# Building resilience to respond to future environmental change across Scottish Catchments

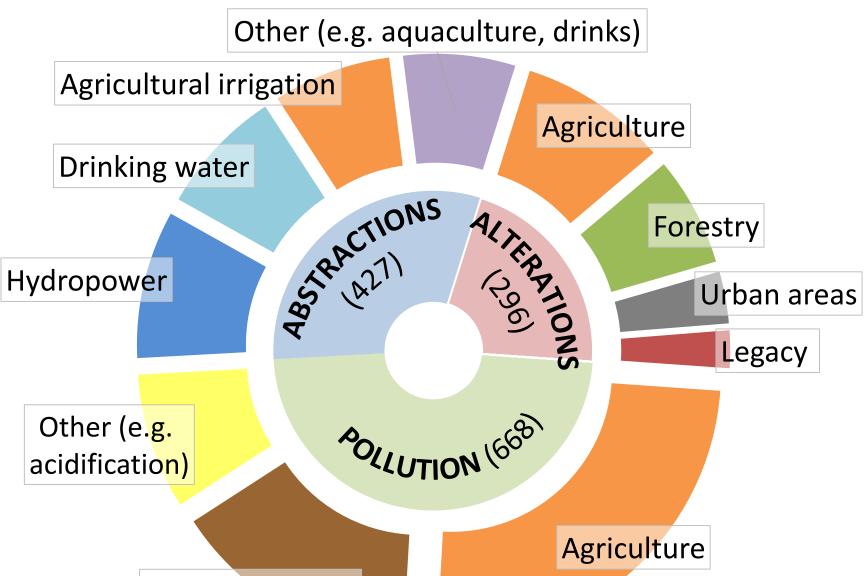
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## **1. Introduction**

Catchments are under **multiple** pressures from human use (Fig. 1). In the future, increasing effects of demands and the will further change climate the impact on ability of catchment systems to provide food, water and energy security, other services such and biodiversity and livelihoods of local people (Fig. 2).



# 2. Methods & project plan

Three Scottish catchments with **contrasting pressures and stakeholder conflicts** will be identified. These catchments and their associated issues will provide a platform for the development of a transferable **socio-ecological framework** to guide decision-making and future catchment management.

The project will adopt both quantitative and qualitative methods and participatory approaches to generate data, which will be used for:



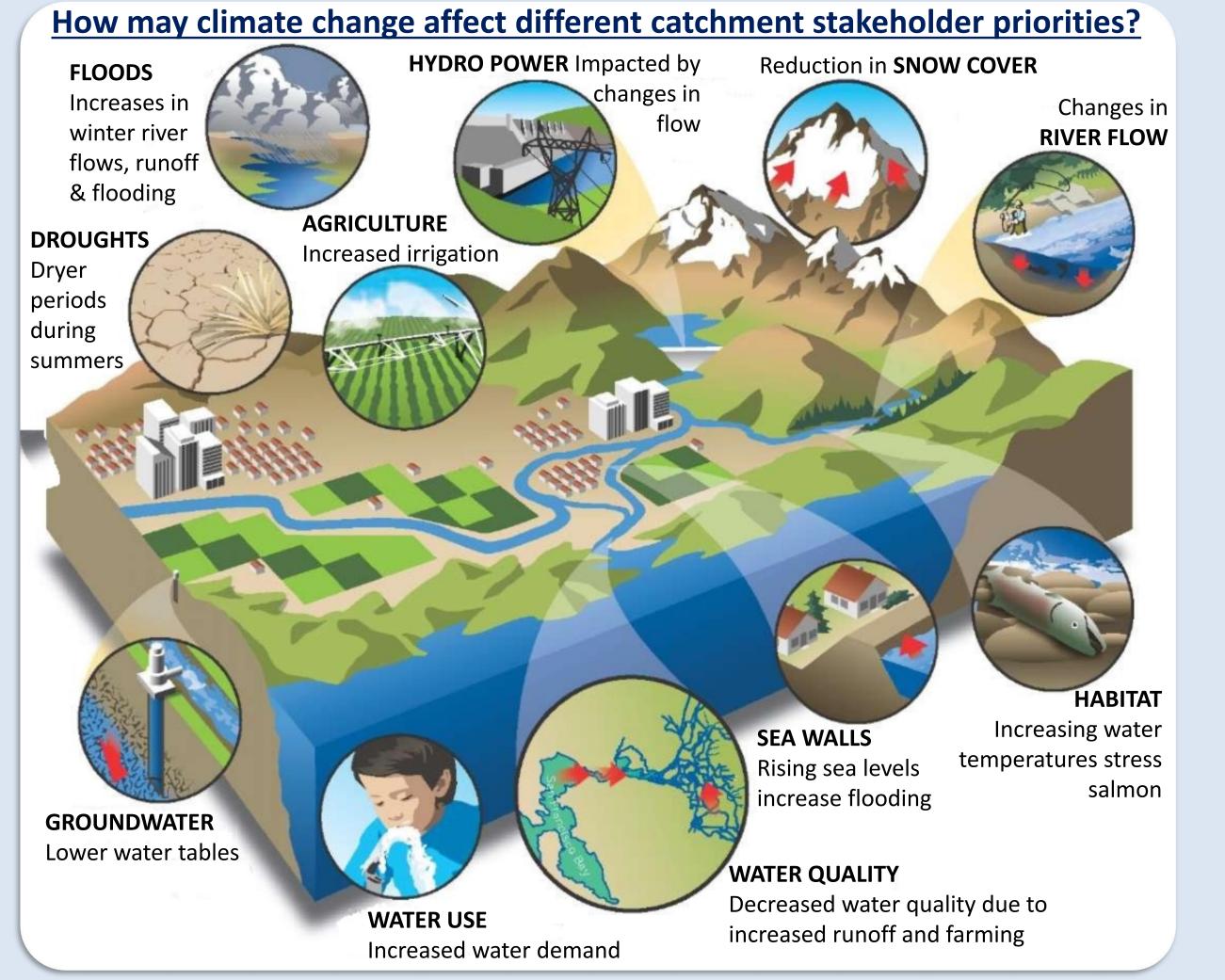
Hydro Nation Scholars Programme



Fig. 1: Pressures on Scottish waterbodies (no. affected 2008 RBMP).

There is a need to **quantify and optimise multiple benefits** from catchments. However, there are **uncertainties** surrounding ecosystem service modelling, climate change and stakeholder opinion which is a further challenge for catchment management (Fig. 3).

The aim of this project is to explore possible **trade-offs** and **synergies** between catchment uses and find ways to optimise landscape scale ecosystem service provision in Scottish catchments.



- Development of conceptual models in association with stakeholder groups to illustrate ecosystem service connectivity within catchments and identify multiple benefits, trade-offs and potential conflict
- Scenario development of catchment futures that will be coupled with **best-worst scaling** of stakeholder judgments
- Elicitation of expert opinion on the uncertainties of catchment management and ecosystem service provision, using fuzzy distributions
- Running of a **Stakeholder Jury**

Finally, the **spatial decision-making tool Marxan**, conventionally used for reserve planning, will be deployed to develop a framework to allow maximisation of multiple benefits in catchments. This will utilise data gained from the mixed methods outlined above.

Fig 2: Likely impacts of climate change on catchment systems (adapted from www.epa.gov).

## **3. Future impacts**

The project will deliver strategies to promote stakeholder collaboration as opposed to conflict. The socio-ecological framework for decision-making will optimise landscape scale ecosystem delivery in the three Scottish catchments, and make them more resilient against the impacts of future climate change.

By doing so the project will deliver a **blueprint** for more

Political change & uncertainty surrounding effectiveness of policy tools accuracy of monitoring and modelling

Management system Defined by political values, stakeholder needs and scientific knowledge **Policy tools** Regulations, agrienvironment schemes, best practice

#### Land use change & uncertainty, changes in commodity prices

#### **Stakeholder system**

Uses and values based on priorities, property rights and socioeconomic situation. Impact on catchment processes.

## Uses of catchment

Fishing, hydro power, nature conservation, floodwater storage, recreation, agriculture, urban rivers, navigation, forestry, drinking water supply, sewage disposal...

### Values

Economic gains, avoided damage costs, secured resource access, human well-being, intrinsic values...

Climate change & uncertainty, spatial and temporal variability

#### **Catchment system**

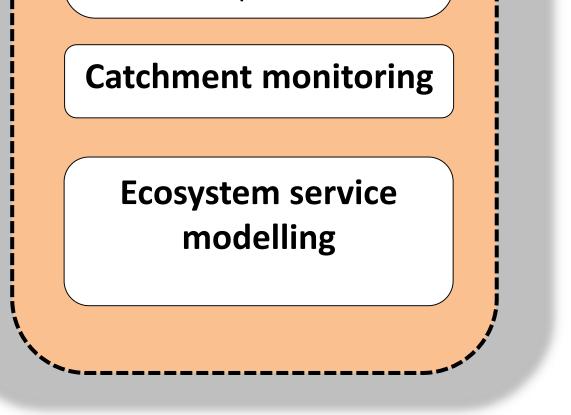
Provides ecosystem services which are based on underlying catchment processes.

Catchment

Catchment ecosystem

integrated, effective and sustainable management of catchment systems and the decision-making framework will be **transferable** to catchments outside of Scotland.

The **mixed methodologies** that will be developed to achieve the project's aim will in themselves form important outputs. The **novel mechanisms** may be transferable to other applications to help unpack stakeholder conflicts and identify opportunities for maximising ecosystem services across landscapes.



processes

Flow regime, sediment availability, 3D connectivity, biodiversity and food webs, chemical characteristics... services Provisioning of water, food, energy, recreation, flood protection putrient and

energy, recreation, flood protection, nutrient and carbon cycling, dilution of pollutants and pathogens, resilience to climate change, habitat provision...

**Fig 3:** The complexity of managing ecosystem services in catchments. The catchment, stakeholder and management systems and sources of uncertainty (grey).



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