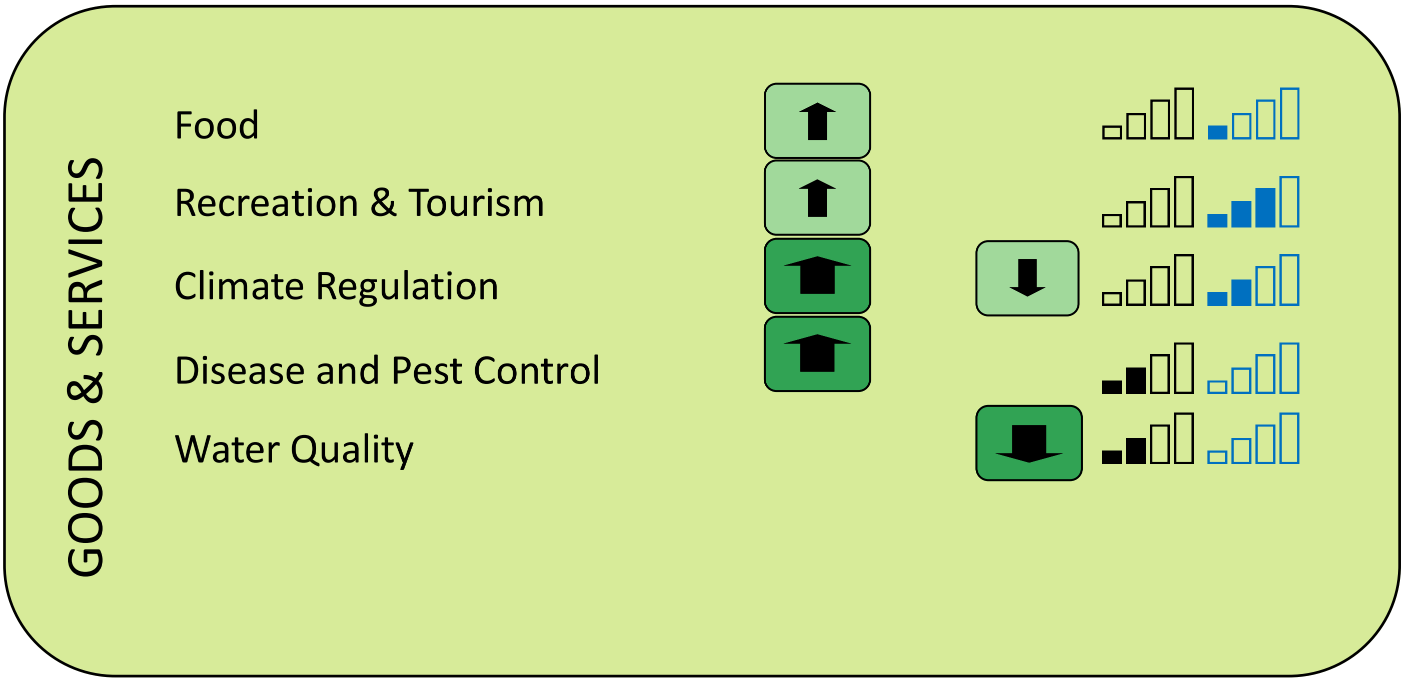
MANAGING ECOSYSTEM SERVICES

LOWLAND AGRICULTURE

INCREASE SOIL ORGANIC MATTER

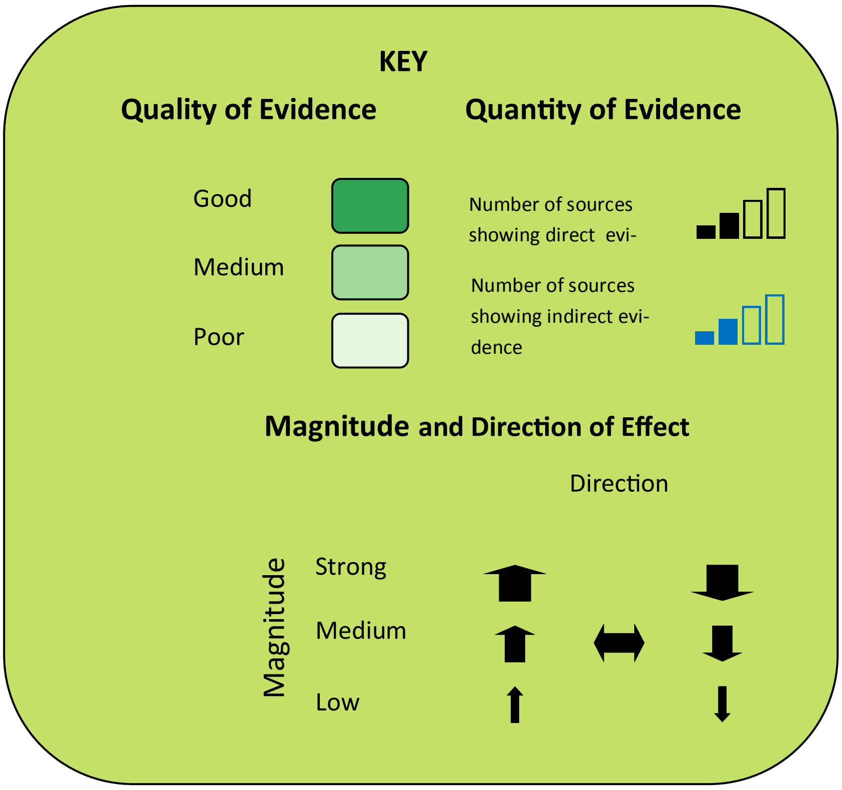
Use organic carbon in the form of manure or slurry as a soil additive on improved grassland and arable.



These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the Evidence Spreadsheet.

Data are correct to March 2015.



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Provisioning Services—providing goods that people can use.

Cultural Services—contributing to health, wellbeing and happiness.

Regulating Services—maintaining a healthy, diverse and functioning environment.

PROVISIONING

Food: ***Moderate Evidence***:- A Swiss study on comparisons between conventional and organic farming, where there is better coupling between livestock and arable regarding the application of manure, found that the application of manure significantly improved a number of indicators of soil quality over the control site[1]. This should lead to improved yields.

CULTURAL

Recreation and Tourism: *Moderate Evidence:-* An assessment was made of 117 farms across two river catchments in South-West Scotland for faecal indicator organism (FIO) bacteria[2]. FIO contamination of watercourses was common, partly as a result of poor manure storage but also partly due to run-off or leaching following heavy rain. This watercourse contamination route was identified in 50% of farms. The contamination of watercourses is predicted to impact bathing waters where the rivers discharge into the sea and therefore impact recreation and tourism.

REGULATING

Climate Regulation: ***Strong Evidence:-*** A European Union-wide analysis of agricultural management practices suggests that animal manure applications to farms could sequester 3.7 Tg carbon yr^{-1} and sewage sludge 0.3 Tg yr^{-1}. This would be a component of the UK's commitment to the Kyoto Protocol in combination with other land use scenarios[3]. A similar analysis shows that increasing organic inputs to agricultural land would sequester carbon, but that it would be a relatively small contribution and that there is also a risk of increasing nitrous oxide N_2O emissions[4]. An analysis of UK soil organic carbon (SOC) stock as climate change mitigation was undertaken with respect to the type of soil addition. SOC increased by 60 kg C ha^{-1} yr^{-1} per tonne of dry solid added as farm manure compared with 180 C ha^{-1} yr^{-1} for digested biosolids[5]. A Canadian study urges caution in only using the top soil surface layers to assess SOC, as under an organic farming regime total (including deep) SOC was found to decrease over time, requiring organic matter inputs just to maintain the current level[6]. Slurry application had no effect on aboveground or root biomass in a USA study, only the age of the grassland affected plant biomass, suggesting no net benefit in carbon sequestration for slurry application[7]. While manure applications can increase carbon sequestration, they may also increase N_2O emissions. Plots in South-East Scotland receiving either organic manure (sewage sludge, poultry manure & cattle slurry) or ammonium nitrate at the same rates of nitrogen application were compared[8]. Plots receiving mineral fertiliser emitted N_2O at a peak rate of 388 g N_2O $ha^{-1}day^{-1}$ compared with 3488 g N_2O $ha^{-1}day^{-1}$ for the organic fertiliser, which also had a longer period of emission. **Moderate Evidence:-** N_2O emissions is linearly related to the application rates of nitrogen and can depend on soil type, being higher for clay soils[9]. In Scotland, maps of N_2O emission show hot spots associated with both wetter soils and higher levels of grazing, with the suggestion that a reduction in manure applications would lead to a reduction in N_2O emissions[10].

Water Quality: ***Strong Evidence:-*** A study of phosphorus loss following application of a range of manure types to a field with recently installed drains found that apart from the first year with applications of pig slurry, there was no significant phosphorus loss[11]. Applications of broiler litter, cattle farmyard manure, liquid sewage sludge or inorganic phosphorus did not significantly increase phosphorus loss in the first or subsequent years[11]. A number of other studies suggest that phosphorus loss to run-off may be considerable following manure applications. One study from the UK found that the losses were greatest from inorganic phosphate, then liquid cattle manure followed by liquid anaerobically digested sludge and finally dewatered sludge cake[12]. Timing and method of applications of slurry can reduce phosphorus export, with incorporation into the soil, splitting the applications into two or avoiding periods of rain reducing export by 25-60%[13]. In Sweden, the surface application of cattle slurry to grass leys resulted in significant losses of soluble reactive phosphorus[14]. At a trial site on a slope in the UK, phosphorus applications from cattle slurry and farmyard manure were compared with inorganic phosphorus[15]. Phosphorus losses were higher following slurry and farmyard manure application. A UK study on nitrate leaching from sandy soil found that applications of farmyard manure increased nitrate leaching by 39%, while broiler litter increased it by 52% above the control[16].

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