwide have needed to adapt their building techniques to both nature and climate. Despite many guidelines and manuals for adaptation measures to mitigate the impact of climate change on built heritage, there is seldom a reference to historic measures.

Research questions and methodology

Our hypothesis is that the historic adaptation measures are useful assets in climate risk management for cultural heritage. Through our cooperation with several Norwegian municipalities that use existing adaptation guidelines, the need to strengthen the link between historical and future adaptation measures has become apparent. The research question is therefore: how can a work model for managing cultural heritage in a changing climate benefit from including historic adaptation measures? To answer this, the aim of this article is twofold: we aim to illustrate the importance of combining a historic location analysis with a local climate adaptation analysis to support integrated planning that takes both heritage management and climate change into account, and to suggest a new working model which puts this in to practice. We will do so by first presenting a literature review on relevant handbooks and studies concerning the management of built heritage in changing climates, and then presenting three projects on the topic. Based on the knowledge gaps in research and in the presented projects, we thereafter suggest a new work model which combines a historic location analysis with a local climate adaptation analysis for developing knowledge-based adaptation strategies at a municipality level. The suggested work model was tested out in Skedsmo municipality, Norway.

A retrospective approach to adaptation measures

When writing about adapting cultural heritage with a retrospective approach, it is important not to use modern phrases in a past context. Past societies did not discuss climate adaptation; they examined natural variations in nature and climate and constructed buildings accordingly. Therefore, the phrase "historic adaptation" refers to knowledge-based improvements in the past, to cope with natural and climate-based hazards. Resilience, in this matter, refers to a building's resistance to climate challenges and

natural hazards due to its materials, construction and placement.

Literature review and knowledge gaps

The European Commission has carried out a relevant overview of past and ongoing European projects regarding the safeguarding of cultural heritage from natural and anthropic disasters.[2] They state, however, that despite the massive amount of projects and research on the topic, the knowledge presented is rarely included in national resilience work. Fatorić and Seekamp's literature review on cultural heritage and climate change presents the most relevant studies from the period 2003–2017.[3] Their review mirrors an increasing interest in climate change, cultural heritage and resources but focuses on European issues. Their article highlights the consistent lack of documentation on whether and how cultural heritage and resource adaptation or preservation have been implemented.[4] Amongst other knowledge gaps, Fatorić and Seekamp point out the lack of focus on built heritage as a recorder of past and present environmental and climate-related changes, which can be used as a proxy to understand socio-ecological interactions.[5]

Challenges in management

The literature elaborates on the need for including cultural heritage in an integrated protection programme and the municipalities' disaster planning.[6] The European Commission has made a comparable analysis of safeguarding cultural heritage from natural and man-made disasters. In their final remarks about gaps to be covered, it is underlined that existing strategies and procedures on disaster risk reduction for safeguarding cultural heritage are not exhaustively integrated into national plans on a political and policymaking level. Knowledge concerning the safeguarding of cultural heritage offers great contribution to the improvement of disaster preparedness. However, this information is largely ignored in the development of related policies.[7]

In risk management, Wang mentions the need to review the present situation by using past studies and scientific analysis to understand and predict possible future disasters in order to reduce loss. However, investigating past incidents and previous ways of dealing with disasters is not included in Wang's study, due to the article's focus on flood risk maps.[8] In their attempt to develop a model for creating climate risk resilience for cultural heritage, O'Brien et al. emphasise learning as a key element – a dynamic ongoing process that occurs in many ways, forms and contexts.[9] Since their article has a more general character, learning from historical adaptation measures and techniques is not tackled. Likewise, historic adaptation is outside the scope of Cassar's work on climate change and the historic environment of English cultural heritage.[10]

Phillips presents the factors that she considers crucial for managing the adaptation of cultural heritage. According to her, the key capacity factors for success are access to needed resources and information, availability of plans and policy instruments, learning capacity (in our present study: heritage as a learning resource), cognitive factors and a functioning leadership with motivation and enthusiasm.[11] Here, we will state that an interdisciplinary approach is essential.

Guides and frameworks

Although buildings have survived climate change and natural hazards in the past, they may still be vulnerable to the accelerating decay processes linked to ongoing climate change. Sesana et al. present a conceptual framework for assessing the vulnerability of cultural heritage to climate change, and compare it to two other frameworks, developed by Woodside and Daly respectively. The aim of Sesana et al. is to provide a framework which is simpler, more adaptable, which doesn't require expertise and which includes the engagement of stakeholders.[12] The three frameworks are compared in a table showing six steps, as follows: 1) Define the study area and the site's values; 2) Define the impact of climate change/ understand the exposure and sensitivity. 3) Identify the hazards and assess the impact on the local scale. 4) Assess the adaptive capacity/de-

velop indicators of vulnerability. 5) Quantify the vulnerability; develop indicators/assess results in a causal model and repeat these periodically. 6) Use stakeholder reviews to refine and communicate the results.[13] The framework by Sesana et al. was developed for World Heritage sites but is designed to suit any cultural heritage site. The application of the framework identified limitations concerning difficulties in interpreting projections due to variations in models.

Fatorić and Seekamp have researched on buildings with historical significance and dealt with decision making in climate adaptation planning.[14] ICOMOS launched the report The Future of Our Pasts: Engaging Cultural Heritage in Climate Action, in July 2019.[15] Amongst other, the report suggests a methodological tool kit, which emphasizes methodological down-scaling to site level. The report states that "[...] acquiring knowledge from the past is a well-honed skill within the sector." This is especially tied to archaeology.[16]

Significance and valuation

Because risks related to water and moisture pose increasing challenges for cultural heritage buildings, there is a need for risk and vulnerability assessments concerning the most valuable and important heritage buildings, implying a great need for prioritising.[17] Fatorić and Seekamp elaborate on the desire to identify and take into account various aspects of a historic building's significance when considering a prioritisation process for cultural resource management and climate adaptation planning.[18] They refer to the condition, significance and use potential with

FIGURE 1. *(Below) Photograph from Lillestrøm dated* 1910. *The photograph depicts one of the many times Lillestrøm has been flooded.* PHOTO: *Akershusbasen/MIA (License BY-NC-SA, no corrections done).*

FIGURE 2. *(Next page) What can we learn from the past when the same extreme hazards keep returning in the same areas? Photograph from Lillestrøm during the flood in* 1967. PHOTO: *Knut Dragsnes, Akershusbasen/MIA (License BY-NC-SA, no corrections done).*

an associated binary score, which ranks heritage buildings to help prioritising within heritage management in changing climates. However, examining historical adaptation measures is outside the scope of Fatorić and Seekamp's study.

When working with cultural heritage and vulnerability and ascribing values, several studies state the importance of developing a democratic process and incorporating a participatory approach to engage stakeholders.[19] Sesana et al. mention it specifically when working with cultural heritage in changing climates.[20]

When the past can contribute to future measures

When discussing vulnerability in future climate conditions, Sesana et al. mention that historical buildings have been resilient in past climatic conditions. They may, however, become more vulnerable under climate change as changing conditions alter and accelerate decay processes.[21] Here, will will state that there is no doubt about the increasing vulnerability of historic buildings. In Gerrard and Petley's article on environmental hazards, risks and resilience in medieval Europe, they cover the medieval development of mitigation, protection and adaptation strategies.[22] They write about civic authorities in continental Europe who assumed a more central role compared to England, where the responsibility for action was delegated to the citizens themselves.[23] One example of hazard protection involves raising floor levels inside buildings. Regarding hazard adaptation, shifting from wood to brick as building material is well-known.[24]

The work by Howard et al. presents the use of historic maps to elucidate the development of the area to be assessed.[25] The authors include a variety of geomorphological, paleoenvironmental, geochemical and cultural archaeological data sets to provide a contextual framework for mitigating the impacts of future climate change.[26]

Knowledge gaps of relevance to this study

Several of the reviewed articles, commissions and reports emphasise the need for new approaches and methods to adapt cultural heritage to changing climates. They also point out the importance of resilience. Some authors (e.g., Gerrard & Petley) examine how people and communities have historically adapted to the climate.[27] Unfortunately, many authors take this issue no further than recognising and discussing historic climate adaptation. The European Commission states that cultural heritage and historic cities, towns, and villages play an important role in the resilience of historic settlements, which are complex adaptive systems with a substantial capacity for resilience. The Commission also notes that the resilience phenomenon is still not effectively approached or even theoretically supported.[28] The ability to do so indicates the clearly expressed need for interdisciplinary assessment work, as also mentioned in the Norwegian national expectations regarding regional and municipal planning.[29]

A review of the related literature on cultural heritage in changing climates, with a focus on preventive management and mitigation measures, shows that few studies mention past mitigation, protection and adaptation to natural disasters, although evidence is seen in geological, archaeological and historical records.[30] When developing an adaptation plan and selecting relevant measures for cultural heritage, it can be argued that it is beneficial to examine how the same community has historically adapted similar or even identical constructions to similar problems. This is especially relevant when working with communities that have been frequently exposed to hazards.

Researchers mention the lack of peer-reviewed publications focusing on the required approaches and methods to cope with the challenges of managing cultural heritage in changing climates, in addition to studies considering climate impacts.[31] However, many projects focusing on managing cultural heritage in changing climates have been undertaken, more recently in the United Kingdom, Sweden and Norway. In the next section, we present some relevant projects and research undertaken in Norway, serving as the basis for the development of the new work model.

State-of-the-art, earlier projects in Norway

Cultural Heritage and Climate Change in Aurland Municipality

The project "Cultural Heritage and Climate Change", carried out in 2015, was a collaboration between several participants: Aurland Municipality, County Council and Governor of Sogn og Fjordane, Norwegian Water Resources and Energy Directorate, and Nærøyfjorden World Heritage Park.[32] The Norwegian Institute for Cultural Heritage (NIKU) participated as a project consultant. Commissioned and led by the Directorate for Cultural Heritage (DCH) in Norway, the project aimed to provide experience and knowledge on how to manage cultural heritage and environments in changing climates on regional and municipality levels. Aurland Municipality was used as a case study. The project's main goals were to obtain an overview of the expected climate change or events in the municipality and to provide an overview of the risk of climate-related damage to Aurland's cultural heritage. A user-based method was developed in the form of a structural and analytical guide for risk and vulnerability assessment. Possible measures were identified to counteract risks and damages due to climate change.

Several steps of this method involved gathering knowledge about expected climate change, as well as assessing how these changes would affect cultural heritage, which cultural heritage

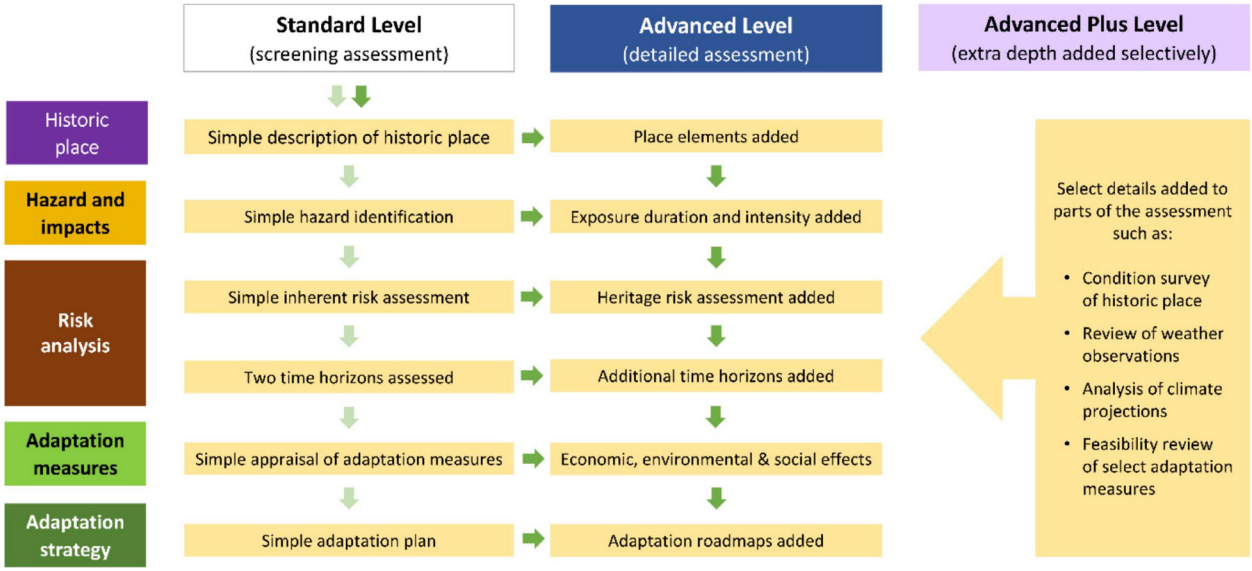

FIGURE 3. *All five planning steps presented in* Adapt Northern Heritage, *with three levels of detail* [17].

in the municipality would be affected and what damage this could generally cause. This information was obtained by cross-analysing expected climate scenarios with the cultural heritage in the area.

Adapt Northern Heritage

Adapt Northern Heritage (ANH) was part of the interregional programme for the Northern Periphery and Arctic, comprising partners from Historic Environment Scotland, Cultural Heritage Agency of Iceland, DCH, NIKU and eleven Associated Partners from Iceland, Ireland, Norway, Russia, Scotland and Sweden.[33] Undertaken in the period 2017–2020, the project aimed to adapt northern cultural heritage to the environmental impacts of climate change and associated natural hazards through community engagement and informed conservation planning. The project also aimed to support stakeholders by helping build capacity and providing tools that would enable communities and authorities in the world's northern regions to cope better with the complexities added to historic place management in times of changing climates. Stakeholders were engaged to test the tools on nine case study sites across Northern Europe. The developed risk management guide is described in eight steps; the first five comprise the planning stages, and the last three cover the implementation stages. All five planning steps have three levels of detail: Standard level, Advanced level and Advanced Plus level (Figure 3). The advanced level allows a detailed exploration, for example, a better description of the historic place.[34] The available resources and time, as well as the objective of the assessment, will undoubtedly influence the choice of the level.

Development of Climate-DIVE

Developed by NIKU, commissioned by DCH and undertaken in 2018, Climate-DIVE was a further development of the DIVE method. DIVE (Describe, Interpret, Valuate, Enable) is a tool for area planning, impact assessments, cultural heritage management, the development of cultural heritage plans and more.[35] In DIVE, cultural heritage is perceived as a resource for society and an asset in the development of a sustainable society. It aims to find out how the tangible and the intangible cultural heritage of a specific site can contribute to the latter's development. This is carried out by analysing landscapes, cities and places through their cultural histories. The four steps

aim to describe, interpret, valuate and enable the urban heritage qualities. In Climate-DIVE, a climate perspective was integrated into each step.

Summary of the three projects

The presented projects all included a democratisation process and incorporated a participatory approach to engage stakeholders. They were all undertaken in collaboration with stakeholders, and vital parts of the projects entailed community engagement and support for stakeholders. For instance, the ANH method was designed as a workshop, including experts in various fields, several management levels, owners and users. The different steps in the workshop formed the basis of ANH, where the work was as useful as the outcome.

Interdisciplinary work is stated as essential in the methods developed in these projects. In a workshop, it is vital to have knowledge from a variety of fields. Knowledge about the values of the cultural heritage and the risk of climate-related damage scenarios is needed when prioritising amongst the cultural heritage objects. It is also important to include expertise in emergency response planning.

In the Aurland project, expected climate scenarios were cross-analysed with the cultural heritage in the area. The same was done in the other two projects, as described below. Historic climate adaptation was also found in Climate-DIVE but without spelling out future planning needs.

The methods in these projects allow an analysis of various heritage typologies, although only buildings were included when testing the method in Climate-DIVE. The developed methods also allow an analysis of large areas, for example, a whole municipality, at both overall and more detailed levels. This facilitates the inclusion of different heritage typologies. This also makes it possible to compare, assess and prioritise cultural heritage in terms of the severity of the climate-related impacts facing it and its cultural historical value. The cross-analysis in all projects provides a good overall perspective of the analysed area, whilst the inspections and risk and vulnerability assessment provide an analysis at a more detailed level. The DIVE method enables society to use the cultural heritage value within the project scope; it is not a tool for decision making, prioritising or implementation. One can, however, use it as a decision support tool.

The majority of the projects incorporated the retrospective approach of measures into their guidelines, but these measures had not been implemented or evaluated when the guidelines were tested.

Result: Presentation of the suggested work model

As previously stated, the work model suggested below is mainly based on the method developed in the ANH project. Through a project in Skedsmo Municipality in Norway, the ANH-method has been modified, simplified and further developed, now reduced from five to three steps (Figure 4).[36] The suggested work model expands Step 1 with information gathering. The hazards and risks are combined and simplified; likewise, the measures are combined with the plan and implementation.

FIGURE 4. *Three main steps of the work plan.*

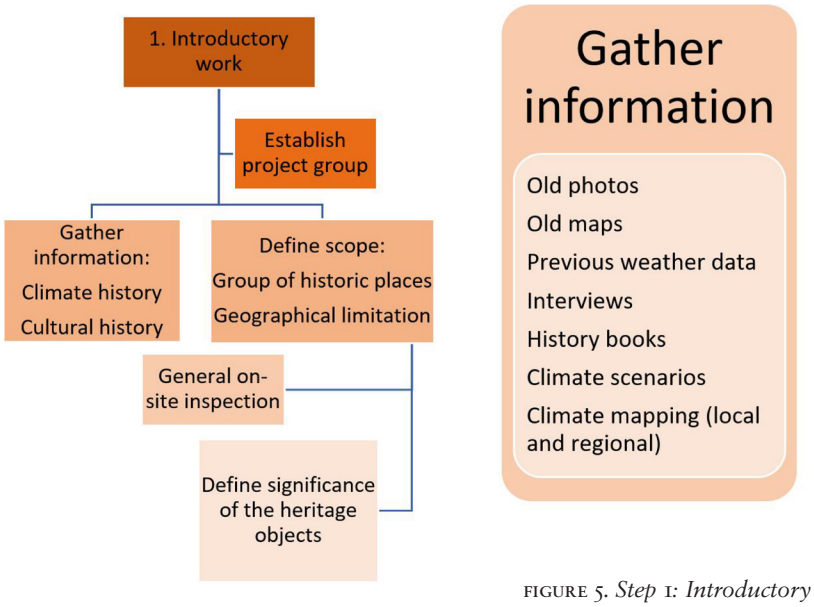

FIGURE 5. *Step 1: Introductory work* with details.

Step 1. Introductory work

In Step 1, the overall aim should be defined, and the needed professions should be in place (Figure 5). When defining the scope, the municipality can choose to examine one group of cultural heritage, it might concern buildings, sites, archaeological sites, road sections or other heritage environments. One might also define a geographical area. However, it is crucial to take into account the landscape surrounding the chosen site, as it plays an important role in possible adaptation measures. As the foundation of the chosen area, it is expected to encounter some sort of climate-related challenge. Information on cultural heritage in the municipality, local climate scenarios and climate-related events that have had the most effect on the development of the area, historically and currently, should be collected. This can be done by examining old photographs, historic weather data and old maps, and by interviewing municipal or local stakeholders. Relevant information can also be obtained through studies of archives and the literature covering the site's history or specific historical events that have shaped the site's development.

To obtain a clear overview, the historical climate information can be organised in a time/space matrix. Additionally, it is useful to create historical climate maps that for example demonstrate how far floods have reached at different times. Information on how buildings and sites have been adapted to these events should be collected. This concerns information on the placement of a building in a landscape, alteration of a building or a site to better withstand the climate, or information on the use of different building materials and techniques in different regions depending on the region's specific climate. This information can be obtained through the above-mentioned methods, and by performing on-site inspections of the building or site. In this first step, an inspection on a general level is sufficient. It is useful for the continued work to gain an overall understanding of the site early in the process. However, the gathered information on historic climate adaptation should be neutrally analysed, and the working group should have sufficient facts before deeming historic adaptation as a preventive and adaptive measure to overcome natural hazards.

After the scope of the assessment is defined, each object's significance or value should also be defined. Here, the municipality might gain valuable information by engaging local stakeholders, for example through interviews or open meet-

ings. Something might be listed as a heritage object, but the work might also include objects that lack protection from national legislation while retaining a local or a regional value. The significance of the heritage is assessed, based on social, historical and aesthetic value as well as age and rarity.

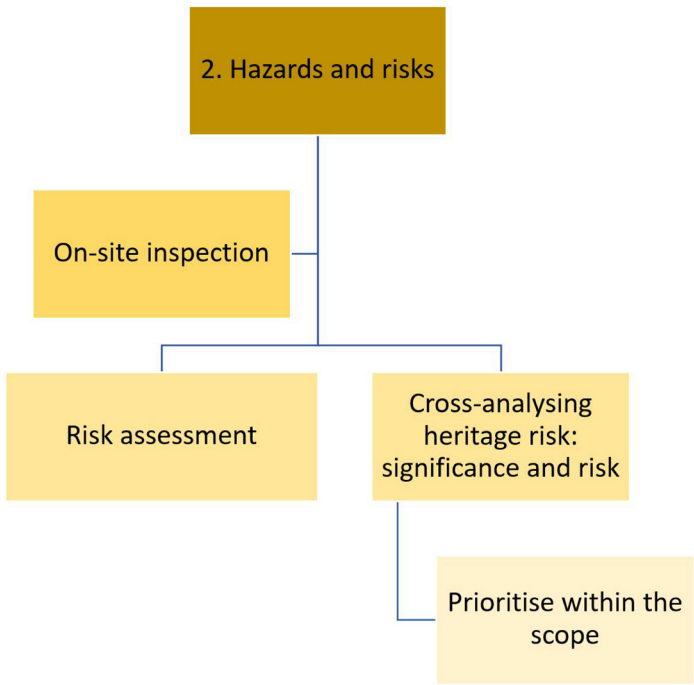

FIGURE 6. *Step 2: Hazards and risks with details.*

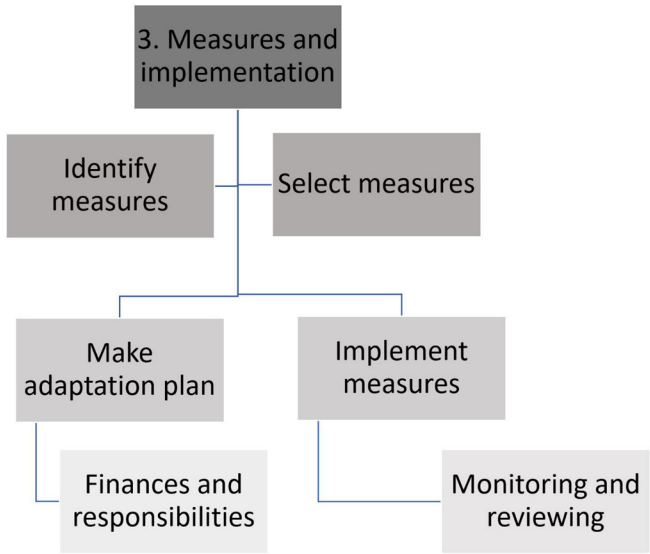

FIGURE 7. *Step 3: Measures and implementation with details.*

Step 2. Hazards and risks

Step 2 involves risk assessment of the chosen areas and/or buildings (Figure 6). Using local future climate projections and detailed local expertise, the working group is able to identify and analyse potential climate-related events that could adversely affect a cultural environment or building. To prioritise adaptation measures, a cross-analysis of risks and the heritage significance is required to identify which cultural heritage with high-ranked significance in the municipality is the most exposed to natural hazards.

This is done by first assessing the consequence of a climate-related incident and rating the consequence's severity (1–5). The probability is similarly evaluated by ranking the value of the cultural heritage (1–5) and multiplying the number with the risk assessment. The final number can be linked to a specific colour – green, yellow, orange or red – showing the current risk level (green and red represent the lowest and the highest, respectively) for the specific cultural heritage, including its cultural historical value.

As part of Step 2, a thorough on-sight inspection should be carried out. If prioritisation work is undertaken, it is preferable to also inspect the interior of the buildings if possible. If so, thoughts on salvaging objects and interiors could be included in the final plan. An inspection is always beneficial and can contribute to double checking and offer new insights to the discussions. A thorough on-site inspection in part two is recommended in addition to the general inspection in step one. However, if it is only possible to perform one inspection, a thorough inspection should be prioritized.

Step 3. Measures and implementation

In Step 3 of the work model, the municipality identifies possible measures, followed by a selection of the needed measures, based on the priority list and in accordance with the financial possibilities (Figure 7). If the municipality is lacking the right expertise, one can ben-

efit from external help if the consultants have knowledge and understanding of the cultural heritage sites/buildings and the future regional climate scenario. In this discussion, the gathered information on historic climate adaptation can be considered. The information on historic climate adaptation can be discussed in relation to the suggested measures. Relevant questions to discuss include which transformation and adaptation measures have been implemented in the past, how effective they were, if they are relevant today, and what should be avoided. More specifically, the working group can discuss possible measures such as using traditional building materials and techniques, or reconstructing or reopening previous green areas, streams or watercourses to help infiltrate surface water near the building or site. However, the information on historic climate adaptation does not give comprehensive answers or solutions to contemporary problems, but it can increase the knowledge related to the specific locality.

Monitoring should also be regarded as a possible measure. When the selection is made, the working group can create the adaptation plan for mitigation and adapt the cultural heritage to the identified hazards. An overview of finances and responsibilities should also be included in the adaptation planning. When the finances follow, the prioritised adaptation measures can be implemented. Thereafter, the selected measures should be implemented, monitored if needed and reviewed.

The work model in use – examples of results

The Climate Change and Cultural Heritage project in the municipalities was carried out in 2019 by NIKU in collaboration with Skedsmo Municipality.[37] This project aimed to develop a pilot study for climate adaptation of cultural heritage in a municipality. In this interdisciplinary project, the involved professionals were engineers, conservators, archaeologists, and antiquarians, as well as specialists in hydrology/drainage and climate scenarios in this municipality. Various heritage typologies were selected as case studies, such as archaeological sites, historic roads, landscapes and buildings.

Lillestrøm is situated along the frequently flooded Nitelva River. Historic maps of Lillestrøm show that the first settlements were located away from the river, in the area's upper region. Comparing historic maps with climate scenarios of a 1000-year flood – a flood of such magnitude that it can be expected to occur on average once in a thousand years – reveals that the area of the first settlements was safe from 1000-year flooding (compare figure 8 and 9).[38] Figure 9 shows the present settlements, and the calculated extension levels of a 1000-year flood

FIGURE 8. *Historic map of Lillestrøm from* 1900. SOURCE: *Skedsmo Municipality.*

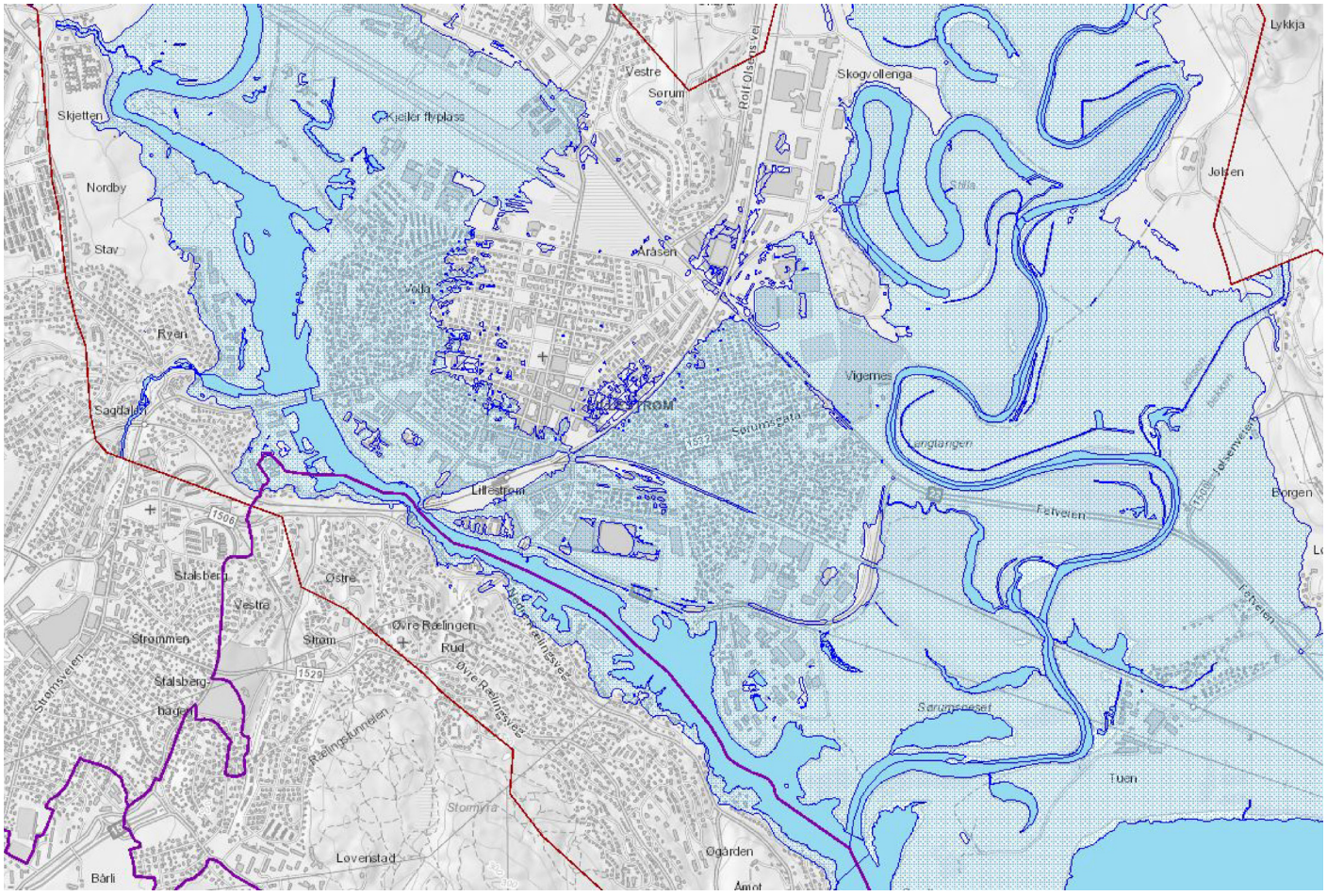

FIGURE 9. *Contemporary map of Lillestrøm and a* 1000*-year flood.* SOURCE: *Skedsmo Municipality).*

as a light blue area. Although the earlier settlements were situated away from the reach of a 1000-year flood, Lillestrøm has built its later cultural heritage within the potentially flooded area.

Old photographs show dwellings built on pillars (Figures 10 and 11), which would be an effective measure for mitigation in the annual floods. During winter, wooden shutters were placed between the pillars for protection from severe weather. The shutters were removed during the summer.[39] Important measures for adapting to wetter and warmer climate and avoiding damages to cultural heritage were identified as reconstructing green areas, reopening streams and watercourses, and maintaining buildings, archaeological sites and the listed road.

FIGURE 10. *(Next page, above) Building on top of pillars in Lillestrøm. "Stolpopp" ("up on pillar") was a cotter's holding in Lillestrøm. The building was constructed on top of pillars to prevent the floods from reaching the building, hence the name.*[40] *The photo was taken in* 1910 *during a flood, but as seen here, the flood reached above the pillars.* PHOTO: *Akershusbasen/MIA (License BY-NC-SA, no corrections done).*

FIGURE 11. *(Next page, under) "Folkets hus" (People's House) in Lillestrøm, another house built on top of pillars.* PHOTO: *Akershusbasen/MIA (License BY-NC-SA, no corrections done).*

Discussion

According to Gerrard and Petley, proactive risk management was common during the Middle Ages, and the current three main categories of hazard-reducing practices – mitigation, protection and adaptation – were all applied during

that era.[41] The historic maps of Lillestrøm show its earlier settlements situated at a distance from the river. However, it does not hold as proof that the inhabitants of Lillestrøm adapted their settlements and buildings to natural hazards. The question of why some areas had no earlier settlements cannot be answered by only looking at maps. Often, the reasons for settlements and adaptation are complex, and include for instance considerations of where the soil is most favourable for cultivation. The historic data does not provide holistic answers. However, it can pinpoint previous local use, transformation and adaptation measures, which can be valuable when planning the adaptation and preservation of cultural heritage.

Another example of valuable information that can be collected through a historic assessment, is the understanding of how buildings were constructed. Houses on pillars have multiple advantages. If people in the past wanted to settle in areas where the ground was less favourable for the construction of houses, this technique might provide a useful adaptation measure. The pillars also kept the water away from the houses, eliminating the risk of basement flooding, and made it easy to tidy up underneath the houses after a flood.

Local historic adaptation measures provide key elements of learning, as emphasised by O'Brien et al.[42] With thorough interpretation of traces of adaptation and mitigation, the Lillestrøm project visualises both benefits and limitations of the retrospective analysis of adaptation measures.

According to Sesana et al., their project is the first to apply a vulnerability assessment framework to more than one heritage typology.[43] They recommend further research on the applicability of the methodology used in areas with mixed cultural and natural heritage. The suggested work model has been used with a positive outcome in adaptation planning for multiple types of cultural heritage. However, different categories of cultural heritage require corresponding professional competence in the municipality to valuate, prioritise and make well-founded recommendations for adaptation planning. The suggested work model aims at reaching various fields of expertise and management levels in the municipality and is linked to the European Commission's statement on the importance of translating the results of academic research on climate change impacts into pragmatic guidelines for stakeholders, including urban planners, conservation practitioners, cultural heritage owners and managers.[44] However, another issue is how the municipalities without the right expertise can benefit from using the work model. The expertise level varies within different municipalities; some might need to work with consultants to cover the expertise in cultural heritage and climate adaptations. Here, we touch on the challenging key capacity factor for success – access to needed resources (both economic and professional) – as discussed by Philips.[45]

Climate-DIVE considers the historic climate and the adaptation of cultural heritage (if present). However, although it includes proposals for future planning, it lacks the steps of implementation and review. Regarding the ANH method and the pilot project in Aurland Municipality, Climate-DIVE supplements them by presenting historical data that can contribute to knowledge on how historical local adaptation has been carried out. It might provide new strategies for the argumentation on possibilities; suggestions might be relevant to consider when planning adaptation strategies.

The lack of implementation and evaluation of the measures is crucial, and these important components of climate adaptation of cultural heritage should be the two final steps in such guides. A step that deals with how to implement selected measures to prevent the disadvantages due to climate change advances the work from discussion to action. Evaluation of the measures can show whether they work in the long term. An ineffective measure can be detected and replaced by a more appropriate one. The other mentioned guides lack a retrospective element in adaptation planning for cultural heritage and climate change.

An important factor for historic adaptation in municipal planning is establishing an interdisciplinary working group, which was done in

all the mentioned Norwegian projects. The interdisciplinary topic not only crosses different departments in the municipality – establishing the topic in multiple departments puts it on the agenda and makes it part of a realistic planning strategy. Another important factor is stakeholder involvement, which was evident in all the three mentioned projects. The suggested work model does not explicitly mention stakeholders, but it mentions interviews as an important source when gathering information (in step 1). The work model also highlights the importance of specific expertise within the municipality, in addition to knowledge about climate change, impacts on cultural heritage and adaptation planning.

The suggested work model is based on the ANH method and emphasizes the focus on gathering historic information. It is open to local adaptations, something that is lacking in the guidelines that have no retrospective approach added in the planning processes.

Conclusion

Our hypothesis states the inclusion of historic adaptation measures as a relevant factor in climate risk management for cultural heritage, despite the difficulties of knowing the reasons behind past decisions. We suggest a work model for developing knowledge-based adaptation strategies at the municipality level. An adaptation strategy that incorporates an assessment of earlier preventive, adaptive and mitigation measures for cultural heritage can be used for different types of cultural heritage. In the presented work model, this has become an integrated part in the process of choosing relevant measures and developing adaptation plans for cultural heritage on municipality level. It is important, however, to relate to additional interpretation when looking at previous solutions for coping with climate and changes. For instance, we cannot be sure of the reasons why the lower areas near the river in Lillestrøm were not developed in the early period. But we can assume that there were specific reasons for the way people built their houses in the past. The historic map does not give holistic answers but looking at maps combined with the built heritage as sources of information, one can highlight prior adaptation and mitigation measures.

A retrospective approach has both benefits and limitations when making a climate adaptation plan for cultural heritage. Examining how the same community has coped with and adapted its buildings, landscapes and sites to similar challenges in the past offers positive effects. However, interpreting old maps and photographs has limitations. Historic adaptations should not be construed as measures to cope solely with climate related issues. Hence, one needs sufficient facts to support the interpretation of historic adaptation as a preventive and adaptive measure to overcome natural hazards. Information gathered through a knowledge-based work model for adaptation is useful for cultural heritage management but should be neutrally analysed, and the working group must be careful not to apply retroactive principles. If the suggested work model becomes part of cultural heritage management, the increased knowledge related to specific localities will benefit the local authorities and enhance the quality of cultural heritage management and future urban planning. The combination of a historic location analysis and a local climate adaptation analysis with a retrospective approach provides a well-founded system as a basis for future planning.

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Notes

1 Miljøstatus 2020.
2 Bonazza et al. 2018, p. 57.
3 Fatorić & Seekamp 2017b.
4 Fatorić & Seekamp 2017b, p. 227.
5 Fatorić & Seekamp 2017b, p. 239.
6 Wang 2015, p. 210, 217; Dastgerdi et al. 2019, p. 7.
7 Bonazza et al. 2018, p. 163.
8 Wang 2015, p. 211, 215.
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A retrospective approach to managing cultural heritage in a changing climate

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Summary

In Norway and throughout the world, predicted climate change will lead to higher temperatures and increased rainfall. A changing climate is nothing new, yet the speed of current changes presents increasing challenges for heritage management bodies, among others. Working with Norwegian municipalities, we have seen a need to strengthen the link between retrospective on-site analysis and future climate-change adaption. The article therefore presents examples of how local heritage management can be improved by examining how past societies adapted their buildings and landscapes in the face of extreme weather conditions. We aim to show that combining retrospective on-site evaluation and local climate-adaption analysis can support integrated planning. A further aim is to propose a new approach for knowledge-based climate-change adaption strategies at a municipal level.

The proposed approach is based on a study of published guidelines and articles that discuss heritage management in a changing climate, alongside an analysis of three completed projects. Many of the articles state that they would welcome new methods for adapting heritage to climate change. Some of the authors examine how past societies adapted their buildings and landscapes to the climate. Yet they do not discuss this historical perspective as a feasible analytical tool within a methodology for adapting cultural heritage to climate change. Instead they call for interdisciplinary methods, involving interested parties where heritage typologies are included and analysed. When developing our new approach, we took into account the expressed needs, pros and cons, and identifiable knowledge gaps, either in the literature or the presented projects.

The article's proposed approach has been developed in cooperation with Skedsmo municipality in Norway, where it was tested too. The interdisciplinary working group featured competence from both the heritage and climate sectors. Heritage typologies were analysed, such as buildings, landscapes and archaeological sites. Also included was a historical perspective on climate adaption. The retrospective approach of the assessment concerning the historic climate adaptation was a crucial part of the work.

Including a historical perspective when devising a climate-change adaption plan proved to have both advantages and limitations. Historical information does not provide holistic answers, and any data so collected must be analysed in a critical light. Working groups must ensure they do not apply contemporary values and views to information obtained in this way. The proposed approach, if adopted by heritage management, will benefit local authorities and increase the quality of heritage management and future planning by municipalities.

Keywords: Cultural heritage, climate change, climate adaptation, historic analysis, built heritage management, resilience, natural hazards