Report on MOVING Task 3.3 activities

Vulnerability of the Speyside whisky industry to environmental change

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1. Summary

- Water quantity is an important input to the Speyside whisky value chain (particularly for cooling processes) and is considered to be a concern for future production.
- Water quantity is connected to the wider land use system in the Speyside catchment, for example via the ability of peatlands to store water.
- Factors, such as overexploitation of water, change in rainfall totals and seasonality, water temperature, and any increase in floods or droughts, are perceived to be important in the mountain reference landscape (Speyside and West Moray).
- The whisky industry is more sensitive to some of these factors than others, reflecting where they can mitigate the effects through onsite distillery operational innovation.
- Land managers and other stakeholders are also undertaking interventions (such as rewetting peatlands, riparian planting or collaborative water management) in the catchment to help manage water resources.
- The research involved three stages (interviews, questionnaire and online workshop) and involved 16 stakeholders. These stakeholders represented land managers, environmental researchers and the whisky industry.

2. Project and research context

MOVING (MOuntain Valorisation through INterconnectedness and Green growth) is a Horizon 2020 project (2020-2024) coordinated by the University of Córdoba. The overall objective of MOVING is to build capacities and co-develop — in a bottom-up participatory process with value chain actors, stakeholders and policy-makers— relevant policy frameworks across Europe for the establishment of new or upgraded/upscaled value chains that contribute to resilience and sustainability of mountain areas. In the UK (specifically Scotland), we are focussing on the Speyside Malt whisky value chain.

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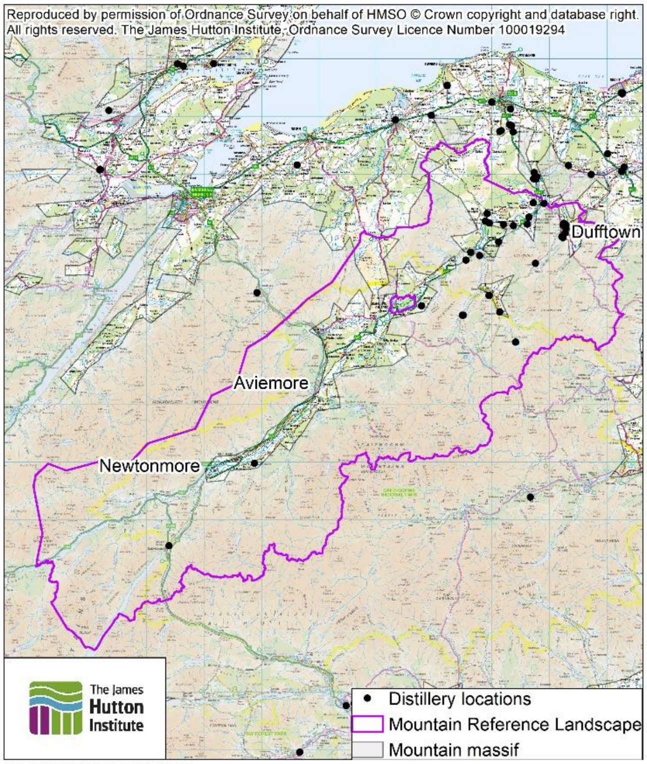

Figure 1: Location of Distilleries in our Mountain Reference Landscape

Ordnance Survey 1:250 000 Scale Colour Raster: © Crown copyright and/or database right 2019 OS; European Environment Agency (EEA) European mountain areas - version 1, Dec. 2008: Copyright holder: European Environment Agency (EEA) (provided by UEvora); Data © OpenStreetMap contributors, ODbL 1.0. Data © OpenStreetMap contributors, ODbL 1.0. https://www.openstreetmap.org/copyright.
Note: in some cases, a single distillery may be represented by more than one point.
Selected locations (within Mountain Reference Landscape, only) are highlighted.

The objective of this specific research task was to assess the **vulnerability** of the upland and hill land use systems that are the source for water for Speyside malt whisky in Badenoch and Strathspey as well as West Moray and to identify the critical pressures that the value chain may face in the upcoming 20 years. Water is needed for the whisky itself (to dilute the alcohol) but also for industrial heating and cooling purposes. Specifically, we assessed the vulnerability of the upland and hill land use systems against a range of biophysical factors to determine past (i.e., last 20 years), current and anticipated future (i.e., upcoming 20 years) vulnerability and threats. The approach notes that the area may be exposed, or susceptible, to changes in these factors, but the whisky industry may not always be affected by these changes; and/or can adapt to changes. The research involved a three-stage process of expert stakeholder interviews to understand the recent trends in water quality and quantity, followed by short online questionnaire to verify the interview findings and explore the potential future trends, culminating in an online workshop to assess how the whisky value chain is affected (through water quality and quantity changes) by these biophysical factors.

This report summarises the findings of each data collection stage in turn, as well as highlighting some measures to manage and mitigate expected changes suggested by the research participants. Finally, it highlights the next steps of the research. A more detailed report, including the maps and figures presented in the workshop can be found here [weblink to be provided in final version]. Initially, we explored both water quality and quantity, but after the interviews and questionnaire data collection stages, we focused solely on water quantity – as this aspect was both most affected by potential changes and less easy for the whisky industry to mitigate.

3. Participants

Across the three research activities (interviews, questionnaires, workshop), 16 stakeholders were involved. Some were involved in every research activity, and some in just a single research activity. The stakeholders represented a range of ages and genders, with some located within the study area, and others holding a more regional or national position. Stakeholders included researchers, advisors and land managers representing the environmental, whisky and agriculture sectors. In total 11 stakeholders undertook interviews (see Section 3.1), and 10 stakeholders participated in the workshop (see Section 3.3). Five stakeholders completed the pre-workshop questionnaire (see Section 3.2), with additional responses to some of the questions gathered during the workshop.

4. Findings

4.1. Semi-structured interviews

We undertook 11 stakeholder interviews. These interviews were conducted online using WebEx and took approximately 45 minutes. These semi-structured interviews explored the connections between hill land management and the Speyside malt whisky value chain, followed by several questions how various biophysical factors affect water quality and quantity for the Speyside whisky industry. The initial list of factors was pre-determined by our partners in University of Cordoba, who lead this part of the project. These were:

- Demographic change
- Precipitation
- Temperature
- Extreme events (not fires)
- Wildfire
- Land-use and land-cover change
- Soil (including peat) health
- Pests, diseases and invasive species
- Pollution

Additionally, stakeholders were asked to comment on how these different factors interacted with each other in relation to water quality and quantity, as well as for identification of any missing, or unnecessary factors. Finally, discussion of potential measures or interventions for improving the situation in relation to water quality and quantity for the Speyside malt whisky value chain was generated, with examples being grouped and organised for further discussion and prioritisation within the workshop stage. These will be discussed further in section 3.4.

In terms of findings, in general water quantity was a more important issue to address than water quality for the Speyside malt whisky value chain in the last 20 years. Water quality was generally considered to be good in the Speyside area. Water quantity, on the other hand, was sometimes more problematic, due to changes in the last twenty years regarding intensity of precipitation events (i.e., precipitation events occurred with greater intensity over a shorter timeframe, which then may impact on water storage and drainage capacities in the surrounding land). There were also potential issues in terms of impacts on/from land use change and water abstraction. Perhaps more positively, there was enhanced restoration of peat in the area which can aid water storage capabilities. The biophysical factors, and their definitions, were also readjusted following the stakeholder interviews. This updated list is included in the table below:

Table 1: Updated Factors from Interviews

Updated factor	Updated definition
Precipitation (rainfall)	Changes to the overall annual average rainfall. This impacts on the surface and groundwater quantity available for distillery fermentation and cooling processes. These is also the need to also consider evapotranspiration loss to the atmosphere for a net input to surface and ground water funds.
Precipitation (snow melt)	Changes in the snowfall regime, which impacts on the intensity and frequency of snow melt. Snow is a good means of longer-term water storage and slow release which is necessary for year-round abstraction for the fermentation and cooling processes used in whisky distilling. Conversely large amounts of non-melting snow may also reduce water quantity in winter. Rate of melt and also be associated with flooding events (dealt with separately).
Temperature (water)	Average annual surface water temperature. Higher water temperatures in sources used for abstraction for cooling purposes means more volume must be abstracted. Higher water temperature may influence the fermentation processes.
Temperature (air)	Average annual air temperature. Water temperature is the direct factor for the reference variable but is infrequently measured, not mapped and there are no future projections, so air temperature is used here as a proxy.
Extreme events (i.e. floods and droughts)	Changes in the frequency and/or extent of flooding and drought. Climatic drought influences the availability of surface water (and potentially spring water) necessary for year-round abstraction for the fermentation and cooling processes used in whisky distilling. The main current risk is to cooling water volumes but future availability of process water in also a concern. Floods can damage the physical infrastructure of the distilleries; and increase the sediment in the water intake.
Muirburn	Extent and intensity of muirburn influencing vegetation cover, water retention and potentially drainage (see Peat Soil Condition factor). This can lead to more sediment or dissolved organic carbon entering the surface water, and potentially the distillery water intake. This factor was discussed in relation to water quality which by the completion of the analysis was seen as less vulnerable use to the sources used and the degree of control possible in the distilling processes.
Land use change	A change in land cover, use or management, in particular the change from rough grazing to forestry. Depending on the location, type and management of the forestry, this can have impacts on the soil-water balance (both positive and negative) with implications for surface and ground water flows. This can have impacts on the availability of water for abstraction for distillery fermentation and cooling processes. Land use/management influences on water quality and

	quantity can be both diffuse and indirect (the mix of land use over the catchment as a whole) or localised and direct (e.g., via riparian woodlands creating microclimates to reduce water temperatures).
Peat soil condition	Changes in the extent of erosion and degradation that leaves soil vulnerable to being washed into surface waters during intense rain fall events, and potentially entering the distillery water intake. The ability of peat soils to function as water stores, buffering higher inputs and minimising low flows at other times.
Over exploitation of water resources	Extraction of surface water or groundwater beyond the sustainable limit, meaning that the quantity of water available for distilleries (and other users) to abstract is limited to retain environmental flows on which river ecosystems depend.
Pests, diseases, and invasive species; water pollution and demographic change	These factors were not seen as relevant to the reference variable, except potentially indirectly through other factors, so where not discussed in the workshop.

4.2. Questionnaire

The online questionnaire was developed in Qualtrics and distributed to all 11 interviewees by email. It was completed by 5 stakeholders before the workshop. The questionnaire explored the appropriateness of our factor definitions (see table 1 in Section 3.1), the trend in each factor over the last 20 years, and the expected trend in the next 20 years. Finally, respondents were asked to assess how important each factor is for affecting water quality and quantity, and therefore whisky production, in Speyside. The trends for each factor were varied in many cases, however there was agreement over the recent and future trends in water and air temperature and extreme events, all of which were considered to have increased slightly and continue to do so in the next 20 years.

4.3. Workshop

The workshop took place on Thursday 18th November (online) with 11 stakeholders, representing a range of whisky, water and land management sectors. The aim of the workshop was to assess the exposure and sensitivity of the value chain (and water quality and quantity) to the updated list of biophysical factors. As an ice-breaker participants were asked, via MIRO, if they had thought about the connection between water, whisky and land before. The poll results highlighted that this was indeed an important area for consideration.

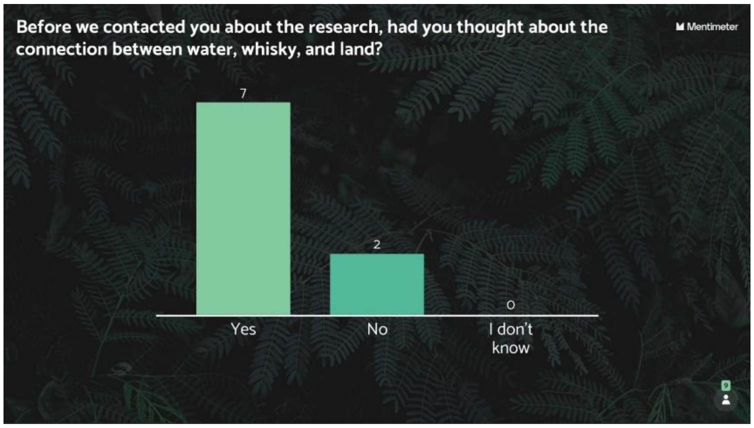

Figure 2 : Icebroker Poll Results

We determined that the following factors were of relevant to maintaining water quantity for Speyside whisky production: Rainfall; Temperature (air); Snowmelt; Temperature (water); Extreme events (floods and droughts); Abstraction; Muirburn; Land use change; and Peat soil condition.

Each of these factors was presented in graphical and mapped format by experts from James Hutton Institute in terms of how they have affected the Speyside area, and how this trend/exposure may continue or change in a business-as-usual future (i.e., no other changes). [These slides will be hyperlinked when this report uploaded to the website]. After the presentation of each factor, participants were asked to individually assess how exposed the whisky value chain would be to the future trends of the specific factors in the next 20 years. These results confirm that the workshop was focussed on the relevant factors and the overexploitation, rainfall and water temperature were the most important factors affecting the reference variable (water quantity).

Participants also assessed whether the whisky industry was sensitive to the trends in factors. Table 2 shows there is a pattern of negative effects (indicated by the positive numbers). Only two cases have potentially positive outcomes. The stakeholders were most certain of the impacts for over exploitation, extreme events and water temperatures but with variability in the degree of impact (0.33-0.66). There was most uncertainty in cases with more complex factors such as land use change. For others such as snow melt, there were different interpretations, generating the widest divergence. The greatest sensitivity was assigned to factors with the clearest links to the refence variable.

Table 2: Sensitivity Results

Factor	Average	Min	Max	Uncertainty
Over Exploitation of Water Resources	0.53	0.33	0.66	2
Extreme Events	0.46	0.33	0.66	2
Water Temperature	0.39	0.33	0.66	2
Air Temperature	0.46	0.33	0.66	3
Rainfall	0.33	0.00	0.66	3
Peat Soil Condition	0.20	-0.33	0.66	3
Land Use Change	0.33	0.33	0.33	4
Snowmelt	0.20	-0.33	0.66	4
Muirburn	0.17	0.00	0.33	4

4.4. Adaptive capacity mechanisms

The second half of the workshop discussed and prioritised the adaptive capacity mechanisms which were the measures and interventions suggested by the interviewees in phase one of this research. The adaptive capacity mechanisms suggested by the stakeholders could be broadly categorised as shown in Table 3.

Table 3: Suggested Adaptive Capacity Mechanisms

Adaptive capacity mechanism	Examples
Managing Infrastructure	• Change abstraction regimes for hydro-schemes to reduce stress • Combine hard engineering with natural flood management (Gynack Burn) • Reduce new housing on private water supplies • New Sustainable Urban Drainage Schemes (SuDS) to manage pollutants from A9
Re-wetting and restoring habitats on wet and peat lands	• Grip and gully blocking to reverse artificial drainage • Increases water storage capacity and recharge rates • Reduces erosion of degraded/ dried out peat hags • Restoring vegetation cover (e.g. sphagnum moss) and soil mix to increase storage capacity of the habitat
Collaborative water management	• Collaborative water sharing solutions based on dialogue • Sharing monitoring data between catchments • User 'digital dashboards' to regulate timing and amount of water between abstractors
Instream Restoration	• Large woody structures instream e.g. River Calder to slow flow in floods and increase storage for lower flows downstream • Instream leaky barriers
Riparian Management	• Flood plain restoration to allow flood storage • Riparian woodland planting to reduce evapotranspiration; slow overland surface water flow; trap sediment; & shade water • Additional biodiversity benefits but must be slow growing & moisture tolerant 'right tree in right place'
Sustainable land management/ land use change	• Good agricultural practice (riparian fencing, buffer strips, spring cropping, minimal tillage, correct fertiliser inputs) • Good practice muirburn techniques • LUC – rewilding beyond riparian planting

Distillery water management	• Onsite reduction of water footprint e.g. re-circulation • Increase on-site reservoirs • Alternative abstraction points and sources to reduce stress • Collaboration to collectively manage flows and levels

These were discussed in breakouts and then prioritised in terms of the ones which would be most effective to improve the water quantity for Speyside whisky production in the future. Subsequently these mechanisms were assessed in house for their economic viability, technical viability, environmental benefit, and social acceptability. The results are presented in Table 4 below. The mechanisms are presented from most to least important based on the prioritisation exercise.

Table 4: Expert Judgement on Implementation of Adaptive Capacity Mechanisms

List of mechanisms	Economic Viability	Technical Viability	Environmental Benefit	Social Acceptability
Collaborative Water Management	Low	Medium	High	High
Distillery water management	High	High	Low	Medium
Sustainable Land Management / Land Use Change	Low	Low	High	High
Rewetting and restoring habitats in wet and peat lands	Low	Medium	Medium	High
Instream Restoration	Low	Medium	Medium	High
Riparian Management	Low	Medium	Medium	High
Managing Infrastructure	Medium	Medium	Medium	Medium

The table below (Table 5) summarises the details of the impact reduction by factor and by adaptive mechanism. The table is ordered by counts of *complete*, *moderate,* and *slight* reductions for both adaptive mechanisms and factors. The most effective measures across the range of factors are thus in the top left and the least effective in the bottom right (noting of course that this only their potential to mitigate the negative consequences of factor on water quantity for the distilling industry value chain in the MRL). The sparkline profiles (miniature charts on the bottom row) highlight the range of factors to which the mechanism is relevant and the sparklines in the rightmost column summarise the mix of potential adaptive mechanism for each factor. An adaptive mechanism may be helpful in mitigating the impacts of several factors, e.g., distillery water management and collaborative water management arrangements are likely effective across most of the key factor. There may be synergies between adaptive mechanisms, for example collaborative water management and managing infrastructure (beyond distillery plant) may well synergise with distillery water management in dealing with rainfall and over exploitation. Finally, implementing a mix of several of these measures with individual slight effects may be effective, efficient, feasible and resilient overall.

Table 5: Efficacy of Adaptive Capacity Mechanisms

	Adaptive Mechanisms								
Potential	Distillery water management	Collaborative Water Management	Managing Infrastructure	Peatland Habitat Restoration	Riparian Management	Sustainable Land Management / Land Use Change	Rewetting Peatlands	Instream Restoration	**All Mechanisms**
Factors									
Rainfall	Complete reduction	Moderate reduction	Moderate reduction	Slight reduction	Slight reduction	Slight reduction	Slight reduction	Does not affect	
Over Exploitation of Water Resources	Moderate reduction	Complete reduction	Moderate reduction	Slight reduction	Does not affect	Slight reduction	Slight reduction	Slight reduction	
Land Use Change	Complete reduction	Slight reduction	Does not affect	Moderate reduction	Slight reduction	Moderate reduction	Slight reduction	Slight reduction	
Extreme Events	Complete reduction	Moderate reduction	Slight reduction	Slight reduction	Slight reduction	Slight reduction	Slight reduction	Slight reduction	
Snowmelt	Complete reduction	Slight reduction	Slight reduction	Slight reduction	Slight reduction	Does not affect	Slight reduction	Does not affect	
Water Temperature	Slight reduction	Slight reduction	Does not affect	Slight reduction	Moderate reduction	Does not affect	Does not affect	Slight reduction	
Peat Soil Condition	Does not affect	Does not affect	Does not affect	Slight reduction	Slight reduction	Slight reduction	Slight reduction	Does not affect	
Air Temperature	Slight reduction	Slight reduction	Does not affect	Slight reduction	Does not affect	Does not affect	Does not affect	Does not affect	
Muirburn	Does not affect	Does not affect	Does not affect	Does not affect	Does not affect	Slight reduction	Slight reduction	Does not affect	
All Drivers									

4.5. Workshop evaluation

Anonymous stakeholder feedback on the workshop's organisation, facilitation, quality was rated good or excellent by all respondents. The usefulness of the workshop was rated as good or excellent by almost all respondents (one respondents felt the usefulness was average). All participants felt that they learnt something from the workshop and from the other participants. There was one comment to perhaps consider the wording of some of the workshop questions more carefully so that the emphasis is collectively understood by all. This will be considered for future research activities in the project.

5. Next Steps

Thank you to all participants involved across one or several of the research activities. A longer and more technical report can be accessed here. The results will feed into the wider research task looking at vulnerability and sensitivity of mountain areas across Europe, with results due by

August 2022 (led by University of Cordoba). The Hutton research team will also use the results to in our understanding of the value chain within the MOVING project as well as other connected research projects. There will be a workshop on the current performance of the value chain, incorporating all aspects not just environmental change, in Spring 2022.

If you have any questions about MOVING more generally, please contact Kirsty Blackstock (Kirsty.Blackstock@hutton.ac.uk). Further information can be found here and on the main project website here.

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