

5. Hydrological Impacts: Summary of Issues

1. Irrigation Abstraction

Problem

Abstractions of water from surface and groundwater bodies for irrigation purposes affect the natural hydrological cycle.

Impact

Hydro-ecological impacts – changes in flow regimes affect aquatic ecology. Abstractions are most commonly made during dry periods when river flows are naturally low, exacerbating drought conditions.

Systems/Areas at Risk

Irrigation is most commonly used in Scotland for potato crops, but is also used for salad crops, grass and soft fruits. These crops are grown most commonly in the east of Scotland, but also in the north around Moray and in the west around Ayrshire. The east coast areas are at greater risk than the other areas because of the drier climate, but also because there is greater ware potato production, which requires more irrigation than the seed production more common in the north.

Abstraction control measures currently exist for only two catchment areas, the West Peffer Burn in East Lothian and the Ordie Burn in Perthshire. However, other streams in Angus, Perthshire, Fife and E. Lothian may be as equally at risk as these catchments. Small streams where surface abstractions take place will be particularly vulnerable to hydro-ecological impacts, because the instantaneous abstraction may constitute a high proportion of the natural flow.

Remedial Measures/ Practical Actions

New regulations for abstraction of surface and groundwaters will be introduced as a requirement of the EU Water Framework Directive. These may not directly impact on all agricultural water usage as they may be applied only to abstractions exceeding a minimum flow volume. The new regulations are likely to be based on irrigation restrictions in relation to stream flow volumes or rates.

Because of the seasonal nature of irrigation abstractions, significant mitigation of the problem could be achieved by using water storage reservoirs, enabling abstractions to take place at times when stream flows are high, to be stored for use during dry periods.

Where possible, there may also be benefits in using groundwater abstractions in preference to surface water, because the impact of the abstraction on the streams will be smoothed over time, rather than instantaneous.

Decreases in the agricultural demand for irrigation water could be achieved through more efficient water use, for example by employing trickle irrigation methods in place of spray irrigation.

Research Gaps

Study of the most appropriate mechanisms for minimising flow disturbance whilst satisfying agricultural needs, including effective implementation of abstraction controls.

Evaluation of impacts of groundwater abstractions compared with surface water abstractions.

Identification of the spatial scale at which controls should be implemented.

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2. Drainage

Problem

Drainage of agricultural land using surface ditches or sub-surface tile drains modifies hydrological flow paths and flow rates.

Impact

Concentration of flow via agricultural drainage may lead to accelerated runoff rates. This in turn may cause an increased risk of flooding.

Conversely, a general lowering of the water-table can increase soil infiltration capacity which will tend to reduce the frequency of storm runoff. Occasionally, reductions in peak flows have been observed following drainage activities.

Changes to the hydrological flow paths have a secondary impact on water quality through changes in the transport of nutrients such as N and P.

Systems/Areas at Risk

Some 50% of productive agricultural land in Scotland is estimated to be covered by networks of artificial drainage (Green, 1979). In particular, areas where there are gleyed soils have been under-drained to improve the land for agriculture. All systems that have been drained will have a modified hydrological regime compared with a natural system. However, there may be environmental benefits as well as negative impacts of drainage, making it hard to generalise about where systems are particularly at risk.

Systems that are in close proximity to the natural stream network are more likely to cause a direct impact on runoff rates.

Remedial Measures/ Practical Actions

The negative environmental impacts of agricultural drainage can be minimised through appropriate design of the systems, including measures such as:

- removing the direct linkage between drainage systems and streams to provide buffer zones / flood plains
- use of transverse collector drains to slow the flow of water from down-slope drainage networks
- the use of controlled drainage where the height of a riser in the drain outlet can be varied to modify the degree of drainage, in response to hydrological conditions

Research Gaps

Further study into the changes in runoff patterns caused by agricultural drainage under different physical conditions.

Research into the relationship between nutrient export and agricultural drainage. Studies into the effectiveness of controlled drainage technology

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