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RESEARCH SUMMARY

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The Water Supply-Demand Balance and Climate Change

Introduction

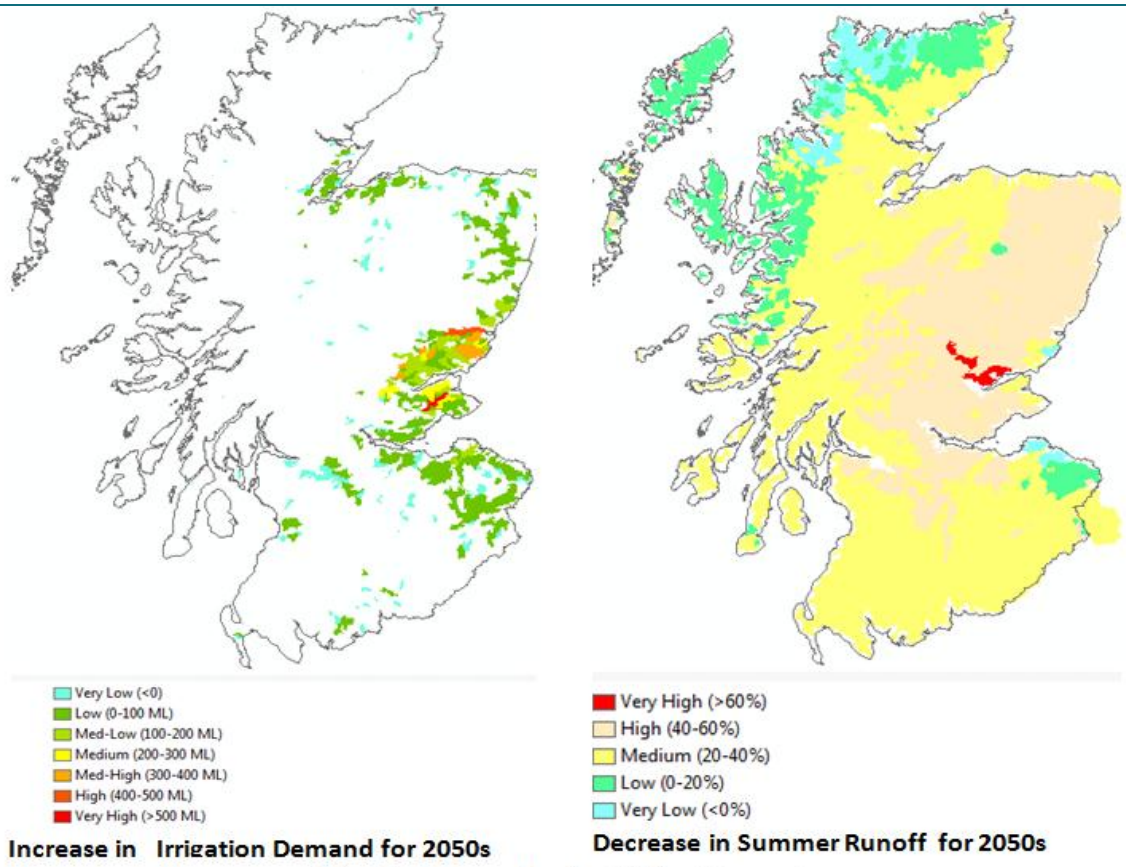
The supply-demand balance is a key measure of water resource sustainability. This balance is highly uneven across Scotland with much of the demand for water in the drier east. Agricultural irrigation is increasing in many areas, linked to land use change and requirements for high-quality produce. Better knowledge of the water balance can help secure its multiple benefits, including food security, energy crops, and the natural environment. A changing climate has implications for both water supply and demand but previous assessments have not included the influence of land use. This project compared the current situation with future patterns for the 2050s based upon climate change projections. It therefore provides a first-order estimate of changes in the water balance, highlights 'hotspot' catchments where the deficit may become problematic, and makes recommendations for further research to address knowledge gaps.

Key Points

- UK climate change projections identify that summers will be warmer and most likely to be drier, leading to reduced supply, drier soils and lower river flows.
- Extrapolation of current crop water demands to the 2050s suggests that water stress could become a severe issue for some areas of East Scotland.
- Demand projections are based upon potatoes as the major irrigated crop.
- In the absence of inter-basin transfers, some small catchments in East Scotland are highlighted as particularly vulnerable.
- Estimated additional irrigation demand in the 2050s for potatoes and similar crops is up to 100mm at some locations (the highest values average values are currently ca. 170mm). Volumetric increases are projected to be up to 50ML per $km^{2.}$
- Summer runoff is projected to decline throughout most of Scotland, with decreases of over 50% in some areas. Reduced river flows at this time of year mean less water would be available for abstraction.
- These results have implications for long-term planning of water infrastructure; implementation of the regulatory framework; and abstraction licensing to meet environmental flow requirements.
- The estimates are made for average years and do not include extreme years when drought conditions may become more prevalent.
- Groundwater resources have not been included. This area needs further research. Further work should also use a wider range of scenarios to establish a more robust approach to future uncertainty.

Research Undertaken

Our analysis combined spatial data for Scotland on land use, climate, soils and hydrology. We estimated water demand using indicator crops to calculate typical water requirements for similar groups of crops. Current cropping patterns were obtained from detailed analysis of the Integrated Agricultural Census System (IACS) database for Scotland using 2010 as the reference year. Water supply was calculated using a rainfall-runoff model. Future climate data for the 2050s was obtained from the regional climate model used in the UKCP09 projections and integrated with the supply and demand models to estimate potential future change. Maps were then produced to investigate climate-related risks for present and future.



Climate change risks for SEPA catchments

NB. Changes shown for the HadRM3 q3 Medium emissions scenario compared to 1981-2000 baseline. A full risk assessment should be based upon a range of scenarios. Orkney and Shetland are not shown (very low risk).

Policy Implications

The projected reduction in summer flows, particularly in East Scotland, makes it unlikely that increased demand can be met by additional abstraction without negative environmental impacts. The EU Water Framework Directive stipulates that water bodies must meet 'good ecological status' The EU Habitats Directive also requires that water bodies and wetlands are maintained in favourable condition. The provisional Adaptation Programme for Scotland (to be statutory in 2013) recognises the key role of sustainable water use. On-going policy development for reform of the EU Common Agricultural Policy needs to integrate adaptation responses. Integration is also central to the Scottish Government Land Use Strategy.

Sustainable water resource management will require both supply- and demand-based measures to reconcile potential adverse impacts for different users. Long planning horizons are required to maintain and adapt infrastructure. Policy measures should also seek to encourage local adaptation options e.g. modification of crop types or varieties, development of more water-efficient management practices, or increased use of on-farm water storage, particularly in the more risk-prone areas.

Research Team and Contacts

- A longer Technical Report is available to complement this Briefing.
- Contact CREW or Iain.Brown@hutton.ac.uk

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