Lessons from the study on Payments for Ecosystem Services (PESLES project)

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Summary briefing for stakeholders

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This briefing summarises the history and outcomes of the 'PESLES' project, which started in 2016 and runs until March 2022. This is intended to provide a summary to aid learning within and beyond the catchment. Work on the project was kindly supported by the Scottish Government Strategic Research Programme, (RD 1.4.3.d).

Introducing the 'PESLES' project

The objective of the PESLES project has been to build understanding of what management tools and supporting institutional arrangements are effective in enabling stakeholders to adopt water management measures in selected Scottish catchments. Our work has focused mainly on two lowland catchments, Lunan Water in Angus, and Loch Leven in Perth and Kinross. Payment for Ecosystem Services (PES) schemes are based on voluntary payment arrangements between individual beneficiaries and service providers to establish or increase the supply of an ecosystem service: exploring the potential for PES to improve water management was part of the original motivation for this project. Ecosystem services are the benefits provided to society by the environment, including services like flood regulation or water purification. We first describe the main activities or workflow of the project, before describing three main interventions considered in both catchments.

The main activities within PESLES

Firstly, In the Lunan water catchment, local stakeholder interviews were carried out in the summer of 2014 with 16 stakeholders. These interviews explored views on water issues in the catchment, causes and potential solutions as well as the potential to establish schemes to pay for water benefits in the catchment. The Lunan Water Catchment Management Group was formed (Angus Council, SEPA, SNH, Scottish Wildlife Trust, Dundee University, NFUS, and Esk Rivers and Fisheries Trust, and James Hutton Institute), with Angus Council chairing, to help oversee the project and act as a forum for catchment management issues.

Secondly, a workshop with Centre for Ecology and Hydrology was held in 2016 to conceptualise and compare water ecosystem services in these catchments. Six main elements of Ecosystem Services provision affected by sediment and water management were identified as common to the two catchments:

1. The ecological response of changing water levels in surrounding wetlands,
2. The potential for management of water quality and pollutant loading into conservation wetlands,
3. The impact of flushing regime on aquatic ecology,
4. Water governance challenges at the catchment scale,
5. Opportunities for ecotourism,
6. Opportunities for hydro-electric generation schemes.

Based on these activities, concepts for three potential schemes emerged, to improve water management in these two catchments.

1. ‘Water for all’ (Lunan Water)
2. ‘Fishing for farmers’ (Lunan Water)
3. ‘Flushing for water quality’ (Loch Leven)

The work done to explore the viability of each of these concepts is described below.

Concept #1. ‘Water for all’ (Lunan Water)

The Water for all scheme on the Lunan Water has focused on hydraulic management i.e. alterations to water flows, using a weir downstream of Balgavies Loch. We proposed that management based on a hydraulic model of water levels (see Box 1) and possible upgrading of the hydraulic structures might generate benefits for flood risk management, irrigation abstraction/low flows and sensitive wetland ecology. A remotely operated tilting weir, releasing surplus storm water from the common lade to the Lunan Water, for example, might alleviate upstream flooding (a widely expressed concern to local residents and Angus Council), and protect sensitive wetlands from pollutant and sediment loading.

The hope was to develop proposals for a locally managed scheme which would be financially justified by the benefits for local stakeholders.

A postal and online survey was implemented in the Lunan Water catchment area in 2017 to measure quantitatively the level of interest and support in such a scheme. This was complemented by qualitative interviews to understand some views in more detail. These data helped us design and calibrate a modelling tool, to simulate and forecast loch water levels and channel flows.

BOX 1. Summary of hydraulic model

Input data are rainfall, evapotranspiration, catchment areas and channel/floodplain hydraulic data. A hydrological model predicts stream and groundwater inflows to the Lunan Water and its wetlands. The loch and wetland water levels and flows in the channels downstream of Balgavies Loch are simulated using the hydraulic modelling package, HECRAS.

We can simulate **past water levels and flows**

Such information could, for example, help alert local water managers to the presence of logjams in the main channel of the Lunan Water, causing much higher water levels than simulated.

Using Met Office Forecast data we are also able to forecast water levels and flows

Such forecasts could help with identifying a need to alter the opening on the gates controlling the existing weir, or, in the case of an upgrade of hydraulic structures, to adapt management by remote control.

Social science research has shown different levels of support between farmers and residents for upgraded engineered management of the catchment. The key differences were found in **i)** local socio-historical norms; **ii)** understandings of the scientific knowledge and practice on which the project was based; **iii)** the perception of individual rights and responsibilities in relation to water; **iv)** and what is perceived as the “natural state” of the catchment and related preferences for interventions.

Further scenarios of management and proposed actions on the upper Lunan Water have been explored. This has led to a concept note for reinstatement of a blocked spillway, which will help relieve pollution pressure on Chapel Mires wetlands. This has been discussed with, and agreed by, the Lunan Catchment Management Group and riparian owners on 31 March 2021. The way is now open for exploration of funding sources to deliver this re-instatement.

Concept #2. ‘Fishing for farmers’ (Lunan Water)

This idea of Payments for Ecosystem Services (PES) focused on achieving agreement between fishing/wetland conservation interests and riparian farmers for erosion control measures. For example:

a. better erosion control could be made a condition of fee payment from riparian recreational fishing interests to riparian farmers who own Rescobie Loch,

b. dredging licence agreements could be tied to upstream erosion and sediment mitigation.

The hydraulic modelling undertaken through the Water for all scheme has shown that **dredging will benefit the delivery of reduction in flood risk** (for example, by lowering the bed level in the common lade downstream of Balgavies Loch).

The linkage between erosion control and finance was pursued by **promoting un-funded regulatory and voluntary measures** (e.g., by adopting erosion control plans drawn up for selected farms) prior to promoting application for funded measures under the Scottish Government scheme.

What lessons on the funding and implementation of the sediment mitigation methods described above can be drawn from the processes in the Lunan Water catchment?

- **Farmers were receptive** to carrying out diffuse pollution audits of activities
- During the early part of the Lunan Water Diffuse Pollution project (2006-2011), Agri-Environment funding was not particularly well aligned with water quality goals, but in some cases, **farmers were ready to fund innovative solutions** (e.g. sediment traps and ponds) from their own resources. However, this meant the design element was somewhat lacking. This issue has to some extent been resolved by the publication of the rural SUDS guide.
- Farmers in the catchment were sometimes **ready to host experimental and demonstration innovative solutions** (e.g. sediment fences), during the research phase of the project (2011-2016), but there was also some resistance.
- At the Lunan catchment science group meeting in June 2013 there was a feeling from farmers that not many people in the lower catchment are involved in funded environmental schemes. **The issue is that most measures involve removing land from production**, and the land there is simply too profitable for that to be economic.

- **Funding is an issue for some.** Rates for agri-environment use of land haven't changed much over the last ~20 years, whilst the return off the land has increased. So, whilst it was once clearly economical in places to adopt agri-environment measures, now it may not be so clear cut.
- Discussions between land-users in the current phase of the project (2016-present) have highlighted the **question of responsibility for receiving /treating and managing sediment from upstream neighbours**. It is a legal responsibility to receive the upstream neighbour's water, but what about their sediment?
- It is difficult to agree setting aside adequate ground for sediment traps or ponds funded by AECS to deliver the rural SUDS guideline of 0.25% of the catchment area. It has been easier to agree funding and area set-aside for swales and buffer strips, and this probably reflects more generous funding and ease of implementation within existing management of fields.
- The **co-ordinated input** of Environmental consultants (SRUC (in 2006-2011), Lockett-Environmental, Moir Environmental (2016-present)), Agencies (SEPA and SNH) and Research scientists (JHI) **has helped facilitate the progress** in implementation of sediment mitigation measures.
- At a very local level, there has been **increased dialogue between upstream producers of sediment and downstream receivers**. However, co-operation to manage sediment can be damaged if upstream measures take time to be effective.
- The AECS funding for water quality measures have achieved some uptake for grant applications and implementation has begun in the upper Lunan catchment.

Concept #3. Flushing for water quality

Climate change effects can produce unexpectedly large algal blooms at a time when nutrient inputs to the water appear to have remained stable. This raises the question of whether current loch and reservoir management practices, many of which have been in place for decades, are still fit for purpose under a changing climate and whether changes could be made to help mitigate climate change impacts in the future.

By applying a scenario-based modelling approach to Loch Leven, a well monitored loch in the Scottish Lowlands, we have undertaken an initial exploration of the extent to which changes in the rate at which water is discharged from the outflow, or "flushing", could help to reduce the likelihood of algal blooms, especially of cyanobacteria, during the summer months.

The results suggest that small changes made to the flushing rate of lochs and reservoirs have the potential to reduce the water retention time sufficiently to reduce algal blooms by as much as 40%.

Increasing flushing rates by increasing inflow volumes is difficult to achieve, due to the extra water required, but reducing water retention time by increasing outflow volumes would be relatively easy to achieve in systems where the outflow from the waterbody can be regulated by dams or sluice gates.

The benefits of achieving lower cyanobacteria levels in Scottish lochs and reservoirs would be to increase their recreational and amenity value and reduce water treatment costs to remove algal toxins and substances that cause taste and odour problems in water supplies. It has been estimated that improving the water quality status of Scottish lochs adds about £1,500 per hectare per year to their value (Glenk et al., 2011).

From this it can be estimated that the value of a single loch, such as Loch Leven, in terms of its recreational and amenity value would increase by about £2m if problems caused by cyanobacterial blooms were reduced.

For lakes that are used for water supply, the costs of water treatment to remove algal toxins and decomposition products were estimated to be about £21.4m per year for the UK by Pretty et al. (2003).

This equates to a present-day value of about £30m, a cost that would be reduced significantly if algal blooms were less common.

Decisions on how to implement such changes would need to take into account a wide range of, often site-specific, factors that could be affected by changes in water retention time and levels of discharges from the outflow.

These include maintaining environmental flows downstream of the waterbody, ensuring that water level changes do not have an adverse effect on the ecology of the waterbody, and the need to maintain levels of abstraction for water supply purposes or of flows to support power generation. So, any decisions to make such changes would need to be taken by all of those involved in the governance of the waterbody, including environmental regulators, conservation bodies and water users. However, the results outlined above suggest that it may be beneficial to explore this potential approach to reducing algal blooms in more detail.

Final reflections

- There is land manager interest for hosting experimental and pilot schemes to influence water management, but the opportunity costs of removing land from agricultural production are rarely seen to be adequately or reliably compensated.
- Existing infrastructure or ways of managing water may be appraised as imperfect for responding to climate change and meeting environmental and social goals; however, people living and working in landscapes may tend to accept these as part of the landscape. This acceptance and attachment, coupled with close scrutiny of new schemes, can make it difficult to change or introduce new infrastructure and activities.
- The responsibilities and liabilities associated with new infrastructure receive close scrutiny and land-owners concerns about liability are understandably a significant impediment to adopting new schemes. Examples of other schemes and governance structures that manage responsibilities and liabilities may be helpful for alleviating these concerns.

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