Socio-economic impacts of moorland activities in Scotland

Part 1 of Research to assess socioeconomic and biodiversity impacts of driven grouse moors and to understand the rights of gamekeepers.

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The views expressed in this report are those of the researchers and do not necessarily represent those of the Scottish Government or Scottish Ministers.

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1 Summary of the key findings from the research

1.1 Background

1. Thomson et al, (2018) noted that the existing evidence base for the socio-economic impacts of grouse shooting and alternative moorland land uses is limited and dated. Phase 1 research recommended that further research be undertaken, to investigate the impact of economic connections between grouse shooting estates and surrounding businesses and wider communities, and the economic impacts of grouse moor management at different shooting intensities. Phase 1 further recommended that an evaluation of the socio-economic impacts of alternative land uses for moorland areas be undertaken
2. This report - **Part 1: Socio-economic impacts of moorland activities in Scotland** is part of a larger, multipart study commissioned by the Scottish Government to **Assess Socioeconomic and Biodiversity Impacts of Driven Grouse Moors and to understand the Rights of Gamekeepers**.
3. The key objectives which Part 1 of this Phase 2 research aimed to address were to: i) **Examine the extent and impact of economic connections between grouse shooting estates and surrounding businesses and communities**; and ii) **Evaluate the socioeconomic impacts of alternative land uses for moorland and how they compare against land used for grouse shooting**.

1.2 Methods and caveats

4. A set of case studies were identified, informed by stakeholder input, to fit case study selection criteria that were developed to provide a diverse set of cases from across Scotland that include variety in enterprise scale, intensity and owner motivations. These included examples of driven grouse enterprises and alternative moorland land use activities, including walked-up grouse, forestry/woodland management, conservation, deer management, sheep farming, and renewable energy.
5. A systematic approach was evolved to collate financial information from 24 examples of relevant estate-based enterprises (and 3 additional examples of specific woodland creation schemes presented as a component of the forestry case study), relating to: (i) capital investments; (ii) recurrent expenditure; (iii) revenue streams; and (iv) employment. Semi-structured interviews were carried out with estate owners/managers to provide the context for the activity in each case. The case studies research required the collation of sensitive financial data and all landholdings were fully anonymised through the data storage, analysis and reporting phases. Using published reports additional information pertaining to the Langholm experiment is also summarised
6. The approach taken allowed for analysis of the sources of finance and the first round of expenditure to be identified, but it **did not account for indirect economic benefits and/or the costs or benefits of positive (e.g. landscape) and negative (e.g. carbon release from muirburn) externalities arising from different land uses**. Accounting for these aspects was beyond the scope of this research. Additionally, **with a limited number of examples there was potential for specific cases to skew results**. To counteract this, the synthesis section contrasts findings with relevant previous studies.
7. The **allocation of costs/revenues to case study land uses was based on estimates provided by the interviewee**. **These allocations were necessarily based on estimates which can change over time**. Furthermore, **not all case study examples were located wholly within the moorland zone.** To increase the comparability of the forestry and woodland case study additional examples were identified and developed which relate to woodland creation on moorland sites.
8. **Although land uses are presented as singular activities, they do not occur in isolation and invariably overlap considerably within estate contexts.** Finances were commonly managed across an estate, with some land uses subsidised from other activities relative to their financial performances and relevance to the priorities of the landowner.

1.3 Grouse moor management

1.3.1 Walked-up grouse shooting

9. In the case studies, walked-up shooting was comparatively low 'intensity' (25 hectares per brace on average), with an apparent emphasis on maintaining traditional values and limiting the degree of active management. The **total combined direct impacts (capital, running and staff costs combined) for walked-up grouse were relatively low compared to other moorland land uses at £13 per hectare**.
10. Walked-up shooting also **generated comparatively low revenues (£5 per hectare), operating at an average net cost across the case studies of £6 per hectare** (or £35,000 at estate level). Walked-up shooting also **had a comparatively low employment impact (1 FTE per 4,700 hectares).** Nevertheless, walked-up shooting (regardless of intensity) required a base level of activity/staffing and expenditure that was commonly facilitated through integration with other sporting activities (e.g. deer stalking) and through subsidisation from other estate land uses or external income.
11. Spending impacts were predominantly local or regional, with an absence of local businesses related to the remote location necessitating regional or national level spending in some cases.

1.3.2 Driven grouse shooting

12. The case studies demonstrated that expenditure levels and impact from grouse shooting varies widely, linked to the size of the moorland and sporting operation and relative commercial emphasis as determined by owner motivations. **Driven shooting required a sustained level of capital spending** (equivalent to £8 per hectare on average), and the total combined direct impacts (capital, running and staff costs combined) for driven grouse shooting (£38 per hectare) were comparable to (or higher than) other moorland land uses. Driven grouse shooting was a more intensive use of the moorland (compared to walked-up) and required 7 hectares per brace shot on average (the most intensive case only required 2 hectares per brace).
13. Driven grouse shooting operations generated substantial annual revenues (over £250,000 for larger operations) in good years, although revenues were generally lower than spending levels, averaging £20 per hectare. However, **income was highly cyclical, depending on the availability of shootable surpluses of grouse** which was related to several factors (weather, parasites and predators). These findings confirmed those of previous studies that **driven grouse shooting enterprises were rarely profitable as stand-alone land uses, as costs generally outweighed revenue, or at best resulted in a break-even position during good years.** On-going net costs meant that **driven grouse shooting was subsidised by other, on or off estate, income streams.**
14. The employment impacts of driven grouse enterprises across the case studies broadly reflected previous findings and indicated that, on average, 1 FTE was generated per 1,450 hectares. **This represented a higher per hectare employment impact than other moorland land uses.** In most cases, grouse shooting enterprises (and associated income) were seen as a key factor facilitating ongoing retention of core estate staff.
15. Reflecting findings from previous work, 60-80% of direct spending in the case studies occurred within the local or regional area. Importantly, **in regions** where driven grouse shooting is most prevalent, **grouse shooting is likely to be of greater local importance as an employer, and in relation to the local economy and community retention.**

1.3.3 Comparison of walked-up and driven grouse shooting

16. Driven grouse shooting generally occurred at higher intensities (based on hectares required per brace shot), although all types of grouse shooting enterprises required healthy grouse populations and on-going active moorland management. Revenue levels from walked-up enterprises were considerably lower than driven grouse (both in total revenue terms and in relation to revenue generated per participant and per shooting day). As expenditure and staffing levels on walked-up enterprises were also lower, **any shift from a driven to a walked-up enterprise would likely result in reductions in staffing and local economy impacts.** Nevertheless, walked-up shooting

represented a valued complementary activity within mixed sporting enterprises that can be sustained at a lower cost than driven grouse**, but was less economically viable as a stand-alone land use** due to lower capacity to generate income. In terms of maintaining the related spending and staffing impacts, walked-up shooting was not perceived by case study interviewees as a viable alternative to driven shooting.

17. **Key constraints identified in relation to both walked-up and driven grouse shooting included:** i) a decline in grouse numbers in 2018-2019, perceived as being linked with increased prevalence of pests (heather beetle and tick) and climatic factors; ii) increased regulatory constraints; iii) loss of heather habitat; iv) political pressure and negative public perceptions; v) and a general unreliability in revenue over the longer term.
18. **Recent trends and perceived opportunities for both walked-up and driven grouse shooting included:** i) increased employment and investment linked partly with sustained demand for driven grouse shooting; ii) reduced parasite burdens from the use of medicated grit and tick mopping; and iii) increased training and professionalisation among gamekeeping staff. Further wider opportunities identified included peatland restoration, integrated estate management plans and potentially limiting the degree of intervention in grouse moor management to gain public support.

1.4 Alternative moorland uses

1.4.1 Forestry and Woodland Creation

19. **Forestry as a commercial enterprise is often less directly comparable to grouse shooting** due to commercial forestry often occurring on lower ground or on sites with higher land capability. Nevertheless, the single forestry case study example illustrated some of the key features of forestry as a land use within an upland estate setting. These included **relatively high capital costs (£41 per hectare) relative to ongoing running costs (£24 per hectare), with most spending and activity occurring during establishment and felling phases.**
20. The intermittent nature of forestry activity results in periods of comparatively high income (relative to other moorland land uses), linked with either revenue from establishment grants and/or timber sales during felling periods. Recorded revenue for the forestry case study was £53 per hectare, with **income relatively evenly split between grant income (47%) and from timber sales (53%).** Importantly, the recorded income from timber sales was **not representative of the longer-term average**. Grant income was also noted as more variable longer term and funding of the forestry enterprise was likely to require cross-subsidisation from other estate enterprises over the longer term.
21. Both forestry and new native woodland creation **generally had lower employment impacts** (outside of peak phases) on a per hectare basis than most other moorland land uses (with the exception of deer and walked-up grouse – both of which occurred over much larger areas). Additionally, spending impacts were less localised due to imported short term specialist labour squads and the use of contractors.
22. Three additional **case studies of native woodland creation** were developed to assess costs and revenues for woodland creation on grouse moors. **None of the schemes expected to generate income from timber sales** but projected income from the sale of carbon units represented a significant additional source of revenue over the main growing phase for two of the schemes.
23. Two of the schemes showed **net (estimated) costs of £144 to £166 per hectare over their life or £9 to £11 over 15 years.** Even with the high extrapolated running costs one of the schemes was projected to return net income of £1,183 per hectare (or £79 per hectare over 15 years).
24. The two most recent schemes viewed the **current grant rates combined with projected income from the sale of carbon as ensuring new woodland creation was now an economically viable land use in upland settings,** with the capacity to generate a profit on a projected annualised basis.
25. Despite the potential benefits of carbon revenues for new woodland creation, a variety of constraints to further new woodland creation on grouse moors were recognised, including**: i) challenging environmental factors, deer browsing pressures and uncertain growth and tree**

survival rates; ii) limited or no potential for returns from timber sales from woodlands created on poorer ground; iii) liabilities for landowners relating to the uncertainties around ongoing costs and requirements to repay grants subject to scheme success; iv) loss of ground to other land uses and increased cover for predators leading to increased grouse losses; v) shortages of available trees to plant; vi) and **a lack of confidence in the long term potential of carbon markets to generate guaranteed income, particularly on challenging upland sites.**

1.4.2 Conservation

26. On a per hectare basis **the average combined spending (capital, running and staff costs) on the conservation estate examples (£39) was marginally higher than for driven grouse**. Notably, the overall proportion of spending in the local area/region was marginally lower than for some other moorland land uses.
27. The larger of the two conservation case study examples demonstrated the potential for conservation **to deliver a comparable (or higher) level of spending and employment impacts relative to other moorland land uses.** This includes a capital spend component equivalent to, or greater than, a large sporting estate.
28. Revenues from conservation **were comparatively low on a per hectare basis (£19) relative to other moorland land uses (reflecting previous studies)**, apart from deer and walked-up grouse. **Conservation management therefore generally operated at a net cost, despite benefitting from substantial public funding,** with the case studies suggesting that over **80% of conservation revenue is from public funding.** Common Agricultural Policy payments represented an important funding component for conservation management.
29. The case studies demonstrated that conservation, as a land use, **was heavily dependent on ongoing public and/or other organisational or external private funding** aligned with the conservation objectives of the estate**.** Nevertheless, as demonstrated on these case studies, the net conservation costs can be reduced through generating income from alternative sources including renewable energy, tourism and sporting land uses (e.g. walked-up grouse) at low intensities.
30. Overall, **conversion of management on moorland sites (i.e. including the cessation of driven grouse) towards a primary conservation goal is likely to be heavily influenced by owner motivations or a change in ownership, the availability of public funding, and the potential to generate long-term revenue streams from complementary activities to offset costs**. Declines in other land uses may also result in opportunities for conversion, in parallel with the availability of payments for ecosystem services.

1.4.3 Deer stalking and deer management

31. The average combined spending (capital, running and staff costs) for the deer enterprise case studies was £12 per hectare, **considerably lower than for most other moorland land use case studies.** On average, annual capital investment was £2 per hectare, suggesting deer management can be maintained without major ongoing capital investment providing the required infrastructure is in place.
32. Average per hectare revenues for the deer case study enterprises were low (around £5), with higher per hectare revenues (£8) for the examples where commercial stalking took place. Regardless of commercial orientation, **deer operations operated at a substantial net cost (around £100,000 on average or £5 per hectare) before any capital investment was accounted for,** due to a combination of the ongoing staffing costs and the low revenue potential (e.g. relative to large driven grouse shooting enterprises).
33. Although **per hectare employment impacts for deer were comparatively low (averaging 1 FTE per 4,000 hectares),** the very extensive nature of deer operations in two of the case study examples resulted in the retention of a substantial local deer related staff component (5-7 FTEs).
34. The complementary aspect of deer management (e.g. in relation to woodland management) were perceived as a key strength. In practice, an integrated/shared staffing model across sporting

activities (deer, grouse, fishing etc.) **enabled the estates to maintain a larger year-round staff team (of which the deer FTEs were one part)** that ensured a high level of active management over large areas of ground.

35. **In the absence of any available public funding, stalking income represented a mechanism to supplement some of the deer management costs** with the remainder funded by other sporting activities, wider estate income (e.g. from renewable energy) or direct owner contributions.
36. **Key perceived constraints** for stalking and deer management included: i) low revenues and low availability of funding support for deer management; iii) conflicting objectives within and between landholdings; and iv) the administrative burden linked to Deer Management Groups requirements.
37. **Perceived opportunities** for stalking and deer management included**:** i) improved collaborative working arrangements; ii) increased uptake of Habitat Impact Assessment; iii) potential recognition of the potential for new hunting models (e.g. shooting in mixed habitat setting and woodland stalking); and iv) generating income from wildlife tourism.

1.4.4 Hill sheep farming

38. Relative to other moorland land use case studies the initial **set-up costs and ongoing capital investment costs for the sheep farming case studies were low**, reducing the potential for local economic impact. However, average per hectare running costs including staff costs (£36) were comparable to other moorland land uses. Additionally, the average total **spending impact (capital, running and staff costs combined) for sheep enterprises (£43 per hectare) were comparable to, or higher than, the per hectare impacts for most other moorland land uses (including driven grouse shooting).**
39. Total **revenues per hectare and returns per £1 spent in the sheep case studies (averaging £61 per hectare and £1.69) were relatively high compared to most other moorland land uses,** and sheep enterprises generated a profit before capital costs of £25 per hectare on average.
40. However, excluding CAP support, all the sheep enterprises returned losses, with average losses of £15 per hectare before capital costs. The **sheep enterprises were therefore heavily dependent on public support (66% of revenue on average) to ensure their financial viability.**
41. The case study sheep enterprises generated around **1 FTE for every 1,800 hectares**, a lower per hectare employment impact than for driven grouse. While the case studies suggest spending impacts are highly localised, economic and job creation impacts from sheep farming can vary widely.
42. Despite declines in livestock numbers, and **subject to the continuing availability of support payments, the complementarity of sheep farming in mixed estates contexts and the potential for supporting new agricultural entrants (due to low set up costs), suggests it remains a viable moorland land use going forward.**

1.4.5 Renewable energy schemes

43. The renewable energy case studies demonstrated that, **relative to other moorland land uses, renewable energy schemes generally require a high level of initial capital investment** - averaging around £1.4 million for hydro schemes and significantly more for wind farms. For large-scale wind farms this initial investment is commonly taken on by an energy company carrying out the development, resulting in (longer term) rental payments to landowners.
44. Ongoing annual running costs for hydro schemes were **comparatively low (averaging £37,000 across the case studies) relative to the initial investment costs.** Cost-efficiencies can influence the scale of renewable energy schemes, with the cost per kilowatt generally decreasing as size increases, with fixed cost elements remaining similar between smaller and larger schemes.
45. Relative to running costs, the **revenues from the hydro scheme and wind farms case studies were comparatively high relative to other moorland land uses**, with the hydro scheme case studies generating an average of £190,000 from energy sales and subsidy payments on an annual basis - the highest overall returns per £1 spent (particularly when initial capital costs are repaid).

Additionally, the wind farm examples generated the **highest overall returns (from rental payments) on a per hectare basis (£217-£272), although this fell to £49-£61 when calculated on a whole estate basis.**

46. Renewable energy development represents a potentially **significant source of reliable revenue to landowners over the long-term relative to other moorland land uses**. In several of the wider cases within this report, income generated from renewable energy schemes was perceived as a key component of ensuring long-term estate financial viability.
47. While **employment impacts (following the initial development) are comparatively low for hydro schemes, wind farms can generate employment impacts comparable to other moorland land uses** and the wider regional economic impacts of the wind farm development phase can be considerable.
48. **Key perceived strengths and opportunities** relating to renewables enterprises among included: i) improved estate access as a result of the renewable energy development; ii) the development of community benefit funds as a result of large renewable energy installations; and iii) compatibility between renewable energy developments and other land uses including agriculture and grouse shooting.

1.5 Conclusions

49. Summary Table 1.1 provides a comparative overview of the key costs, revenues and staffing levels for each of the moorland uses examined through these case studies. The importance of the wider context of these stand-alone enterprises cannot be underestimated as the owners of businesses did not consider each type of land use in isolation, rather they contributed to a holistic estate business model.
50. **Grouse shooting can generate significant economic impacts for communities, with** impacts generally localised and disproportionately important in regions where grouse shooting is most prevalent. However, grouse shooting enterprises are rarely profitable in their own right and **commonly exist as part of an integrated, mixed, sporting enterprise**. Spending and staffing occur across these enterprises, which are also integrated financially with the wider estate business, with more profitable aspects often subsidising less profitable activities.
51. **'Alternative' moorland land uses can generate comparable spending and revenue impacts (and in some cases more consistent revenue) to driven grouse shooting on a per hectare basis.** Moorland land uses are not mutually exclusive and are often at least partially integrated, and the level of direct comparability of 'alternatives' can vary.
52. **Native woodland creation offers scope for biodiversity and carbon gains and h**as the capacity to generate a profit over a rotation **on suitable moorland sites.** The **availability of carbon revenues has the potential for altering the economic viability of woodland creation on moorlands**, although uptake may be constrained by site constraints, perceived conflicts and uncertainty.
53. **Grouse shooting is perceived as facing increasing regulatory requirements**, as well as longer term uncertainty around climate change impacts, although sustained market demand, capital values and owner motivations remain significant drivers for retaining driven grouse. Wider **drivers for alternatives include the availability of carbon revenues, favourable grant rates for woodland creation and peatland restoration, a continuing emphasis on renewable energy, and wider market shifts (e.g. increasing demand for nature-based tourism),** all of which have potential for influencing land use change. **Landowner motivations and how these reflect ownership change or succession, are a further factor potentially influencing future retention (or not) of grouse shooting.**
54. A widespread **transition away from driven grouse towards woodland creation would likely result in job losses in some regions**. A wider shift towards conservation and woodland restoration may also result in decreased levels of private owner investment in some rural economies. The case studies demonstrate that **some of these losses could be offset through tourism development** (and visitor spend), and the ongoing need for deer management suggests some retention of

gamekeeping roles, particularly where estates have already developed diversified enterprises to offset costs.

55. A **significant moorland transition towards conservation, native woodland restoration and/or high nature value farming, also implies a shift in the balance of public-private investment (or increased funding from organisational memberships or wealthy individuals), at a time of increasing pressure on public budgets**. Any loss of sporting revenues is also likely to increase funding requirements for essential deer management, necessitating either further internal estate cross-subsidisation, or public support. The role of **emerging markets for ecosystem services is also likely to become increasingly important longer term**.

Table 1.1 Comparative socio-economic indicators for the moorland land uses derived from case studies

Impact	Walked-up grouse	Driven grouse	Forestry	Woodland creation[1]	Conservation	Deer stalking	Sheep	Renewables - Hydro[2]	Renewables -Wind
Case study enterprises	4	4	1	3	2	3	4	3	3
Average annual capital costs	£10,465 (£2/ha)	£59,096 (£8/ha)	£173,000 (£41/ha)	£32,924 (£151/ha)	£153,815 (£10/ha)	£45,624 (£2/ha)	£16,341 (£7/ha)	£1.4m (build cost); (£93,444 over 15yrs) (£4,024/kW)	£89m (developer) costs (n/a)
Average running costs (incl. staff costs)	£61,247 (£11/ha)	£219,292 (£30/ha)	£102, 056 (£24/ha)	£26,548 (£122/ha)	£480,284 (£29/ha)	£182,813 (£10/ha)	£87,019 (£36/ha)	£37,172 (n/a)	Est. £4.8-5m for larger examples (n/a)
Average revenue	£26,281 (£5/ha)	£147,916 (£20/ha)	£220,000 (£53/ha)	£63,039 (£290/ha)	£313,816 (£19/ha)	£87,826 (£5/ha)	£146,971 (£61/ha)	£192,280 (£552/kW)	£334,000 (£245/ha wind farm or £55/ha estate)
Hectares per FTE / average FTEs	**4,685 (1.2)**	**1,446 (5)**	**4,000 (1)**	**n/a**	**2,100 (8)**	**4,005 (4.8)**	**1,793 (1.4)**	**n/a (0.2)**	**n/a (5)**
Net balance (before capital)	**-£34,966 (-£6/ha)**	**-£71,375 (-£10/ha)**	**£117,944 (£28/ha)**	**£36,491 (£168/ha)**	**-£166,468 (-£10/ha)**	**-£94,987 (-£5/ha)**	**£59,952 (£25/ha)**	**£148,878 (£428/kW)**	**n/a**
Net balance (capital included)	**-£45,431 (-£8/ha)**	**-£130,472 (-£18/ha)**	**-£55,056 (-£13/ha)**	**£3,567 (£16/ha)**	**-£320,283 (-£20/ha)**	**-£140,611 (-£7/ha)**	**£43,611 (£18/ha)**	**£92,606 (£266/kW)**	**n/a**
Average revenue (%) from public funding[3]	**0%**	**0%**	**47%**	**86%**	**79%**	**0%**	**66%**	**69%**	**n/a**
Level of local-regional spending	**Moderate/ High**	**High**	**Low/ Moderate**	**Low/ Moderate**	**Moderate/ High**	**High**	**High**	**Moderate/ High**	**Moderate**
Revenue per £1 spent	**£0.43**	**£0.67**	**£2.15**	**£2.37**	**£0.65**	**£0.48**	**£1.69**	**£1.93 (£4.43 after payback)**	**n/a**

[1] Data relates to annual costs and revenues averaged over 15 years. Average annual costs and per/ha costs are considerably lower over a full rotation.

[2] Average annual running costs and revenues exclude the initial capital costs – but the net balance including repayment of capital investment is shown over 15 years.

[3] The public funding contributions only relate to the specified land use and a low or zero percent figure does not imply that the estate within which the land use/enterprise sits did not receiving any public funding in relation to other activities (e.g. farming, conservation). Furthermore, some estate land uses which may receive public funding (e.g. sheep grazing) overlap with, complement, and form part of the management of the moorland area over which grouse shooting and other activities may take place. Landowners may also receive public funding for deer fencing but this is generally recorded as relating to forestry management as opposed to deer revenues.

2 Background

This report is **Part 1: Socio-Economic Impacts of Moorland Activities in Scotland** of the commissioned research project to **Assess Socioeconomic and Biodiversity Impacts of Driven Grouse Moors and to understand the Rights of Gamekeepers (CR/2019/01).** The overall project was led by Scotland's Rural College (SRUC) and Part 1 was undertaken by an experienced team of interdisciplinary researchers from SRUC. This research builds on the evidence base developed, and evidence gaps provided in 'Phase 1' of this research *Socioeconomic and biodiversity impacts of driven grouse moors in Scotland* (Brooker et al, 2018). A summary for the full project is available as a stand-alone report from the Scottish Government[4] and other technical reports from the project are available from the SEFARI website.

2.1 Policy context

2.1.1 Grouse shooting in Scotland

The sport of shooting red grouse on heather moorlands is unique to the UK and has occurred since the mid-19th century. A ground nesting bird, the red grouse is fast and agile, providing a testing game shooting opportunity. Today, productive grouse moors are mainly found in Scotland and the North of England, where moorlands are actively managed at different intensities by gamekeepers to provide these wild birds with favourable breeding and rearing habitats. Specific management activities include muirburn, predator control and the use of medicated grit to improve grouse health (Moorland Working Group, 2002).

There are three types of grouse shooting: driven, walked-up and over pointers. Driven grouse shooting is the most intensive form and accounts for the majority of commercial grouse shooting in Scotland. The grouse shooting season runs from 12th August to 10th December each year. Unlike some other game birds, red grouse cannot be reared in captivity meaning their numbers vary considerably between years, with weather, habitat, disease and predators all having potential impacts on numbers.

2.1.2 Multiple benefits from moorlands

Scotland's Land Use Strategy promotes an integrated approach to land management, with woodland regeneration, biodiversity conservation, carbon sequestration and recreation encouraged in moorland areas alongside traditional sporting activities (Scottish Government, 2016). Therefore, there is increasing pressure on land managers to deliver multiple benefits from moorlands, including the public benefits that these areas provide.

There have been questions raised about the positive and negative impacts of grouse shooting on biodiversity and other public benefits. While grouse moor managers and collaborators are taking active steps to reverse the decline of wading birds in Scotland[5], concerns generally focus on large-scale culls of mountain hares on grouse moors, muirburn and the persecution of raptors. It is particularly the latter that has generated emotive reactions from the general public, conservation organisations and campaigners, and led to increasing pressure on politicians to address the issue. [6]

2.1.3 Recent scrutiny

There has been a growing public and political concern relating to the disappearance of golden eagles in Scotland. In 2016, the Cabinet Secretary for Environment, Climate Change and Land Reform asked Scottish Natural Heritage (SNH) to report on the issue. In May 2017, SNH published a commissioned report that studied the movements of 131 young golden eagles over a 12-year period, finding that

[4] https://www.gov.scot/ISBN/978-1-80004-212-4

[5] For example, through the Working for Waders initiative that began in 2017.

[6] For example, the Revive Coalition call for reform of driven grouse moors and a petition submitted to the UK Parliament in 2016 to ban driven grouse shooting.

more than 40 had disappeared in suspicious circumstances. The majority of cases were found to have occurred on or near to (within 2km) land that was intensively managed for driven grouse shooting (Whitfield and Fielding, 2017). Indeed, in summer 2019, further, significant attention was brought to the disappearance of two golden eagles in Perthshire, with more calls being made for political action to regulate grouse moor management.[7]

When the SNH report was published, the Scottish Government specified the intention to establish a group (the Grouse Moor Management Group – GMMG), with a remit to look at "*the environmental impact of grouse moor management practices such as muirburn, the use of medicated grit and mountain hare culls and advise on the option of licensing grouse shooting businesses*" (Scottish Government, 2018). In the same month, the Cabinet Secretary also announced commissioning of research into the costs and benefits of large shooting estates to Scotland's economy and biodiversity.[8] A related Programme for Government commitment (2017-2018) also confirmed that a research project would be commissioned on the topic, alongside "*work in relation to protecting gamekeepers' employment and other rights*" (Scottish Government, 2017).

These announcements by the Cabinet Secretary focused specifically on driven grouse shooting. The GMMG, chaired by Professor Alan Werritty began its work in November 2017 to "*ensure grouse moor management [driven and walked-up] continues to contribute to the rural economy while being environmentally sustainable and compliant with the law*". During the working life of the GMMG, 'Phase 1' of this research into the socio-economic and biodiversity impacts of driven grouse (Brooker et al, 2018) was completed and the GMMG considered the results. The GMMG's final report and recommendations to Scottish Ministers' was published in December 2019 (GMMG, 2019).

This 'Phase 2' of the socioeconomic and biodiversity impacts research, along with the study of gamekeepers' rights, provides new evidence that addresses some of the knowledge gaps identified during the Phase 1 research and in the evidence collated by the GMMG.

2.2 Objectives of the research

The key aims of the wider research project are shown below, with the specific component of the research presented in this report developed to address objectives 1 and 2 below.

1. **Examine the extent and impact of economic connections between grouse shooting estates and surrounding businesses and communities (Task 1a).**
2. **Evaluate the socioeconomic impacts of alternative land uses for moorland and how they compare against land used for grouse shooting (Task 1b).**
3. Understand the employment rights and benefits available to the gamekeepers involved in grouse shooting, as well as their working conditions, attitudes, behaviours and aspirations for the future (Task 2).
4. Provide a more up to date assessment of the area of grouse moors in Scotland under management for driven grouse, mapping clearly the areas of moorland that are actively managed for grouse and the intensity of current management regimes (Task 3).
5. Understand further the impacts of driven grouse shooting on biodiversity making use of more up to date estimates of grouse moor management intensity and linking it with the best available biodiversity data. Introduction (Task4).

[7] See, for example, coverage in The Guardian (01.07.19).
[8] Scottish Government news: Golden eagle deaths (31.05.2017) .

3 Research context

In 'Phase 1' of this research (Thomson et al, 2018) it was noted that the existing evidence base for the socio-economic impacts of grouse shooting is relatively limited and dated. Therefore, industry-collated and reported data is often cited in contemporary discourse regarding grouse moor management. The Phase 1 research also highlighted that grouse moor management and shooting activities on estates do not sit in isolation. Rather, a range of activities can occur on or around (or partially utilise) grouse moors (e.g. management for sheep, deer, walked-up grouse shooting, driven grouse shooting, wind energy generation, tourism, conservation) which can overlap, complement or even conflict with other to greater or lesser extents. Different land management activities can be undertaken together on the same piece of ground, and whilst some moorlands are principally managed for driven grouse, many others do not have any driven grouse activities. Furthermore, some staff members on estates may be engaged primarily in grouse shooting while others may be engaged in a combination of activities including both other sporting and non-sporting activities. The Phase 1 review provided some estimates of the socio-economic impacts of these different uses of moorlands, using secondary data already available in the literature (see Table 3.1).

Table 3.1 Indicative comparisons of annual expenditure per hectare and hectare required per FTE job

Land use	Spend per hectare	Hectares per full-time equivalent
Driven grouse - *Angus Glens* - *Monadhliath*	 £120/ha £51/ha	 875 ha/FTE 1,038 ha/FTE
Rewilding NGOs (average) - *RSPB*	£181/ha £144/ha	277 ha/FTE 173 ha/FTE
Sheep farming	£98/ha	580 ha/FTE
Largescale wind	£2,240/ha local investment costs £7,150/ha Scottish investment costs £517/ha community benefit	15 ha/local FTE 5 ha/UK FTE
Forestry	£346/ha	422 ha/FTE

Source: Thomson, et al. (2018)

The Phase 1 research noted that evidence on the socio-economic impacts of alternative land uses on moorland areas is currently limited, particularly of the emerging rewilding and conservation approaches being taken on some private estates. Some alternatives (e.g. farming, forestry and renewables) are heavily reliant on public payments to justify the activity economically, with others (e.g. rewilding, conservation) are often more reliant on the benevolence of owners or organisational memberships. It is challenging to make comparisons between land uses as there are regulatory limitations (e.g. for wind farms, forestry and woodland management) and biophysical constraints (e.g. to farming, forestry and woodland management, wind energy, housing) on some alternatives, meaning they are only viable or permitted across some of the current grouse moor area (or do not wholly operate within what might be characterised as the 'moorland zone').

To address the points identified in the Phase 1 report, this part of the current research builds on these indicative findings collated in Phase 1 by gathering primary socio-economic data on grouse shooting (walked-up and driven shooting) and on alternative moorland land use activities (i.e. sheep farming, forestry/woodland creation, conservation management, renewable energy and deer stalking), using a systematic approach and assessing the nature, extent, and locality of investments, revenues and expenditures.

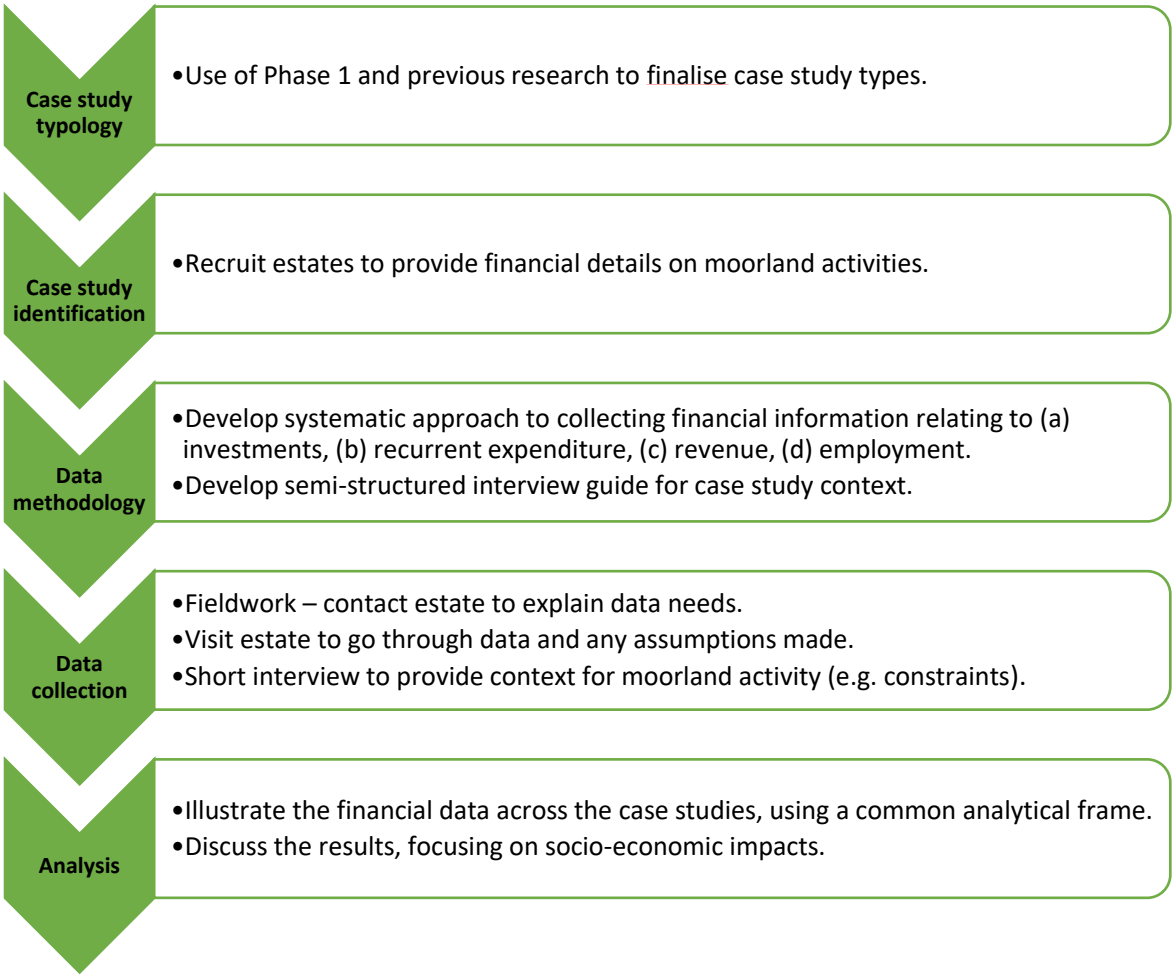
4 Methods

The research uses a case study approach to profile investment, revenue and expenditure streams from driven grouse and a range of alternative moorland land use activities. The alternatives considered are:

- Walked-up grouse
- Forestry/woodland management
- Conservation
- Deer management
- Sheep farming
- Renewable energy

An overview of the approach is shown in Figure 4.1 and each step is explained in more detail below.

Figure 4.1 Methodological approach for data collection and analysis



Step 1 - Case study typology

The Phase 1 evidence review noted that many moorland activities, including management for grouse, occur at differing scales and intensities. In order to generate sufficient evidence to illustrate the socio-economic impacts of different scales and intensities of alternative moorland management, evidence was collected from across the land uses and scales/intensities detailed in Table 4.1.

Table 4.1 Moorland use case studies with measures of scale/intensity[9]

Moorland use (case study)	Number of cases	Case study characteristics
Walked-up grouse/ grouse over pointers	3 walked-up estates and 1 walked-up/driven transition	• Small (walked-up, no commercial shooting) • Small-medium (walked up, some commercial shooting) • Large (commercial walked-up shooting) • Walked-up estate which has developed driven shooting
Driven grouse	4 estates and 1 additional 'mini' case study showing costs of restoring a managed commercial moor	• Sporting estate (smaller, commercial focus) • Sporting estate (medium size, commercial emphasis) • Sporting estate (medium size, mixed commercial/private) • Sporting estate (large, commercial emphasis) • Sporting estate (example of re-establishing a driven moor)
Deer stalking/ management	3 estates	• Commercial focus (large deer stalking enterprise) (two estates) • Maintenance focus (medium size, deer management)
Rewilding/ conservation	2 conservation estates	• Mixed land-use focus • Primarily conservation focus
Forestry/ woodland creation	1 forestry enterprise and 3 woodland creation schemes in moorland areas	• Upland estate based mixed forestry enterprise (one example) • Specific examples of new woodland creation schemes established on moorland (3 scheme examples)
Sheep farming	3 estate-based sheep enterprises and 1 tenanted sheep farm	• Estate based sheep enterprise (part moorland based) (3) • Upland sheep farm (with moorland component)
Renewable energy	3 hydro scheme and 3 wind farm examples	• Hydro schemes (3 hydro schemes on grouse shooting estates) • Wind farm (3 moorland located examples)

The main land use case studies have been developed by collating and analysing data provided for 24 different examples of relevant enterprises (not including specific woodland scheme examples). These land use case study examples were derived from twenty distinct landholdings, with a small number of landholdings providing information for more than one land use case study. This was particularly the case in relation to renewable energy scheme examples, most of which were derived from estates which has provided information relating to a different land use case study (e.g. driven grouse, sheep etc.). Additional data was also utilised for the driven grouse case study from an established publicly available case study example of a long-term project to re-establish a driven grouse moor (see Section 4.2). Two additional estates also provided data relating to specific woodland creation schemes, with woodland creation scheme examples added as a specific component of the main forestry/woodlands land use case study.

Step 2 - Case study identification/recruitment

Initially, stakeholder contacts were used to identify potential participants for the study (including the Scottish Moorland Group, Scottish Land and Estates, and the Game and Wildlife Conservation Trust). Stakeholder organisations with knowledge of potential participants conducting alternative moorland uses were also asked to suggest potential participants (including Scottish Forestry, Scottish Natural

[9] Typology has been modified from the original proposal to expand the number of estates cases within land use case studies in some cases to allow for sufficient diversity and depth of examples.

Heritage, National Trust for Scotland, the National Park Authorities, Trees for Life, land agents, energy companies, SAC Consulting, etc.).

A short information sheet was sent to potential participants to provide details about the project background, the methodological approach and how financial data would be used (see Appendix A). In the first instance, a 'longlist' of potential participants was constructed. This list was then refined to ensure coverage of the case study typologies shown in Table 4.1 and sufficiently widespread geographic coverage to include moorland/former moorland areas being used for a variety of land uses. The approach taken has been modified and expanded from the original proposed approach to include additional walked-up and driven grouse shooting case studies to account for variation, focus more specifically within the forestry case study on examples of woodland creation on grouse moors (as opposed to 'forestry' per se) and include additional short sheep farming case studies.

Step 3 – Data methodology

A robust and straightforward methodology was developed to gather appropriate data needed to assess the nature (i.e. industry sector), locality and extent of financial transactions relating to different moorland activities. To minimise the data burden on landowners/managers, clear and concise data requirements and accompanying instructions were developed. This approach also ensured that the approach was replicable both across the case studies in this research and in the future, if the assessment is repeated[10]. Figure 4.2 illustrates the types of information collected to understand the socio-economic impacts of each land use. This simple, repetitive structure was used to make it easier for participants to complete the worksheet relating to each aspect (investment, expenditure, revenue, employment). A full list of all the data points collected for each case study can be found in Appendix B. For capital expenditure, participants were asked to provide data on all investments over the past five years (2014-2019). For recurrent expenditure, revenue and employment data they were asked to estimate a three-year average (2016-2018[11]). Expenditure was organised into categories, to allow cross-comparison (e.g. vehicles, equipment, etc.). A list of the categories is shown in Appendix B.

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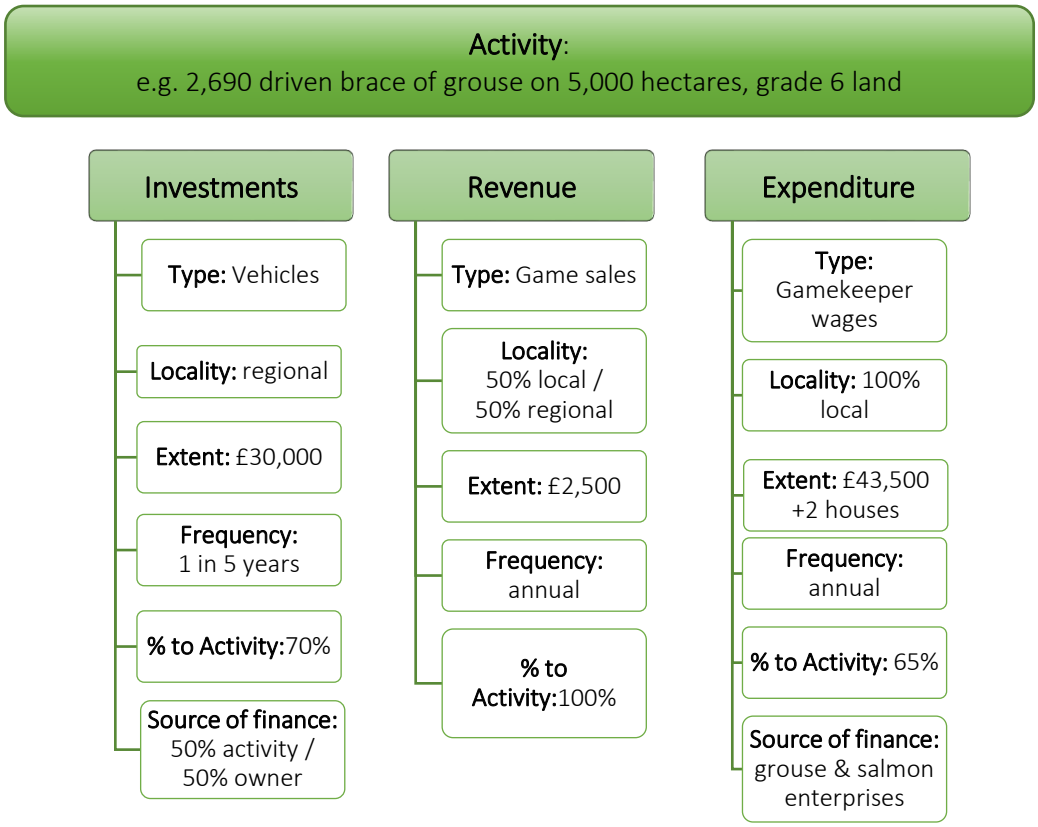
[10] The Phase 1 research recommended that a more systematic data collection approach is used by industry bodies to record/demonstrate impact. The methodology developed here can be used by others in the future.

[11] In a minority of cases (see specific case studies) the time period was adjusted to account for data availability and to avoid exceptional outliers skewing data.

Figure 4.2 Example data types collected to assess impacts of investments, revenue and expenditure



In relation to forestry and woodland creation schemes the data was annualised to generate estimates of annual per hectare revenues and spending, based on total costs/revenue annualised over a scheme length of fifteen years (the contractual length of the grant scheme) and over a proposed (estimated) eighty year rotation length.

It is important to note that while this approach allows analysis of the sources of finance and the first round of expenditure from the land uses, it does not enable a full assessment of the local economic impacts and benefits to communities[12].

Step 4 – Data collection

After agreeing to take part in the research, participants were asked to complete the template outlined in Step 3. The spreadsheet comprised five sections: general information, capital expenditure, recurrent expenditure, revenue, employment.

Participants also took part in a short, semi-structured interview with the researchers to provide additional context for each of the case studies and understanding of key aspects (e.g. motivations, length of time engaged in the activity, key constraints and linkages with other land uses, future aspirations and perceived future opportunities etc.). The interview (conducted either in person or over the phone) also provided the opportunity to guide the participants through the spreadsheet and ask questions to confirm/explore the data in more detail. Where possible, participants were provided with details of the data needs at least two weeks before the interview to ensure participants had a suitable time period within which to collect and disaggregate data, where required. After the

[12] A more in-depth study could quantify any multiplier effects stemming from any further secondary (indirect) or induced expenditure. This would typically involve a survey of businesses where estates (and their guests) spend money. For example, the New Economics Foundation have developed a 'Local Multiplier 3' methodology for assessing economic impacts three 'rounds' of expenditure in a local economy.

interview, follow-up phone calls/emails were used to assist further with the process and ensure that completed responses were returned.

This part of the research required access to detailed and sensitive financial data. Therefore, all estates used within the case studies have been anonymised within this report.

Step 5 - Analysis

In the sections that follow, data has been aggregated by moorland use and comparisons made within and between the case studies. The following headings have been used to structure each case study to ensure consistency across them:

- Estate characteristics and context (description of the activity, motivations, general information, etc.);
- Capital expenditure (including analysis of total and annual average capital expenditure for 2014-2019, types of costs and assessment of locality of spending);
- Recurrent expenditure and employment (including analysis of annual recurrent costs for 2016-2018, types of costs, assessment of locality of spending and employment costs);
- Revenue (including average annual income for 2016-2018 and types of income);
- Discussion and key points (critical reflection across the estate included in each case study to identify common themes, challenges and future aspirations).

Task 1a (examining the extent and impact of grouse shooting enterprises on businesses and communities) was addressed through assessing the direct economic impacts of estates engaged in both walked-up and driven grouse shooting, the findings from which are presented in Sections 5.1 and 5.2. Sections 5.3 to 5.7 address Task 1b by assessing the direct economic impacts of 'alternative' moorland land uses. A full assessment of indirect effects was outside the scope of this research. A detailed assessment of direct spend (capital, running and staffing costs), revenue and employment impacts has been used to develop a functional comparison of indicative economic impacts, including on a per hectare basis.

4.1 Case study caveats

The land use case studies presented in this report are based on a relatively **small set of estate examples** drawn from a large and diverse pool of potential cases across Scotland. The case study approach allowed for a relatively in-depth consideration of the finances, constraints and future opportunities for these land uses and how they relate to each other (or not) within an estate context. Nevertheless, with a limited number of examples for each land use **there is potential for specific estate cases to skew results and misrepresent costs and revenue linked to the land use in question**. To counteract this and effectively 'test' key findings, the final case study synthesis contrasts and compares case study findings with the most relevant previous studies where available.

This study has attempted to **develop case studies which are broadly comparable as potential alternative land uses on upland sites currently wholly or partly under moorland cover**. The majority of activity in most of the example estates used within the case studies occurs predominantly within upland areas where heather moorland is (or has in the recent past) been the dominant land cover. Nevertheless, there are several caveats in relation to case study comparability. In particular, the **allocation of costs/revenues to the specific case study land use is often based on estimates provided by the interviewee** (e.g. allocating 50% of all sporting spend to grouse shooting management etc.). The reality in certain cases is that staffing, infrastructure and other assets/resources are shared between different land uses (e.g. deer stalking and grouse shooting) and the emphasis on one over the other can vary throughout a given year, or between years based on shifts in activity levels (as influenced by grouse populations for example). This allocation of staffing time/costs and revenue is therefore based on estimates which can change over time, although estate respondents were often reasonably confident regarding time and cost allocations while recognising that a degree of error is inevitable.

Furthermore, **not all of the land use examples within the case studies were located wholly within the moorland zone**. The main forestry case study, for example, related to land under forestry/woodland cover located mainly below the moorland zone on the estate. To increase the relevance and comparability of this case study the additional examples which have been added relate predominantly to woodland creation on upland sites dominated by existing moorland cover. These additional woodland creation cases are therefore comparable, to an extent, to other case study land uses subject to the factors noted in the forestry case study section (e.g. the moorland areas used may have been relatively unproductive in terms of grouse populations relative to other areas of actively managed grouse moors). Importantly, these case studies relate to native woodland schemes planted at low densities primarily for biodiversity gains, achieving grant income and the long-term potential for the sale of carbon units. These schemes are not, therefore, examples of tree planting where a primary objective is long term timber production.

In the case of the conservation case study costs/revenue and staffing data relates to the whole estate (in both cases), although estimates for the indicative moorland specific component have been derived based on per hectare values. The per-hectare costs and revenue impacts derived in each case are based on spending within the moorland zone on the specific relevant case study land use/activity wherever possible. Additionally, the key trends evident in different land use case studies (e.g. FTE impacts), constraints and future opportunities are relevant to the wider discussion of land use compatibility and potential land use change over time.

Financial data for the case studies has been collated for fixed time periods (i.e. previous five-year's capital spend, three-year average for recurrent spending). This was achieved on a relatively consistent basis, with some specific case studies providing data over different timescales, due to data availability or other factors. **Capital expenditure items have been averaged over a three to five year period and are reported on that basis and not on an annualised cost over the life of each category of asset** – the logic being across the population of estate owners are at different capital investment stages and therefore investment should average out across the estates within a land use case study. Data on grouse numbers (brace shot) was initially requested as a three year average (2016-2018); however, due to grouse numbers having been particularly low (below average) some estates provided numbers for earlier periods or averaged over different lengths of time, with the aim of providing grouse data more representative of the long-term norm[13] on these estates.

For the purposes of this study and identifying the specific characteristics of management activities carried out in moorland areas, the individual land uses have been separated as singular activities. **In reality, these land uses are not conducted in isolation from one another and overlap and complement and conflict with each other to a greater or lesser within estate contexts. In particular, estates commonly manage their finances across the estate as a whole, with different land uses commonly subsidised from other estate land uses relative to their differing financial performances over time and relevance to the personal priorities and motivations of the landowner**. As apparent from the case studies, deer stalking and grouse shooting (walked-up and driven) are commonly heavily linked for example, with decisions relating to sheep farming and woodland management and creation also often strongly linked with ensuring the continuation of grouse shooting on individual estates.

[13] An alternative approach for future case studies would be to request data on brace shot and shooting days based on a ten year average to account for variability in grouse populations over a longer time period.

5 Findings

This section of the report provides the findings from each of the different case studies before Section 6 synthesises the findings to compare and contrast the socio-economic impacts of grouse shooting and alternative moorland activities. This section covers:

5.1 Walked-up grouse shooting

5.1.1 Estate characteristics and sporting activity

The walked-up grouse case study incorporated four estates (WU1-WU4) with managed grouse moors varying in size from 1,600ha (WU1) to 12,500ha (WU4). The four estates (detailed Table 5.1 Management context and size for walked-up (WU) grouse shooting case study estates) were selected to include: (i) a range of moorland scales; (ii) different management contexts; (iii) diversity in levels of active 'on-the-ground' management and (iv) difference in the mix of commercial and private/family shooting.

WU3 was included as an example of a moor which transitioned from management for walked-up to driven grouse (with some walked-up shooting remaining) during the last 30 years as a result of increasing grouse numbers. WU1 was being managed for grouse with the aim of restoring grouse populations to allow commercial shooting as low grouse numbers had meant that there had been no commercial shooting for several years. Two of the estates (WU1 and WU2) actively managed sheep flocks on their moorland, with one specifically doing this for 'tick mopping' benefits[14], whilst WU3 had limited sheep grazing on part of its grouse moor. In all cases sporting land uses were occurring as part of wider estate land use mixes, including agriculture, hydro schemes and forestry / woodland management, with tourism and/or events also a feature on three of the estates. The expenditure reported included all spending on moorland management, with the costs specifically associated with grouse shooting/management identified as a component of this overall spend.

Table 5.1 Management context and size for walked-up (WU) grouse shooting case study estates

Walked-up grouse	WU1	WU2	WU3	WU4
Estate summary	Mixed estate, active management for grouse but low numbers. Large sheep flock.	Small, remote, upland sporting estate, walked-up grouse, deer stalking. Sheep herd, hydro scheme.	Mixed upland estate, grouse, forestry and deer. Hydro scheme and holiday cottages, limited sheep flock.	Large mixed estate, deer and grouse as part of a wider land use mix.
Approx. Estate size and grouse moor area (brackets)	Small: 4,000ha **(1,600ha)**	Small-Medium: 5,100ha **(5,000ha)**	Medium: 6,500ha **(3,300ha)**	Medium-Large 12,500ha[15] **(12,500ha)**

[14] Sheep are used to 'mop up' ticks that may cause louping-ill virus in red grouse that can lead to mortality rates of up to 80%. See https://www.gwct.org.uk/advisory/briefings/driven-grouse-shooting/

[15] The area shown for WU4 relates to the actively managed moor. The whole estate area was not included for anonymity purposes. The moor was part of a larger mixed estate but the size and reported financial data relates to the moorland area.

The extent of sporting activity and the emphasis on commercial and private/family sporting activity is shown for each of the estates in Table 5.2. This varied from very limited activity on WU1 (due to low grouse numbers), to a shared ownership model on WU2 (where owners essentially paid the estate for walked-up grouse shooting, with some additional limited revenues earned from commercial shooting). This contrasts with WU3, which carried out both commercial walked-up and driven shooting, and WU4 which provided mainly commercial sporting opportunities based on walked-up grouse shooting as part of a wider mixed sporting offer that included red deer stalking. None of the estates had any long-term sporting tenant, but commercial shooting clients were commonly long-term returnees. Two of the estates had been in long term family ownership (WU3 and WU4), with WU1 WU2 having undergone more recent ownership changes. Commercial deer stalking occurred on three of the four estates and represented an important component of both the management activity and sporting income on WU3 and WU4.

The underlying motivations for sporting objectives varied, but WU3 and WU4 placed considerable emphasis on maintaining the opportunity for private sporting activity and ensuring sport remains a core activity of the estate for personal and cultural reasons. Ensuring the estate was managed as a viable unit was also of key importance in most cases, although WU2 accepted the need for ongoing personal financial contributions to the estate due to their limited focus on income generation opportunities. On WU4, the focus on walked-up grouse was largely attributed to lower grouse numbers – influenced by climate, topography and predation. Despite their commercial focus, WU4 also placed an emphasis on traditional approaches and a 'wilder' shooting experience. WU3 also referred to the value of the social aspects of driven grouse shooting, as well as emphasising the importance of a 'social conscience' and 'sense of responsibility'.

Table 5.2 Sporting activity on case study estates (figures based on three-year average)

Walked-up grouse	WU1	WU2	WU3	WU4
General sporting activity	Limited walked-up grouse (low numbers), deer stalking and pheasant shoot.	Walked-up grouse and deer stalking. No driven grouse due to low numbers, remoteness and owner motivations.	Walked-up, driven grouse and red deer stalking.	Walked-up grouse and red deer stalking. Walked-up commonly part of a mixed sporting offer.
Commercial /private sporting emphasis	Insufficient numbers for commercial grouse. Deer cull not commercial. 2-3 private walked-up days.	Shared ownership, owners paying estate for shooting (15 days). Some commercial walked-up (<8). 24 commercial stag days.	Mixed (5 private, 4 commercial walked-up days, 4 commercial, 9 private driven days). Commercial/ private stalking (30 days).	Primarily commercial (2 private walked-up days, 26 commercial). Commercial stalking (100 stag days).
Walked-up days (and brace shot)	3 days (14 brace)	21 days (242 brace)	9 days (322 brace)	29 days (301 brace)
Driven days (and brace shot)	0 days (0 brace)	0 days (0 brace)	13 days (1,057 brace)	0.5 days (30 brace)

All four estates were actively managed for grouse, which included heather burning, predation control and the use of medicated grit. In most cases, due to a combination of low staffing levels and owner motivations, grouse management was referred to as being relatively low input - due in part to less emphasis placed on ensuring sufficient grouse numbers existed for driven grouse shooting.

Sporting activities (including walked-up grouse) on all four estates were loss making or just managing to break-even in better years, and therefore were required to be cross-subsidised by other estate activities or subsidised directly from external sources in the form of owner contributions. In most cases other estate activities were considered to be consistently more profitable, including income from hydro-electricity (WU4), tourism and retail (WU3 and WU4). Whole estate financial viability was therefore commonly seen as a more important economic driver of activity, with sporting viewed as

part of a 'mix of activities' which complemented each other in relation to staffing and land management activities (e.g. gamekeepers were funded from multiple sporting activities and carried out a number of different functions - as reported in Part 2 of this research).

Grouse shooting was also referred to as being profitable on a cyclical basis, with losses being absorbed by wider estate activities during periods of low grouse numbers. Whilst high quality sporting experiences were perceived as a factor that influenced the underlying capital value of sporting estates none of the estates viewed increasing the capital value of the estate (e.g. by increasing stag or grouse numbers) as a core ownership objective since none had plans to sell their landholding in the future. Investment was generally undertaken where there was a clear business case, and as a means for enhancing the sporting opportunities and estate as a whole. Interviewees from all estates stated that they were likely to continue the same level of capital and ongoing expenditure, subject to external threats and uncertainties.

5.1.2 Capital expenditure[16]

Table 5.3 summarises the annual capital expenditure (average of 2015-2019) on moorland sport management on each case study estate. Total annual moorland sport capital expenditure across the four estates amounted to £113,000 with an average of £5.12 per hectare. This ranged from £1.47 to £11.01 per hectare with the larger amount spent on WU2 related to a recent property refurbishment. Each estate provided estimates of the proportion of each item of moorland capital spend that was directly related to grouse activities (as opposed to relating to more general moorland management, deer management etc.). The average capital expenditure specifically on grouse related activities was £1.90 per hectare although this was significantly diluted by the very large moorland area on WU4. The grouse related annual capital expenditure ranged from £0.28 to £8.18 per hectare and if WU4 was excluded the average jumps to £4.05 per hectare). The relatively low grouse-specific capital investment on WU4 was due to the majority (80%) of its moorland investment being related to deer management (e.g. vehicles being used more for deer stalking) with the converse holding true for WU1 where most moorland activity was grouse related.

Table 5.3 Average annual capital expenditure on walked-up case study estates

Walked-up grouse	WU1	WU2	WU3	WU4	Average
Average annual moorland sport capital expenditure	£15,777 (£9.75/ha)	£50,472 (£11.01/ha)	£28,200 (£8.62/ha)	£18,396 (£1.47/ha)	**£28,212** (£5.12/ha)
Average annual direct grouse capital spend	**£13,234 (£8.18/ha)**	**£14,673 (£3.20/ha)**	**£10,450 (£3.19/ha)**	**£3,499 (£0.28/ha)**	**£10,465 (£1.90/ha)**
Annual direct grouse spend as a % of moorland sport capital spend	84%	29%	37%	19%	37%

Figure 5.1 shows the variability in capital expenditure by investment category - and this was directly related to the extent of grouse shooting/management across the four estates. Vehicles were a consistent area of capital spending with buildings refurbishment (e.g. shooting lodges) a major spending component (71%) on WU2[17], alongside investments into new grouse butts, fencing and drainage works. As expected, each estate had a differing investment profile that is linked to replacement schedules for depreciating assets as well as new investments to expand or enhance the grouse shooting activity. For example, on WU1 58% of the £13,200 expenditure went towards vehicles of some sort (with nearly 25% on Argocats to ease hill access/work and a further 17% on other off-

[16] Note that these are actual average capital expenses undertaken by the estates and do not represent the annual charge that could be allocated over the life-span of the assets.

[17] It should be noted that estate WU4 had also undertaken a major (£450,000) lodge refurbishment which is not reported here due to the refurbishment having begun outside the five-year period. The lodge was for grouse shooting accommodation as well as other purposes.

road vehicles). When combined across these four estates, 43% of the total capital spend related to grouse activity was on vehicles, with 29% on buildings and refurbishments, 22% on new sporting infrastructure, 8% on sporting equipment, 7% on roads and tracks and 6% on fencing. All four estates revealed that while some expenditure was more specifically related to deer or other aspects of estate management, many broader areas of capital investment were partly dependent on the continuation of grouse shooting, as it was considered integral to the estate.

Figure 5.1 Proportion of average annual capital costs by spending category directly related to grouse

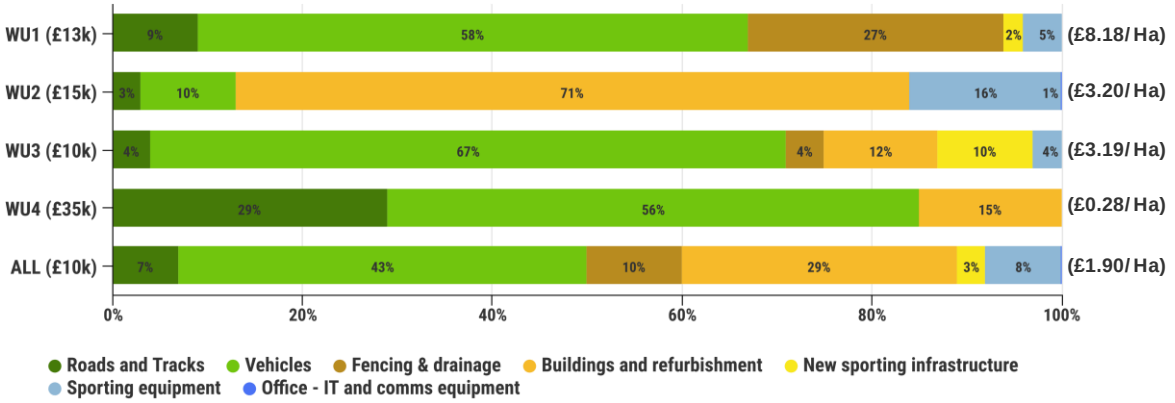
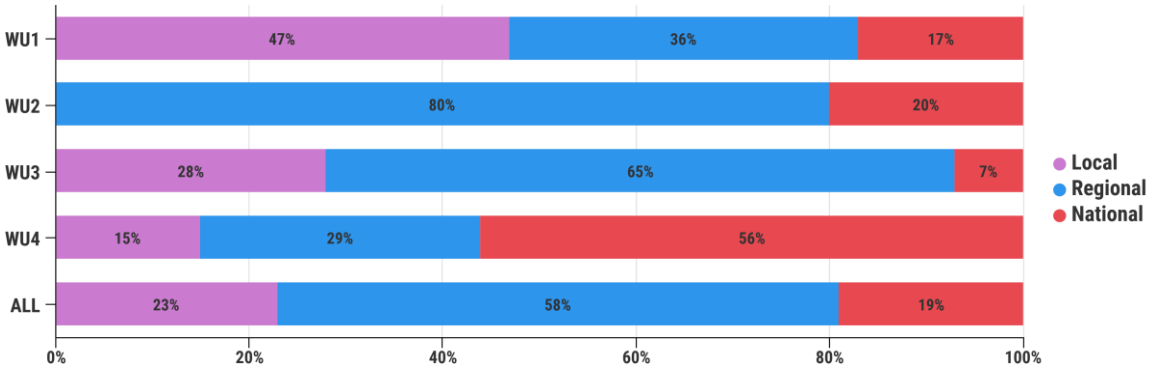


Figure 5.2 illustrates the locality of capital spending directly related to grouse activity based on the distance of suppliers (equipment and services) from the estate (where local was less than 20 miles, regional was between 20 and 50 miles and the remaining expenditure was classed as national or international). Critically, on WU3 and particularly WU2, their remote locations meant that locally available suppliers (within 20 miles) were very limited - meaning a combination of local and regional spending is a more accurate reflection of the spending footprint of each estate in the surrounding economy. This combined local/regional spend equated to about 80% of capital spend on WU1 and WU2, with capital spending at national level a more important component on WU4 (56%) - due mainly to the use of national vehicle providers. In general, contractors used in building and land management were local/regional. When combined, over 80% of the capital expenditure was spent locally or regionally (within 50 miles) of the estates. This indicates that there was relatively little direct expenditure leakage from the local economies from capital expenditure associated with walked-up grouse.

Figure 5.2 Location of five year capital spending (directly related to grouse) on walked-up estates



5.1.3 Recurrent expenditure and employment

Table 5.4 summarises annual recurrent non-staff expenditure on sporting/moorland management on the case study estates based on a three-year average (2017-2019). Average non-staff running costs for all moorland sporting was £12.07 per hectare (ranging from £6.68 to £24.72 per hectare) and the

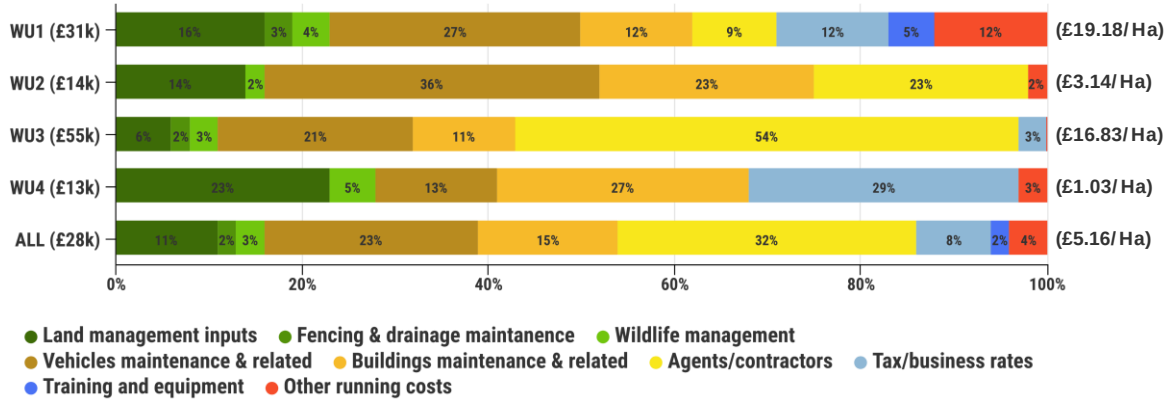
average amount specifically for grouse shooting was £5.16 per hectare (ranging from £1.03 to £19 per hectare). The variance in per hectare grouse non-staff running costs reflects the relative importance of grouse activities to wider estate activities, with grouse activities relating to only 15% of annual moorland sporting costs on WU4 (£1 per hectare) for example, but 78% on WU1 (£19.18 per hectare). The higher level of grouse-specific spending on WU3 was due to its greater amount of grouse shooting activity as well as its driven grouse shooting component. WU2 reported their recurrent spend was normally higher at around £30,000 which would double its reported per hectare annual non-staff cost of £3.14. As with capital investment, WU4 had a relatively high moorland recurrent spend but a relatively low component (15%) of this was attributed to grouse shooting due to the high amount of deer stalking that was undertaken.

Table 5.4 Annual recurrent non-staff expenditure on case study estates

Walked-up grouse	**WU1**	**WU2**	**WU3**	**WU4**	**Average**
Average annual sporting expenditure	£40,000 (£24.72/ha)	£50,650 (£11.05/ha)	£91,300 (£27.89/ha)	£83,790 (£6.68/Ha)	**£66,435 (£12.07/ha)**
Recurrent spend directly related to grouse	**£31,041 (£19.18/ha)**	**£14,410 (£3.14/ha)**	**£55,100 (£16.83/ha)**	**£12,962 (£1.03/ha)**	**£28,378 (£5.16/ha)**
Direct grouse spend as % of total recurrent spend	78%	28%	60%	15%	**43%**

Figure 5.3 shows wide variability in the breakdown of recurrent annual expenditure directly attributable to grouse shooting/management across the four case study estates. As with capital investments the non-staff grouse running cost profiles vary significantly between estates – related to their operational motives and models. Generally, vehicle costs, land management inputs (e.g. grit) and buildings maintenance were consistent areas of expenditure with spending on agents and contractors also significant (54%) on WU3 but not used in WU4. When averaged across all four estates the largest recurrent annual cost was agents / contractors at 32%, although this was heavily influenced by WU3 and their driven grouse activities. The other main annual recurrent costs related to vehicle maintenance and running costs (23%), building repairs (15%), land management inputs (15%) and tax/business rates (8%).

Figure 5.3 Proportion of recurrent annual non-staff expenditure by category directly relating to grouse



As an example, Figure 5.4 provides a more detailed breakdown of grouse-specific recurrent costs on estate WU1. It is notable the vehicle costs were evenly split between general estate vehicles and those specific to moorland activities (specialised Argocats, etc.). It is also perhaps worth noting the 10% spent on bracken control in this example and the 10% spent on working dogs and livestock (including veterinary costs).

Figure 5.4 Breakdown of non-staff recurrent expenditure directly related to grouse shooting on estate WU1

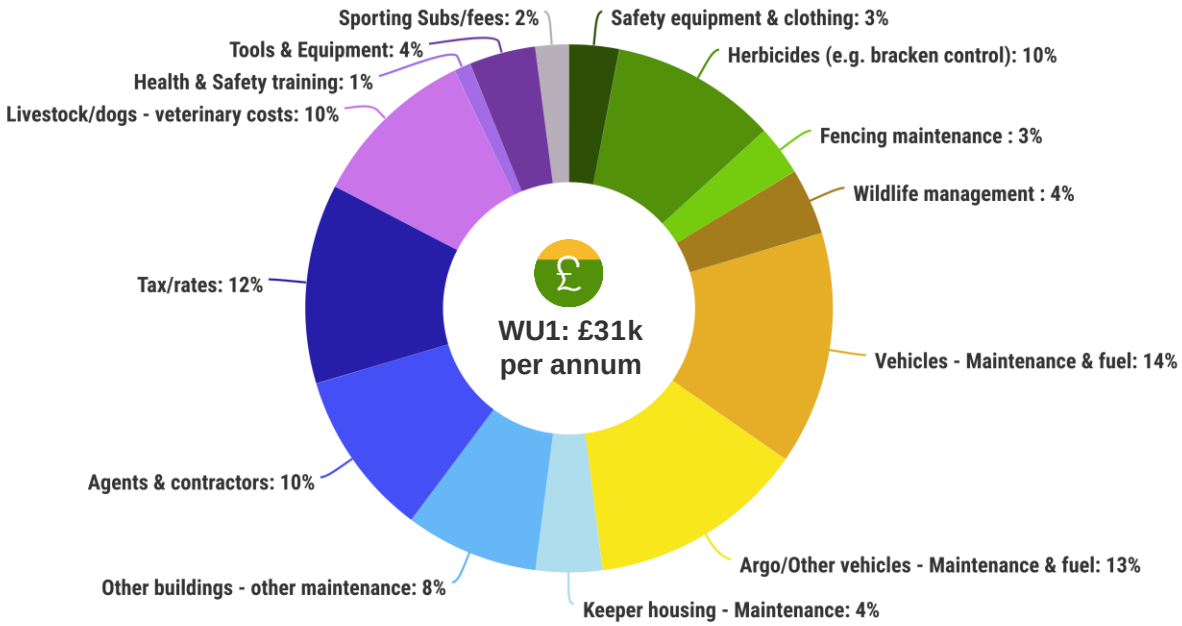


Figure 5.5 illustrates where the recurrent annual expenditure took place. There was a high degree of variability amongst the estates, with high levels of national spending a feature on WU3 and WU4 whilst WU1 had very little spend outwith its region. When combined 39% of the running costs on these four estates was spent locally (within 20 miles), 14% regionally (within 50 miles) and 47% nationally. This indicates a higher level of local/regional economy leakage on recurrent costs compared to capital expenditure on these estates and closer scrutiny of the data reveals this leakage was generally payment for agents, insurance, taxation as well as some sporting related costs.

Figure 5.5 Location of annual grouse-specific recurrent spending on walked-up estates

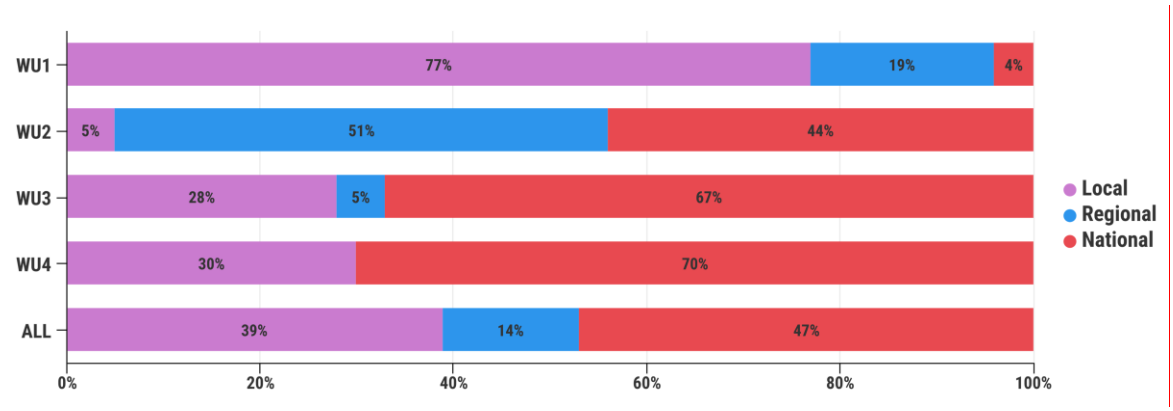


Table 5.5 shows the number of staff employed in sporting/moorland management on the case study estates along with the estimated staffing costs, including those directly attributable to grouse shooting/management. Staff costs represent an important component of moorland management costs, and total sporting staffing costs averaged £13.22 per hectare, ranging from £4.66 to £70.53 per hectare. Grouse-specific staff costs accounted for 25-50% of total sporting staff costs at £5.97 per hectare. On WU4 the lower level (25%) related to grouse reflects the relatively high level of deer stalking on the estate. Gamekeeping staff were generally accommodated in tied housing on the case study estates (as reported in Part 2 of this research) and they received additional benefits, including dog allowances, the provision of an estate vehicle and vehicle-related costs. Staffing costs were

therefore predominantly local (estate based) in terms of locality of impact. In the majority of cases gamekeepers lived on the estates in tied housing with their families (another feature reported in Part 2 of this research). On WU3 and WU4 a proportion of wider staff costs (including shooting lodge and catering staff) was linked with grouse shooting and WU4 estimated this to be in the region of 15-20% of lodge/catering staff time.

Table 5.5 Employment related to sporting / grouse management and related costs for walked-up estates

Walked-up grouse staffing	WU1	WU2	WU3	WU4	Average
Sporting FTEs	5	2	2.3	2	2.8 all sport (1.2 grouse)
Job roles	Head keeper, keeper, 3 estate staff	Head keeper and stalker	Head keeper, 2 assistant keepers (1 self-employed)	1 senior stalker, 1 stalker	
Staffing costs	£114,120 (£70.53/ha)	£47,000 (£10.26/ha)	£48,000 (+£23,400 beaters) (£21.81/ha)	£58,500 (£4.66/ha)	**£72.755 (£13.22/ha)**
Grouse %	49%	33%	50%	25%	**45%**
Specific grouse staff costs	**£53,950 (£33.34/ha)**	**£15,500 (£3.38/ha)**	**£47,400 (£14.48/ha)**	**£14,625 (£1.17/ha)**	**£32,869 (£5.97/ha)**

5.1.4 Revenue

Table 5.6 shows the main areas of revenue attributable to grouse shooting, as well as additional areas of sporting-related revenue on the case study estates. Average sporting incomes were £14.05 per hectare (ranging from £8.45 to £27.50 per hectare). The fact that there was no grouse related income on WU1 impacted the average grouse revenue of £4.68 per hectare – with WU3 averaging nearly £19 per hectare over the 2017-19 period despite having a higher level of private/family grouse shooting – this elevated return was due to the presence of driven grouse. WU1 and WU2 noted the potential for generating higher levels of income subject to sufficient grouse numbers.

Table 5.6 Average annual revenue from grouse shooting and moorland sporting for walked-up estates

Category	WU1	WU2	WU3	WU4	Average
Commercial walked-up grouse	-	£23,500	£10,000	£19,625*	£13,281
Commercial driven grouse	-	-	£50,000	-	£12,500
Grouse game sales	-	-	£2,000	-	£500
Deer stalking	-	£22,000	£18,000	£64,215	£26,054
Other sporting income (pheasant, salmon)	£13,666	-	-	£8,045	£5,4,8
Sales – venison	-	£12,000	£10,000	£56,267	£19,567
Total sporting revenue	**£13,666 (£8.45/ha)**	**£57,500 (£12.55/ha)**	**£90,000 (£27.50/ha)**	**£148,152 (£11.81/ha)**	**£72,423 (£14.05/ha)**
Walked-up grouse as % of sporting revenue (all grouse as % sporting revenue)	0% (0%)	41% (41%)	11% (67%)	13% (3%)	17% (33%)
Revenue from grouse shooting activity	**£0 (£0.00/ha)**	**£23,500 (£5.13/ha)**	**£62,000 (£18.94/ha)**	**£19,625 (£1.56/ha)**	**£25,781 (£4.68/ha)**

*The walked-up shooting income figure for estate D includes income from grouse shooting parties staying in the estate lodge (i.e. estate-based accommodation costs).

Income from deer stalking represented an important component of the sporting business on WU2, WU3 and WU4, whilst estates WU3 and WU4 both stressed the importance of being able to offer a mix of sporting opportunities to clients. Income sources and sporting clients were generally noted as

mixed (i.e. with clients originating from both local/regional areas and in some cases more from national/international markets). The accommodation for sporting clients on WU3 and WU4 was estate based, with WU3 also using local hotels for stalking clients. In most cases the estates did not generate significant additional income from public funding for moorland management (e.g. grants), but one had previously received funding for peatland restoration and WU2 received about £47,500 from agricultural support payments due to the presence of a sheep enterprise.

5.1.5 Discussion and key points

Table 5.7 summarises the financial data from the walked-up case studies, including income/revenue balances for all sporting activity and those specific to grouse shooting. On average the case studies needed 1,949 hectare of grouse moor per FTE worker and reflecting the range of business models and moorland sizes this ranged from as low as 324 hectares to 6,273 hectares per worker. On average the annual cost of running sporting enterprises (excluding annualised investment costs) was £25 per hectare (with a wide range from £11 to £95 per hectare) with average earned revenue only covering 56% of running costs at £15 per hectare (ranging from £9 to £28 per hectare). This meant that sporting activities were loss making on average with a net business cost of £11 per hectare excluding annualised capital costs. Indeed, sporting activities were loss making on all estates except WU4 where it broke even due to its more commercial focus (the extent of net losses ranged £9 per hectare on WU2 to £87 per hectare on WU1. Furthermore, on WU4, when additional income earned from renting out their sporting lodge to non-sporting customers outwith the shooting season was taken into account the wider operation ran at a profit.

Table 5.7 also illustrates the grouse specific costs and staffing. On average grouse activities on these case study estates required 4,685 hectares of grouse moor per FTE worker (ranging from 674 Ha in WU1 to 25,090 per FTE on WU4). Grouse revenues averaged £5 per hectare, and with average running costs of £11 per hectare it meant that grouse activities had a net annual cost of £6 per hectare (or £35,000 at estate level) to the businesses before annualised capital costs are accounted for. The range of grouse enterprise net losses ranged from £1 to £53 per hectare. Notably, although grouse shooting costs on WU4 were relatively low, this was only achievable due to the staff being available and in-place due to their primary roles in the deer stalking enterprise (i.e. this lower cost managed walked-up shooting would otherwise not be possible). On WU2 and WU3, the estate owners effectively subsidised the sporting operation to facilitate their own private sporting activity (as opposed to marketing all available shooting days commercially). For example, WU3 undertook nine driven grouse shooting days privately that had an equivalent commercial value of over £100,000 (£30 per hectare).

The analysis of the location of estate spending suggests that the levels of spending in the local (<20 miles) is low on some estates, with regional and national level spending more common. This is often due to the absence of businesses within the area defined as local, particularly on remoter estates (WU2 and WU3 in particular). Staffing related spend was generally referred to as local, with sporting staff generally living on or near the estate. In some cases, spending (capital and recurrent) was recorded as national, with leakage occurring particularly in relation to vehicles and in some cases agents and contractors.

Table 5.7 Summary of costs and revenue on walked-up case study estates

Walked-up grouse	**WU1**	**WU2**	**WU3**	**WU4**	**Average**
Managed grouse moor (ha)	1,600	4,600	3,300	12,500	**5,500**
Hectares per Brace of Grouse (including driven)	116 (116)	19 (19)	10 (2)	42 (38)	**25** **(11)**
All Sport - Costs and revenue					
Sporting staff (FTEs)	5	2	2.3	2	**2.8**
Sport capital expenditure	£15,777 (£10/ha)	£50,472 (£11/ha)	£28,200 (£9/ha)	£18,396 (£1/ha)	**£28,212** **(£5/ha)**
Annual running costs for sport	£154,120 (£95/ha)	£97,650 (£21/ha)	£162,700 (£50/ha)	£142,290 (£11/ha)	**£139,190** **(£25/ha)**
Annual sporting revenue	£13,666 (£9/ha)	£57,500 (£13/ha)	£90,000 (£28/ha)	£148,152 (£12/ha)	**£77,330** **(£15/ha)**
Net sporting balance - excluding capital	-£140,454 (-£87/ha)	-£40,150 (-£9/ha)	-£72,700 (-£22/ha)	£5,862 (£0/ha)	**-£61,861** **(-£11/ha)**
Hectares per FTE - sporting	324	2,292	1,091	6,273	**1,949**
Revenue generated per £1 spent	£0.09	£0.59	£0.55	£1.04	£0.56
Grouse - Costs and revenue					
Grouse staff (FTEs)	2.4	0.65	1.5	0.5	**1.2**
Grouse capital expenditure	£13,234 (£8/ha)	£14,673 (£3/ha)	£10,450 (£3/ha)	£3,499 (£0.3/ha)	**£10,465** **(£2/ha)**
Annual moorland costs - grouse	£84,991 (£53/ha)	£29,910 (£7/ha)	£102,500 (£31/ha)	£27,587 (£2/ha)	**£61,247** **(£11/ha)**
Annual grouse revenue	£0 (£0/ha)	£23,500 (£5/ha)	£62,000 (£19/ha)	£19,625 (£1.5/ha)	**£26,281** **(£5/ha)**
Net grouse balance -excluding capital	**-£84,991** **(-£53/ha)**	**-£6,410** **(-£1/ha)**	**-£40,500** **(-£12/ha)**	**-£7,962** **(-£1/ha)**	**-£34,966** **(-£6/ha)**
Hectares per FTE - grouse	674	7,051	2,182	25,090	**4,685**
Revenue per £1 running cost	£0.00	£0.79	£0.60	£0.71	£0.43

5.1.5.1 Walked-up versus driven grouse

Despite lower requirements for staffing and active management than driven grouse, the relatively low per hectare revenues generated from walked-up grouse shooting (see Table 5.7) necessitate a degree of owner input and/or cross-subsidisation from other estate land uses to fund the required land management and staffing. In particular, a minimum level of spend is required to ensure a full-time staff presence and ongoing management. Additionally, due to grouse population cycles, to retain staff and maintain management levels the annual investment and recurrent spend is also required during periods of low grouse numbers (and therefore low income).

Nevertheless, walked-up grouse shooting can act as an important component of a wider sporting enterprise, in particular to offer clients the opportunity of a 'mixed bag' which includes red grouse and a red deer stag. This case study demonstrates that managing walked-up grouse in combination with a deer stalking enterprise can increase the viability of both enterprises and justify a sufficient level of staffing, with staff more focused on the different land uses at different periods of the year (for example, see WU4 in Table 5.7 and see the Gamekeepers activity mix in Part 2 of this research).

Despite an emphasis on traditional values and clear recognition of the importance of walked-up grouse shooting (to the estate owners), none of the estates were undertaking walked-up shooting purely for reasons relating to ethos. In most case the sporting mix was the result of multiple factors including available grouse numbers, remoteness (making getting beaters on site challenging), topography, available sporting infrastructure (e.g. a lack of grouse butts on WU2) and personal owner preferences. As one owner stated: '*well, we would rather walk all day, have a nice day and shoot ten*

brace than drive around and shoot hundreds of brace. That is more about personal motivation because walked-up is fewer people's cup of tea, it's probably less exciting and less social'.

From a cost perspective a walked-up operation can also be sustained at a lower cost than a driven shoot, due to the lower requirement for staffing and related inputs, reducing the pressure to generate income relative to driven shooting. Nevertheless, interviewees recognised that sustainable walked-up shooting did require management input to ensure sufficient numbers. A further aspect which had been developed on WU3 (an objective of the owners), was the option of undertaking driven shooting during periods of high grouse numbers. Whilst this has been achieved it has also led to a need for increased gamekeeping staff and associated costs. For example, there was one gamekeeper in 1984 where the 5 year average walked-up bag was 714 grouse - this increased to 2 keepers in the period around 2000 where the average walked-up bag was 243 with 389 driven grouse and in2019 there were 2.5 gamekeepers with an average bag of 366 walked-up and 824 driven grouse. The achievement of driven grouse required investment in infrastructure and staff and involves considerable additional running costs associated with grit and beaters – something that the additional income derived from driven shooting days helped cover.

5.1.5.2 Constraints

The walked-up case study interviewees referred to a number of key challenges or constraints for the grouse shooting sector, which are relevant to both walked-up and driven grouse shooting. Their sentiments included:

- Declining grouse numbers, with many estates currently unable to shoot either walked-up or driven grouse due to low bird numbers. It was considered that in some instances grouse numbers were unlikely to ever increase to a level to allow for driven grouse shooting.
- Climatic factors, predation and loss of heather habitat were referred to as the key factors influencing current grouse population trends.
- Heather beetle attacks[18] were also referred to as having reduced the area of heather moorland in Scotland, affecting grouse populations.
- Increasing prevalence of tick on higher ground in Scotland, perceived as being linked with climate change (warmer winters).
- Agricultural improvements and the historic afforestation of moorland areas resulting in the loss of moorland habitat.
- Political pressure to reform or ban grouse shooting was perceived as reducing confidence in the sector. Respondents considered the decline in the number of people involved in land management and increasing numbers of incoming retirees in rural areas influenced by environmental groups as leading to changing public and political attitudes.

Whilst interviewees recognised some potential for conflicting objectives (e.g. between recreation and shooting/stalking) and the impact of historic afforestation on grouse moors, none reported experiencing major land use conflicts. WU3 referred to the changing wider context, with deer populations having been reduced substantially on neighbouring landholdings, potentially affecting deer numbers across the wider landscape. A perceived future challenge related to Scottish Government objectives to increase forest cover, with concern expressed by WU3 and WU4 that further planting should consider any carbon gains against potential losses of soil carbon during the establishment phase. In general, sheep farming and walked-up grouse shooting were seen as very compatible land uses.

5.1.5.3 Recent and potential future change

Recent, significant, changes influencing the sector referred to by estate interviewees included the use of medicated grit (particularly in the absence of natural grit), which was viewed as a counter-measure

[18] For a description of the damage caused see https://www.heathertrust.co.uk/heather-beetle

to declining grouse numbers linked to parasitism and other factors. Two of the case studies referred to their preference for moderate use of medicated grit, with heavier use perceived as being a "more intensive approach".

Other shifts in recent years included the increasing use of night vision systems which increased the ability of gamekeepers to control foxes, and (in certain areas) increasing employment on grouse shooting estates in recent years. The most significant shift was noted as the general decline in grouse numbers in parts of Scotland over recent seasons which was considered to be being linked to climate change and possibly beyond the range of normal grouse population cycles.

Interviewees referred to the future of the sector as being uncertain, although walked-up shooting was recognised as facing less opposition than driven shooting due to lower levels of management and shooting. In most cases, continuing to invest and improve the shooting and wider estate (including buildings) was also an important future focus.

The other main future shift acknowledged by two of the estates was an increasing emphasis on woodland creation and carbon sequestration, with interviewees stressing that while opportunities for new woodland may exist on their landholdings, woodland expansion should occur where it does not result in the loss of important peatland and moorland habitats and underlying carbon stores. Woodland creation and/or peatland restoration were recognised as potential opportunities for generating additional income from grant income, wildlife tourism and/or carbon trading, although these were viewed as uncertain in the long term.

5.2 Driven grouse shooting

5.2.1 Estate characteristics and sporting activity

The driven grouse shooting land use case study included four estates (DR1-DR4) ranging in size from just over 2,000ha (DR1) to 20,000ha (DR4) as summarised in Table 5.8. The four estates were selected to include grouse moors of different scales and operational contexts - including differing emphasis on private/family sporting activity and commercial/let sport. All four estates had in-house sheep flocks (with DR3 also farming beef cattle) and sheep were considered complementary to grouse shooting due to the potential for tick mopping (undertaken on all four estates) and contributing to maintaining open moorland habitats. Deer management was undertaken on all four estates, with varying levels of emphasis on commercial stag stalking on DR2, DR3 and DR4. Deer numbers had declined on these estates in recent years (with less current emphasis on deer stalking on DR3) but commercial stalking remained a major aspect of the sporting enterprise on DR4.

DR2, DR3 and DR4 also had operational hydro schemes, with a large windfarm (approximately 100MW) in place on DR3. All four estates had some woodland and/or forestry elements, with DR3 and DR4 having recently undertaken native woodland creation schemes (<100ha), and DR3 having undertaken woodland creation on an area of moorland where grouse had not been successful. Amenity woodland was managed on DR1, and DR2 had restocked a recently felled commercial plantation with native woodland. Tourism was not a significant land use on estates DR1, DR2 or DR3, but estate DR4 had a number of tourism accommodation properties as well as agricultural and business tenancies. None of the estates let out land to sporting tenants, but DR2 and DR4 leased in land to increase the area of land available to them for sport.

Table 5.8 Management context and size for driven grouse shooting case study estates

Driven grouse	DR1	DR2	DR3	DR4
Estate summary	Small upland mixed estate with grouse, sheep, woodland and conservation objectives.	Mixed sporting estate with main focus on driven grouse, also deer stalking, hydro scheme and sheep.	Mixed sporting estate managed for grouse and conservation. Includes deer stalking, renewables (windfarm and hydro scheme), sheep, cattle and forestry.	Mixed sporting estate, with equal emphasis on grouse and deer. Estate includes sheep, forestry and wildlife tourism enterprises, four hydro schemes, property and farm tenancy lets.
Estate size and grouse moor area (brackets)	Small: 2,000ha **(1,900ha)**	Medium: 3,440ha (and 5,800ha leased) **(4,900ha)**	Medium: 5,600ha **(4,500ha)**	Very large: 20,000ha **(18,000ha)**

The level of sporting activity and the emphasis on commercial and private/family sporting activity on the four estates is shown in Table 5.9. All four estates had commercial driven grouse shooting that was subject to the availability of a sufficient surplus of grouse. This ranged from eight to nine days of commercial shooting (DR2) to 15 commercial days on DR4, with DR2 and DR3 also engaged in commercial and private walked-up shooting. All four estates undertook some private (family) shooting - usually a minority of driven and/or walked–up days, although DR3 had an equal amount of private and commercial driven and walked-up shooting. Deer management and commercial stalking was also an important aspect of the sporting operations, particularly on DR2 (50-60 stags shot annually) and DR4 (100 stags). Deer stalking was less significant on DR3 and mostly absent on DR1. Both DR2 and DR4 also engaged in low ground and/or mixed shooting.

Table 5.9 Sporting activity on case study estates (figures based on three year average)[19]

Driven grouse	DR1	DR2	DR3	DR4
General sporting activity	Predominantly grouse shooting, some deer management.	Primary focus on driven and walked-up grouse shooting. Deer stalking also important.	Strong emphasis on driven and some walked-up grouse. Deer stalking also important to an extent.	Equal emphasis on driven grouse shooting and commercial stalking. Limited walked-up grouse shot as part of mixed shooting days.
Commercial/ private grouse shooting emphasis	Predominantly commercial driven grouse shooting (15 days). Some private shooting if numbers allow.	Commercial emphasis, 8-9 commercial walked-up and 7-8 driven days; one private day of each.	Mixed commercial/ private emphasis. 10 days commercial driven and 10 private; 6 days commercial and 6 private walked-up.	Predominantly commercial emphasis with some family days. 15 commercial driven days and 5 private driven days.
Commercial /private deer stalking emphasis	No commercial deer stalking. Deer cull for population reduction.	Deer stalking predominantly commercial (40-50 stag days with 50-60 stags shot plus 10 hind days).	Deer stalking predominantly commercial; 15 commercial stag and 20 hind days plus 3 private stag days.	Large commercial stalking enterprise; 100 commercial stag and 30 hind days plus 20 private stag days.
Walked-up days (and brace shot)	Minimal walked-up shooting	11 (192)	15 (n/a)	Minimal mixed shooting (<5 days)
Driven days (and brace shot)	15 (850)	8 (792)[20]	15 (1,105)[21]	16 (1,259)[22]

[19] For the number of commercial / private days respondents were asked to provide a general estimate based on the level over the last 5-10 years (as opposed to a three-year average). As 2018-2019 grouse numbers (and shooting days) were particularly low, they were less representative of the longer-term average on these estates.
[20] Two-year average (2016/2017) taken as more representative, as very low numbers of grouse shot in 2018.
[21] Data averaged from 2011-2014 period as more representative, very low numbers shot 2017-2019.
[22] Two-year average (2016/2017) taken as more representative as low numbers of grouse shot in 2018.

On all four estates the number of shooting days and grouse shot (the 'bag') were lower in the 2018-2019 period than over the preceding 10-20 year average. This was reported as indicative of grouse population declines across much of Scotland in recent seasons. The length of current estate ownership varied from relatively new ownership on DR1 (9 years) and DR2 (8 years), to longer term ownership (32 years) on DR3 and long-term family ownership on DR4 (over 250 years).

The motivations for sporting objectives on all four estates included an emphasis on maintaining traditional values and established land uses. These objectives were in the context of ensuring the continued availability of sporting opportunities for personal reasons and to contribute to the financial viability of the estate and maintenance of staffing levels. Grouse was referred to as one of the primary motivations for the ownership of the estate in all four cases. On all four estates conservation of biodiversity and landscapes was also an important part of the management principles, with DR1 and DR4 specifically referred to conservation of peatlands, heathland habitats and maintenance of water quality.

Interviewees from all four estates referred to a desire to develop and maintain an estate which was sustainable for the longer term both financially and in relation to habitat and landscape improvement. The retention of farming activities on all four estates was perceived by interviewees as relating to the desire to maintain established (cultural) activities and the estate community (i.e. of staff and/or tenants). The development of other land uses and in particular hydro schemes and (DR3) a wind farm, was motivated by a desire to enhance income generation and the overall financial viability of the estate in the longer term.

Sporting activities on all four driven shooting estates were either loss-making or broke even in good years. As the DR3 interviewee stated: '*We look at it in the round, we would like the individual parts to all pay, but we don't really expect grouse to be self-funding, because the management is expensive and delivers other outcomes, there is a family element to it and you get years where we don't shoot so no income'.* All four estates therefore subsidised grouse moor management, either with external (off-estate) income (more a feature on DR2 and DR3) or from other estate activities. This was justified on the basis of the sporting activity incorporating a private/family component, increased staffing availability, perceived additional benefits from moorland management and associated traditional and cultural values. Deer stalking, although providing less financial return than driven grouse shooting (when sufficient numbers of grouse were available), was considered relatively consistent in terms or costs and revenue, whereas forestry/woodlands only provided occasional income from grants or timber sales. Farming activities on all four estates either broke even or were loss making. However, both deer and sheep management were seen as complementing other land uses and therefore an important aspect of wider estate management. On DR1, the smallest of the four estates, revenue generation was predominantly limited to driven grouse shooting and farming.

Renewable energy schemes (present on DR2, DR3 and DR4) were reported as being the most consistently profitable land uses on these estates. Specifically, there was a hydro scheme and windfarm on DR3 and four hydro schemes on DR4, the income from which was used to offset losses incurred from other estate activities. In the case of DR3 this renewables income effectively ensured the estate was profitable, with DR4 restructuring their assets to ensure future profitability. Despite this ability to offset sporting losses with internal or external funds, all four interviewees noted that grouse shooting was an integral part of a holistic set of estate activities. The removal of grouse shooting from the estate mix would therefore require structural changes, and reduction of estate spending and employment, with implications for the overall 'quality' of estate management (e.g. due to lower staff numbers overall).

None of the four estates had any intentions of selling their landholding and therefore did not have any particular motive to increase grouse or stag numbers to grow the capital value of the estate. Nevertheless, DR2 and DR3 recognised that they managed grouse moor areas with the aim of ensuring a shootable surplus of birds. They explained that the existing management regime had resulted in

increased grouse populations, and that cessation of moorland management would likely result in the capital value of the estate declining. All four estates stated they were likely to continue current capital and ongoing expenditure subject to constraints and substantive policy shifts.

5.2.2 Capital expenditure[23]

On average, across these four estates nearly £72,000 (£41 per hectare) annual capital investment relating to moorland sport management had been undertaken (per estate). Table 5.10 summarises this data with total annual sporting capital expenditure ranging from £2 per hectare on the very large DR4 to £68 per hectare on the relatively small DR1. The total moorland capital spend for DR1 was notably high due to the costs of developing two houses for estate staff and additional investment in improving grouse moor management[24].

On average the grouse specific annual capital investment was £6.86 per hectare (amounting to a total of £236,000 across the four estates) ranging from £1.03 per hectare to £68.05 per hectare. Whilst DR1, DR2 and DR3's principal moorland focus was grouse shooting on DR4 there was also a significant deer management enterprise (with 50% of all sporting costs allocated to deer). DR4 also was a very well-established sporting enterprise meaning there was a limited requirement for new property development, roads or other sporting infrastructure in recent years.

Capital spend is therefore variable, dependent on owner motivations, existing infrastructure, the need for new facilities or refurbishment and scale (not all moorland is used for grouse shooting on the larger estates diluting per hectare spend). Nevertheless, the case studies demonstrate the need for a high level of initial investment on the infrastructure required for a driven grouse enterprise, alongside regular capital spending relating to maintaining and enhancing the offering. It should be noted that the figures in Table 4.11 show sporting and grouse specific capital expenditure only and not the wider capital expenditure (e.g. on farms, tourism, business units, forestry, etc.) of the participating estates.

Table 5.10 Average annual capital expenditure on the driven grouse case study estates

Driven grouse	DR1	DR2	DR3	DR4	Average
Average annual moorland sport capital expenditure[25]	£129,300[26] (£68.05/ha)	£70,012 (£14.42/ha)	£50,833 (£11.25/ha)	£37,004 (£2.06/ha)	**£71,787 (£9.81/ha)**
Average annual direct grouse capital spend	**£129,300 (£68.05/ha)**	**£45,567 (£9.38/ha)**	**£43,017 (£9.52/ha)**	**£18,502 (£1.03/ha)**	**£59,096 (£8.07/ha)**
Annual direct grouse spend as a % of moorland capital spend	100%	65%	85%	50%	**82%**

Figure 5.6 shows the variability in capital expenditure by grouped category directly related to grouse shooting/management across the four estates. Property development or refurbishment represented 59% on capital spend on average – but more than 70% of spend on DR1 and nearly 60% on DR2 (both had undertaken recent building works). Vehicle purchases (including off road vehicles, Argocats, quad bikes, vans) were a consistent area of capital spending (29% of annual spend on average) with other important components including sporting equipment such as traps, rifles etc. (6% on average) and

[23] Note that these are actual average capital expenses undertaken by the estates and do not represent the annual charge that could be allocated over the life-span of the assets.

[24] These housing investments clearly do not occur on all estates each year – but this is indicative of the types of investments that sporadically occur – and are countered by the other case study estates where no such development took place during the period in question.

[25] Capital spending data was requested for over the previous five years but for DR2 and DR3 data provided was for over the preceding three years and calculations for annual average were adjusted accordingly.

[26] This figure includes a major £400,000 cost component for two new houses developed on the estate for estate staff.

fencing and drainage (8% on average). On DR2 road and track refurbishments accounted for 11% of their annual capital spend during the 2016-2108 period.

Figure 5.6 Annual driven grouse capital expenditure by main spending category (average 2015-2019)

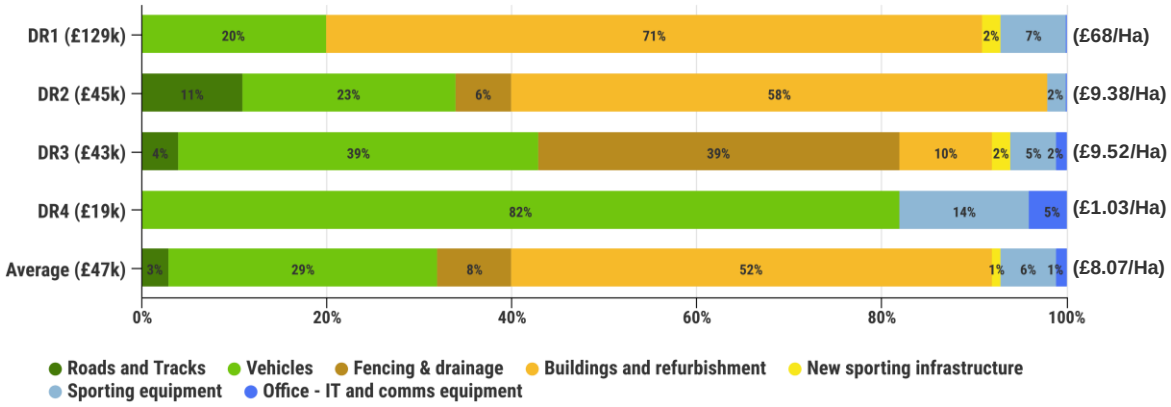


Figure 5.7 shows where the estates spent money related to grouse activities on the four case study estates. Spending on capital items was predominantly local (60-80% local on DR1-DR3), with DR1 in particular having access to a relatively diverse local economy (e.g. local contractors, caterers etc.). All four estates emphasised they endeavoured to buy form within their local economy wherever possible. Regional and national level spending were more of a feature on DR3 and DR4, predominantly relating to capital spending on speciality vehicles (that were not available locally) and sporting equipment (e.g. rifles, scopes etc.) as well as a drainage/peatland restoration contractor on DR3. DR4 was more remote than the other estates meaning there was no real 'local' (within 20 miles) options. It is worth noting that this location profile only shows the relative leakage from local and regional economies from first round expenditure as it did not look into second round expenditure (e.g. where a vehicle dealer purchases – including staff wages – were spent).

Figure 5.7 Location of five year capital spending (directly related to grouse) on driven grouse estates

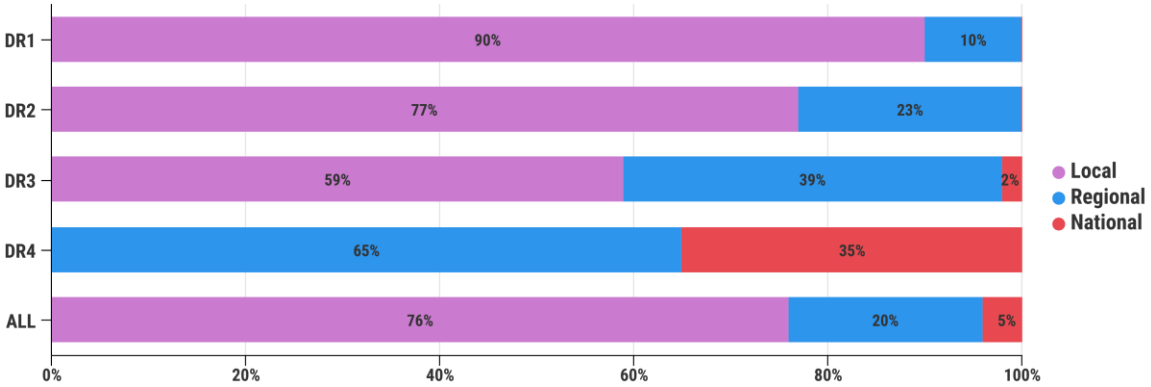
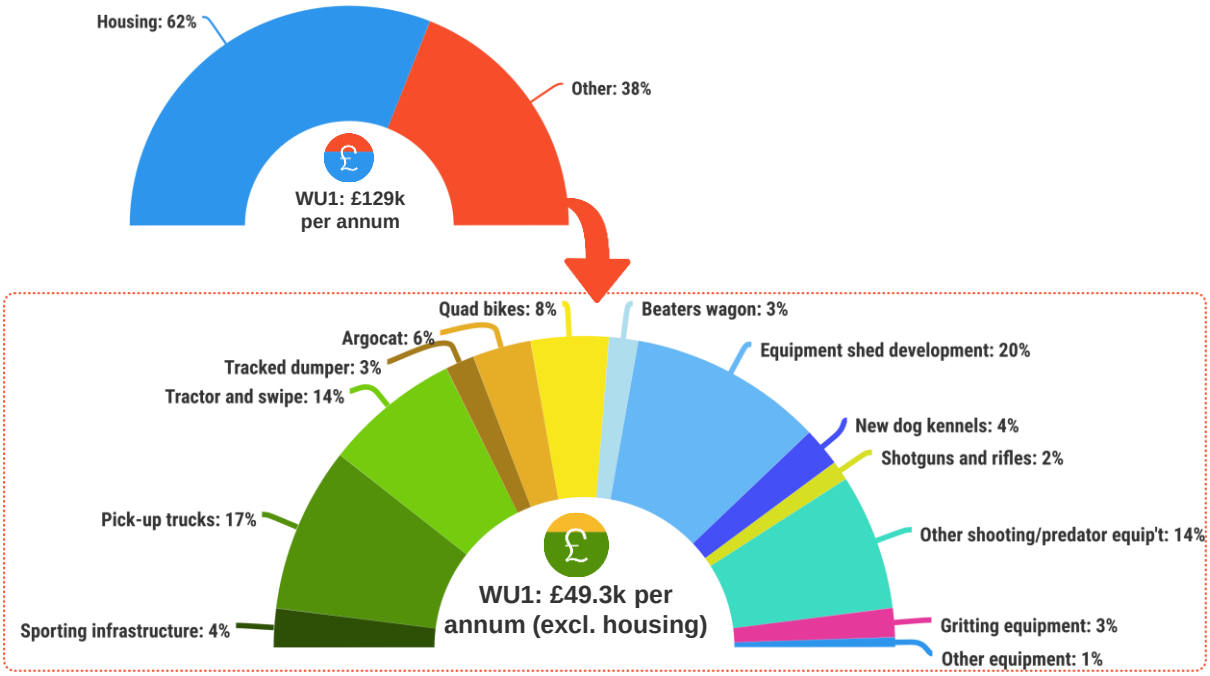


Figure 5.8 shows a more detailed breakdown of specific spending areas on a driven grouse shooting estate (estate DR1). In this example since such a large proportion of the capital spend was on new housing the sub graph shows the more routine capital profile of the estate. This demonstrates the relative diversity of capital spending and the type of businesses supported by this estate. It is noteworthy that purchases of replacement vehicles and equipment were a consistent area of spending on all four estates. However, by its very nature, the interviewees noted this spending is often cyclical depending on the age and condition of facilities and equipment, with annual capital spend more variable than recurrent spend in most cases.

Figure 5.8 DR1 driven grouse capital expenditure profile (2016-2019)



5.2.3 Recurrent expenditure and employment

Table 5.11 summarises annual recurrent non-staff sporting management running costs on the case study estates based on a three-year average (2017-2019). Overall, these four case study estates spent £626,000 per year on their running costs for moorland sporting activities at an average of £157,000 (£21.41 per hectare). The annual costs of running moorland sport on these estates ranged from £14.87 per hectare on the very large DR4 to £41.05 per hectare on the much smaller DR1.

Grouse specific annual non-staff running costs represented over two thirds of the total sporting spend on average, demonstrating the primary sporting focus was grouse shooting on each estate with the exception of DR4 (50%) which also had a high level of deer stalking. Average direct grouse annual non-staff costs were £14.30 per hectare (ranged from £7.44 to £37.63 per hectare) and the four estates spent £418,000 on running costs for their collective grouse enterprises excluding staff wages.

Table 5.11 Annual recurrent expenditure on case study estates

Driven grouse	**Estate DR1**	**Estate DR2**	**Estate DR3**	**Estate DR4**	**Average**
Annual recurrent sporting expenditure (per hectare)	£78,000 (£41.05/ha)	£191,784 (£39.49/ha)	£89,350 (£19.78/ha)	£267,738[27] (£14.87/ha)	**£156,718 (£21.41/ha)**
Expenditure directly related to grouse (per hectare)	£71,500 (£37.63/ha)	£147,865 (£30.45/ha)	£65,300 (£14.45/ha)	£133,869 (£7.44/ha)	**£104,634 (£14.30/ha)**
Direct grouse spend as a % of total sport	92%	77%	73%	50%	**67%**

The extent and profile of grouse enterprise running costs varied considerably between the case study estates, as illustrated in Figure 5.9. For example, 38% of DR3's non-staff running costs was on land agents/contractors whilst the other estates had no external agency costs. On DR2 19% of the grouse costs were on renting additional grouse moor from other estates. This reiterates that no two estates are the same – with grouse running costs dependent on a wide variety of factors. That said, on average

[27] Recurrent spending data for estate DR4 relates to the estate's 2018 profit and loss accounts as 2018 was identified as a relatively average year in relation to spending levels.

20% of the grouse running costs related to vehicles, with 13% spent on buildings costs, 10% on land management inputs and 9% on hospitality costs.

Figure 5.9 Annual driven grouse running cost by category

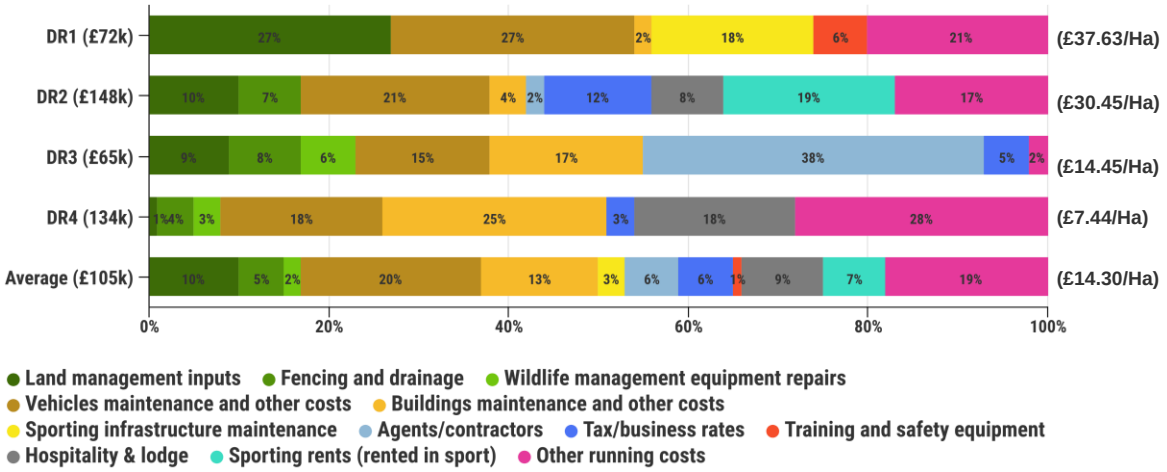


Figure 5.10 provides a more detailed breakdown of all grouse-specific management and shooting costs on DR2. This reveals a wide range of spending areas, including the catering costs related to hospitality and wider aspects such as estate insurance and administrative/office (e.g. sales) costs. This is indicative of the wide range of businesses and authorities that gain financially from expenditure on driven grouse moors.

Figure 5.10 Detailed breakdown of recurrent expenditure directly related to grouse shooting on estate DR2

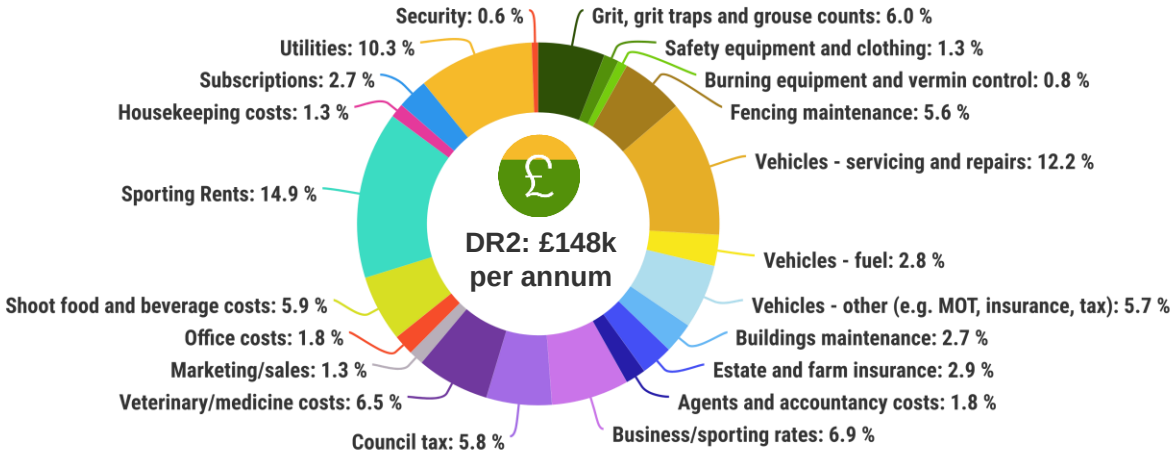


Figure 5.11 shows the location of where the case study estates spent their running costs. Local-level spending represented 40-65% of all spending with an average of 52%. Regional spending was important on DR1 and national spend more of a feature on DR2 and DR3 related to these two estates being located more remotely from appropriate businesses.

Figure 5.11 Location of annual grouse-specific recurrent spending on driven grouse shooting estates

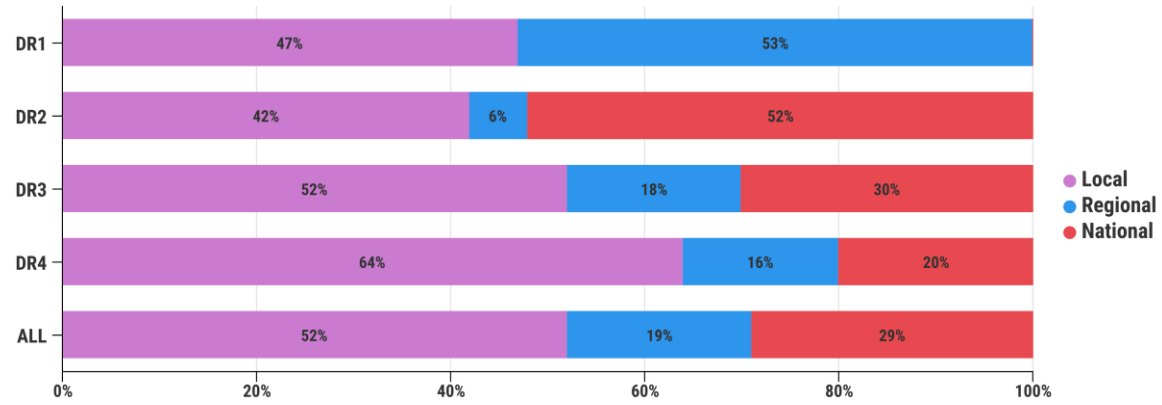


Table 5.12 shows the number of staff employed in sporting/moorland management on the driven grouse case study estates and the estimated component of staffing costs which is directly attributable to grouse shooting/management activities. The number of core full-time sporting staff averaged six FTEs (ranged from two to nine) and when associated staff costs (including grouse beaters) were added the average staff costs associated with moorland sports was £18 per hectare (with a range of £11 to £34 per hectare). Staff costs associated with moorland activities on the four case study estates amounted to £690,000 per annum. The sporting staffing contingent was recognised as having increased on most of the case study estates over the last ten to fifteen years. This was considerably higher than on walked-up caste study estates.

Accounting for core gamekeeping staff, casual beaters and associated employees grouse activities employed 5.1 FTEs on average across the case study estates (ranged from 2.9 - 7.25 FTEs). The total staff costs associated with grouse averaged 59% of total moorland sport costs with DR1 only having grouse sporting activities compared to DR4 where 55% of staff costs were allocated to grouse. On average grouse staff costs were £13.93 per hectare and ranged from £8.41 on the very large DR4 to £41.84 on the relatively small DR1. The number of sporting related (and grouse specific) staff was particularly high on estates DR2 and DR4 as both had a much higher component of deer stalking and a greater commercial focus. The use of beaters and other casual staff sourced predominantly from the local area was a consistent feature, with the number of casual staff variable, ranging from £8,000 to over £30,000 of staff costs. Notably this wage cost is not present every year as it is dependent on adequate grouse numbers to engage in driven shoots, whereas other core staff costs are a feature of estate finances regardless of whether driven shooting is undertaken in a given year.

Gamekeeping staff on all four estates were accommodated in tied housing (meaning staff expenditure was predominantly local to the estate) and they also received additional expenses that usually included dog allowances and the provision of a vehicle and vehicle-running costs. In all four cases sporting employees had young families with children attending local schools. Catering and accommodation provision was a more established feature on driven shooting estates relative to walked-up estates, with all four estates either utilising on-estate accommodation (DR2 and DR4 in particular) or making use of local hotels as accommodation providers - or using a combination of both.

Table 5.12 Employment related to sporting / grouse management and related costs on driven estates

Walked-up grouse staffing	**DR1**	**DR2**	**DR3**	**DR4**	**Average**
Core sporting FTEs (grouse FTEs)	2 all sport (2 grouse)	9 all sport (4.7 grouse)	4 all sport (2.4 grouse)	9 all sport (4.74 grouse)	**6 all sport (3.5 grouse)**
Core sporting roles	Head keeper & 1 keeper	Head keeper, 5 keepers, 1 shepherd, 1 ghillie & 1 admin	Head keeper & 2 keepers & 1 under-keeper	Head keeper, 6 keepers, 2 trainee keepers, & handyman	
Core sporting staff costs	£48,000 (£25.26/ha)	£163,200 (£33.61/ha)	£113,000 (£25.01/ha)	£205,000 (£11.39/ha)	**£132,300 (£18.08/ha)**
Other related staff roles	Beaters[28] (35 for 15 days @ £60)	Beaters (20 for 10 days @ £70) 2 housekeepers, handyman, cook, 2 farm hands	Beaters (12 for 10 days @ £70)	Beaters (25 for 15 days @ £96) Lodge staff (cook, housekeeper, butler, etc)	
Total sporting staff costs	£79,500 (£41.84/ha)	£221,635 (£45.64/ha)	£121,400 (£26.87/ha)	£267,281 (£14.85/ha)	£172,454 (£23.56/ha)
Grouse %	**100%**	**48%**	**63%**	**55%**	**59%**
Total grouse FTEs	**4.1**	**6**	**2.9**	**7.25**	**5.1**
Core grouse staff costs	**£48,000 (£25.26/ha)**	**£86,280 £17.77/ha**	**£67,800 (£15.01/ha)**	**£96,750 (£5.38/ha)**	**£74,708 (£10.21/ha)**
Total grouse staff Costs	**£79,500 (£41.84/ha)**	**£106,280 (£21.89/ha)**	**£76,200 (£16.87/ha)**	**£145,890 (£8.11/ha)**	**£101,968 (£13.93/ha)**

5.2.4 Revenue

Table 5.13 shows the main areas of revenue attributable to grouse shooting[29] on the driven grouse case study estates, as well as additional areas of sporting-related revenue. Shooting clients on all four estates comprised of a mix of national and international customers, with international clients making up 40-50% of the custom across the four estates. Total sporting revenue averaged £26.14 per hectare and ranged from £22 to £67 per hectare. Sporting revenues across the four estates totalled £765,000 bringing external commercial revenues to these locations and on average grouse shooting contributed 77% of this revenue. The higher level of grouse related income related to the higher cost of sporting and the inclusion of accommodation (lodge) and catering costs within grouse shooting revenue. Notably, DR2 and DR3 also had a walked-up grouse component that generated about 16% of their total grouse revenue (a similar level of income generation as reported in the walked-up case study). Deer stalking also represented an important revenue component on DR2 (21% of total sport revenue) and on DR4 (16%).

Table 5.13 Annual revenue from grouse shooting and other sporting activities on case study estates

Income Category	DR1	DR2	DR3	DR4	Average
Commercial walked-up grouse	N/A	£15,190	£16,000		£7,798
Commercial driven grouse	£127,500	£69,715	£90,000	£273,260	£140,119
Deer stalking		£26,525	£6,000	£62,561	£23,772
Other (rough shoot, pheasant, hare etc.)				£12,265	£3,066
Sales - venison		£13,450	£2,500	£47,917	£15,967
Sales - other game (including grouse)	£1,500	£702	£1,500		£926
Annual total sporting revenue	£127,500 (£67.11/ha)	£125,582 (£25.86/ha)	£116,000 (£25.68/ha)	£396,003 (£22.00/ha)	£191,271 (£26.14/ha)
Annual grouse shooting revenue	£127,500 (£67.11/ha)	£84,905 (£17.48/ha)	£106,000 (£23.46/ha)	£273,260 (£15.18/ha)	£147,916 (£20.11/ha)
Grouse revenue as % total sport revenue	100%	68%	91%	69%	77%

[28] Beater category includes beaters, loaders and pickers.

[29] The cost for a day of driven grouse shooting was in the region of £1,500-1,800 per person per day, or £150 per brace for walked-up shooting.

It should be noted that sporting management did not occur in isolation, with all four estates engaged in other income generating activity including sheep farming, renewable energy and, in some cases, occasional timber sales. For example, in the case of DR2 (which made a substantial loss within their sporting enterprise), additional annual income included £96,000 from their sheep enterprise, £122,000 from their hydro scheme and £41,000 from deer stalking and venison sales of (although each of these revenue streams also had associated costs). As noted previously, renewable energy income played a key role on DR2, DR3 and DR4 in subsidising loss-making activities on all three estates (with income from hydro schemes in the region of £250-300,000 on estate DR4). In should be noted that despite renewable energy providing major contributions to estate finances, in most cases owner contributions continued to be an important element of the overall estate financing – representing inward private investment to these locations and the surrounding economies.

5.2.5 Discussion and key points

Table 5.14 summarises the financial data from the driven grouse case studies, including income/revenue balances for all sporting activity and those specific to grouse shooting. On average the case study estates needed 949 hectares of moorland per FTE worker and reflecting the range of driven grouse management models and moorland sizes this ranged from as low as 463 hectares to 1,565 hectares per worker. On average the annual cost of running sporting enterprises (excluding annualised investment costs) was £45 per hectare (with a range from £30 per hectare on the very large DR4 to £85 per hectare on the relatively small DR1). On average, earned revenue only covered 58% of the total associated running costs, generating an average of £26 per hectare (ranged from £22 to £67 per hectare). In all cases sporting activities were loss making with an average a net business cost of £19 per hectare that other estate enterprises or owners needed to fund. Sporting losses on these estates ranged from £8 per hectare on DR4 to £59 per hectare on DR2 - in part reflecting DR4's more commercial focus - whilst other estates had higher proportions of private sporting days.

Table 5.7 also illustrates the grouse specific costs and staffing. On average grouse activities on these case study estates required 1,446 hectares of grouse moor per FTE worker (ranging from 463 Ha in DR1 to 2,483 per FTE on DR4). Grouse revenues averaged £20 per hectare (four times that achieved on average in the walked-up case studies) but were as high as £67 per hectare. The average annual running costs (excluding annualised capital costs) were £30 per hectare (ranging from £17 to £79 per hectare) meaning that driven grouse activities had a net annual business costs of £10 per hectare (or £71,000 at estate level) before accounting for investment costs - ranging from marginal losses of £1 per hectare to £40 per hectare net cost.

With the exception of estate DR2, these estates operate grouse shooting at a lower net cost relative to the walked-up estates, largely due to the increased potential for generating revenue from driven grouse shooting.

Table 5.14 Summary of costs and revenue on driven grouse case study estates

Driven *grouse*	**DR1**	**DR2**	**DR3**	**DR4**	**Average**
Managed grouse moor (ha)	1,900	4,856	4,518	18,000	**7,319**
Hectares per Brace of Grouse	2.2	4.9	4.1	14.3	**7.0**
All Sport - Costs and revenue					
Sporting staff (FTEs – including casual)	4.1	10.3	4.48	11.5	**8**
Sport capital expenditure	£129,300 (£68/ha)	£70,012 (£14/ha)	£50,833 (£11/ha)	£37,004 (£2/ha)	**£71,787 (£10/ha)**
Annual sport running costs	£157,500 (£83/ha)	£413,410 (£85/ha)	£210,750 (£47/ha)	£535,019 (£30/ha)	**£329,170 (£45/ha)**
Annual sporting revenue	£127,500 (£67/ha)	£125,582 (£26/ha)	£116,000 (£26/ha)	£396,003 (£22/ha)	**£191,271 (£26/ha)**
Net sporting balance - before capital	**-£30,000 (-£16/ha)**	**-£287,828 (-£59/ha)**	**-£94,750 (-£21/ha)**	**-£139,016 (-£8/ha)**	**-£137,899 (-£19/ha)**
Hectares per FTE - sporting	463	471	1,008	1,565	**964**
Revenue generated per £1 spent	£0.81	£0.30	£0.55	£0.74	**£0.58**
Grouse - Costs and revenue					
Grouse staff (FTEs)	4.1	6	2.9	7.25	**5**
Grouse capital expenditure	£129,300 (£68/ha)	£45,567 (£9/ha)	£43,017 (£10/ha)	£18,502 (£1/ha)	**£59,096 (£8/ha)**
Annual moorland costs - grouse	£151,000 (£79/ha)	£278,590 (£57/ha)	£149,316 (£33/ha)	£298,261 (£17/ha)	**£219,292 (£30/ha)**
Annual grouse revenue	£127,500 (£67/ha)	£84,905 (£17/ha)	£106,000 (£23/ha)	£273,260 (£15/ha)	**£147,916 (£20/ha)**
Net grouse balance - before capital	**-£23,500 (-£12/ha)**	**-£193,685 (-£40/ha)**	**-£43,316 (-£10/ha)**	**-£25,001 (-£1/ha)**	**-£71,375 (-£10/ha)**
Hectares per FTE - grouse	463	809	1,558	2,483	**1,446**
Revenue generated per £1 spent	£0.84	£0.30	£0.71	£0.92	**£0.67**

Notably the net cost was lowest on DR4, which was the largest of the four sporting enterprises and had the highest level of commercial activity (particularly when deer stalking was taken into account). When taken in combination with the costs shown for walked-up estates, these case studies demonstrate that grouse shooting (walked-up or driven) requires a high level of baseline capital investment, and ongoing spending on overheads and staff costs, regardless of the size or level of activity.

The specific spending on grouse can be reduced when staff and management costs are shared with another activity (most commonly deer stalking), but grouse moor management generally requires a basic level of ongoing minimum investment in the region of about £150,000 to £200,000 annually to have a viable shoot, and this figure increases in line with the size of the managed moor area and the level of management input (i.e. staffing costs). This requirement for high initial and ongoing spending is further evidenced by Box 1, which summarises investment and spending on the Langholm Moor demonstration project during 2008-2017. The project demonstrated a requirement for annual spending (on a relatively large moor with 4,200 hectares of grouse beats) of nearly £250,000 on running and staff costs (£58 per hectare of grouse moor), equating to £2.25 million over the ten years of the project, with additional capital investment during this period of £2.3 million.

Box 1 The cost of re-establishing a driven moor – the Langholm Moor project

The Langholm moor demonstration project[30] was established in 2008 as a collaborative project over a ten year timescale, thought to be typical of the time for recovering a driven moor. The project aimed to demonstrate moorland management could return the moor to a state where grouse shooting would be practically and financially viable (i.e. a model of moorland management based on private funding), while simultaneously meeting the conservation objectives for the area's designated sites (SPA and SSSI). A project manager and five gamekeepers were employed to manage the 11,960ha study area (containing 4,200ha of grouse beats), which had not been actively managed for driven grouse for the previous eight years.

Staff and running costs	**Annual total**
Wages -1 Head Gamekeeper	£30,000
Wages - 4 Beat keepers (£20,000)	£80,000
Vehicles - 5 Pick-ups, 5 ATVs, 1 Argocat (annual/5 year write down)	£22,000
Vehicles - Repairs/tax/insurance	£11,000
Vehicles - fuel	£20,000
Dog allowance (£1,400 per keeper)	£7,000
Housing (£5,000 per keeper)	£25,000
Clothing and miscellaneous	£6,700
Other costs	£30,000
SUB TOTAL	**£231,700**
Equipment - Annual costs, based on 5 year write down of total 5 year costs (£31,000)	
Heather burning equipment	£1,000
Butts	£1,000
5 shotguns and 5 rifles	£3,000
5 binoculars	£800
Vermin control	£400
SUB TOTAL	**£6,200**
Additional costs	
Bracken control (material) per year	£1,831
Heather reseeding (annual cost)	£2,000
Additional habitat/grazer management per year	£3,000
TOTAL EXPENDITURE	**£244,731**
£20.46/Ha for the whole managed area £58.27/Ha if costs allocated to grouse moor	

The project board set an interim target of 1,000 brace per annum – which did not even represent a break-even position (that would have required 3,000 brace per annum). A sustained period of investment was undertaken on habitat improvement, livestock removal and new roads. SNH and Buccleuch funded these separately through a combination of private investment, SRDP grant schemes and its SSSI Management Agreement. This additional investment over the ten-year period was **£2.3 million.** The total spend on moorland management was **£2.25 million,** with annual staffing costs of **£110,000** and non-staff moorland management costs of **£135,000.** This equates to a per hectare staffing and running cost of **£58 per hectare.**

During the ten-year timeframe sufficiently high grouse numbers to undertake commercial shooting on a sustainable basis were not achieved. The project was therefore unsuccessful within the timescale (2008-2017) in demonstrating that driven grouse shooting could be used as the main source of funding (and management of the moor for grouse has now ceased). Although grouse populations did increase, a variety of factors constrained the level of population growth, including high levels of winter predation (with Langholm being an isolated moor lacking neighbours engaged in predator management).

The case studies demonstrate that driven grouse shooting is generally a loss-making enterprise (before any account is taken for, often significant, capital investment) largely due to the high level of recurrent and staffing costs associated with moorland management. Nevertheless, as DR1 and DR4

[30] For further detail see: http://www.langholmproject.com/ The project was a partnership between Buccleuch estate, Scottish Natural Heritage, the RSPB, Game and Wildlife Conservation Trust and Natural England.

demonstrate that substantial revenue can be generated from driven grouse shooting at both smaller and larger scales of operation, albeit reliant on grouse population cycles. Critically, estates also viewed their finances on a more integrated/whole-estate basis, and in all four case study estates the losses attributable to grouse shooting were being offset from other income streams. These off-set income streams included other sporting operations (e.g. deer stalking and low ground/rough shooting) as well as other estate activities - where renewable energy was the most important profit centre on three of the cases study estates. There was further subsidisation of grouse through owner contributions where required particularly in relation to longer term investment, refurbishments etc. needs. From a whole estate perspective, this approach enabled the estates to maintain (and financially securing) their staffing levels in the long-run, ensuring a higher level of moorland and wider estate management that may be achievable without significant levels of public funding. Driven grouse shooting was therefore perceived as integral to the rationale and functioning of the estate in all four cases providing commercial income and a strong basis for ongoing management which delivered on other estate objectives.

As Section 5.2.3 showed that employment impacts on driven grouse estates are generally higher than for walked-up estates, with staffing spend also higher due to a greater requirement for casual and seasonal staff - particularly where estates provide accommodation and catering on site. This was reflected in the higher per hectare costs and revenues and the higher grouse density (measured by hectare per brace shot) on driven grouse estates, which were an outcome of a higher level of management input. Overall, relative to walked-up estates, the driven grouse estates showed a higher level of investment and recurrent spending as occurring within the local or regional economy - although relative remoteness/proximity to relevant businesses was a key factor in some cases. In all four cases, the estates viewed themselves as part of a wider grouse shooting industry within their region, which increases the availability of relevant products and services within their local area. These regional clusters are perceived as important due to the potential knock-on economic and community impacts, as well as the existence of predator control across a wider landscape and the potential for working collaboratively (e.g. in relation to fire management). The four estates were engaged with the local community to varying extents, with DR2 particularly involved with their local primary schools and facilitating estate school visits to demonstrate estate-based land uses to local children.

The driven grouse estate interviewees did not recognise major conflict between driven grouse shooting and other estate land uses, more commonly referring to the complementarity of land uses. In particular sheep grazing and deer population reductions (either directly on the estate or as a result of neighbouring estate culls) were viewed as largely compatible with grouse moor management due to the potential to reduce tick burdens. Further woodland expansion was being considered on two of the four estates, where it was compatible with existing land uses and would not impact on peatland conservation. In the case of DR3, the development of a 40 turbine wind farm was not perceived to have negatively affected the estate's grouse shooting interests, with the area around the wind farm maintained for driven grouse shooting and the two land uses seen as relatively compatible in practice.

In relation to the balance of walked-up and driven shooting and the rationale for each activity, the four estates recognised two main points: i) driven grouse shooting represents a unique sporting experience of value to the owners from a personal perspective; and ii) the potential for generating income from driven grouse shooting far exceeds the potential income from walked-up shooting and driven shooting parties often use estate based accommodation - thereby further increasing the financial returns further (to three to four times the value of walked-up shooting or stag stalking). This impacts directly on labour affordability (see Section 5.2.3) and therefore the number of more permanent estate staff. On these estates, walked-up shooting was therefore not perceived as a viable alternative to driven shooting from revenue generation and employment impacts perspectives. Furthermore, as DR1 and DR3 noted, shooting grouse sustainably (commercially) even on a walked-up basis requires a healthy population surplus, with breeding success the critical underlying factor

which determines grouse population sizes, as opposed to the bag sizes in any given year (which are based on an assessment of breeding success).

5.2.5.1 Constraints

When discussing constraints, driven grouse case study interviewees referred to many of the same issues as in the walked-up case studies, with most having experienced a significant decline in grouse numbers in 2018-2019 (with no shooting on some of the estates during this period). Other factors referred to include increased prevalence of heather beetle and tick, perceived as being linked to climatic factors (increased drought and high rain events). As well as the political pressures on the sector referred to in the walked-up case study, the driven estate interviewees also noted increased public interest and a shift in public perceptions linked to reduced numbers of people involved in land management and an increasing presentation of all grouse shooting as intensive and environmentally damaging. This was perceived as contrasting with the reality of an increasingly regulated and professionalised industry which delivered both socio-economic and environmental outcomes within the context of declining grouse bags (relative to the pre-1950s period). Increased regulation, wider policy dimensions (including land reform) and the threat of licencing of grouse moors[31] was perceived as undermining landowner confidence around long-term investment and representing a threat to the potential for controlling predators in the future.

5.2.5.2 Recent changes/opportunities

A number of recent shifts and changes within the sector were recognised by interviewees, with a particular emphasis on increased employment within sporting management - two interviewees noted that the number of gamekeeping jobs in their region had more than doubled since the early 1990s. This was perceived as being driven by increased investment (and business restructuring on some estates), sustained demand for driven grouse shooting opportunities and increased recognition of the need for proactive grouse moor management. This included predator control, reduction of deer populations (in line with wider pressures to reduce deer numbers and to reduce the transfer of tick), tick-mopping operations using in-house sheep flocks and the use of medicated grit. Nevertheless, all four interviewees noted that while medicated grit can be effective in reducing grouse population fluctuations, it does not eliminate them. In conjunction with the development of new areas of regulation and codes of practice (e.g. the Muirburn code and meat hygiene regulations) the gamekeeping industry was considered to have become more professional over the last two decades, with increasing levels of training.

All four estates noted the value and importance of research relating to moorland management and as well as the need to better educate the general public in relation to moorland management practices and the biodiversity (and rarity) value of moorland habitats. The increasing emphasis on biodiversity and climate change related outcomes in Scottish Government policy were seen as both a potential constraint (in relation to the potential for increased pressure to afforest moorland sites) and an opportunity, with DR4, for example, emphasising the potential for restoration of peatland sites and landscape scale approaches that considered the potential for more integrated land use mosaics. Opportunities to deliver greater environmental outcomes was highlighted as achievable partly through ongoing estate management plans and biodiversity audits. Increased woodland cover was recognised as increasing cover and habitat for predators and creating challenges for moorland management; however, improved night vision systems were seen as offering some potential for managing predators more effectively within more mixed land use settings.

Two estates (DR2 and DR4) referred to the growing importance (due to policy shifts, including the climate change agenda) of limiting the degree of intervention (e.g. the use of medicated grit and tick mopping) within all forms of grouse moor management where feasible, to ensure the industry maintained a degree of public support and avoid being heavily legislated/controlled. This was

[31] Associated with the recommendations within the Werrity review for the Scottish Government (2019).

perceived by one estate as reflecting the wider (unavoidable) direction of travel, with the 'right to roam' and deer-related policy (for example), having increased access rights and resulted in deer population reductions on many estates. A key recognised opportunity was ensuring that moorland habitats were valued in terms of their potential contribution to carbon storage and biodiversity. In one case the estate had begun to develop an ecotourism enterprise in recognition of this increasing market and potential for capitalising on the estate's natural capital.

5.3 Forestry and woodland management

5.3.1 Estate characteristics and forestry/woodland management activity

This case study makes use of one private estate to illustrate the expenditure, employment impact and revenues associated with a relatively typical forestry and woodland management enterprise (on an upland estate). To supplement this forestry enterprise example, the case study also incorporates three woodland creation mini-case studies (WCS1-WCS3) and the related identifiable expenditure and revenue directly related to the specific schemes. One of these woodland creation schemes (WCS1) was located on the main forestry and woodland case study estate, with the other two schemes also located on private mixed sporting estates. All three woodland creation schemes were within a size range of 190-240 hectares and consisted of mixed native woodland schemes located wholly or partly within the moorland zone and (in the case of WCS2 and WCS3) the sites had previously been managed for grouse shooting to some extent. In the case of WCS1, the woodland creation site was chosen due to the area being considered as unfeasible as a productive driven grouse moor.

The main forestry and woodland estate example was a large (over 30,000 hectares) mixed upland sporting estate which was in very long-term family ownership. The estate had a large sporting enterprise that included commercial deer stalking and driven grouse (with over 20,000 hectares of managed moorland), as well as considerable farming interests (tenanted and in-house), domestic housing and business lets as well as tourism enterprises. The estate also had increased the amount of environmental and recreational management activity, including peatland restoration and core paths maintenance.

The forestry enterprise managed a mixed woodland resource (over 4,000 hectares managed for forestry/woodland) of predominantly native woodland, approximately a quarter of which was managed with a greater emphasis on commercial timber production. The broad objectives for the estate engaging in forestry management included the management of the estate landscape and ecosystems, the potential for income generation and to ensure the most suitable land uses were in place across the estate (i.e. matching land uses to site conditions). The estate did not have immediate plans for further forest or woodland expansion citing commercial viability concerns.

Critically, the majority of the forestry and woodland on the estate was located in the lower ground/valley areas due to better growing conditions (soils, degree of exposure, etc.) for trees in these areas. The forestry and woodland resource was, therefore, not a comparative moorland land use, since it was predominantly not located within the areas characterised as the moorland zone. In general, on the higher ground sites (within the moorland/montane zones) the predominant land uses remained sporting and sheep farming, due to their inherent suitability for these activities and relative unsuitability for woodland.

Therefore, an important caveat for this case study is that the financial data shown for the main forestry and woodland case study are not directly comparable to other (more moorland specific) case studies. This is because the financial data relates to a forestry enterprise which was predominantly located on lower ground areas outside of the moorland zone. These lower ground areas were considered by the estate to be more suitable for commercially viable woodland than the moorland zone, resulting in higher levels of revenue than would be expected within the moorland/montane zones. Additionally, the main case study had undertaken a programme of clear-felling (of over-mature plantations) over the last two to three years that resulted in substantially

higher than average annual revenue figures that will be countered by high restocking costs (and considerably reduced timber revenue) in future years.

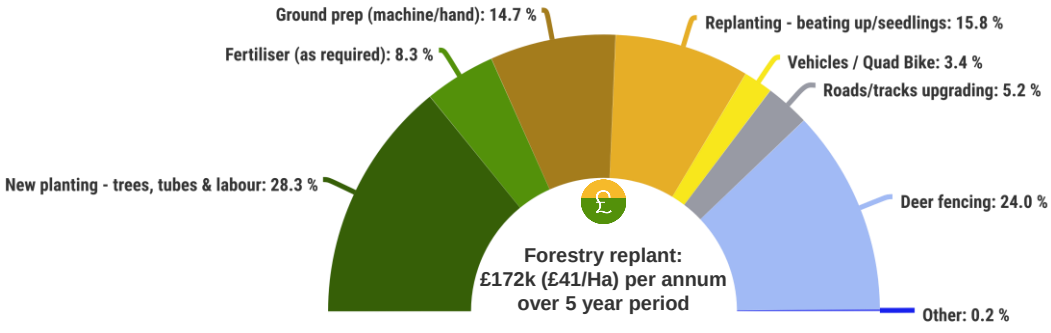
The forestry case study estate was self-financing, with no requirement for sustained private owner contributions. The whole estate had an average turnover in the region of £2-3 million. Tourism activity was an important profit-generating activity, including accommodation and tourism businesses and a number of commercial property lets. The income generated on the estate was predominantly from estate sales and direct revenue, with approximately 5-10% annually from public funding, including grants for peatland restoration in recent years. The sporting and tourism enterprises sustained the greatest amount of employment on the estate, with employment in forestry much more limited.

5.3.2 Forestry-related expenditure, employment and revenue

This section presents the summarised data relating to capital and recurrent (including staffing) expenditure and revenue from the forestry enterprise on the main forestry estate case study. The capital expenditure category includes items which occur on a relatively regular basis (e.g. restocking and ground preparation) and which represent recurrent costs to some extent. They have been included here as capital costs as they are required to establish the land use and represent embedded ongoing capital costs, which can vary over time. Capital and recurrent expenditure were recognised as being less distinct in forestry, due to the long-term nature of forestry and the exclusion of forestry from the tax system (thereby reducing the requirement for separation of capital and recurrent expenditure/overheads).

The total annual capital costs[32] for the case study forestry enterprise was £173,000 or (£41.34 per hectare) over the 2014-2019 period and Figure 5.12 illustrates the main areas of capital spend over that period. New planting (including labour and tree protection costs) accounted for 28%, deer fencing (24%), ground preparations (15%) and replanting (16%). Woodland 'establishment' costs related to approximately 91% of annual capital spend but it was acknowledged that these expenses occurred only once 'once in every 100 years' for upland commercial woodland (relatively slow-growing Scots Pine being the major species). The expectation for native woodland projects was that no future felling (income) would be generated and no further restocking costs would be required. For these reasons it is acknowledged that ongoing capital expenditure needs for any one area of woodland are limited.

Figure 5.12 Distribution of forestry/woodland management capital for the main forestry case study



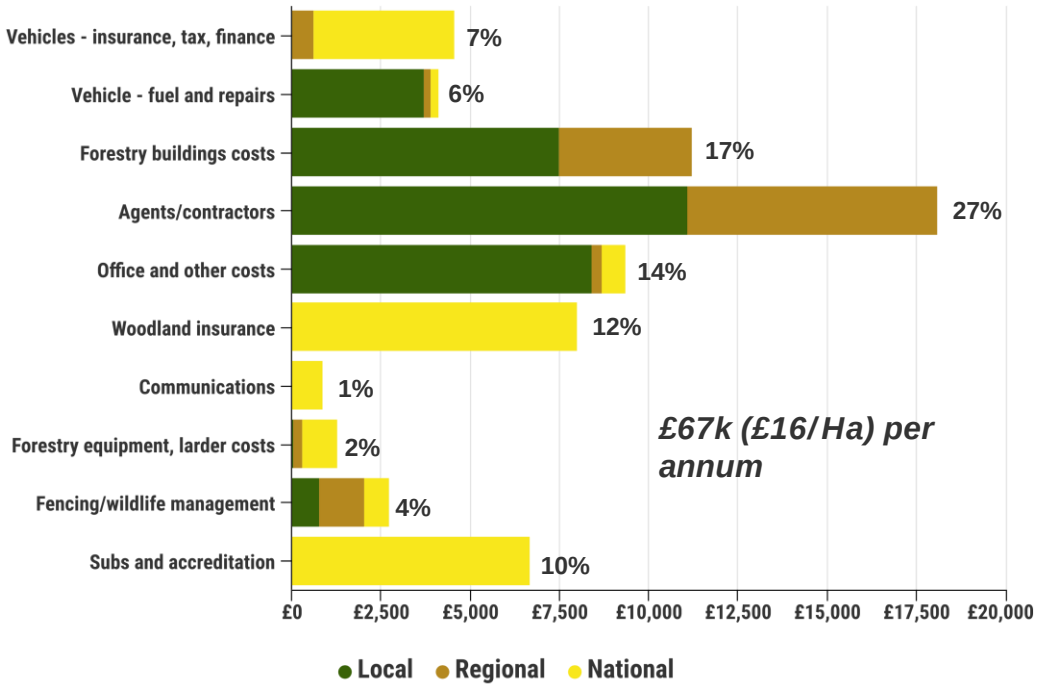
The majority of capital spending (72%) occurred at national level. In this case study national spending on road upgrading, new planting, fertiliser, ground preparation and replanting reflected the lack of available regional (within 50 miles) contractors and suppliers. Regional spending (28%) accounted for the remainder of capital spending, with the bulk of this relating to vehicles, equipment upgrades and deer fencing contractors. The underlying source of finance for the majority of capital spending (91%)

[32] Expenditure figures are based on data for the April 2014-March 2019 period and revenue data is based on the April 2016-March 2019 period.

over the five- year period was government forestry establishment and woodland management grants, with the remaining 9% provided from combined estate cashflow.

Total annual non-staff running costs for the forestry case study (£16 per hectare or £67,056 at project level) were considerably lower than capital costs, due to the investment-oriented approach to forestry as a land use (in a financing budget these costs would likely be annualised over 40-60 years). The source for the majority of recurrent spending was cashflow from the forestry enterprise (e.g. timber sales) and other estate enterprises. Figure 5.13 shows the breakdown of recurrent spending by grouped spending category and locality of spend, with recurrent spending more localised than capital spending, particularly in relation to the main areas of recurrent spend (forestry buildings maintenance, agents and contractors and office/administrative costs.

Figure 5.13 Forestry running costs (three year average) by grouped category and locality of spending



Direct employment within the forestry enterprise was limited to one head forester, with this role cross subsidised by other estate enterprises in exchange for input to these other estate management activities. This equated to a direct/permanent staff cost in the region of £35,000, resulting in total annual running costs (including staff costs) of £102,056 or £24 per hectare. Despite the estate historically having a relatively large forestry staff contingent, the forestry enterprise no longer directly employed other forestry staff due to increased mechanisation, the centralisation of processing to deliver economies of scale and the increased health and safety considerations in the woodland management sector. Nevertheless, the establishment phase for both new woodland creation and restocking requires significant short phases of high levels of labour input, ordinarily provided by contracted labour squads. Within the case study estate, for example, over 90% of the of capital spending had an element of contract labour embedded in the costs (e.g. replanting, deer fencing, ground preparation etc.). Assuming (conservatively) that 25% of these capital costs related to labour it would add a further £9.44 per hectare per annum spent on labour during this establishment phase, or 1.75 FTEs.[33] Currently, and particularly on remoter estates, labour squads working on forestry

[33] For estimated forestry staffing wage costs at UK level see: https://www.payscale.com/research/UK/Industry=Forestry_and_Logging/Salary

establishment are likely to derive from outside of the local area, although some potential exists for local level impact during periods of intensive labour input.

Total annual revenue across the estate forestry enterprise, based on a three year average, was £52.50 per hectare (about £220,000 across the whole forest), with income relatively evenly split between grant income (47%) and from timber sales and cross subsidisation of the head forester's time (53%) (see Table 5.15). As noted in Section 5.3.1, timber sales income related to a relatively intensive two to three year period of clear felling as part of their Long-Term Forest Plan, and is not representative of the longer term average. Restocking costs were also projected to increase substantially from 2020 onwards to facilitate replanting of clear-felled sites. The annual management grants (40% of revenue) shown in Table 5.15 related to new woodland schemes and these end in 2021. As such, funding of the estate forestry enterprise in the longer term is likely to require cross-subsidisation from other estate enterprises (see Section 5.3.1) and the long-term revenues will likely be substantially lower than over the 2016-2019 period.

Table 5.15 Annual revenue from the forestry enterprise on the forestry case study estate

Revenue type	Amount (£)	%
Forestry/Woodland establishment grants	£9,242	4%
Forestry Annual Maintenance Grant	£86,087	39%
Direct support payments – agri-environment forestry	£7,883	4%
Timber sales - Capital (i.e. clear-fell)	£82,629	38%
Timber sales - Revenue (i.e. thinnings)	£2,789	1%
Income for forester's work in other departments	£29,373	13%
Total revenue	**£218,003 (£52.20/ha)**	
Revenue component from grants/support payments	£103,212 **(£24.72/ha)**	47%
Revenue component from sales/income generated	£114,791 **(£27.49/ha)**	53%

5.3.3 New woodland creation on moorland sites – economic case studies

This section summarises the available financial data for three specific woodland creation schemes, including one undertaken on the estate used for the forestry enterprise case study above. All three schemes were native pinewood schemes of a similar size (195-234 hectares), with WCS1 established in 2013, and WCS2 and WCS3 both in 2019. In all three cases the main establishment period (including fencing, ground preparation and planting) occurred within a 12 to 18 month timescale, with a further five year period of relatively intensive input (i.e. weeding, fertiliser application, wildlife management and additional tree re-planting as required). After this establishment phase management input and costs were projected to decrease.

All three schemes were developed on upland sporting estates of different sizes, with grouse shooting and deer stalking being undertaken on all three estates to varying extents (see Table 5.16). In each case the estates had an existing forestry management and/or woodland context, with considerable forest cover and forestry management on WCS1 and WCS3. As WCS1 had been underway for a significantly longer period, additional data on post-establishment management costs was available. WCS2 and WCS3 were both established on moorland sites previously managed, to some extent, for grouse shooting, with WCS1 established on an area of unmanaged moorland ground adjacent to an existing woodland that was considered unsuitable as a productive grouse moor. As detailed earlier (in Section 5.3.1), the WCS1 estate had a large mixed sporting enterprise; the WCS2 and WCS3 estates had more limited sporting enterprises and plan to maintain some future sporting activity - although probably at a relatively low level (e.g. walked-up grouse shooting and 10-15 commercial stag stalking

days). WCS2 and WCS3 recognised the establishment of the new woodland has resulted in the loss of land used for sporting activity. In both cases this was seen as acceptable due to the land area utilised representing a relatively small percentage of the whole estate (7% for WCS2 and 3% for WCS3).

Table 5.16 Woodland creation scheme (WCS) mini-case study outlines

	WCS 1	WCS 2	WCS 3
Estate/moorland area (Ha)	39,000ha (22,000ha moorland)	2,800ha (2,400ha moorland)	6,500ha (5,600ha moorland)
Existing woodland on the estate (Ha)	4,176ha (27% commercial and 73% conservation/amenity)	202ha (50% commercial and 50% conservation)	1,114ha (3% commercial and 97% conservation)
Estate and use context	Mixed sporting estate in long-term ownership. Forestry, driven grouse, deer stalking, farming, tourism and property.	Sporting estate under relatively new ownership, conservation emphasis. Deer stalking, walked-up grouse and farming.	Sporting estate with conservation emphasis, current ownership 20 years; deer, walked-up grouse and tourism.
New woodland scheme details	Native woodland (started 2013); 223ha planted, 39ha regeneration (Scots pine, Silver birch mix).	Mixed native woodland (234ha) Scots pine, Silver birch mix); Started 2019.	Mixed native woodland (195ha); started 2019.
Component of new woodland area within moorland zone	Scheme area includes some moorland ground, none of which has been managed for driven grouse for some time.	Whole new woodland area established on moorland previously managed for grouse shooting.	Whole new woodland area established on moorland previously managed for grouse shooting.

The rationale for woodland creation across all three schemes related primarily to two factors: i) owner interest in contributing to increasing native woodland cover and enhancing the biodiversity and landscape of the estate; and ii) the available grant income associated with native woodland and potential income from the sale of carbon units.

In relation to WCS1, the estate had undertaken the scheme for these reasons and due to the ground being unsuitable for other land uses (agriculture or grouse shooting). The WCS2 interviewee also referred to ongoing uncertainty around agricultural support (relating to Brexit) and increasing regulation and restrictions around sporting land uses, as factors influencing the interest of the estate owners in woodland creation. On both WCS2 and WCS3 the interviewees referred to the potential to diversify the land use mix on the estate and carry out stalking and shooting within a more mixed landscape in the future. On both WCS2 and WCS3 these motivations had been influenced by a change in ownership arrangement within the last five years[34], resulting in an increasing emphasis on environmental objectives and (in the case of WCS3) developing the context for future wildlife and ecotourism as a basis for sustainable future estate enterprises. The potential for long-term capital gain from timber sales or increased land values were not referred to as motivations for their woodland schemes, with planting densities lower than those normally required for more commercial forestry (due to the underlying emphasis on biodiversity in line with the grant scheme requirements).

Figure 5.14 shows that the three woodland creation schemes each had similar capital expenditure profiles, with average establishment capital costs of £2,272 per hectare, where 26% was spent on deer fencing, 30% on ground preparation, 22% on plants and guards and 14% on labour.

[34] For WCS2 the estate had changed ownership five years previously whereas on the WCS3 estate the estate had been transferred from collective family ownership to ownership under one family member who had specific interests in forestry and conservation.

Figure 5.14 Distribution of woodland creation scheme total establishment capital costs

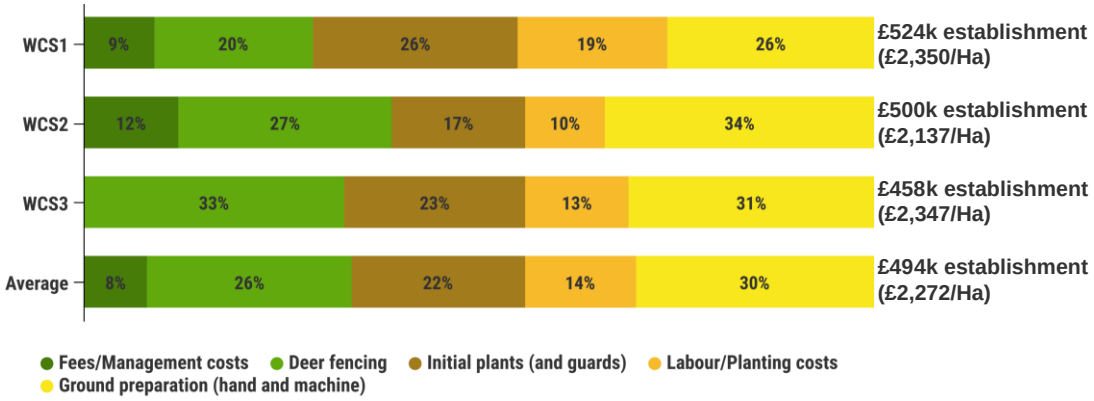


Table 5.17 presents a summary of woodland creation scheme costs and revenue, including income from grant schemes and, in the case of WCS2 and WCS3, projected income relating to the sale of carbon units certified under the Woodland Carbon Code[35]. The costs shown in Table 5.17 are based on the actual establishment costs incurred on each estate. The total running costs for WCS1 between 2014 establishment and 2018 amounted to £855 per hectare, split as:

- Wildlife management – 24%
- Fertiliser (and labour) – 28%
- Beat-up, labour and surveys (2 beat ups) – 29%
- New plants (beat-ups and monitoring) – 19%

In addition, WCS1 had projected future 10 year running costs of £976 per hectare that included ongoing costs for maintenance (including fencing), vermin control, beat-up surveys and beat-up labour and planting costs (for two further re-planting operations) and scheme insurance to the end of the fifteen year scheme period[36]. As post establishment costs were unavailable for WCS2 and WCS3 due to where they were in the establishment cycle their future running costs have been estimated based on WCS1. In both cases the extrapolated figures should be treated with caution because different sites exhibit markedly different costs and tree establishment success rates (affecting future potential tree replacement costs[37]). Additionally, both WCS2 and WCS3 perceived ongoing management costs as relatively low and the extrapolated ongoing management costs for these sites may be an over-estimate.

On that basis, Table 5.17 shows that on average the total 15-year establishment and running costs for these three woodland schemes was £4,105 per hectare with 55% accounted for by the initial capital outlay required during the establishment phase. The woodland establishment grant (average £2,552 per hectare) was adequate to cover the initial capital outlay but the 5-year Annual Management Grant (average £1,185 per hectare) was not adequate to cover the estimated 15 year running costs (as detailed on WCS1) on average, with the exception of WCS3. On average, 86% of the incomes for these woodland schemes came from the woodland grants ranging from 78% in WCS2 to 100% in WCS1.

- The main establishment grant payments (capital costs) are awarded following satisfactory completion of the different elements of the establishment phase (e.g. deer fencing grant

[35] The Woodland Carbon Code is the voluntary standard for UK woodland creation projects which provides independent validation and assurance relating to the carbon savings of woodlands certified under the code.
[36] The landowner retains liability to the end of the fifteen-year scheme period, with repayment of the capital grant potentially required if the scheme is deemed a failure subject to assessments (i.e. of tree survival).
[37] In the case of WCS1 for example a 2018 drought period resulted in a high failure rate for tree survival rates for one of the tree replacement operations, resulting in relatively high costs for replacement tree planting.

payments are awarded once the deer fence has been erected). In all three cases the establishment grants were awarded on the basis of a fifteen year official scheme period (although most capital costs are awarded in the first two years), with the landowner effectively liable for ensuring the success of the scheme (i.e. sufficient levels of new woodland establishment as determined by an end of scheme assessment) up to the end of this period.

- The management grants are awarded on an annual basis in relation to management (weeding, beating up, vermin control, etc.) during the critical five-year phase following initial establishment, with £237 per hectare per annum awarded across the three schemes.

None of the schemes expected to generate future incomes from timber sales but Table 5.17 illustrates that projected income (discounted) from the sale of carbon units (on a five-yearly basis following establishment as per Woodland Carbon Code certification requirements) represented a significant additional source of revenue on WCS2 and WCS3 over the main growing phase for the new woodland[38]. It should be noted however that carbon revenues relate to projected income only and not current income or income paid at the outset of the scheme.

Table 5.17 Costs and revenue for woodland creation scheme examples

	WCS1	WCS2	WCS3	Average
Costs				
Total establishment/capital costs	£523,975 (£2,350/ha)	£500,000 (£2,137/ha)	£457,583 (£2,347/ha)	**£493,853 (£2,272/ha)**
15 Year Running Costs*	£408,603 (£1,832/ha)	£428,758* (£1,832/ha)*	£357,299* (£1,832/ha)*	**£398,220 (£1,832/ha)**
Total Costs	**£932,578 (£4,182/ha)**	**£928,758 (£3,969/ha)**	**£814,882 (£4,179/ha)**	**£892,073 (£4,105/ha)**
Incomes				
Woodland establishment grant	£636,928 (£2,856/ha)	£480,000 (£2,051/ha)	£547,098 (£2,806/ha)	**£554,675 (£2,552/ha)**
Total (5 year) Annual Management Grant	£264,224 (£1,185/ha)	£210,000 (£897/ha)	£298,520 (£1,531/ha)	**£257,581 (£1,185/ha)**
Total grant revenue	**£901,152 (£4,041/ha)**	**£690,000 (£2,949/ha)**	**£845,618 (£4,337/ha)**	**£812,257 (£3,737/ha)**
Estimated projected income from sale of carbon units	£0	£200,000 (£855/ha)	£200,000 (£1,026/ha)	**£133,333 (£613/ha)**
Total income (grants, carbon sales)	**£901,152 (£4,041/ha)**	**£890,000 (£3,803/ha)**	**£1,045,618 (£5,362/ha)**	**£945,590 (£4,351/ha)**
% income from woodland grants	100%	78%	81%	**86%**
Net Balance of Revenue and Costs				
Total Net Balance	-£31,426 (-£141/ha)	-£38,758 (-£166/ha)	£230,736 (£1,183/ha)	**£53,517 (£246/ha)**
Net Balance over 15 years income	**-£9.39/ha**	**-£11.04/ha**	**£78.88/ha**	**£16.42/ha**
Net Balance over 80 year rotation	**-£1.76/ha**	**-£2.07/ha**	**£14.79/ha**	**£3.08/ha**

*Conservative estimate based on WCS1

Table 5.17 also presents the net financial balance of woodland creation schemes with both WCS1 and WCS2 showing net estate costs of £144 to £166 per hectare over their life or £9 to £11 over 15 years or £1.76 to £2.07 over an 80 year rotation (noting WCS2's 15-year running costs are an estimate based on WCS1). Even with the high extrapolated running costs it is anticipated that WCS3 will return net

[38] Estimates are based on the sale of carbon increments accredited under the Woodland Carbon Code on a five yearly basis (subject to sufficient biomass being achieved based on repeat assessments), resulting in estimated income of £1000 per/ha (discounted at 3%) over the main growth phase of the woodland (with native woodland schemes contracted for an eighty year period during which time the woodland cannot be felled). For further detail on per/ha estimates see: https://www.woodlandcarboncode.org.uk/images/PDFs/FCRN031a.pdf and https://www.woodlandcarboncode.org.uk/

income of £1,183 per hectare (or £79 per hectare over 15 years and £15 per hectare over an 80 year rotation). Notably, both WCS2 and WCS3 viewed the current grant rates combined with projected income from the sale of carbon increments as ensuring new woodland creation was now an economically viable land use in upland setting with the capacity to generate a profit on a projected annualised basis.

In relation to staffing input, WCS1 and WCS2 both estimated that development of the scheme and the main five-year establishment phase required an ongoing commitment of 15-20% of the estate forester's or factor's time to implement. As detailed above in relation to the wider forestry enterprise component of the case study, the bulk of the labour input was derived from labour squads obtained through forest management companies.

5.3.4 Discussion and key points

As noted in the introduction to the forestry/woodland management case study section, the main forestry enterprise reviewed here managed forest and woodland cover which is predominantly or wholly outside of the area on the estate that could be considered as the moorland zone. The moorland zone is generally more elevated, with greater exposure and poorer soils resulting in the estate considering it less suitable for successful woodland establishment. Nevertheless, this enterprise (Sections 5.3.1 and 5.3.2) illustrated some of the key features of forestry and woodland management as a land use within an upland estate setting. These included relatively high capital costs relative to ongoing running costs, with the majority of spending and activity occurring during key establishment and felling phases. This results in periods of comparatively high income, as illustrated for this case study, linked with either revenue from establishment grants and/or timber sales during felling periods. The case study did not cover the periods of comparatively low income and ongoing costs linked with restocking and forest management costs. This has resulted in the costs and revenues for the main forestry enterprise reported here being considerably higher than the longer term average.

For estate-based forestry enterprises, these fluctuations are challenging to address in the longer term, due to the need for major economies of scale to ensure a more consistent revenue/costs balance over the longer term. As apparent from the main forestry enterprise case study, direct (on-estate) employment impacts from forestry were limited relative to some other estate land uses due to the very long-term nature of forestry and short-term requirements for high levels of labour input. Nevertheless, it should be noted that forestry can provide the operational context for a variety of other estate-based enterprises, including recreation and wildlife tourism.

The woodland creation case studies presented in Section 5.3.3 demonstrated the capacity for new woodland creation on upland sites to have significant spending and revenue impacts. Nevertheless, interviewees identified a number of constraints in relation to new woodland creation on upland/moorland equivalent sites which can be summarised as:

- The challenging nature of environmental factors (relating to elevation, exposure, shallow soils and exposure) on upland sites which, when combined with potential browsing impacts, result in slow growth rates and a requirement for extended rotations, thereby limiting any potential financial gain linked to grant income or timber sales with intervening periods of many decades without such income.
- Additionally, due to the lower planting densities for native woodland schemes (which are more suited to poorer quality upland sites), the potential for future income from timber sales is very uncertain.
- The relative unpredictability of management costs on upland sites due to challenging environmental factors, potentially reducing the capacity of five-year management grant income to completely cover costs (as for WCS1) incurred during the full fifteen year period of a woodland creation scheme.
- The level of liability/risk associated with the requirements under woodland establishment capital grant agreements for the landowner to repay the capital grant during the fifteen year

formal agreement period subject in the case of the scheme being deemed a failure by the grant awarding authority.

- Potential loss of ground to other land uses including driven grouse shooting and indirect impacts on sporting interests (including on neighbouring estates), due to the provision of increased cover and habitat for predators. This can be exacerbated by the need to fence an area larger than the planned woodland scheme to reduce straight edged fence lines.
- Increasing interest in new woodland creation due to the perceived gains from grants and future carbon sales resulting in shortages of trees for planting schemes in some areas.

Despite these recognised constraints, the more recent woodland creation scheme examples (WCS2/3) demonstrate the potential impact of carbon markets on the economics of new woodland establishment in shifting woodland creation from a net cost to a break-even position or an annualised net gain. However, as this represents a relatively new and undeveloped market, interviewees expressed caution and uncertainty around the specific levels of longer-term income generation. More specifically, the environmental challenges on upland sites increased uncertainty around the potential for new woodlands to establish and grow at sufficient rates to ensure sufficient marketable carbon gain increments over time. Furthermore, as one interviewee noted, peatland restoration may offer greater potential for long-term carbon sequestration than afforestation on specific sites.

A further area of opportunity perceived by the WCS2 and WCS3 interviewees was the potential for diversification of hunting and shooting opportunities in Scotland, including the potential for hunting and shooting within mixed woodland-open ground landscapes. Nevertheless, this was recognised as considerably different to the dominant sporting paradigm in Scotland. Combined with the challenging environmental constraints, these factors were perceived as potentially limiting wider uptake of woodland creation on poorer quality upland sites, which may require an additional level of support or grant supplement to counteract the uncertainty and low potential for long-term income generation. Critically, the low potential for direct income from future sales (excluding carbon) from woodland established on poorer ground necessitated an ongoing high level of public funding commitment to ensure both uptake of new woodland creation and ongoing management of existing forestry and woodland sites.

5.4 Conservation

5.4.1 Estate characteristics and conservation activity

This case study includes two estates managed predominantly for conservation (CE1 and CE2) that were selected to provide contrasting sizes and management contexts. CE1 was a smaller upland estate and management focused primarily on biodiversity conservation. Approximately a quarter of the estate was moorland and red grouse were present on this area, with the estate including a large area of higher montane ground. This estate had been under its current ownership for over 30 years.

CE2 had a range of land uses, including some commercial walked-up grouse shooting and deer stalking. Visitor management and other tourism-related activities took place alongside the primary conservation land uses. This estate was considerably larger than CE1 and had been owned by the current owner for over 20 years. Approximately 80% of this estate was moorland. Table 5.18 provides more detail about the management context for each estate.

Table 5.18 Management context and size of conservation estates (total size not shown for anonymity)

Conservation	CE1	CE2
Estate summary	Conservation land management, including tree planting, a hydro scheme and deer management. Visitor management and education/skills training. No let land.	Predominantly upland estate with mixed land uses guided by overarching conservation aims. Half of the moorland under sporting management (commercial deer stalking and some walked-up grouse). One seasonal grazing tenant. Visitor management and tourism activities, including holiday cottages.
Estate size and moorland area (in brackets)	Small <5,000ha (25% moorland)	Large >20,000ha: (82% moorland)

There was no commercial sporting activity on CE1, where deer management was carried out predominantly by estate staff (averaging 100 days stag stalking and 85 days hind culling a year), with contractors employed when staff are not available. On CE2, walked-up grouse shooting (10 days a year and approximately 120 brace in total) was offered on a commercial basis, along with stag and hind stalking (averaging 100 let stag-days and 40 commercial hind-days) to complement considerable non-commercial deer culling for conservation purposes. Neither estate had sporting tenants.

The underlying motivations for conservation management were similar on both estates, reinforced by the presence of designated sites for both habitats and species, and a focus on native woodland expansion. Both estates delivered a high level of outdoor recreation and education opportunities for visitors (see below for visitor numbers), including through extensive path maintenance and ranger services. This included, for example, an ongoing programme of investment in path maintenance on CE2 for over twenty years to upgrade the condition of path networks across the estate. CE1 was managed on a not-for-profit basis, with some management costs reduced through generating income from on-site activities that included: a small hydro scheme, visits by groups, residential volunteers conducting other activities and office work. CE2 was managed both for primary conservation aims and as a commercial sporting estate and running costs were covered to some extent by direct income from estate activities, with additional owner contributions as well as through public funding streams. Nearly all of the direct income generated by commercial activity on CE2 was from sporting clients and holiday cottage (tourism) rentals. The income-generating activities included rental of holiday cottages and the use of one of the estate buildings as an events venue. Neither estate viewed increasing the capital value of the estate as a core objective as there was no intention to sell either estate in the future.

The figures presented below for capital, recurrent and staffing expenditure related to all conservation related activity across each estate. Moorland-specific estimates (i.e. the estimated amount of conservation spending/revenue which specifically related to the areas of land on the estate characterised as moorland) were not calculated as neither estate assigned their costs on this basis. It should therefore be noted that moorland does not constitute the total area of the estate area in either case (see Table 5.18).

5.4.2 Capital and recurrent expenditure

Table 5.19 summarises total annual capital investment on the case study estates (average 2015-19) at whole-estate level and also that for specific conservation-related activities. Estates were asked to specify the percentage of each item of capital expenditure that is directly related to conservation management, with these estimates used to derive the conservation specific spend figures shown in Table 5.19. On average capital investment figures were largely representative of the very large CE2 – however CE1 spent £7.54 per hectare on all estate activities and £4.52 on conservation specific capital items (60% of total capital). CE2 was over seven-times larger than CE1 and its annual capital investment of £13.88 per hectare at estate level and £9.89 per hectare (71%) on conservation capital reflected a recent emphasis on capital works. CE2 had spent spending over £400,000 per annum

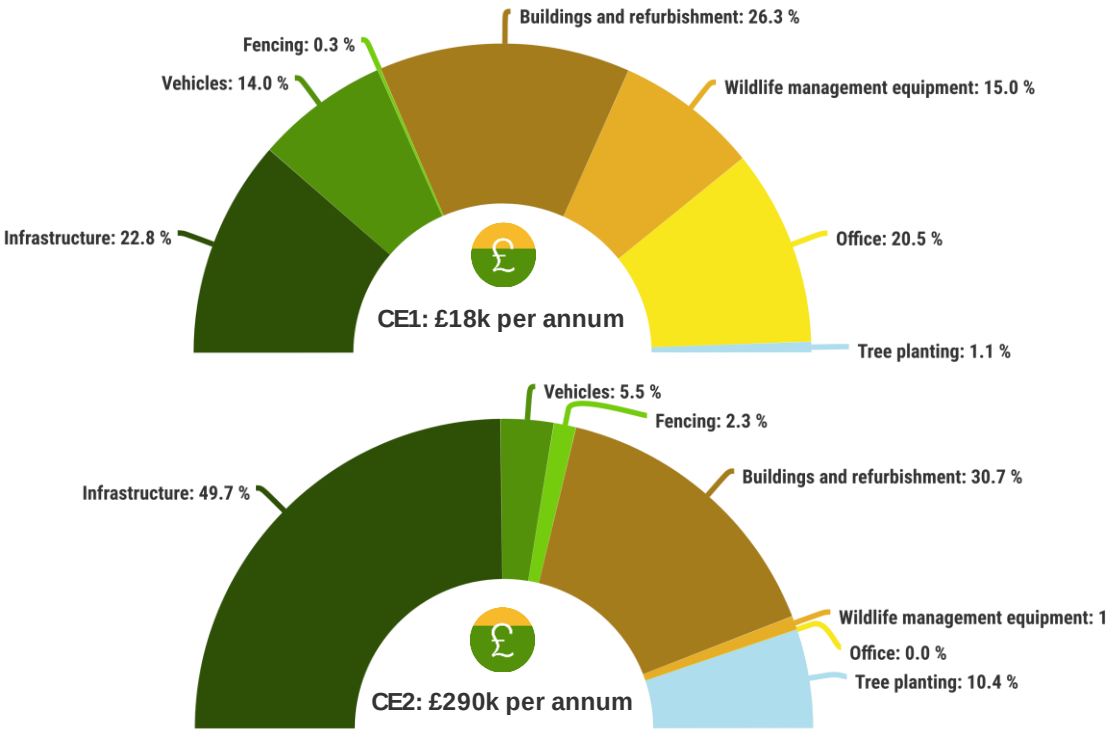
between 2015 and 2019 on capital improvements on their estate and this related to a renewable energy project and extensive infrastructure development and ongoing repairs (particularly estate roads, paths and a bridge) - not all of which was categorised as relating directly to conservation management).

Table 5.19 Total capital expenditure and conservation related capital costs on the case study estates

Conservation	CE1	CE2	Average
Annual estate capital investment	£29,840 (£7.54/ha)	£406,600 (£13.88/ha)	**£218,220 (£13.12/ha)**
Annual conservation capital investment	£17,890 (£4.52/ha)	£289,740 (£9.89/ha)	**£153,815 (£9.25/ha)**
Conservation as % of capital investment	60%	71%	**70%**

Figure 5.15 shows the variability in the profile of conservation related capital expenditure on both estates. Half of the conservation capital investment on CE2 (and 26% on CE1) had been made on infrastructure (particularly footpath management, roads and track repair for recreational access and conservation management) and vehicle costs. Both estates had also invested in buildings and refurbishment with capital spend on both residential and other buildings on both properties related to conservation (26%-30% of conservation investment). CE1 had constructed a small hydro scheme on the property, which although not categorised as a conservation cost, generated income to fund other activities, including conservation management on the estate. CE2 had recently undertaken significant infrastructure repairs required after storm events, as well as having invested in a new bridge to assist access on the property. A further 10% of conservation capital investment on CE2 related to tree planting.

Figure 5.15 Annual capital investment profile (average 2015-2019) on the conservation estates



Over 40% of the expenditure on CE1 was made locally, with the remainder occurring at national level (mostly related to capital items such as vehicles and specialist equipment unavailable locally. CE2 spent proportionally less in the local area (11%) although when combined with regional spending this

proportion rises to 93% of capital expenditure made within 50 miles of the estate – the low local spend reflected the remoteness of the estate to local suppliers (i.e. within 20 miles).

5.4.3 Recurrent expenditure and employment

Table 5.20 summarises the non-staff running costs on conservation activities across each estate, based on the 2017-2019 average. Non staff conservation running costs extended to 53% of total estate running costs on CE1 at £8.40 per hectare whilst on CE2 conservation running costs amounted to £17.89 per hectare (64% of total estate running costs).

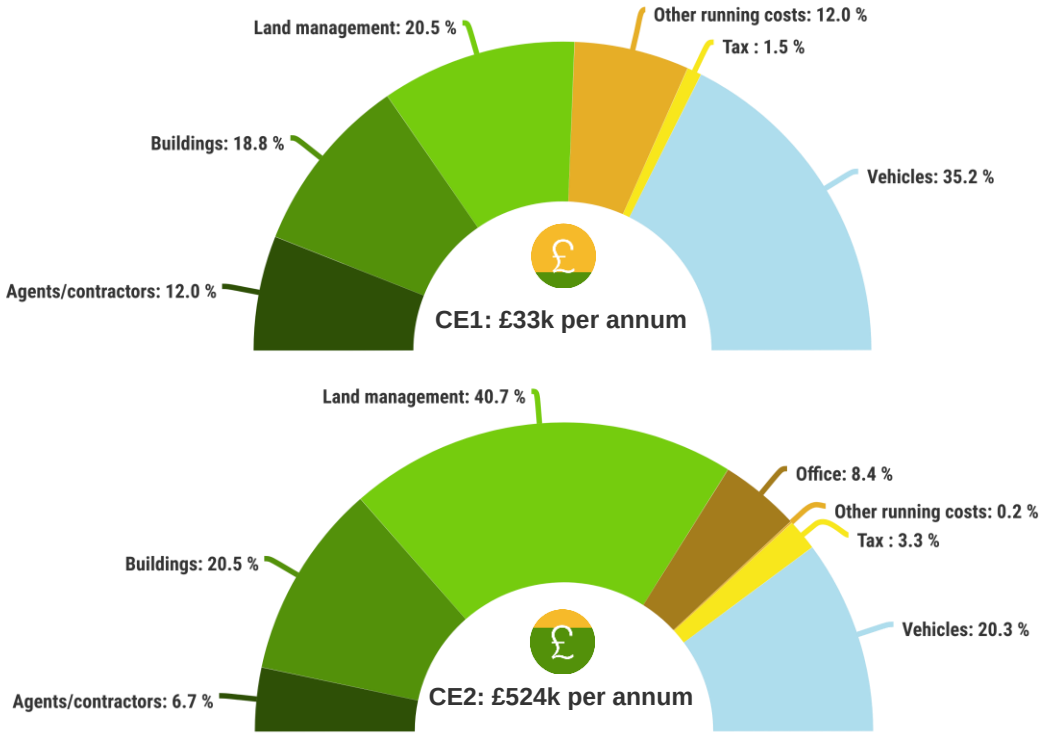
Table 5.20 Annual recurrent expenditure on the conservation estates

Conservation	**CE1**	**CE2**	**Average**
Annual recurrent expenditure (total estate recurrent costs)	£63,200 £15.98	£803,646 £27.43	£433,423 £26.07
Annual recurrent expenditure related to conservation*	**£33,250** **£8.40**	**£524,317** **£17.89**	**£278,784** **£16.77**
Conservation as % of running costs	53%	65%	64%

* Calculated using % of recurrent expenditure allocated to conservation land uses (by respondent).

Figure 5.16 shows the variability in the profile of non-staff running costs for conservation activities. Reflecting its scale CE2 had a higher proportion of costs allocated to administration and taxation costs and 41% of running costs related to on-the-ground land management activities including forestry (compared to 21% on CE1). Both estates had about 20% of running costs relating to buildings with CE1 spending a higher proportion on agents / contractors (contract stalkers). On CE2 a fifth of running costs were on vehicles, whist for CE1 35% of running costs related to their vehicles.

Figure 5.16 Breakdown of annual recurrent expenditure on the conservation case study estates



Approximately 20% of recurrent conservation expenditure on CE1 was made locally, with 9% spent locally by estate CE2. When local and regional spend were combined 69% of CE1's and 44% of CE2's running costs were spent within a 50-mile radius with the remainder spent nationally (except for 11% international on CE1 that related to specialist equipment). Generally, if goods and services were

available locally they were utilised but the peripheral nature of these estates meant that there were limited suppliers locally (within 20 miles), particularly of providers of specialist goods or services.

Other local impacts from the estates included estate CE1 hosting land management training courses and both estates consulting the local community on the contents of the estate's management plan at regular intervals.

Table 5.21 shows the number and costs of staff employed in conservation-related activities on the two estates. Despite the differences in the physical scale of these conservation estates the overall conservation staffing costs were both very similar at just over £12 per hectare. CE1 had two permanent, year-round staff who worked fully on conservation-related activities. An additional seasonal student intern was employed in the summer months, and an average of about 20 long-term volunteers stayed on the site for between one and six months at a time. Volunteering and related skills training/development was an important component of the objectives on both estates, with volunteers working on conservation management as well as rangering opportunities. Both of the permanent staff had young families who live in the local area. CE2 employed 20.5FTEs, with approximately 14 of these working solely on conservation-related tasks. This included conservation management staff as well as a component of deer management/stalking staff costs since deer management represented a key component of the wider estate conservation management. An additional (non-conservation) staff component on CE2 (6.5 FTEs) mainly consisted of staff focussed on the management of the holiday cottages/events venue. On both CE1 and CE2 the majority of staff lived relatively close to the estate (in the local community), and interviewees considered this an important aspect of local community retention in both cases.

Table 5.21 Employment related to conservation and related costs on moorland area of each estate

Staffing	Estate CE1	Estate CE2	Average
Core estate FTEs (conservation specific FTEs)	2 FTEs (both conservation focused)	20.5 FTEs (14 conservation FTEs)	11.25 FTEs
Core job roles	Site managers	Operations Manager, Head Ranger, Ranger, Foreman and estate staff, Head stalker, stalkers, ecologist, office staff.	
Total estate staff costs	£50,000* (£12.64/ha)	£517,551 (£17.66/ha)	£283,776 £17.07/ha
Conservation staff costs	(£50,000) (£12.64/ha)	£288,000 (£9.83/ha)	£169,000 (£10.16/ha)
Seasonal conservation staff roles	Seasonal student placement and c.20 long-term volunteers	Ecologist, rangers, sporting ghillies	
Seasonal conservation staff costs	N/A	£65,000 (£2.21/Ha)	£32,500 (£1.95/Ha)
Total conservation staffing costs (annual)	£50,000 (£12.64/ha)	£353,000 (£12.05/ha)	£201,500 (£12.12/ha)
Conservation staff as % total staff costs	100%	68%	71%

* Exact costs not provided, figures based on an average for individual staff costs on Estate CE2.

5.4.4 Revenue

Table 5.22 shows the main areas of revenue and the specific areas of revenue directly related to conservation activity on each estate. CE1 generated a relatively modest level of revenue across the estate (£13.45 per hectare) and the two main income sources were the hydro-electricity scheme payments (a recent installation) and venison sales. In this case venison sales were categorised as conservation-derived revenue due to the deer management on the estate being conducted wholly for

land management and conservation reasons (as opposed to relating to commercial stalking activity). CE2 generated considerably more revenue than CE1, with total estate income of over a £1 million annually at about £35 per hectare. This included a significant component of revenue from public grants and subsidies (£16.93 per hectare totalling £496,000) across forestry, conservation management grants and land management support under the Basic Payments Scheme. These funding streams were categorised as conservation revenue due to the payments being made on the basis of conservation-oriented management (e.g. native woodland restoration, specific management measures for designated sites and low-intervention land management). Public funding therefore represented a significant component (42%) of the overall estate revenue for CE2 and the majority (82%) of conservation specific revenues. Nevertheless, revenues generated from tourism and other commercial activities provide an additional significant component of CE2s overall estate revenue, generating 41% of the overall estate revenues). This includes income derived from holiday cottage rentals, an events venue and other tourism-related activities (including commercial stalking). Similarly to sporting estates, both CE1 and CE2 utilised income from wider estate activities (tourism, renewables, property rentals) to subsidise costs associated with their core conservation management activities.

Table 5.22 Total annual estate revenue and revenue from conservation activities on the case study estates

Conservation	**CE1**	**CE2**	**Average**
Conservation related grants and support payments			
Conservation management grants (designated sites)	n/a	£204,000	£102,000
Forestry Grant Scheme (native woodland restoration/restructuring)	n/a	£40,000	£20,000
Land management payments (Basic Payment Scheme) for low intensity/conservation management	n/a	£252,000	£126,000
Direct conservation-related income			
Conservation related visitor spend (donations, parking etc.)		£19,991	£9,996
Other conservation related revenues	£22,000	£89,640	£55,820
Other estate income			
Tourism revenue (holiday cottages and functions)	n/a	£260,368	£130,184
Other commercial activity including renewables, property and commercial sporting income	£31,200	£165,846	£98,523
Total estate revenue	£53,200 (£13.45/ha)	£1,031,845 (£35.22/ha)	**£542,523 (£32.63/ha)**
Total conservation related revenue	**£22,000 (£5.56/ha)**	**£605,631 (£20.67/ha)**	**£313,816 (£18.87/ha)**
% Revenue from conservation	**41%**	**59%**	**58%**
Conservation income from public funding	**0%**	**82%**	**79%**

Whilst tourism was not classified as revenue directly related to conservation, CE2 noted that tourism and recreation income streams sat within the context of conservation management – a core ethos that drew visitors to the estate. The conservation activities of the estate therefore represented a marketable asset when linked directly with tourism provision. The number of people visiting CE1 increased markedly in the last decade to over 20,000 per year in 2019/20. Approximately 135,000 people visited CE2 per year and they offered guided walks and other educational. The facilitation of access and provision of facilities, information, interpretation and education was a core component of the management aims on both sites. The visitors to both sites were recognised as contributing to the local economy in both cases. To put the wider economic impact of visitors in context, using the

published average daily visitor spend across the wider region[39] it suggests that visitors to CE2 could spend around £11 million per year in the local economy during their visit (whether the visit to CE2 was their core reason for visit or not).

5.4.5 Discussion and key points

Table 5.23 summarises financial data from the conservation case study estates. Both estates were run at a net cost, with both owners subsidising estate activities as required. In the case of CE1 this equates to a net cost (owner contribution) of over £15 per hectare before any account was taken of on-going capital investment costs. For CE2 the net cost of the business was £9/Ha but without CAP scheme monies (including conservation management and forest management grants) the conservation work would have had a net estate cost of £26/Ha.

The scale of CE2 meant that in order to continue with this conservation management model the owners had to invest significant amounts (£300,000 per annum) from other cost centres or external sources of finance. CE2 relied on income from sporting clients and the holiday cottages/event venue for reducing their operating deficit. While the tourism operation was arguably not directly related to conservation land management, the conservation context of the estate provided an important appeal to visitors wishing to come to the area. Tourism and income from other commercial activity, including deer stalking, were viewed as largely complementary activities for the conservation focus on CE2. The CE2 example therefore demonstrates the potential for income for tourism activity and commercial sporting activity (which accounted for 36% of total estate income) to offset some of the costs arising from the core conservation management activity of the estate. This cost offsetting was also apparent on a smaller scale with regards to hydro-electricity income and venison sales on CE1.

As CE2 received a high level of public grant income and because this income source may not be available in the future, staff were considering other opportunities for on-site enterprises and other future grant options - particularly in relation to forest management and the potential for obtaining longer-term support for deer management. The use of agricultural support payments to facilitate conservation land management (without livestock grazing) on CE2 also demonstrated the current potential for agricultural support payments to be used on large landholdings to facilitate non-agricultural (conservation-oriented) land management.

The relatively high operating deficits for the estates in the conservation land use case study demonstrated the importance of long term private, organisational or public funding for subsidising conservation land activity, as a largely loss-making enterprise in its own right. In broad terms, the direct spending, revenue and employment impacts of CE1 and CE2 are not dissimilar to a smaller sporting estate with some walked-up grouse shooting (CE1) and a very large mixed sporting estate with commercial driven grouse shooting as a core activity. Notably, the conservation management activities on CE2 were currently heavily dependent on ongoing availability of public grants and support payments which were aligned with the management objectives of the estate. Nevertheless, CE2 represented one of the highest overall spending levels of any of the estates across all the land use case studies and comparable (or higher) direct FTEs than for most other land uses. This demonstrated the potential for conservation-oriented management to deliver high levels of investment and local-regional economic impact through benevolent conservation focused owners or through alternative, appropriate, funding models. The high level of visitors to both CE1 and CE2 demonstrated a public demand for such tourism / recreation opportunities - capitalised on by both estates through access facilitation and provision of facilities, information, interpretation and education as core components of the management aims. When considering average daily spend in the local economy these visitors can have a considerable wider rural economy impact (estimated at circa £11 million in the case of CE2).

[39] Visitor spending estimate is based on a regional visitor survey (not referenced here for anonymity purposes).

In both cases income generated on site is also reinvested in the site's management. In the past three to five years, CE1 reduced its operating deficit and was increasingly focussed on trying to achieve financial sustainability through site-based activity. Income from venison sales and hydro-electricity were an important part of reducing the operating deficit and the option to lease-out some of the deer management as commercial stalking was being considered. In the case of CE2 the option to develop part of the estate to encourage more visitors was also being considered, to increase the income generated from guided walks and other educational/interpretive activities.

Table 5.23 Summary of costs and revenue on the conservation estates

Conservation	CE1	CE2	Average
Total estate area (ha)	<5,000	>20,000	**16,000**
Managed moorland area (ha)	25%	80%	
Conservation FTEs	2	14	**8**
Annual conservation capital investment	£17,890 (£5/ha)	£289,740 (£10/ha)	**£153,815 (£10/ha)**
Annual conservation running costs (incl. staff)	£83,250 (£21/ha)	£877,317 (£30/ha)	**£480,284 (£29/ha)**
Annual conservation revenue	£22,000 (£6/ha)	£605,631 (£21/ha)	**£313,816 (£19/ha)**
Annual CAP schemes	£0/ha	£17/ha	**£15/ha**
Net conservation balance (incl. CAP) - before capital	**-£61,250 (-£15/ha)**	**-£271,686 (-£9/ha)**	**-£166,468 (-£10/ha)**
Net conservation balance (excl. CAP) - before capital	**-£61,250 (-£15/ha)**	**-£767,686 (-£26/ha)**	**-£414,468 (-£25/ha)**
Hectares per FTE	2,000	2,100	**2,100**
Revenue generated per £1 spent	£0.26	£0.69	**£0.65**

* Estimates of conservation-related spend provided by the respondents. Per/ha values are based on total spend/revenue or total conservation spend/revenue across the estate as a whole (as opposed to segmenting moorland-specific spending which is particularly challenging due a lack of specific focus on the moorland area from a spend/revenue perspective).

Looking forwards, neither estate anticipated major changes to their current land use in the next decade. Respondents from both estates expected woodland regeneration will continue, as well as an increase in areas of wet-heath on CE1. Both estates acknowledged the potential for generating revenue from the estates' natural capital, particularly for carbon offsetting and similar commercial activities. For example, CE2 had drafted a prospectus for seeking investment in activities that can contribute to carbon offsetting and estate CE1 had integrated natural capital aspects throughout its current management plan.

5.5 Deer stalking and deer management

5.5.1 Estate characteristics and deer-related activity

This case study includes three estates, a small to medium-sized (4,000ha) conservation-oriented estate (DE1), a large (over 15,000ha) mixed sporting estate with substantial grouse and deer stalking interests (DE2), and a very large estate (DE3) with a sporting emphasis on deer stalking and salmon fishing (see Table 5.24). The estates were selected to allow for examination of deer stalking/management in different contexts and at different scales. DE1 and DE3 do not carry out (or aspire to develop) grouse shooting, with no significant grouse populations on either estate. All costs shown in this case study are those identified by participants as being directly related to deer stalking and management.

Deer populations on all three estates have been reduced in recent years, in response to estate-level and Deer Management Group targets. DE2 had reduced their estate deer population by over 50% since the 1990s and DE3 had carried out targeted deer population reductions, related to designated sites and woodland/forestry management. These reductions resulted in a deer density of 10.5 per km^2

on DE2 and 9 per km^2 on DE3, with a density of 10 deer per km^2 on DE1. DE1 manages deer with the aim of reducing browsing pressure (and limiting non-native sika deer) to facilitate woodland regeneration around existing native woodland areas, with an overarching aim of increasing woodland cover to 60% of the estate (from 25%). Woodland expansion and restructuring plantations, funded by both estate funding and existing Forestry Grant Schemes, are therefore core activities for DE1. There was no commercial stalking or other sporting land use on DE1 whereas DE2 and DE3 had large commercial stalking enterprises, averaging 100-120 stags (DE2) and 200 stags (DE3) over a three-year period. Both DE2 and DE3 also engaged in some private/family stalking and substantial culls of hinds and calves (see Table 5.24).

Table 5.24 Management context and size for deer stalking estates

Deer	DE1	DE2	DE3
Estate summary	Conservation managed estate with a focus on native woodland ecosystem restoration. Managing deer primarily to achieve woodland regeneration.	Mixed sporting estate, with commercial driven grouse and deer stalking. Estate includes sheep and forestry enterprises, hydro schemes, property and farm tenants.	Mixed sporting estate with commercial deer stalking and salmon fishing, forestry, conservation management (designated sites), three large hydro schemes and holiday cottages/wildlife tourism.
Approx. estate size (moorland area)	Small-medium 4,000ha (3,000ha moorland)	Large: 17,500ha (14,500ha of moorland with deer stalking)	Very Large: 35,000-40,000ha (deer managed over majority of area, mixed upland landcover, limited/no grouse potential)
Annual stag/cull numbers	No commercial stalking. Annual cull 15-25 stags, 50-75 hinds.	100 commercial stag days and 30 hind days with 20 private/family stag days (3-year average cull: 143 stags, 329 hinds and 141 calves).	200 stags (commercial). 350 hinds and 200 calves culled annually (3-year average).

Both DE2 and DE3 had substantial hydro scheme enterprises, as well as forestry and property lets, and DE3 also provided a 15 year sporting lease on one area of ground. Farm tenancies were a feature of DE1 (one sheep enterprise) and DE2. Although DE1 was explicitly conservation-focused, both DE2 and DE3 also had multiple national and EU conservation designations and considered habitat and species conservation a core aspect of their woodland and upland management, requiring ongoing deer management and monitoring.

The underlying rationale for deer management for DE1 reflected a strong owner focus on native woodland restoration. Motivations for managing deer stalking on DE2 and DE3 related to an emphasis on maintaining established land-uses, ensuring the availability of high-quality stalking, and for part-funding deer management as an ongoing concern. As DE3 noted: *"you have to manage the deer regardless of your view on them, the* [commercial] *stalking is almost a by-product, it allows us to generate some income from deer and increase employment on the estate, and part-fund the management of deer on a very large land area"*. This mixed (commercial/private) model was therefore key to the financial viability of the operation, as it facilitated long-term management of deer densities (and grazing pressure) sufficient to facilitate biodiversity conservation and compliance with designated site requirements. Additional estates activities, such as tourism and hydro schemes (on DE2 and DE3), were motivated by a desire to increase income generation and the financial viability of the estates.

As whole estates, both DE1 and DE3 operated at a significant net cost to the owners between 2016 and 2018 (in the region of £150,000 and £500,000 annually), while DE2 operated at closer to a break-even basis. On all three estates deer management operated at a substantial net cost (see below). The

deer enterprise was therefore subsidised in all three cases by other estate land uses and/or additional owner contributions. As in the case of grouse shooting, DE2 and DE3 perceived deer as part of a larger, integrated set of estate activities, with deer stalking and management providing an essential activity, as well as facilitating a larger staffing cohort, which could be used for other activities at different times of the year (e.g. maintenance, moorland management, fishing). The hydro schemes on DE2 and DE3 were projected to reduce net estate running costs once the schemes were paid off. Nevertheless, the operational scale of DE3 was likely to continue to require a substantial degree of owner subsidisation of estate management. In the case of DE1, short to medium-term income related to one-off forestry felling operations could be offset against operating and investment costs, with the development of an interpretative/ecotourism initiative planned to offset operating costs in the longer term.

5.5.2 Capital and recurrent expenditure

Table 5.25 summarises the capital expenditure[40] for the case study estates, with average annual capital expenditure of £46,000 or £2.39 per hectare. Both the very large DE3 and small DE1 had very similar per hectare annual investment costs (£2.78 and £2.59 respectively) reflecting their on-going estate improvement programmes, with DE2's £1.28 per hectare lower due to their stage in the investment cycle. On DE3 there had been continual major investment in refurbishments of staff housing and work on estate roads and tracks, over a very large area. In contrast DE2 had not undertaken any major (specifically deer-related) property development or improvements during the period for which data was collected, in-part due to having a well-established estate infrastructure. For example DE2 had invested £60,000 in road repairs in the year prior to the five year data collation period and two related property refurbishments (a stalking lodge and a keepers house) had also been undertaken in the current financial year (at a combined cost of £110,000) and were therefore not recorded. Capital investment was therefore variable, with estate scale and the level of existing infrastructure and housing a key factor influencing ongoing capital investment levels. Wider capital investment also occurred on the estates but was less directly related to deer management - including (grant funded) investment of £150,000 in peatland restoration in 2019 and £45,000 in woodland expansion in 2020 on DE2.

Table 5.25 Capital expenditure on the deer case study estates (deer-specific costs)

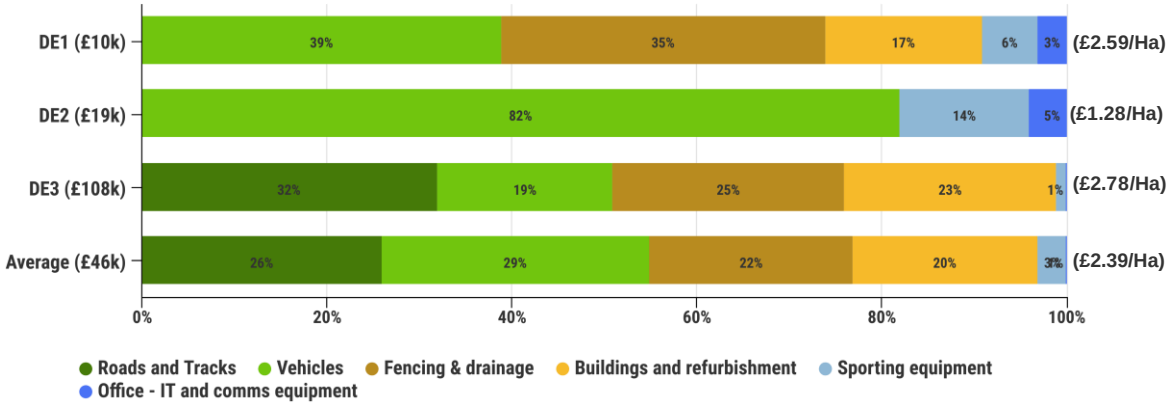
Category	DE1	DE2	DE3	Average
Annual deer management capital costs (per hectare)	**£10,340 (£2.59/ha)**	**£18,502 (£1.28/ha)**	**£108,030 (£2.78/ha)**	**£45,624 (£2.39/ha)**

Figure 5.17 shows the variability in the average capital expenditure related to deer stalking and management (2015-2019) by grouped category. Vehicles were a consistent component (including off road vehicles, quads bikes and Argo cats) and accounted for 29% of annual investment on these estates over the 2015-19 period (it was the majority of DE2's annual spend due to where the estate was on its investment cycle as described above). Fencing and drainage (primarily fencing spend) accounted for 22% of annual investment over the period – being a key component of spending on DE1 and DE3 in relation to deer management for forestry and woodland creation/restructuring. As DE1 explained, as fencing requirements related directly to relatively high levels of deer impacts, fencing costs were regarded as a deer management cost. Only DE3 had invested in roads/ track during the reporting period, but their scale meant that on average it accounted for 26% of investment overall. Accommodation refurbishments had been ongoing on DE1 and DE3 that meant that 20% of annual investment costs over the five-year period related to buildings. The ongoing buildings and tracks

[40] Note that these are actual average capital expenses undertaken by the estates and do not represent the annual charge that could be allocated over the life-span of the assets.

investment represented the major capital costs for DE3, which resulted in capital costs for DE3 being considerably more than double on a per hectare basis than the other large estate, DE2.

Figure 5.17 Annual deer-specific capital investment on deer estates by category (average 2015-2019)



In all three cases the majority of capital spending occurred regionally, with local spending (within 20 miles) limited by estate remoteness and therefore lack of a local business base. For all estates some technical equipment or vehicles were purchased outside the region, subject to availability. All three estates emphasised their preference to make purchases within the local area or wider region wherever possible.

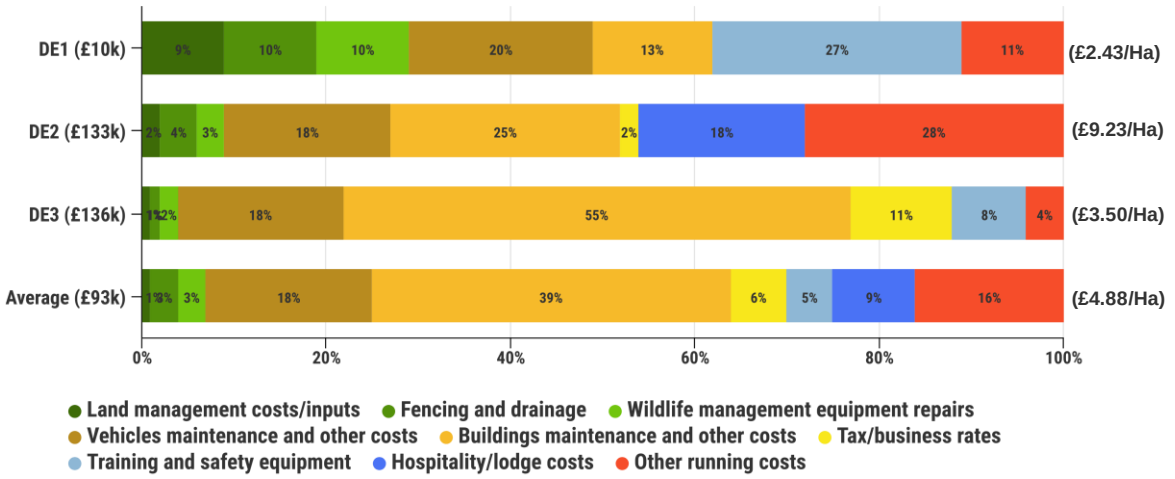
Table 5.26 summarises the annual non-staff running costs for deer stalking and management enterprises, based on a three-year average (2017-2019). On average non-staff running costs amounted to £4.88 per hectare and ranged from £2.43 per hectare on DE1 to £9.23 per hectare on DE2 to £2.43 on DE1.

Table 5.26 Annual recurrent non-staff deer shooting and management running costs on case study estates

Category	DE1	DE2	DE3	Average
Annual non-staff deer management running costs (per Hectare)	**£9,720 (£2.43/ha)**	**£133,869 (£9.23/ha)**	**£136,000 (£3.50/ha)**	**£93,196 (£4.88/ha)**

Figure 5.18 reveals that vehicle-related costs represent a consistent component of recurrent spending in all cases (18%-20%), with building costs (maintenance of keeper housing, etc.) accounting for the largest component of running costs at 39% on average. The variation across estates was apparent, and it was particularly noticeable that DE1 spent a higher proportion of their running costs on land management and wildlife management – that reflected its owner's conservation motivations. Hospitality and lodge costs were a feature of DE2 (the proportion which relates to deer stalking parties), with this factor either absent or not accounted for on DE1 and DE3. Land management costs commonly included aspects relating to Habitat Impact Assessments and deer counts. The 'other' running costs category was relatively broad and included utilities, marketing, administration and costs relating to stalking ponies. As for capital costs, recurrent costs were allocated to deer on the basis of on an estimated level of deer-specific use (e.g. 50% of keeper housing costs for DE2 and DE3 due to keepers also working on other activities such as grouse (DE2) or fishing and general maintenance (DE3)).

Figure 5.18 Annual running costs for deer by category on deer estate case studies (average 2017-2019)



The case study estates also indicated the locality of running cost spend, with the level of regional spending similar on DE1 and DE3 (87% and 77% respectively), with the remainder in both cases occurring at national level. Local (within 20 miles) represented over 60% of spending on DE2 (with 15% regional and 20% national for DE2), due to the availability of relevant local businesses, but the remoteness of both DE1 and DE3 meant that spending could only occur at regional or national level (within the definitions of local and regional used). In all three cases, it was reported that local economic impact extended beyond the estate's primary spend as sporting parties and contract workers (e.g. forestry) visiting and working on the estates often stayed in the local area and spent money within the local economy. This additional impact related to both sporting parties and ecotourism visitors on DE2 and DE3 and specifically related to nature watching and ecotourism (including conservation training groups) on DE1.

5.5.3 Deer related staff costs

Table 5.27 shows the number of staff employed in all sporting activities and the estimated FTE component which is directly attributable to deer stalking and management. The staff employed on deer-related work (including seasonal/casual staff input) averaged 4 FTEs and ranged from 1.5 FTE on the small DE1 to 7 FTEs on the large DE2. Annual core staff costs relating to deer shooting and management averaged £3.77 per hectare (ranging from £2.92/ha to £6.28/ha) and when seasonal and casual staff contributions to the deer enterprises were added the total deer annual deer staffing costs were £4.69 per hectare or £90,000 at estate level. The deer-related staffing component had generally increased or been stable over the last 10 years. Table 5.27 also shows that total sporting employment was considerably higher on DE2 (9 FTEs) and DE3 (16 FTEs), due to additional estate work including grouse shooting and related management (DE2) and fishing and wider estate management (DE3). In both of these cases the specific work of the gamekeeping staff varies according to the timing of the stalking, shooting and fishing seasons and related required management. This allows for a larger number of staff to focus on deer stalking/management at certain times of the year, than is indicated by the total deer specific FTEs.

Table 5.27 Employment relating to deer and total sporting activity and related costs on deer estates

Category	DE1	DE2	DE3	Average
Core Sporting FTEs (deer-focused FTEs)	1 (0.6 deer)	9 (4.75 deer)	16 (4.25 deer)	**8.7 (3.2 deer)**
Core sporting job roles	Stalker	Head keeper, 6 keepers, 2 trainees	Head keeper, 7 stalkers, 8 ghillies	
Core deer staff costs	£15,600 (£3.90/ha)	£72,800 (£6.28/ha)	£109,550 (£2.82/ha)	**£72,050 (£3.77/ha)**
Seasonal/casual staff FTEs related to deer	1 trainee and 2 volunteer stalkers	0.5 FTE catering staff and 2.5 FTE seasonal stalking staff	1 seasonal stalker and 4 ghillies with some activity. 0.75 FTE total	
Total deer staff costs	**£24,600* (£6.15/ha)**	**£117,300 (£8.09/ha)**	**£126,950 (£3.27/ha)**	**£89,617 (£4.69/ha)**
Total deer specific FTEs (incl. seasonal/casual staff)	**1.6 (+ 0.7 unpaid)**	**7**	**5**	**4.3**

*Trainee wage costs (£9,000) covered by Scottish Government trainee support scheme

On DE1, unpaid volunteers also represented an important staffing component, equating to estimated indicative staff costs of £24,500. In this case the volunteers benefitted from gaining professional deer management qualifications and receiving venison. Seasonal/casual staff were an important feature on DE2 and DE3, including in relation to seasonal stalking staff and stalking related in-house catering on DE2 as well as seasonal ghillies and stalking assistants on DE3 (who provide support to gamekeepers during stag stalking season). Gamekeeping staff on DE2 and DE3 all lived in tied housing (with staffing spend predominantly localised) and receive additional expenses and the provision of a vehicle and vehicle-related costs. In a number of cases staff had young families. Stalking parties commonly made use of local accommodation providers. Both DE2 and DE3 perceived employment in the sporting enterprise (and wider estate employment) as their most critical contribution to the local economy due to the knock-on impacts in terms of community cohesion and staff living and spending in the local area. The deer enterprise (for DE2 and DE3) was considered part of a larger integrated sporting and deer management operation, with deer management facilitating employment of a larger team that could be used effectively to run different aspects on the wider estate at certain times during the year.

5.5.4 Deer revenues

Total annual revenue from deer stalking and venison varied on the three estates from £1.75 to £7.62 per hectare with an average of £4.59 per hectare (see Table 5.28). On average 51% of income related to commercial stalking with venison contributing 32% and deer stalking lets 17% (although this only occurred on DE3). Commercial hind stalking generated valuable stalking income on DE2 whilst contributing to the larger hind cull required for effective population management. Venison sales also represented an important component of income and were important in terms of part-funding deer population management (i.e. hind culls). None of the estates received any substantial public funding to support deer management, although both DE1 and DE3 noted that forest management grants (which they received) provided relevant support to mitigate deer impacts through payments for fencing repairs and replacement planting.

Table 5.28 Revenue from deer related activities on case study estates (average 2017-2019)

Category	DE1	DE2	DE3	Average
Commercial deer stalking income	N/A	£62,561	£73,000	£45,187
Sales - venison	£7,000	£47,917	£29,000	£27,972
Sporting lets (deer stalking)			£44,000	£14,667
Total deer revenues (per hectare)	**£7,000 (£1.75/ha)**	**£110,478 (£7.62/ha)**	**£146,000 (£3.76/ha)**	**£87,826 (£4.59/ha)**

Total revenues from commercial stalking (£62,000-£73,000) were arguably low in relation to the effort (number of staff days) required to deliver the stag return (i.e. 100-120 and 200 stag days on DE2 and DE3 respectively). The additional staff costs (not covered by revenues) were supplemented with income from other sporting and non-sporting activities including driven grouse (DE2), salmon fishing (DE3), owner input (DE2 and DE3) and renewable energy (DE2 and DE3).

5.5.5 Discussion and key points

In terms of direct spatial comparability of between different land uses, the area (hectares) reported for deer related to the whole estate in all three cases. This contrasts with the approach used, for example, in relation to grouse shooting which focused specifically on the area of moorland. This approach to the deer case study was, however, necessary as deer on the case study estates were not confined to moorland - also making use of forestry and woodland areas and moving across the majority of the estate area (as opposed to being solely restricted to the moorland zone like grouse). Whilst this simplifies the analysis it means that the 'per hectare' impacts are lower for deer than if only the moorland area was considered as the der management unit.

Table 5.29 summarises the data for the deer enterprises. The annual running and staff costs relating to deer stalking and management averaged £9.56 per hectare before any account was taken of capital investment, about £180,000 at average estate level. Annual deer costs ranged from £6.77 to £17.32 per hectare (with the higher annual cost on DE2 perhaps offsetting low annual capital investment). On average annual capital investment was £2.39 per hectare and the relatively low £1.28 per hectare on DE2 suggests deer management can be maintained without major ongoing capital investment providing infrastructure is in situ. Deer revenues were as low as £1.75 on DE1 where no commercial deer stalking took place, and with a strong commercial emphasis reached £7.62 on DE2.

When viewed in isolation, regardless of commercial orientation, deer operations operated at a substantial net business cost before any capital investment is accounted for. Deer enterprise losses were £4.97 on average (£95,000 at the average estate level) and ranged from £3.01 to £9.70 per hectare. The large scale of the operation on DE3 required the retention of a substantial related staff component year-round, supplemented by additional seasonal staff. Notably, as DE1 also made use of volunteer input equivalent to an additional £24,500 in staff costs the actual net costs for deer management of a similar site may be closer to £50,000 or £12.50 per hectare. It is apparent that despite venison sales and commercial deer stalking incomes deer management activities resulted in significant net costs to these case study businesses. Therefore, in the absence of any available public funding mechanism, stalking income represents a mechanism to supplement deer management costs with the additional costs of deer management being funded by other sporting activities (in a complementary/shared sporting operation), wider estate income (e.g. from renewable energy) or direct owner contributions.

Despite deer providing relatively low returns it was noted by the estate participants that deer revenues were relatively reliable and consistent, subject to long-term market demand. Furthermore, the shared funding model enabled the estates to maintain a larger year-round staff team (as opposed to relying more on seasonal staff). This ensured a high level of active management and a presence over what are very large areas of ground in the absence of significant levels of public funding with 1 FTE staff member covering between 1,700 to 7,700 hectares of hill ground. This employment (see Section 5.5.3) was considered by the estates to contribute important local socio-economic impacts, particularly in more remote locations (as was the case for DE3).

Table 5.29 Summary of annual costs and revenue on deer case study estates

Deer enterprise	DE1	DE2	DE3	Average
Estate size (and moorland area)	4,000ha (3,000ha moorland)	17,500ha (14,500ha moorland)	38,850ha	**19,117ha**
Annual deer cull	15-25 stags 50-75 hinds	143 stags 329 hinds 141 calves	200 stags 350 hinds 200 calves	**141 stags** **247 hinds** **170 calves**
Annual deer capital investment	£10,340 (£2.59/ha)	£18,502 (£1.28/ha)	£108,030 (£2.78/ha)	**£45,624 (£2.39/ha)**
Deer staff and running costs	£34,320 (£8.58/ha)	£251,169 (£17.32/ha)	£262,950 (£6.77/ha)	**£182,813 (£9.56/ha)**
Deer jobs (FTEs)	2.3	7	5.0	**4.8**
Deer revenue	£7,000 (£1.75/ha)	£110,478 (£7.62/ha)	£146,000 (£3.76/ha)	£87,826 (£4.59/ha)
Net deer balance - before capital	**-£27,320 (-£6.83/ha)**	**-£140,691 (-£9.70/ha)**	**-£116,950 (-£3.01/ha)**	**-£94,987 (-£4.97/ha)**
Hectares per FTE	1,724**	2,071	7,770	**4,005**
Income generated per £1 spent	£0.20	£0.44	£0.56	**£0.48**

*Includes £44,000 income from a long-term sporting lease
**If trainee and unpaid labour is included

Deer management was not perceived by the estate representatives as conflicting heavily with other estate land uses, although this related to ensuring deer populations were maintained at sufficiently low levels to facilitate native woodland regeneration in the case of DE1. On all three estates, deer management was carried out to facilitate and complement forestry and woodland management objectives, including locating future forestry and woodland to complement sporting interests. This complementary aspect of deer management was perceived as a key strength, with deer stalking and management facilitating a larger estate-wide staffing component due to alignment with other land uses (which also co-funded the relevant staff).

Specific constraints or challenges referred to by the deer case study enterprises included:

- Operating across large spatial scales, which required high levels of time and effort to ensure the ground was sufficiently covered. In some instances, this required input to more than one Deer Management Group, with related requirements in terms of sufficient deer counts and habitat impact monitoring, etc.
- These operational aspects equated to high running and staffing costs, with limited scope for offsetting operational costs against income from deer stalking and venison sales – necessitating a high level of ongoing financing from other sources.
- As deer operations often occurred in relatively remote rural settings, there was an ongoing challenge to ensure there was sufficient housing available for staff (with related cost implications exacerbated by the loss of housing to holiday homes in some areas).
- Challenges relating to habitat impacts (particularly on designated sites) and the resulting need for increased deer management.
- Communication challenges related to presenting alternative deer management models within Deer Management Groups (DMG) settings. Further, the general need for further, open, collaborative discussions and consultations relating to access and wider management changes at landscape scale.
- Difficulties relating to external/societal perceptions of deer management resulting at times in negative media coverage about necessary deer management (e.g. 'Bambi syndrome').

Some specific themes were referred to by the case study enterprises in relation to recent changes in the sector and related future opportunities. This included a perceived continual increase in the level of public scrutiny of deer management[41] and increased consideration of defining and assessing the public good aspects relating to deer and their management (e.g. positive and negative habitat impacts, deer vehicle collisions etc.). In particular, as DE3 noted, there was now a burden of proof on land managers to demonstrate the positive impacts of their management over time (for public goods outcomes). Three specific areas referred to by the case studies as being key to the future success of the sector were:

- Continuing and building on the work of Deer Management Groups. Collaborative working was referred to as challenging, but all three enterprises recognised that progress had been made in relation to demonstrating the role and value of DMGs and developing a more informed basis for sustainable management of deer at landscape scales through DMG management plans.
- Increased uptake and regular use of Habitat Impact Assessments to assess deer impacts (and related deer population management requirements) over the long term against baseline information (to facilitate adaptive management), particularly on high value/designated sites.
- Recognising and appreciating different perspectives on deer management within collaborative settings and the value and role of diverse/differing objectives at landscape scales. The emergence of some new landowners and groups was referred to by two participants as having increased the level of discussion around 'alternative' models for deer management in Scotland (e.g. population reductions in some areas sufficient to facilitate woodland regeneration in the absence of fences). Nevertheless, a compromise approach at landscape scales was referred to as critical to ensuring effective collaborative management.

DE2 and DE3 noted that increasing the level of public approval and sustainability of deer management represents an opportunity for the sector, as they currently manage large areas of land with considerable potential for peatland and woodland restoration and long-term carbon sequestration. This aspect, linked with the existence of established collaborative management frameworks (DMGs), offered future scope for delivery of public goods in line with potential future payments for ecosystem services (PES) delivery. In addition, the larger estates (DE2 and DE3) had both engaged in limited wildlife tourism which was recognised as a future opportunity. DE1 was currently investing in a nature-based interpretative initiative to increase visitor numbers and conservation-related revenue to the estate (through a café, visitor centre and education group visits).

5.6 Sheep enterprises using moorland areas

5.6.1 Characteristics and scale of enterprise

The sheep land use case study includes three as in-house sheep enterprises operated on mixed estates (SH2, SH3 and SH4) with one additional tenanted farm on a large mixed upland estate (SH1). The three estate sheep enterprises ranged from 2,000-4,700 hectares, with the tenanted farm (SH1) extending to 1,500 hectares, of which around 700-800 hectares was commonly used for sheep grazing (see Table 5.30). The enterprises were selected to include sheep enterprises with variable flock sizes and different operational contexts. All four enterprises operated within a wider estate context of commercial sporting, including driven and/or walked-up grouse and deer stalking. In all four cases, the estates also engaged in deer management, with hydro schemes established on SH2 and SH4 and tourism businesses on SH1 and SH4. For SH2, SH3 and SH4, the estates had been under the current ownership for between five and 15 years, and SH1 had a long-term tenancy agreement (99 years). SH1 also managed a cattle herd as part of their wider farm business.

[41] This specifically included the Scottish Natural Heritage Review of Deer Management in Scotland and the final report of the Scottish Government Deer Working Group.

Flock sizes varied from 650-2,450 breeding ewes with some variation in sheep numbers (and area of ground used) evident between years. Sheep breeds varied and blackface was common, with texels or texel/blackface crossbreeds also used. These sheep enterprises commonly made use of lower ground over winter and during lambing periods – but hill summer grazing took place. Lambing percentages were all between 95% and 105% - meaning there was around one lamb born per ewe on average. However, post lambing deaths meant that generally the number of successfully reared lambs were 10% lower. Some of the enterprises needed to purchase replacement breeding stock in some years where home reared replacements did not suffice (due to high mortality, low lambing percentages, etc).

Table 5.30 Management context and size of landholding and sheep area on case study estates/farms

Sheep	SH1	SH2	SH3[42]	SH4
Landholding/ enterprise summary	Tenanted sheep farming enterprise (part of larger mixed farming enterprise) operating on a large mixed upland estate.	Mixed estate including mixed sporting enterprise, farming and a hydro scheme.	Small upland mixed estate, grouse, sheep, woodlands and conservation objectives.	Mixed estate, including sheep, grouse and partridge shooting and deer stalking, farming (sheep), holiday lets and hydro scheme.
Landholding size (grazed moorland)	1,458ha tenant (720ha sheep)	4,732ha (4,562ha)	2,023ha (1,900ha)	3,200ha (2,500ha)
Sheep flock size (breeding ewes)	659	2,450	1,100	750

The motives for retaining sheep farming activities on all four case studies related to the desire to maintain an established activity as a component of the wider business model in which it operated. In the case of sheep farming it was considered financially feasible due to the availability of agricultural support payments and the ability to offset potential losses against gains in other areas/land uses. Related to this was the underlying rationale that sheep were considered complementary to other land uses on the estates/farm. This complimentary role included the potential for reducing tick numbers (for grouse populations), with tick mopping a factor in most cases (sheep flocks were also maintained on some of the grouse shooting case studies for this reason). Additionally, sheep farming was perceived as an established land use which represented an ongoing component of wider moorland management and facilitated retention of a farming interest (and employment) in the area and therefore a component of the 'estate community'. This complementary aspect was also an important factor for the mixed tenanted farm holding (SH1) in a number of respects:

i) Operating a mixed sheep and cattle enterprise ensured the available ground was fully utilised, as the cattle did not graze the hill ground and were over-wintered indoors. The sheep flock therefore ensured the ground was used during the winter months and that more marginal ground was utilised.
ii) This optimisation and balanced livestock mix were important in obtaining agricultural support payments under the Less Favoured Areas Support Scheme (LFASS), which related to the balance of the farm enterprise.
iii) As sheep are softer hoofed animals and selective grazers, grazing paddocks with sheep 'cleaned' the ground and reduced worm burdens for cattle later in the year, thereby reducing the requirement for pesticide treatments.

Cost allocations were generally fully related to the sheep enterprise. SH1 had previously carried out financial budgeting to correctly allocate their spending on cattle and sheep whilst the estate-based case studies all managed their sheep as distinct financial entities. One caveat in relation to the sheep

[42] Data provided for SH3 was based on 2018 figures as opposed to an accurate three-year average. 2018 was considered typical in a number of respects, although it should be noted severe 2018 winter weather conditions are likely to have increased overwintering and feed costs.

enterprises and direct comparability to the other land-use case studies is that sheep flocks often make preferential use of more grassy and less heathery areas of moorland (in contrast to grouse, for example), although the grazing often occurs within the same general 'moorland area' as alternative moorland uses, at least on a seasonal basis. The extent to which sheep flocks were kept on the hill and largely within the moorland zone can vary between holdings and established flocks are often hefted to certain locations on the hill linked with productivity and shelter. Additionally, more detailed financial data was available from some participants (SH1 and SH2), with less specific detail available for SH3 and SH4. Nevertheless, all four enterprises are included here and discussed further below.

5.6.2 Capital and recurrent expenditure

The case study enterprises provided investment and running cost data for the previous three years. Table 5.31 reveals that on average annual capital costs for the sheep enterprises was £6.75 per hectare (based on capital depreciation schedules or actual expenditure). Very little capital expenditure (£2.40/hectare) took place on SH4's sheep enterprise where a sub-contractor managed the estate flock and provided their own equipment (the £6,000 capital costs mainly related to fencing). In contrast on SH3 (£15.79/ha) some housing repairs and fencing had taken place and there was an allocation of farm vehicle depreciation. On the relatively small SH1 the capital costs related to some property repairs and their depreciation schedule for farm equipment and it was noted that the landowner also made some capital investment on infrastructure. Participants reported that the majority (over 80%) of capital spending occurred within the local area or wider region.

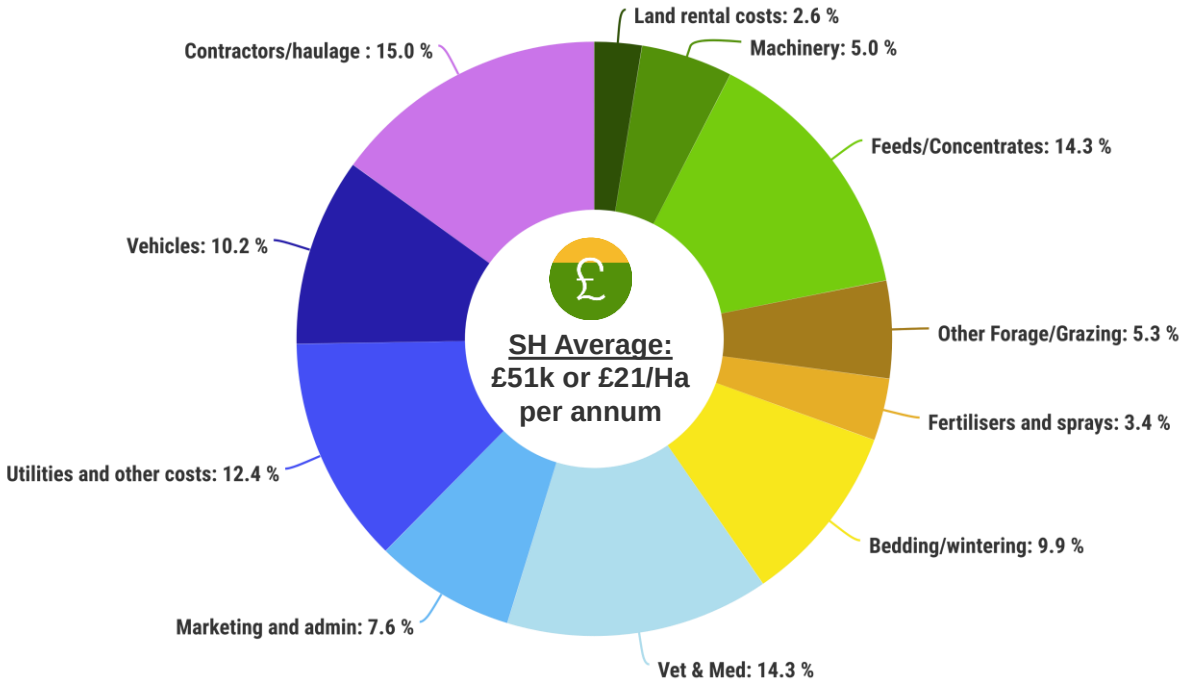
Table 5.31 Annual capital investment and non-staff running costs relating to moorland sheep case studies

Sheep	SH1	SH2	SH3	SH4	Average
Annual sheep capital investment (per hectare)	£7,079 (£9.83/ha)	£25,285 (£5.54/ha)	£30,000 (£15.79/ha)	£6,000 (£2.40/ha)	**£16,341 (£6.75/ha)**
Non-staff sheep running costs (per hectare)	**£29,935** (£41.58/ha)	**£72,451** (£15.88/ha)	**£60,000** (£31.58/ha)	**£43,500** (£17.40/ha)	**£51,471** (£21.26/ha)
Stocking density (ewes per hectare)	0.92	0.54	0.58	0.30	**0.52**

Table 5.31 also shows the annual running costs associated with the case study sheep flocks. On average non-staff running costs were £21.26 per hectare based on half a ewe per hectare stocking density. On the smaller tenanted SH1 running costs were £41.58 per hectare and this farm had the highest stocking density (0.92 ewes per hectare) of all the case studies. SH2 (£15.88) and SH4 (£17.40) had lower per hectare costs and SH4 had the lowest ewe grazing density overall. SH3 reported running costs per hectare of £31.58, despite a similar stocking density to SH2. It was noted that relative land qualities, efficiencies of scale and a requirement for haulage on SH3 were all factors that impacted on these annual running costs.

Figure 5.19 shows the basis for annual non-staff running costs based on the average across the four sheep enterprises. The largest cost item on average was livestock feed/grazing (20%) with 14% coming from bought in feed and 6% from on-farm forage/grazing costs. Contractors / haulage were the next largest cost on average (15%) and this was a particular feature on SH3 and SH4. Veterinary and medicine costs (14.3%), wintering costs (10%), vehicle running costs (10%) and utilities and other costs (12%) were also important features across all the farms. Rental costs of only 3% reflected the fact that only one in four of the enterprises were tenanted (which is slightly higher than the average tenancy rate across Scotland). Feed/concentrate costs were particularly high on SH3, which may relate to elevated costs due to the severity of 2017/8 winter weather conditions experienced. Recurrent spending was seen as occurring predominantly in the local area or wider region, subject to availability although it was noted that whilst feedstuff and fertilisers may have been purchased locally, their production likely occurred outside the area or country.

Figure 5.19 Distribution of running costs directly related to the average sheep enterprise



5.6.3 Staffing costs and revenue

The number of FTEs employed within the sheep enterprises varied from 0.5 on SH1 to 2.4 on SH2 (see Table 5.32). SH1 was a family-run tenanted farm and the majority of labour input to the sheep enterprise was unpaid owner labour. The recorded wage represented a component (20%) of a wage paid to the farmer's son to work on the farm as a whole (where the majority of work related to the cattle enterprise). This reflects the non-wage systems that self-employed / family farms often operate under – instead drawing from profits retained on the farm business. This is reflected by the low per hectare labour cost recorded on SH1 (£2.69) compared to around £18 per hectare on both SH2 and SH3 and the lower figure of £9.20 per hectare on SH4 reflecting their greater use of contractors.

The labour input to the sheep enterprises was considered relatively stable in recent years. The overall FTE inputs to sheep enterprises were relatively low, the largest sheep enterprise (with a flock of 2,450) directly employing two full-time shepherds and an additional 40% of the time of a general handyman being accounted for by the sheep enterprise. Notably, both SH3 and SH4 spent £10,000 and £20,000 on contractors and haulage, with all labour-related expenditure generally occurring within the local area. SH2 also provided additional figures for related employment costs which included an additional spend of £5,289 on casual labour, £393 on training and £1,557 on pension and expenses costs.

Table 5.32 Employment (FTEs) in sheep enterprise and related direct wage costs (three-year average)

Sheep	SH1	SH2	SH3	SH4	Average
Number of direct sheep FTEs	0.5	2.4	1.5	1.0	**1.4**
Total sheep staffing costs	£1,936[43] (£2.69/ha)	£82,256 (£18.03/ha)	£35,000 (£18.42/ha)	£23,000 (£9.20/ha)	**£35,348 (£14.69/ha)**

[43] This £1,936 figure represents the 20% (0.2 FTE) of the staff costs paid to the farmer's son only and does not include the unwaged labour element (an additional 0.3 FTE) for the sheep enterprise provided by the farmer and his wife.

Sheep enterprise staff were, in some cases, accommodated in tied housing and received additional expenses and the provision of a vehicle and vehicle-related costs.

Table 5.33 shows the average annual revenue streams (including market returns and CAP support payments) for the case study sheep enterprises. Sheep returns from the market averaged £20.69 per hectare and the values for individual case study enterprises were correlated to their stocking density with SH4 lowest at £11.40 per hectare and SH1 highest at £38.59 per hectare. On a per ewe basis the average return was £40.39 and there was only £7 per ewe difference between all the enterprises.

Table 5.33 also reveals that Common Agricultural Policy (CAP) support payments made up more than half of all income streams (average 66%) on all farms with the exception of the tenanted SH1 (41%) where CAP receipts were the lowest at £26.42 per hectare. This contrasted with SH4 where total CAP support was £47.37 per hectare (all direct support of LFASS) and SH4 where payments were £45.80 per hectare (with £9.80 per hectare coming through a targeted agri-environment scheme). The higher market returns and lower CAP receipts on SH1 averaged out meaning that it had the second highest overall return per hectare (£65.01). On average the sheep enterprises in their totality generated revenue of £60.72 per hectare on average – with a high of £73.68 per hectare (SH3) and a low of £56.57 per hectare (SH2).

Table 5.33 Recurrent annual expenditure (three year average) directly related to sheep enterprises

Revenues (Outputs) and Subsidies	SH1	SH2	SH3	SH4	Average
Livestock Sales	£28,017	£104,340	£50,000	£27,500	**£52,464**
Replacement Cost	-£6,958	-£14,130	£0	£0	**-£5,272**
Sundry Income	£5,624	£312	£0	£0	**£1,484**
Wool sales	£1,102	£3,473	£0	£1,000	**£1,394**
Sheep output - less replacement costs	**£27,785 (£38.59/ha)**	**£93,995 (£20.60/ha)**	**£50,000 (£26.32/ha)**	**£28,500 (£11.40/ha)**	**£50,070 (£20.69/ha)**
LFASS	£8,095	£56,707	£15,000	£10,000	**£22,451**
Direst payments (BPS, SFP, LMC, SUSS)	£9,044	£99,175	£75,000	£80,000	**£65,805**
Environmental Scheme	£1,886	£8,198	£0	£24,500	**£8,646**
Total CAP support	**£19,025 (£26.42/ha)**	**£164,080 (£35.97/ha)**	**£90,000 (£47.37/ha)**	**£114,500 (£45.80/ha)**	**£96,901 (£40.03/ha)**
Total Returns (Total output + CAP)	**£46,810 (£65.01/ha)**	**£258,075 £56.57/ha)**	**£140,000 (£73.68/ha)**	**£143,000 (£57.20/ha)**	**£146,971 (£60.72/ha)**
CAP as % of Total Returns	**41%**	**64%**	**64%**	**80%**	**66%**

5.6.4 Discussion and key points

Table 5.34 summarises the available data for the sheep enterprises. Costs and revenues vary between the enterprises, linked with stocking density and scale of enterprise. In general, these enterprises generated a profit before capital investment considerations of £25 per hectare on average (ranging from £21-31 per hectare). However, when CAP support payments were removed from the revenue component all of these sheep enterprises returned losses, with average losses at £15 per hectare before capital costs. Excluding CAP support, these losses ranged from £6 to £24 per hectare before capital investment costs were considered highlighting the heavy dependency public support (66% of revenue on average) to ensure their financial viability.

Overall capital costs varied between enterprises, which partly related to use of contractors (which reduced capital needs) on SH4. Some interviewees recognised that initial capital (set-up) costs were comparatively low for sheep enterprises relative to other land uses (e.g. grouse, renewables, forestry) although initial flock investment could indeed be costly. Recurrent/ongoing costs for feed, wintering and machinery, were a significant component of costs and review of data on three-year costs and

revenue for SH1 and SH2 demonstrated that these costs varied considerably between years, subject to bad weather events, livestock replacement rates due to lamb losses, and variable feed and fuel costs. The level of FTE/staff spending depended on the scale of the enterprise and level of farmer input and whilst FTEs employed on SH3 and SH4 were relatively low, additional spending occurred on contractors to account for this labour gap.

Table 5.34 Summary of costs and revenue on sheep enterprise case studies

	SH1	SH2	SH3	SH4	Average
Flock (breeding ewes)	659	2,450	1,100	750	**1,240**
Grazed area (ha)	720	4,562	1,900	2,500	**2,420**
FTE impacts	0.5*	2.4	1.5	1.0	**1.4**
Sheep capital costs	£7,079 (£10/ha)	£25,285 (£6/ha)	£30,000 (£16/ha)	£6,000 (£2/ha)	**£16,341 (£7/ha)**
Sheep Running Costs (incl. staff)	£31,871 (£44/ha)	£154,707 (£34/ha)	£95,000 (£50/ha)	£66,500 (£27/ha)	**£87,019 (£36/ha)**
Total revenues and CAP payments	£46,810 (£65/ha)	£258,075 £57/ha)	£140,000 (£74/ha)	£143,000 (£57/ha)	**£146,971 (£61/ha)**
CAP payments	£19,025 (£26/ha)	£164,080 (£36/ha)	£90,000 (£47/ha)	£114,500 (£46/ha)	**£96,901 (£40/ha)**
Balance of costs/ revenues (incl. CAP before capital costs)	**£14,939** (£21/ha)	**£103,369** (£23/ha)	**£45,000** (£24/ha)	**£76,500** (£31/ha)	**£59,952 (£25/ha)**
Balance of costs / revenues (excl. CAP before capital costs)	**-£4,086** (-£6/ha)	-£60,712 (-£13/ha)	-£45,000 (-£24/ha)	-£38,000 (-£15/ha)	**-£36,949 (-£15/ha)**
Revenue from support payments (%)	41%	64%	64%	80%	**66%**
Hectares per FTE	1,440ha	1900ha	1,266ha	2,500ha	**1,793ha**
Revenue (including CAP) per £1 running cost (including CAP)	£1.47	£1.67	£1.47	£2.15	**£1.69**

*Although 60% of this figure is unpaid labour input

The participating enterprises generally recognised that spending across all categories was predominantly in the local area or wider region, with livestock sold at local markets and feed and fertilisers sourced locally. An important impact was recognised as the retention of farming opportunities and agricultural employment (including supporting local agricultural contractors) in rural areas, albeit at relatively low levels. The participating enterprises faced a range of constraints, with the key constraining factors outlined as:

- The low profitability of sheep enterprises and dependence on agricultural support payments to ensure financial survival. This was compounded by uncertainty linked to Brexit and potential impacts on agricultural support in the medium term.
- The recent and immediate impact of Covid-19 reduced sheep prices dramatically (by 30-40% as of March 2020), limited the availability of markets (including export markets) and led to increased social isolation of farming families.
- Despite relatively low set-up and capital costs, recurrent costs (inputs, feed, machinery, etc.) for sheep enterprises are often high, relative to comparatively low returns in some cases.
- This sustained level of input costs can be compounded by livestock losses through predation, seasonal mortality and livestock theft (with sheep rustling a growing problem in some parts of Scotland). Livestock losses reduce farm output, profitability and therefore business substantially.
- These factors can be compounded during periods of extreme weather events (such as the 'Beast from the East' in 2018), which increased livestock losses and increased requirements for (and spending on) supplementary feed and bedding.
- While sheep were often referred to as a complementary land use, some participants recognised the potential for loss of grazing land to other land uses (e.g. forestry) and conflicts between grazing sheep flocks and designated sites (which was sometimes compounded by increasing deer numbers and related impacts on vegetation and woodland regeneration).

Despite the challenges faced by sheep enterprises, the complementary aspects of sheep strengthened its perceived (as well as actual financial) value to estates through the potential for contributing to outcomes relating to other agricultural, sporting and/or conservation land management. Specific future directions and opportunities for hill sheep enterprises highlighted by participants included:

- Increasing the efficiency of sheep operations through technical input, advice and analysis of where financial losses are incurred (e.g. during lambing, weaning, rearing phases) and where costs can be reduced and output increased, using a benchmarking approach.
- Modifying existing livestock systems to increase outputs, including changes in livestock breeds to match livestock to specific farm/site conditions.
- Consideration, where appropriate, of rotational grazing systems (division of grazing into smaller fenced units) to allow for periods of grass recovery and continual rotation of livestock to higher quality (high energy and protein) new growth grass.
- Promotion of lamb as a high-quality meat product and adding value to outputs through local sales (e.g. farm shop diversification).
- Building on the low capital (set-up) costs for sheep enterprises (and relatively rapid development of turnover), availability of seasonal grazing and the current downturn linked to Brexit and Covid-19, to facilitate increased numbers of new entrants (as existing farms become available due to disruption) to sheep farming in Scotland.

5.7 Renewable energy initiatives

5.7.1 Background

The renewable energy case study draws on data and information relating mainly to three hydro schemes (HEP1-HEP3) and three wind farms (WIND1-WIND3). The hydro schemes were all located on estates used in relation to grouse or alternative land use case studies within this report. Two of the wind farm case studies also used wind farm information provided from other case studies, with some partial information obtained for a separate wind farm case on a landholding not included in any of the other case studies within this report.

This approach was taken due to difficulties in obtaining information and financial data relating to renewable energy schemes on estates not previously contacted for other land-use case studies. Some additional, partial, information was also drawn from the other land use case studies where the participant commented on an existing renewable energy installation on their property. Across all the case studies included in this report, eight had installed hydro schemes, with two estates having installed multiple hydro schemes (four in one case and two in the other). In all eight cases, the hydro schemes were located on mixed estates with sporting interests (commonly including grouse and deer).

The hydro and wind energy developments described here were generally located on upland sites. This included hydro schemes from which the related catchment constituted, or included, areas of managed moorland. In addition, in all three wind farms examples were located on moorland/montane sites, and the land was also managed for driven grouse on two estates (WIND1 and WIND2).

In terms of comparability to other moorland uses, the wind farm areas were therefore broadly comparable as being located on sites currently or previously (partly or wholly) used for driven and/or walked-up grouse shooting. For both WIND1 and WIND2, the areas around the wind farms were continuing to be managed for grouse shooting.

In contrast to the other land uses reviewed in this report, renewable energy schemes (particularly wind farms) were commonly developed by energy companies as opposed to being developed and managed by the landowner and/or their direct employees. Unlike other case studies, the development costs, and related risk, for large wind farms were therefore absorbed by the energy company. The revenue generated for the landowner was normally accrued in the form of land rental payments based on an agreed rate per megawatt (MW) of energy generated. This rental was provided for one of the

wind farms shown in Table 4.41 and used with supplementary data to estimate returns for the other case studies.

Hydro schemes followed different models, including the landowner funding the capital costs with ongoing maintenance provided by a relevant company (on a contract basis) and the landowner accruing income through energy sales and Feed in Tariff (FIT) payments. The data and views presented below is primarily from the landowner perspective in each of the case studies, with some additional data and qualitative input from one wind energy company.

The primary motivation for developing renewable energy enterprises on all the landholdings was to generate income and improve the long-term financial security of the landholding. In relation to hydro schemes, although the initial capital costs were perceived as high, these were balanced against potentially strong (and reasonably reliable) returns, once the initial investment had been paid off.

In one of the larger driven grouse shooting case studies, revenue from hydro schemes was sufficient to offset the deficit created by other estate enterprises, thereby enabling the estate to break-even annually. Hydro schemes therefore represented a long-term investment, with the capacity to subsidise estate staff costs and deficits arising from other activities over the long-term[44] although the extent of this impact related to the size and/or number of hydro schemes installed.

Revenue generated from wind farm rents was also referred to in two cases as having ensured the long-term financial sustainability of the estate. As one landowner noted, the decision to permit a wind farm development primarily related to the wind energy capacity, their existing on-going running and investment costs, available financial resources and their positive attitude to renewable energy. Improving the carbon footprint of this estate was also referred to as a motivating factor, with this outcome viewed as a fortunate by-product for longer running schemes, which helped align estate activities with government policy.

Collated information on relevant hydro and wind energy schemes is presented in two separate sections below, with partial data used in some cases.

5.7.2 Hydro scheme enterprises

In all three cases, the hydro scheme developments were located on mixed estates with sporting (grouse and deer) and farming enterprises. As Table 5.35 shows, the capital (installation) costs ranged from £675,000 to £2.5 million (and averaged about £4,000 per kW installed capacity). In addition to the initial installation cost, HEP1 also incurred a further significant capital outlay in relation to remedial works (costing £300,000) to replace piping which had been damaged through incorrect installation seven years after the initial installation. The initial investment costs for even relatively small-scale schemes (under 100kW) were therefore substantial, with the case study schemes experienced higher establishment costs than the average range for smaller scale hydro schemes across the UK of (£250,000-500,000)[45]. These higher costs related, in part, to the remote location of the case study schemes and the level of site engineering required as a result - with engineering works (including road access and penstocks) the largest component of capital costs (about 50% as illustrated in

Figure 5.20) for HEP1 and HEP2.

[44]A factor also noted in a study of small-scale hydro schemes in Wales which also considered four Scottish cases See Bere et al. (2015) The Economic and Social Impact of Small and Community Hydro in Wales.

[45] See: British Hydropower Association (2012) A Guide to Mini Hydro Developments.

Figure 5.20 Breakdown of total capital installation costs for two specific hydro schemes (HEP1 and HEP2)

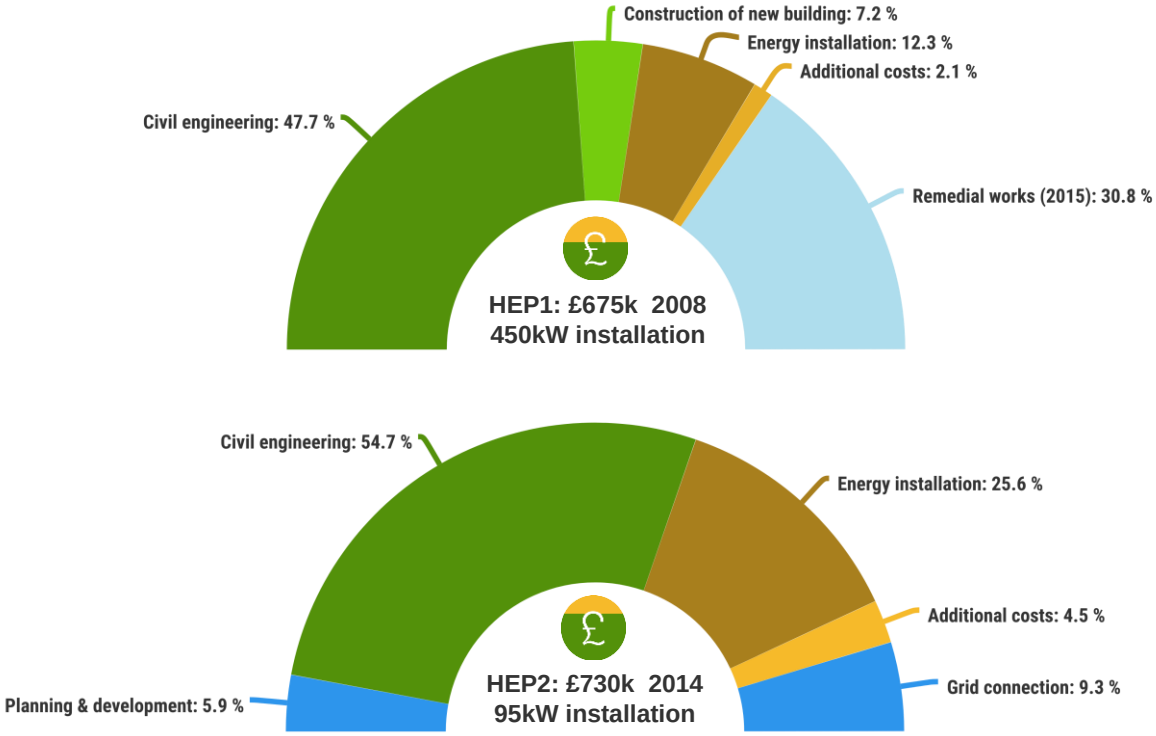


Table 5.35 breaks down the costs and revenues associated with the three hydro schemes, illustrating the balance between an initially high capital investment cost against moderate running costs and relatively high longer-term returns. Based on these case studies, running costs (including staff costs) for schemes of this size range averaged £37,000 (or £107 per kW installed capacity). The running costs consisted of a combination of business rates, insurance, an annual maintenance fee and administration and software costs. The higher operational costs for HEP3 partly related to the annual cost of a rental agreement (over £30,000) for part of the relevant catchment area and a higher level of administration and accounting costs. In addition to annual maintenance, hydro schemes required a degree of ongoing regular input/basic maintenance including checking and cleaning of operational components. This required estate staff input, equating 0.17 FTEs per annum on average. The level of staff input was, however, variable and depended on site-specific challenges and maintenance. The level of capital depreciation was also provided for HEP3 (2%), and the annual depreciation cost of £110 per kW installed capacity, is not shown in Table 5.35.

To provide an illustration of the balance of capital costs against revenue over time, Table 5.35 includes an indicative calculation of annual costs and revenue for an initial 15 year period (assuming a 15 year capital repayment period) and projected costs and revenues after this period. This demonstrates the long-term potential for hydro-electricity to provide a sustained long term source of estate income against comparatively low ongoing running costs. On an average hydro installation of 348kW the net return was £266 per kW installed capacity during the 15-year capital repayment period, rising to £428 per kW installed capacity after the initial capital had be repaid. The difference in the Government scheme revenues between case studies in Table 5.35 related mainly to HEP1 receiving payments under Renewable Obligation Certificates (ROCs), with HEP2 and HEP3 receiving payments at higher rates through the Feed in Tarriff (FIT). In all three cases regionally located contractors were mostly used meaning a significant proportion of the total capital expenditure undertaken, and the majority of ground works, occurred within the local area or region.

Table 5.35 Hydro scheme related costs, staffing and revenues for three estate-based hydro schemes

	HEP1	HEP2	HEP3	Average
HEP installation	450kW installed 2008	95kW installed 2014	500kW installed 2014	**348 kW**
Capital cost (£/kW)	£975,000* (£2,167/kW)	£730,000 (£7,684/kW)	£2.5 million (£5,000/kW)	**£1.4 million (£4,024**/kW)
Capital costs annualised to 15 years	£65,000	£48,666	£166,666	**£93,444**
Annual running costs	£20,000	£11,404	£80,112	**£37,172**
FTE impact (labour needs and cost)	0.1 FTE (£2,000)	0.1-0.2 FTE (£2,000)	0.25 FTE (£6,000)	**0.17 FTE (£6,230)**
Projected annual costs first 15 years	£87,000	£62,070	£246,778	**£99,674**
Projected annual costs after 15 years	£22,000	£13,404	£86,112	**£43,402**
Revenue energy sales	£80,000	£22,000	£76,716	**£59,572**
Revenue from Govt schemes **(ROCs of FIT Payments)**	£70,000	£75,000	£253,123	**£132,708**
Total revenue [46]	**£150,000 (£333/kW)**	**£96,000 (£1,011/kW)**	**£329,829 (£660/kW)**	**£192,280 (£552/kW)**
Balance of costs/revenue – including capital repayment	£63,000 (£140/kW)	£33,930 (£357/kW)	£83,051 (£166/kW)	**£92,606 (£266/kW)**
Balance of costs/revenue - after 15 yrs. life	**£128,000** (£284/kW)	**£82,596** (£869/kW)	**£243,717** (£487/kW)	**£148,878 (£428/kW)**
Revenue per £1 spent (first 15 years)	£1.76	£1.54	£1.33	**£1.93**
Revenue per £1 spent (after 15 years)	£7.50	£7.16	£3.83	**£4.43**

*Remedial works totalling £300,000 in 2015 increased overall capital costs for this site from the initial investment of £675,000. For the purposes of the indicative 15-year revenue/costs projections the combined capital costs (£975,000) figure is used as opposed to the initial investment cost.

Annual income estimates were also provided for hydro schemes on two of the estates used as grouse shooting case studies (both within the 300-500kW range), with these annual incomes reported as between £200,000-£300,000. These returns did not account for capital repayment, running costs nor depreciation and assumed no further capital costs in the short-medium term (hydro installations often require some degree of remedial works over longer-term periods - as demonstrated with HEP1

5.7.3 Wind farm developments

The three wind farm examples shown Table 5.36 in were all located on medium-sized, mixed estates (3,000-7,000ha), all of which had a combination of sporting (grouse and deer), farming and forestry enterprises. WIND1 and WIND2 were large wind farms (with both consisting of over 90MW of installed capacity), and WIND3 was relatively smaller-scale wind development.

All three installations were developed, and were managed by, a large renewable energy company. The related capital costs of development were therefore absorbed by these companies and varied from £8 million to £200 million. There is therefore variability in development costs for onshore wind (i.e. costs per installed MW), a factor reflected in wider studies[47]. This high level of capital costs was the

[46] These are generally in the range of illustrated published figures: https://www.renewablesfirst.co.uk/hydropower/hydropower-learning-centre/how-much-income-would-my-hydro-system-provide/

[47] See: Biggar Economics (2012) Onshore Wind Direct & Wider Economic Impacts. May 2012.

key factor in limiting direct landowner investment into large-scale wind farm development, with the risk and investment costs instead passed on to the energy developer in these three cases.

Notably, while turbine construction often occurred at national/UK level (or internationally), civil engineering works were noted as using local and regional contractors in each case shown in Table 5.36. In the case of WIND2, this related to spending of over £20 million on a regional contractor to deliver the groundworks for the site, including road upgrading and new estate roads, a substation site, turbine bases, cabling and drainage works.

The ongoing operational and staffing costs for large wind farms were not obtainable for the wind case studies. However, an economic assessment of onshore wind conducted in 2012 concluded that the average cost for onshore wind farms for maintenance and operational costs was £52,659 per installed MW per annum, 29% of which was spent in the immediate local area and 65% in the wider region[48]. This would suggest operational costs for the two larger wind farms in Table 5.36 of around £4.8-£5 million on an annual basis, although it is acknowledged that wind farm running costs can vary significantly relating to site-specific constraints and other factors, with energy company staff often working across multiple sites.

The estimated FTE impacts (energy company employees) for the wind farms shown in Table 5.36 are broad/indicative FTE estimates only (with collated site staffing data again limited), and critically do not include the shorter-term, but significant, employment impacts during the construction phase.

For the two larger on-shore wind energy developments there were also wider, localised, long-term socio-economic impacts delivered through community benefit funds. For WIND1 a community benefit fund was established to distribute community benefit payments from the wind farm developer to the local community, including an initial capital sum and approximately £700 per MW produced thereafter. This resulted in annual payments to the community (with a population of 200) in the region of £600,000-£700,000 that support local community benefit projects. A similar fund was established for WIND2, with expectations that £6.2 million of funding for local projects will be distributed between 2015 and 2040.

Revenues to the energy developers/companies were not provided for the cases study developments shown in Table 5.36. However, extrapolation from revenue ranges provided by Renewables First (for 2019) [49] can be used to estimate generalized energy company returns for large onshore windfarms. Based on a per turbine revenue return (at low to moderate mean wind speeds) for a 3MW turbine of £286,000-£578,000, a 40 turbine wind farm (120MW installed capacity) would generate, on average, between of £11-£23 million annually in energy. Based on the median wind speed range this suggests an estimated total return over a 25-year operating period of £578 million (or £192,000 per MW per year). This should be considered against a total capital build cost of £200 million in the case of WIND2, and estimated annual operational costs of £5-6 million (or £125-150 million over a 25 year life cycle), in addition to annual rental payments.

Wind farm revenues for landowners related to rental payments, as part of a long-term lease agreements for the lifetime of the developments. The payments were based on an agreed return per MW and often a minimum payment rate that is required to be paid regardless of electricity production level. These payments were ordinarily negotiated with consideration for prevailing energy prices and existing rates paid on other sites. In a wind power in agriculture energy briefing in 2015, the National Farmers Union suggested typical wind farm rental values were in the range of £4,000-£5,000 per MW of installed capacity, ordinarily paid quarterly as a variable fraction of total gross income from energy sales in any given year[50]. This range reflects figures provided for WIND1 -for consistency the estimated

[48] See: Biggar Economics (2012) Onshore Wind Direct & Wider Economic Impacts May 2012

[49] See here: https://www.renewablesfirst.co.uk/windpower/windpower-learning-centre/how-much-wind-energy-income-would-a-wind-turbine-provide/

[50] See: https://www.nfuonline.com/assets/46020

revenue range of £4,000-£5,000 per MW was been used for all three revenue calculations in Table 5.36.

It should be noted that lease agreements vary considerably based on a variety of factors. Actual rental payments may be lower or high in each of these cases and annual payments can vary due to differences in mean wind speed.

Table 5.36 provides an illustration of indicative landowner wind farm rental incomes ranging from £147,000-£184,000 per annum for the smaller wind farm (WIND3) to £368,000-£470,000 for the two larger wind farms. An indicative per hectare revenue rate to the landowner is also shown in Table 5.36, both for the wind farm area (the main footprint of the windfarm site) and based on the total hectarage of the estate. On average these wind farms generated between £217 and £272 per hectare for landowners based on the wind-farm footprint, or £49 to £61 per hectare across the whole estate.

Table 5.36 Wind farm details including installation costs, staffing and estimated landowner revenues

	WIND1	WIND2	WIND3	Average
Year built	2005-2006	2014-2017	2010-2012	
Installed capacity	40*2.3MW turbines 92MW capacity	33*2.8MW turbines 94MW capacity	16*2.3MW turbines 36.8MW capacity	**74MW**
Windfarm area / turbine size	2,000ha 60m hub height	1,800ha 80m hub height	300ha 65m hub height	**7,367ha**
Installation cost (capital costs)	£60 million	£200 million	£7.93 million	**£89 million**
Estimated direct FTEs	6-8 FTEs	6-8 FTEs	2 FTES	**5 FTEs**
Landowner revenues*	**£368,000-£460,000**	**£376,000-£470,000**	**£147,200-£184,000**	**£297,000 - £371,000**
Landowner revenues per/ha wind farm (/ha estate)	**£184-£230 (£82-102)**	**£208-£261 (£67-83)**	**£490-£613 (£18-£23)**	**£217 - £272 (£49 - £61)**

*Based on an estimated rental payment range of £4,000-£5,000 per installed MW 391+402

5.7.4 Discussion and key points

The indicative revenues to landowners from large scale wind farm developments and, to a lesser scale, estate-based hydro schemes suggest long-term revenue gains from renewable energy can be significant. In several of the cases within this report, income generated from renewable energy schemes was perceived as a key component of ensuring long-term estate financial viability. From a comparability standpoint, it should be noted that the wider visibility and access-related footprint of the windfarm is greater than the actual main wind farm area. The high per hectare revenue calculations shown in Table 5.36 were elevated by the more confined nature of a wind farm site relative to the extensive areas of moorland managed and used for grouse shooting and deer stalking that tended to have comparatively low per hectare returns, even in cases where estate sporting revenues are higher than average. However, the opportunity for increasing the extent of on-shore wind development is limited by a number of socio-political factors, including designated sites.

The small number of wider economic impact studies referred to above show that while leakage to the UK level relating to installation costs for wind farms can be reasonably high, the high level of total investment results in significant regional level economic impacts and additional local community benefits through community benefit schemes. Additionally, in all three hydro scheme examples presented here, local and regional contractors were used for the civil engineering works, with the 'local embeddedness' of construction and development phases for hydro schemes also identified within a UK wide review of small-scale hydro scheme impacts[51]. Although direct employment relating

[51] See Bere et al. (2015) The Economic and Social Impact of Small and Community Hydro in Wales

to large wind farms may be significant in a rural context, direct local employment impacts appear low relative to indicative annual operational costs and the actual related capital spend of wind farm installations (relative to on-site staff costs as a proportion of total costs in the case of most other moorland land uses, for example).

The participants in the renewable energy case studies referred to a number of wider challenges related to renewable energy developments, which included:

- The high initial capital costs of renewable energy development. These were borne by energy companies in the case of wind farms but either taken on fully (or shared through some form of partnership agreement) by the landowner in the case of hydro scheme developments. Hydro schemes therefore represented a major capital outlay, often compounded by challenging operational contexts and the requirement for major civil works, with associated financial risks. Risks of requiring future remedial works (reducing long term projected gains) were also identified.
- Potential declining performance of hydro generation over time, related to factors such as build design and fouling of screens, which can require high levels of staff input/maintenance.
- Uncertainty relating to weather conditions which can affect both mean wind speeds and river flow rates, which can impact directly on energy revenues - with extreme weather events potentially damaging energy installations and related infrastructure.
- Additional uncertainty was evident relating to longer term rates renewable energy support payments (e.g. FITS) for hydro schemes, which had already declined in recent years. A further concern related to the quality and capacity of local grid connections and the total volume of energy which can be placed on the grid, creating uncertainty around the potential for further energy developments.
- The potential/perceived landscape and environmental impacts of renewable energy (and related perceived impacts on tourism) were mentioned, with a presumption that wind farms in particular will not receive planning consent in certain areas (e.g. National Parks and Wild Land Areas). Additionally, planning requirements for renewable energy schemes of any scale were viewed as complex and challenging in practice.

Despite the scale of large wind farms (and challenges noted above), the estates generally viewed wind energy as relatively compatible with their other estate land uses, including deer stalking, sheep grazing and grouse shooting. Financial losses in other estate activities as a direct consequence of wind farm development were therefore considered to be low. In WIND1 and WIND2, for example, agreements had been put in place to ensure any related restrictions on grouse shooting (and associated income) and related management were minimised, with grouse witnessed nesting directly under the turbines.

Grouse shooting was, in at least some cases, continuing to occur in the vicinity of the turbines, with the two land uses referred to as *"working well together once you have an agreement in place and you do some health and safety with shooting parties around the particulars of shooting near a wind farm".* Further specific strengths and longer-term opportunities linked to renewable energy enterprises identified by participants included:

- The potential for local and regional economic impacts were perceived as significant during the build phase for renewable energy installations. In addition, from the landowner perspective, this capital investment occurred with low associated financial risks.
- A perception that wind farm developments aligned strongly with government policy on climate change, which had the potential for impacting wider public opinion on wind farms more generally.
- A general perception that renewable energy schemes (hydro and wind) offered a relatively reliable long-term return relative to some other land uses. This had, in a number of the case studies reviewed for this report, resulted in a sustained additional cashflow which increased

overall estate financial viability by providing support for wider estate land uses and related spending and employment.

- Increased technological capacity which offered greater scope for remote assessments of hydro scheme performance in combination with on-site assessments, for example.
- The related civil engineering works often increased estate road networks and therefore accessibility to the estate for management related to other land uses.
- The longer-term potential for expansion and or re-powering of renewable energy schemes and in particular extensions to existing wind farm developments (requiring new planning and development, etc.). This had or was occurring on some sites, including the addition of further turbines or installation of alternative larger turbines increasing the overall wind farm lifecycle timeline and potential energy output.

6 Case study synthesis and conclusions

This section summarises the findings of the case studies and incorporates wider evidence to examine the economic impacts of different moorland land uses in further detail. To address the first research objective, Section 6.1 examines the direct economic impacts of walked-up and driven grouse shooting and their importance for rural economies. Section 6.2 addresses the second research objective and reviews the economic impacts of 'alternative' moorland land uses, comparing and contrasting these impacts with impacts from grouse shooting. Relevant wider evidence is used in this section to highlight indirect and wider public benefits or impacts of land uses where necessary. A fuller consideration of indirect effects, as well as public costs and public good values, using a similar case-study based framework, offers scope for future studies.

Table 6.1 provides a summary overview of the key costs, revenues and staffing levels for each of the moorland uses as presented and examined in the case studies. The importance of the wider context of these stand-alone enterprises cannot be underestimated as the owners of businesses did not consider each type of land use in isolation, rather they contributed to a holistic estate business model. Equally, the summarised figures relating to public funding contributions in Table 6.1 only relate to the specified land use and a low or zero percent figure does not imply that the estate within which the specific land use/enterprise sits is not receiving any public funding in relation to other activities (e.g. farming, conservation). Furthermore, some estate land uses which may be receiving public funding (e.g. sheep grazing) overlap with, complement, and form part of the management of the moorland area over which grouse shooting and other activities may be taking place. In addition, landowners may also be receiving public funding for deer fencing however, this is generally recorded as relating to forestry management as opposed to deer revenues.

Table 6.1 Comparative socio-economic indicators for the moorland land uses derived from case studies

Impact	Walked-Up Grouse	Driven Grouse	Forestry	Woodland creation (15yr scheme)[52]	Conservation	Deer stalking	Sheep	Renewables - Hydro[53]	Renewables -Wind
Case study enterprises	4	4	1	3	2	3	4	3	3
Average annual capital costs	£10,465 (£2/ha)	£59,096 (£8/ha)	£173,000 (£41/Ha)	£32,924 (151/ha)	£153,815 (£10/ha)	£45,624 (£2/ha)	£16,341 (£7/ha)	£1.4M (build cost); (£93,444 over 15yrs) (£4,024/kW)	£89M (developer) costs (n/a)
Average running costs (incl. staff costs)	£61,247 (£11/ha)	£219,292 (£30/ha)	£102, 056 (£24/ha)	£26,548 (£122/ha)	£480,284 (£29/ha)	£182,813 (£10/ha)	£87,019 (£36/ha)	£37,172 (n/a)	Est. £4.8-5M for larger examples (n/a)
Average revenue	£26,281 (£5/ha)	£147,916 (£20/ha)	£220,000 (£53/ha)	£63,039 (£290/ha)	£313,816 (£19/ha)	£87,826 (£5/ha)	£146,971 (£61/ha)	£192,280 (£552/kW)	£334,000 (£245/Ha wind farm or £55/Ha estate)
Hectares per FTE / average FTEs	**4,685 (1.2)**	**1,446 (5)**	**4,000 (1)**	**n/a**	**2,100 (8)**	**4,005 (4.8)**	**1,793 (1.4)**	**n/a (0.2)**	**n/a (5)**
Net balance (before capital)	**-£34,966 (-£6/ha)**	**-£71,375 (-£10/ha)**	**£117,944 (£28/ha)**	**£36,491 (£168/ha)**	**-£166,468 (-£10/ha)**	**-£94,987 (-£5/ha)**	**£59,952 (£25/ha)**	**£148,878 (£428/kW)**	**n/a**
Net balance (capital included)	**-£45,431 (-£8/ha)**	**-£130,472 (-£18/ha)**	**-£55,056 (-£13/ha)**	**£3,567 (£16/ha)**	**-£320,283 (-£20/ha)**	**-£140,611 (-£7/ha)**	**£43,611 (£18/ha)**	**£92,606 (266/kW)**	**n/a**
Average revenue (%) from public funding[54]	**0%**	**0%**	**47%**	**86%**	**79%**	**0%**	**66%**	**69%**	**n/a**
Level of local-regional spending	**Moderate /High**	**High**	**Low/ Moderate**	**Low/ Moderate**	**Moderate/ High**	**High**	**High**	**Moderate/ High**	**Moderate**
Revenue per £1 spent	**£0.43**	**£0.67**	**£2.15**	**£2.37**	**£0.65**	**£0.48**	**£1.69**	**£1.93 (£4.43 after payback)**	**n/a**

[52] Data relates to annual costs and revenues averaged over 15 years. Average annual costs and per/ha costs are considerably lower over a full rotation.

[53] Average annual running costs and revenues exclude the initial capital costs – but the net balance including repayment of capital investment is shown over 15 years

[54] The public funding contributions only relate to the specified land use **and a low or zero percent figure does not imply that the estate within which the land use/enterprise sits did not receiving any public funding in relation to other activities (e.g. farming, conservation).** Furthermore, some estate land uses which may receive public funding (e.g. sheep grazing) overlap with, complement, and form part of the management of the moorland area over which grouse shooting and other activities may take place. Landowners may also receive public funding for deer fencing but this is generally recorded as relating to forestry management as opposed to deer revenues.

6.1 Economic impact of grouse shooting

6.1.1 Expenditure impacts

The case studies show that expenditure levels and impact from grouse shooting varies widely, linked to the size of the moorland and sporting operation and relative commercial emphasis. **Driven grouse shooting requires a sustained level of capital spending**, in the region of £60,000 per year (or £7 per hectare) in order to sustain adequate grouse habitats and populations. Despite recognition that grouse numbers increase estate capital values, decision makers on the case studies appeared to be less influenced by capital value effects with their main focus ensuring the continuation of grouse shooting opportunities.

On average the on-going non-staff running costs varied, from around £30,000 per year (£5 per hectare) for walked-up to £100,000 (£14 per hectare) for a driven operation. This compares to the average annual grouse moor non-staff running costs estimated from FAI (2010) of £9 per hectare[55], and the annual non-staff management costs of £23 per hectare for the grouse moor at Langholm (see Section 5.2.5). With labour costs included the total annual running costs averaged £11 per hectare for walked-up and £30 per hectare for driven compared to £55 per hectare at Langholm and an estimated £17 per hectare FAI (2010).

It is evident that there is high variability in the economic impacts of grouse moors linked to operational scale and intensity. However, when capital, running and staff costs were combined, on average the annual costs for walked-up were £13 per hectare (£72,000 at estate level) and £38 per hectare (£278,000 per estate) for driven grouse (see Table 6.1) – comparable with £29 per hectare reported on average across Scotland by FAI (2010). These case study figures are, however, low compared to £51 - £120 per hectare in the Monadhliath and Angus Glens (core grouse shooting areas) reported by Mc Morran et al. (2015) and £515,000[56] (excluding wages) per estate recorded by the Scottish Moorland Group (Thomson et al., 2018). The later higher average SMG figures may be due to the group including larger moors and/or the inclusion of capital costs or costs difficult to disaggregate from other sporting and estate activities (with the driven grouse case studies averaging over £400,000 annual total costs for all sport before wider estate costs were considered).

6.1.2 Employment impacts

The direct employment impact of walked-up was considerably lower than for driven shooting across the case studies**.** The average wage related to grouse activity was £27,000 per FTE for walked-up and £21,000 per FTE for core driven grouse staff (dropping to £20,000 per FTE when all seasonal staff were included). This compared to £16,000 per grouse FTE reported for FAI (2010) and £22,000 (plus £5,000 housing cost) per FTE at Langholm.

On a per hectare basis the average staff costs of £6 per hectare for walked-up and £14 per hectare for driven grouse) appear similar to the £8 per hectare average grouse-specific staff costs estimated from FAI (2010). However, these figures were low in comparison to Langholm (£26 per hectare) recognising that the Langholm projects was working to re-establish a driven grouse moor and therefore required higher than average staff input. As shown in the case studies and Thomson et al. (2018), staffing impacts can include a significant seasonal component and employees working across other estate activities, making the direct attribution of time and spend to grouse shooting challenging.

The case studies illustrate differences in labour intensity, from around 4,700 hectares required per FTE for walked-up to 1,450ha per FTE for driven grouse. Reflecting their larger sample, FAI (2010) suggested an impact of around 1 FTE per 2,600 hectares, while research in the Angus Glens and

[55] Estimates based on the average area of grouse moorland (80% of the reported heather area) and the running costs of the 76 estates submitting data with grouse moors.

[56] Scottish Moorland Group unpublished report. Related material available here: http://www.scottishmoorlandgroup.co.uk/grouse-shooting

Monadhliath identified grouse-specific employment impacts of around 1 FTE per 1,400 hectares (Mc Morran et al. 2015). **This represents a higher employment impact for grouse than most other moorland land uses** (see Table 6.1), although employment impacts vary in relation to scale and commercial activity. Both the case studies in this report and Phase 1 of this research (Thomson et al. 2018) suggested **an upward employment trend for the sector since the mid-1990s.**

6.1.3 Locality of spending

Reflecting findings from Phase 1 (Thomson et al. 2018), 60-80% of direct spending in the case studies occurred in the local or regional area. Importantly, as impacts vary considerably, **grouse shooting is likely to be of greater importance as an employer, and in relation to local spending and community retention, in areas where driven grouse shooting is prevalent**. The case studies illustrate the wide range of businesses used by grouse shooting enterprises, which generates additional economic impacts from induced and indirect effects (not quantified here). As noted in Phase 1 (Thomson et al. 2018), further impact occurs in relation to visitor spending (accommodation and shooting parties), although the grouse shooting season is relatively short and in some cases visitors may stay confined to their chosen estate.

6.1.4 Revenue

In the cases studies, revenues were generally lower than spending levels, from around £26,000 (or £5 per hectare) for walked-up to around £190,000 (averaging £20 per hectare) for a driven enterprise (see Table 6.1). The £46 per hectare revenues reported by Mc Morran et al. (2015) for the Angus Glens and Monadhliath indicate the revenue potential when grouse operations are sufficiently commercialised Nevertheless, whilst larger operations can generate annual revenues exceeding £250,000, **the case studies demonstrated that walked-up and driven shooting are rarely profitable as stand-alone land uses due to high costs.** This reflects wider findings (e.g. PACEC, 2014; Hindle et al., 2014) that reinforce that **costs generally outweigh revenue, or at best result in a break-even position during good years.**

As identified in Phase 1 of this research (Thomson et al. 2018), **income is also highly cyclical, depending on the availability of shootable surpluses of grouse**. Measures undertaken to moderate population fluctuations, including tick mopping and medicated grit, are viewed as having reduced population fluctuations to some extent. FAI (2010) also identified a longer-term trend of increased commercial activity and increased revenues related to higher prices. Nevertheless, the case studies demonstrated a recent substantial decline in grouse numbers in parts of Scotland, suggesting population fluctuations (and revenue unpredictability) remain a 'normal' aspect of grouse operations.

As evident from the case studies, management intensity varies considerably between walked-up and driven grouse, with walked-up shooting requiring less intervention and operating with lower grouse numbers. Nevertheless, sustaining walked-up shooting still requires a base-level of management not dissimilar to much of what occurs on driven moors (i.e. heather burning, predator control, etc.). Revenues generated from walked-up shooting were considerably lower than from driven grouse, on a per brace basis and per shooting day. Expenditure and staffing levels on walked-up enterprises were generally considerably lower, indicating that **any shift from a driven to a walked-up enterprise would likely result in reductions in staffing and spending impacts.** Nevertheless, as evidenced here, walked-up shooting represents a valued complementary activity within mixed sporting enterprises and can be sustained at a lower cost than driven grouse.

Importantly, while grouse shooting is often unprofitable, the revenue generated allows estates to subsidise wider moorland and estate management through employment of a larger staff contingent capable of working on different activities throughout the year. **Estates therefore operated an integrated financial model, with losses in one area offset by profits in another (e.g. renewable energy), to ensure the overall viability of the estate and different land uses over time**. **Grouse shooting requires an ongoing spending commitment from owners which generates local economic**

and employment impacts. This generally requires additional private financing, often derived from other estate-based activities. **This may include activities which generate revenues from both sales/outputs (e.g. venison, commercial stalking and shooting, timber etc.) and public grants or subsidies (e.g. CAP payments, FIT payments, wind farm lease agreements etc.).**

Notably, grouse shooting can generate significant local-level impacts without the need for direct input from public grants and subsidies. Nevertheless, while direct revenues are potentially high on commercialised moors, they are lower than for some other moorland land uses and relatively unpredictable. **The high level of ongoing investment suggests that any substantial reduction or loss of driven shooting could affect the viability of other estate activities (e.g. deer management) and/or result in reduced employment in regions where driven grouse shooting is most prevalent**.

Alternative land uses offer scope for replacing some of this loss of local economic impact, although this may result in a higher requirement for public spending. As Matthews et al. (2018) stated in Phase 1 of this research:

> "*There are holdings that […] appear to specialise in little else, others in which driven grouse can be a substantial element in a mix of enterprises and others where it is a minor part of an enterprise mix […]. This means the consequences of any policy, regulatory or management prescriptions are likely to vary strongly between businesses, and the ex-ante estimation of effects will be non-trivial"* (p.1).

6.2 Economic impacts of other moorland uses

This section synthesises the economic impacts of 'alternative' moorland land uses (Sections 5.3 to 5.7) incorporating relevant wider evidence where available.

Higher relative spending and revenue levels (and/or financial viability) for land uses do not necessarily imply greater levels of local economic impact or a higher level of future uptake of the land use among landowners. Socio-economic dimensions represent one set of drivers, with a range of other environmental, landscape and biophysical factors constraining moorland land uses and the potential for land use change differently in different parts of Scotland (see Matthews et al. 2018).

As shown in the case studies, moorland land uses are not mutually exclusive and the extent of usage (total hectarage) can be difficult to estimate accurately due to the very extensive nature of some activities (e.g. deer management). Additionally, while care was taken to select comparable case studies (in relation to moorland specificity and related constraints), the level of direct comparability as 'alternative' options for moorland areas varies[57]. These comparability aspects have been discussed within the case studies and will be considered again below.

6.2.1 Forestry and woodland creation

The forestry enterprise case study is less directly comparable to other moorland land uses due to the productive forestry components being located on lower ground areas. This reflected the assessment of alternative options for grouse moors in Phase 1 (Matthews et al. 2018), which concluded that **land capability for forestry is typically low on holdings with grouse butts present** and *"areas considered unsuitable for trees with any expectation of delivering harvestable timber are substantially greater than the areas considered as having very little agricultural value"* (p.1). Nevertheless, Matthews et al. (2018) also found that **substantial areas with limited or very limited flexibility for forestry on grouse moors exist**, but this should be assessed against the relative potential for delivery of public/private benefits from different afforestation options. The woodland creation case studies partly addressed this need, in presenting costs and revenues related to woodland creation for biodiversity and/or game interests.

[57] Sheep flocks may utilise lower ground areas for example, deer herds may range beyond the moorland zone (and indeed onto other properties) and productive forestry is often located on lower/less constrained ground.

Forestry and woodland creation are capital intensive, relative to most other moorland land uses (due to high establishment costs), with a lower level of ongoing running and staff costs. The woodland creation examples had establishment costs of £450,000-£500,000 for a 200ha native woodland (about £31 per hectare over an 80 year rotation). The total per hectare spending impacts from the forestry enterprise example (£66 per hectare) is similar to the forestry spending of £74 per hectare based on £10.5 million spend for a sample of over 200 estates reported by Hindle et al. (2014). Based on the case studies, **the proportion of spending in the local area/region from forestry and woodland creation is lower than for most other land uses**, reflecting the use of non-local labour squads during establishment and national contractors during harvesting phases.

The **employment intensity for the forestry case study (4,000 hectares per FTE) was comparatively low relative to most other land uses**, suggesting a low labour demand for forestry outside peak plantation and harvest phases. Nevertheless, Confor (2018) identified that 400ha of conifers and 50ha of broadleaved woodland can generate 2.5 FTEs over a full rotation - a similar employment impact to an equivalent sized hill farm. Whilst Hindle et al. (2014) reported and average of 1,242 hectares per FTE for Scottish estates the low employment impact evident in the forestry case study may be a reflection of the high level of biophysical constraints (and very long rotations) on the case study estate.

The revenues generated for the forestry case study were relatively high (£53 per hectare) reflecting the felling and grant income that this case study's forestry phase was in - only sheep and renewables had higher per hectare revenues. As with sheep farming and conservation, forestry revenues were heavily reliant on public grants, with grant aid of even greater importance in upland/marginal contexts where production cycles are very long. **Woodland creation therefore comes at a high cost to the public purse relative to some other moorland land uses, although this should be considered against the potentially considerable public benefits and ecosystem services derived from woodlands**[58] - particularly in the context of the climate emergency. Notably, the figures from Hindle et al. (2014), suggest revenues of £90 per hectare were achievable across all Scottish estates woodlands.

As Hindle at al. (2014) noted, the level of commercial forestry activity and direct timber and grant revenue varied considerably and often estates were at different stages in the investment cycle. While direct comparisons of forestry and farming suggest a higher overall rate of return for forestry (e.g. see Bell 2014), this often relates to forestry in less marginal settings on shorter rotations. As Matthews et al. (2018) noted, forestry in the uplands faces considerable environmental constraints, which impacts on long-term financial viability. Nevertheless, the woodland creation examples in Section 5.3 indicate that, based on current planting grants and projected carbon revenues**, woodland creation for biodiversity/game on marginal ground is broadly comparable (over an eighty year rotation) on a per hectare annual return basis to other moorland land uses.**

6.2.1.1 Revenue from carbon sales

Projected returns from carbon sales through the Woodland Carbon Code[59]**, when combined with competitive planting and management grant rates, represent a critical component of the future long-term viability of woodland creation on marginal sites.** Notably, the carbon value calculations in Section 5.3 were based on conservative estimates for total carbon sequestered (of 200 tonnes CO_2 per hectare over the rotation) to account for constrained sites. Haw (2017) suggested a sequestration rate of 330 tonnes of CO_2 per hectare for a broadleaved woodland (planted for biodiversity/game), which at a carbon price of £3-6 per tonne equates to a per hectare return of £1,000-£2,000 over the life of a woodland (or around £200,000-400,000 for a 200ha scheme). Importantly, carbon prices in 2020 are in the region of £7-20 per tonne[60]. **Taking the mid-point for carbon values (£13.50) and a**

[58] See for example Burton et al. (2018) Reviewing the evidence base for the effects of woodland expansion on biodiversity and ecosystem services in the United Kingdom.
[59] See: https://www.woodlandcarboncode.org.uk/
[60] Based on personal communication with Woodland Carbon Code staff.

sequestration rate of 100-200 tonnes per hectare, suggests a higher rate of return of £270,000-£540,000 for a 200ha native woodland could be achieved that reported in the case study[61]. Carbon prices vary and depending on payment timescales may also be affected by inflation and therefore require discounting[62].

Despite constraints, the availability of carbon revenues has the potential to substantially alter the economic viability of woodland creation on moorlands, given their normally low potential for generating timber revenues[63]. As Haw (2017) stated, based on analysis of carbon sale values for five woodland types "*net present value for woodland creation increased by around 40–70% for some projects and enabled other projects to produce positive returns"* (p.1). Nevertheless, it should be recognised that **long-term woodland creation schemes for primarily biodiversity (and carbon) objectives are likely to deliver lower per hectare employment impacts than grouse shooting and other moorland land uses**, with economic impacts relating to longer term management costs also comparatively low. Additionally, many moorland sites may be unsuitable for woodland creation due to environmental factors or designations. **Owner/manager uncertainty relating to carbon revenues and uncertainty around long-term management costs on marginal sites, may also constrain uptake**. Furthermore, forestry and woodland creation is perceived as a very long-term investment, which can impact negatively on other estate land uses including sporting (e.g. through increasing cover for predators). **Wider estate objectives and the loss of ground for other land uses are therefore key factors influencing future uptake of woodland creation on moorland sites**.

6.2.2 Conservation and landscape-scale ecological restoration

Conservation management occurs at different scales and in relation to different species and habitats across a range of landholdings. Hindle et al. (2014) reported that, from a sample of 277 estates, 109 reported claimed to engage in conservation, including in relation to moorland management (e.g. for waders), peatland restoration and native woodlands. This often occurred in mixed estate settings in parallel with other commercial and non-commercial land uses. Conservation also occurs as a primary objective on some private, NGO and public landholdings. For example, conservation NGOs owned 207,000 hectares of land in Scotland in 2013 - managed for conservation and recreational purposes (Mc Morran et al. 2013).

The larger estate example in Section 5.4 demonstrated the potential for conservation **to deliver a high level of spending and employment impacts relative to other land uses.** This included a capital spend component equivalent to or greater than a large sporting estate. Notably, this was one of the largest estates studied in the research project, and a significant proportion of estate expenditure was attributed to conservation meaning total spending levels contrasted considerably with the smaller scale conservation example.

The average **spending impact across the two conservation sites (capital, running and staff costs combined) of £39 per hectare was comparable to that of driven grouse (£38), but lower than for sheep and forestry** (see Table 6.1). In comparison, Hindle et al. (2014) reported £16 per hectare conservation expenditure over 109 estates. This contrasts with the spending impacts reported for conservation NGOs in Scotland of £37 million or £181 per hectare on all site management, with these much higher spending levels related to the small size of many NGO-owned sites and high additional spending on visitor management (Mc Morran et al. 2013). For example, the RSPB manages over

[61] The rate of return is also affected by the degree to which the landowner undertakes validation and carbon assessments or contracts this to an agent/consultancy, such as Forest Carbon: https://www.forestcarbon.co.uk/

[62] The process of determining the present value of a payment which may be received in the future. The Woodland Carbon Code has developed a discounting calculator for carbon to develop more accurate long term assessments of revenues: https://www.woodlandcarboncode.org.uk/landowners-apply/template-documents

[63] Carbon sales contracts also normally require that the 'project end' amount of sequestered carbon be maintained within the woodland after the project duration, although thinning/felling for woodland management purposes can be accounted for in the original carbon calculation.

150,000 hectares of land in Scotland, spending £243 per hectare on site management[64]. In comparison, SNH manages 43,000 hectares of reserves with operational costs of £1.5 million (or £35 per hectare)[65] and the Scottish Wildlife Trust manages 20,000 hectares at a cost of around £1 million or £50 per hectare. Conservation spending levels are therefore highly variable, reflecting the different levels of emphasis, resourcing, and variability in the scale of the approach. Given this range, **the £39 per hectare average from the case studies may be broadly representative of spending levels in upland contexts**. Notably, **the overall proportion of spending in the local area/region was marginally lower than for some other land uses** – but this, in part, reflected the remote locations of the estates.

A wide range of employment impacts from conservation was also apparent, with the case studies suggesting an impact of one FTE per 2,100 hectares, compared to an impact of one FTE per 6,000 hectares (on private estates) recorded by Hindle et al. (2014), and a much higher level of one FTE per 281 hectares recorded for NGO-owned land managed for conservation (Mc Morran et al. 2013). The results from the larger case study example combined with the evidence from conservation initiatives in Hindle et al. (2014), demonstrate that conservation management can occur at different scales and in both conservation-focused and mixed landholding settings whilst providing opportunities for additional employment (e.g. in nature-based tourism).

Revenues from conservation **were comparatively low on average (£19 per hectare) relative to most other moorland land uses**, with the exception of deer and walked-up grouse (Table 6.1). This finding mirrored the relatively low level of revenue (£11 per hectare) from conservation management recorded in the Hindle et al. (2014) study. **Conservation management therefore generally operates at a net cost, despite benefitting from substantial public funding,** with the case study and national estates survey (Hindle et al., 2014) suggesting that over **80% of conservation revenue is sourced from public funding.**

Critically, **CAP payments represent an important funding component for conservation management**. The RSPB, for example, received £4.5 million in CAP payments (at UK level) in 2017[66] and conservation-focused private estates benefit from agricultural subsidies[67] particularly as the current Basic Payment Scheme permits an environmental audit as a measure of 'activity'. This reliance on public funding suggests future uncertainty relating to Brexit, as well as a growing requirement for owner/organisational input or site-based revenue generation. As demonstrated by the larger conservation estate example, **tourism represents a potentially key area of future income for conservation** (generating over £260,000 in this case). This has been constrained in 2020 due to the Covid-19 pandemic, creating some uncertainty around the longer-term potential of tourism to provide additional revenues. Notably, generating income from visitors brings additional costs and can be challenging without accommodation. High visitor numbers can also generate additional management and facility costs. Other potentially complementary land uses include sporting (e.g. walked up grouse) at low intensities.

Conservation land management can have considerable additional economic impacts through attracting visitors into the surrounding area. SNH-owned National Nature Reserves attracted 610,000 visitors in 2016[68] for example, with over four million people visiting NGO owned sites in Scotland annually, generating local impact of between £28 million and £106 million (Mc Morran et al. 2013).

Importantly, the case studies did not considered or quantify the positive or negative externalities arising from moorland land uses. Societal benefits can occur from conservation management, for example, relating to the provision of recreational opportunities and educational benefits. A pilot

[64] See https://www.rspb.org.uk/globalassets/downloads/about-us/rspb-annual-accounts-2017.pdf
[65] See: https://www.nature.scot/snh-annual-report-and-accounts-2017-18
[66] £676,652 in Scotland, £3,403,664 in England and £446,456 in Wales. http://cap-payments.defra.gov.uk/Default.aspx
[67] Phase 1 of this research (Thomson et al. 2018) identified one conservation-focused estate which had received £205,000 in direct support payments and £170,000 in rural development support under the CAP in 2016-2017.
[68] https://www.nature.scot/snh-annual-report-and-accounts-2017-18

natural capital assessment for SNH-owned land estimated that, excluding tourism impacts, natural capital benefits (on 56,000 hectares) were valued at £500 per hectare (Dickie et al., 2019). As such, **while conservation generally operates at a net cost and requires a high level of public investment, the potential for additional visitor impacts in the local economy and natural capital benefits, suggest that conservation may represent good value for money relative to other moorland land uses.**

Notably, the retention and management of moorland areas is a form of conservation land management (in maintaining a specific form of land cover/habitat). The conservation case study focused specifically on sites where the primary aim was conservation and where management may include reduced intervention, peatland and woodland restoration, reduction of grazing pressure, species-specific measures and management of designated sites for explicit conservation goals. Further **conversion of management on moorland sites (i.e. including the cessation of driven grouse) towards a primary conservation goal is likely to be heavily influenced by owner motivations or a change in ownership, the availability of public funding, and the potential to generate revenue from complementary activities to offset costs (e.g. tourism)**. Declines in other land uses may also result in opportunities for conversion, in parallel with the availability of payments for ecosystem services.

6.2.3 Hill sheep farming enterprises

Sheep farming (Section 4.6) is commonly perceived as a complementary estate land use in relation to tick mopping, muirburn compatibility, biodiversity benefits of low intensity grazing, and for increasing efficiencies in mixed livestock farm enterprises. Relative to some moorland land uses the **set-up costs and ongoing capital investment costs for sheep farming are low**, reducing the potential for local economic impact. Ongoing running on a per hectare basis were broadly comparable with driven grouse and conservation (although considerably lower on a total enterprise costs basis) and these can increase during poor winters due to feed, bedding and livestock replacement needs.

The average total **capital, running and staff costs for sheep enterprises was £43 per hectare, which was comparatively high relative to most other moorland land uses** (see Table 6.1). This is lower than the Scottish average of £98 per hectare (£58 of which is from support payments)[69], reflecting the higher level of physical constraints in upland estate contexts and low stocking densities. The lower stocking densities limit employment impacts, with the case study enterprises generating around 1 FTE for every 1,800 hectares. This compares to an average employment impact of 1 FTE per 514 hectares for sheep farming across Scotland[70] and 1 FTE per 1,446 for driven grouse (Section 5.2). While the case studies suggest spending impacts are highly localised, economic and job creation impacts from sheep farming can vary, with low ground farms delivering higher direct impacts.

Despite there being many constraints for hill sheep farming, total revenues per hectare and returns per £1 spent in the case studies (averaging £61 and £1.69) were relatively high compared to other moorland land uses (Table 6.1). CAP support payments were fundamental to the financial viability of sheep enterprises, with the majority of revenue in all cases (averaging 66%) derived from payments under various schemes. Furthermore, the performance of sheep enterprises can vary widely across Scotland, with 27% making a loss in 2016/17 despite commonly utilising an unpaid/family labour component (Thomson et al. 2016).

The reliance on CAP support and importance of lamb exports to the EU present future challenges in light of Brexit and have been exacerbated from challenges related to the Covid-19 pandemic. Changes to the CAP regime also resulted in longer term reductions in stocking densities and removal of livestock from hill ground in parts of Scotland[71], with this abandonment of marginal agricultural land replicated across Europe (Perpiña Castillo et al. 2018). This **shift in land use is perceived by some as**

[69] Scottish Government (2017) Published Specialist Sheep Farm Data. https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/2017docs

[70] See previous footnote.

[71] For a full review see: https://www.sruc.ac.uk/info/120484/support_to_agriculture_archive/54/2008_farmings_retreat_from_the_hills

an opportunity for large-scale ecological restoration (see for example Pereira and Navarro, 2015). Broader opportunities may therefore exist in relation to capturing future markets for ecosystem services. Importantly, while some species may benefit for the removal of livestock, others may be negatively affected and some areas of High Nature Value farmland in Scotland may experience reductions in biodiversity (Holland et al., 2011). **Despite declines in livestock numbers, and subject to the continuing availability of support payments, the complementarity of sheep farming in mixed estates contexts and the potential for supporting new agricultural entrants (due to low set up costs), suggests it remains a viable moorland land use going forward.**

6.2.4 Deer stalking and deer management

Deer management is an essential management activity, with deer population reductions undertaken to limit negative impacts on habitats and other land uses (e.g. forestry, agriculture), reduce deer vehicle collisions and for deer welfare. Relative to other moorland land uses, deer management is particularly extensive, with 44 Deer Management Groups in Scotland's red deer range, covering around three million hectares (Albon et al. 2019). Deer densities vary across Scotland, with the approach to deer management often reflecting a combination of existing deer densities and wider estate objectives. This results in a varying degree of emphasis on commercial (and recreational owner) stalking and 'in-house' deer population management (Putman 2012).

Based on the case studies, **initial investment and ongoing capital costs are lower than for driven grouse** (averaging £2 per hectare). Large deer management and commercial stalking operations have relatively high ongoing/operational and staff costs (around £200,000-£250,000). Despite this, relative to other land uses **the deer case study enterprises exhibited the lowest overall spending levels (capital, running and staff costs combined) on a per hectare basis of £12 per hectare** (see Table 6.1). This partly reflects the extremely large scales over which deer management occurs (as opposed to low overall costs in relative terms). These spending levels corroborate the deer management costs for Scotland reported by PACEC (2016) of around £14 per hectare (based on the hectarage of the main DMG areas). The PACEC study also identified a similar proportion of total spend on staffing (43%) relative to the case study examples, suggesting **staff costs are a consistently high component of costs**. Reflecting the extensive nature of deer management and commercial stalking, **the employment impact on a per hectare basis (1 FTE per 4,005 hectares on average) is low relative to other land uses**, with the exception of walked-up grouse (Table 6.1). This was supported by PACEC (2016), which estimated 1 FTE for every 4,000ha of the DMG area[72].

Based on the case study examples, the **average revenue of around £5 per hectare** from deer (even where estates had large commercial stalking enterprises) was low in comparison to other moorland land uses, with the exception of walked-up grouse shooting. This confirms the PACEC (2016) report, which identified total revenues for deer enterprises across Scotland of **£4 per hectare.** As in the case studies, this revenue was split between venison sales and commercial stalking, with an additional income from sporting lets. The costs of deer operations are therefore generally not fully offset by revenues[73], with the case study examples exhibiting **the second lowest overall return (£0.48) per £1 spent across the moorland land uses** (Table 6.1).

Notably, deer populations can cause considerable damage to public interests and high deer densities on designated sites remain a concern in many parts of Scotland[74]. Nevertheless, **the case study**

[72] An estimate, derived by dividing the total DMG area (not including lowland DMGs) by the PACEC FTEs estimate.

[73] With Scottish Natural Heritage also concluding deer management operations generally ran at a nest cost to the landowner. See: SNH (2016). Deer Management in Scotland: Report to the Scottish Government from Scottish Natural Heritage, October 2016. https://www.nature.scot/deer-management-scotland-report-scottish-government-scottish-natural-heritage-2016

[74] For a recent detailed review see: Pepper et al., (2020) The management of wild deer in Scotland: Deer Working Group report.

examples were not receiving additional public funding to support deer management[75], except for some specific measures under the Forestry Grant Scheme (relating to deer fencing). Within the case study examples, revenues from deer stalking and venison were perceived (to an extent) as a by-product of a necessary management activity and insufficient to cover costs. **This absence of direct public funding for deer management contrasts with the public support obtained by the sheep and conservation enterprises reviewed here**. As a result, **income from driven grouse shooting, tourism and/or renewable energy enterprises often provides a component of the underlying spend on deer management as an essential management activity and/or commercial enterprise.**

6.2.5 Hydro electricity and wind energy

Relative to other moorland land uses, renewable energy schemes require a high level of initial capital investment (averaging around £1.4 million for hydro schemes and significantly more for wind farms). Nevertheless, ongoing annual running costs for hydro schemes were comparatively low (averaging around £37,000) relative to the initial investment and running costs for other moorland land uses. Notably, economies of scale exist, with the cost per kilowatt generally decreasing as size increases as fixed cost elements tended to remain similar between smaller and larger schemes. The very high capital and running costs for large wind farms are reflected elsewhere in Scotland, with a total construction cost for the Crystal Rig II 138MW windfarm in Southern Scotland (built in 2010) of £168 million (Biggar Economics 2013) and annual operational costs in the region of £6.7 million per annum (Biggar Economics 2012), which included £500,000 for site maintenance that was retained in Scotland. This broadly reflects an assessment of the potential economic impacts of the Harryburn wind farm in South Lanarkshire, which suggested operational costs in the region of £2.8-£3.6 million per annum (for a 54-69MW wind farm proposal) (MKA Economics, 2017). Critically, in contrast to hydro schemes and other moorland land uses, **the capital and recurrent costs for large wind farms are ordinarily wholly incurred by the energy developer, making them an attractive proposal for landowners.**

As apparent from Section 5.7.3, wind farms generate a comparatively high level of per hectare employment impact, with the larger wind farm examples supporting in the region of 6-8 FTEs. This reflects employment impacts identified elsewhere, with the Harryburn wind farm study projected as generating 9-12 FTEs (during the operational phase) (MKA Economic, 2017).

As was the case for other moorland land uses, the indirect impacts of the hydro schemes and wind farms considered in this report were not assessed, although wider studies have demonstrated a significant level of local to regional economic impact from renewable energy developments. A socio-economic assessment of the potential impacts for the proposed Harryburn wind farm, for example, indicated that from a total potential investment of £68-86 million, 7% would occur in the immediate local area, 29% in the region and 45% within the UK (MKA Economics, 2017). Total predicted leakage beyond the region (64%) was therefore considerable, although the scale of investment results in a significant regional impact. A multipliers study of a medium-sized windfarm in the Scottish Highlands further indicated significant second-round spending (equivalent to over 50% of the first-round investment), over half of which went to firms located in the local area (NEF Consulting 2014).

Relative to ongoing running costs, the revenues from the hydro schemes and wind farms in the renewable energy case study were comparatively high relative to other moorland land uses, with hydro schemes generating the highest returns per £1 spent (particularly when initial capital costs are repaid) and wind farms resulting in the highest returns on a per hectare basis (see Table 6.1), although this reflects the concentrated nature of a wind farm (in spatial terms) and this figure decreases to £49-£61 per hectare when calculated on a whole estate basis. Crucially for landowners, renewable energy development represents a significant potential source of reliable income over the long-run in

[75] Some relevant public support is available for deer fencing as part of Woodland Improvement Grants https://www.ruralpayments.org/topics/all-schemes/forestry-grant-scheme/ and notably public spending on deer management does occur on government owned land totalling around £12.9m, including deer management costs on Forestry and Land Scotland holdings, public sector grants and £1.5m of expenditure on SNH as the deer authority for Scotland.

comparison to other moorland uses. Based on the two larger wind farms in Section 5.7.3, for example, over a 25-year life span these projects have the potential to generate revenue for the landowners in the region of £9.2-£11.75 million, with the operational costs borne by the energy company. These additional revenues can be, and are being, used to subsidise other estate land uses and related employment and secure estate financial viability.

Despite the relatively low level of ongoing input and low employment impacts for hydro schemes, most of the initial capital build phase (based on case examples reviewed here) often generates localized economic impacts. Studies of the economic impacts of wind farms by Biggar Economics (2013) and BVG Associates (2017) suggest that local and regional economic impacts of wind farm developments can be significant. The BVG Associates study, for example, estimated that in relation to eight Scottish Power wind farms commissioned in 2016-2017, 16% of the £1.6 billion investment will be spent locally with 35% in the rest of Scotland. Nevertheless, as apparent from Table 5.35, direct on-site (i.e. estate based) employment impacts of hydro schemes are relatively low (NEF Consulting 2014).

While the wider economic impacts of wind farms may be considerable, this does not consider landscape and environmental impacts of renewable energy developments. As noted by Werritty et al. (2015) for example, large-scale wind farms can have significant adverse impacts relating to moorland habitat loss, altered hydrology regimes and species-specific impacts. Wider studies have also highlighted the potential for loss of soil carbon stores during wind farm installation, impacts on specific bird species through bird-turbine collisions and a reduction of the total area unaffected by visible development in Scotland (see Smith et al. 2012, Bright et al. 2008 and SNH 2014).

7 Conclusions

1. Reflecting previous work, **the case studies demonstrate that grouse shooting can generate significant economic impacts for local communities.** These impacts can vary considerably, relating to the level of commercial emphasis and the size of the enterprise. As evident in Phase I, the economic impact is generally localised and can be disproportionately important in regions where grouse shooting is most prevalent. Although impacts are considerably higher for driven shooting (as opposed to walked-up), a minimum level of staffing and investment is required for walked-up and smaller driven operations. **Any substantial reduction in driven grouse is likely to result in job losses (due to the sectors high employment impacts in relative terms) and reduced spending,** where this is not replaced with alternative activities with comparable impacts.
2. Despite generating substantial revenues, **due to consistently high costs and fluctuating grouse populations, grouse shooting enterprises are rarely profitable, and** are commonly subsidised by other revenue streams, even on more commercial shooting estates.
3. Grouse shooting **commonly exists as part of an integrated sporting enterprise**, often including deer stalking and in some cases low ground or rough shooting. Spending and staffing therefore occurs across these activities and **grouse shooting generally does not operate financially as a stand-alone enterprise.** Sporting enterprises are also integrated financially with the wider estate business, with more profitable estate-based activities often subsidising less profitable activities. This can result in land uses which are dependent on private investment being subsidised by land uses which are more enabled by public subsidy or vice versa.
4. The case studies demonstrated that **'alternative' moorland land uses can generate comparable spending and revenue impacts to driven grouse shooting on a per hectare basis.** Additionally, some alternatives can offer more consistent revenue on an annual basis, although this may not account for longer term concerns, such as potential changes to agricultural support. Furthermore, the case studies demonstrated that **moorland land uses are not mutually exclusive and are often**

at least partially integrated, and the level of direct comparability of 'alternatives' can vary considerably, due to their differing moorland 'specificity' and related constraints.

5. While productive **forestry** offers less scope as an alternative on many moorlands due to site constraints, **native woodland creation offers scope for biodiversity and carbon gains on suitable moorland sites. The woodland creation schemes reviewed here suggest** that woodland creation on moorland sites has the capacity to generate a profit over a rotation on an annualised basis. The **availability of carbon revenues in particular, has the potential for altering the economic viability of woodland creation on moorlands**. Nevertheless, increased uptake of woodland creation may be constrained by perceived conflicts with sporting objectives, uncertainty around rates of return for carbon, and a degree of risk relating to tree survival and securing full grant payments.
6. **Conservation land management can generate spending and employment impacts comparable to (or higher than) other moorland land uses.** Notably, **conservation generally operates at a net cost and requires a high level of public support**, **although this should be considered against the potential for additional visitor spend impacts and positive externalities.** Further **conversion of management on moorland sites towards a primary conservation goal is likely to be heavily influenced by owner motivations (or a change in ownership), the availability of public funding (or private wealth) and the potential for generating long-term revenue streams from complementary activities** (e.g. tourism) to offset costs.
7. Despite the marginal nature of upland sheep farming, per hectare spending and employment impacts are comparable to (or higher than) other moorland land uses. However, **the majority of revenue in all case study examples (averaging 66%) was derived from support payments**. Furthermore, the performance of sheep enterprises can vary widely and most are dependent on some unpaid (family) labour. Despite wider declines in livestock numbers**, the complementarity of sheep farming in estate contexts, combined with the availability of support and potential for new agricultural entrants (due to low set up costs) suggests it remains a viable moorland land use.**
8. While often undertaken as a commercial activity (stalking), **deer management also represents a necessary estate activity**. While per hectare costs are comparatively low relative to other moorland land uses, this reflects the extensive nature of the activity, with **operational costs and staffing requirements very high relative to revenues.** Importantly, staff are often 'shared' with other sporting activities (e.g. grouse) and venison and stalking revenues can be utilised to offset some costs. In contrast to sheep, conservation and forestry/woodland creation, deer management is largely privately funded. As a result, **income from grouse, tourism and/or renewable energy often provides a component of the spend on deer management** as an essential activity.
9. Despite relatively high set-up costs, **renewable energy schemes can deliver a comparatively high rate of return**, with the capital costs for wind farms also generally not borne by the landowner. Large wind farms can also generate considerable regional economic impact. Nevertheless, longer term **employment impacts from hydro schemes are comparatively low, while wind farm employees may be located off site.** Notably, grouse shooting and wind farms are not incompatible land uses. Renewable energy revenues were critical on a number of estates for offsetting losses in other areas, increasing overall estate viability. **Future uptake of these schemes is likely to be dependent on existing site constraints** (e.g. energy generation potential, designations, scenic value etc.), **revenue potential (linked to the availability of subsidies) and owner motivations.**
10. Land use shifts are driven by a combination of increasing (and geographically variable) constraints (including environmental factors, regulations, lower revenues etc.) on one land use and increasing incentives or opportunities relating to others. **Grouse shooting is perceived as facing increasing regulatory requirements, as well as longer term uncertainty around climate change impacts, although sustained market demand, capital values and owner motivations remain significant drivers for retaining driven grouse**. Wider **drivers for alternatives include the availability of**

carbon revenues, favourable grant rates for woodland creation and peatland restoration, a continuing emphasis on renewable energy, and wider market shifts (e.g. increasing demand for nature-based tourism), all of which have potential for influencing land use change. The regulatory and support framework and how this reflects and responds to global challenges, such as climate change and food security, may have implications for the relative viability and future continuity of driven grouse shooting. **Landowner motivations and how these reflect ownership change or succession, are a further factor potentially influencing future retention (or not) of grouse shooting.**

11. The potential impacts of any substantive reduction in driven grouse shooting activity largely relates to which alternative, or combination of alternatives, subsequently occurs on the same land. A widespread **transition away from driven grouse towards woodland creation for example, would likely result in job losses in some regions** – due to the comparatively lower levels of employment from woodland creation. More broadly, a wider shift towards conservation and woodland restoration may result in decreased levels of private owner investment in some rural economies. The case studies demonstrate that **some of these losses could be offset through tourism development** (and related visitor spend), and the ongoing need for deer management suggests some retention of gamekeeping roles, particularly where estates have already developed diversified enterprises (e.g. hydro schemes) to offset costs. Nevertheless, tourism represents both a seasonal and potentially unpredictable longer-term market (as demonstrated by the current Covid-19 crisis) with relatively high associated costs.

12. A **significant moorland transition towards conservation, native woodland restoration and/or high nature value farming, also implies a shift in the balance of public-private investment (or funding from organisational memberships or wealthy individuals), at a time of increasing pressure on public budgets**. Any loss of sporting revenues is also likely to increase funding requirements for essential deer management, necessitating either further internal estate cross-subsidisation, or direct public support. The role of **emerging markets for ecosystem services (e.g. carbon) and the potential linkage of grant schemes and ecosystem services provision is also likely to become increasingly important longer term**, in relation to the balance of public and private funding for moorland land uses.

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Appendix A. Participant information sheet

This sheet was sent to participants prior to the fieldwork.

Socio-economic assessment of moorland activities - case studies

Background

In May 2017, the Cabinet Secretary for Environment, Climate Change and Land Reform announced commissioning of "research into the costs and benefits of large shooting estates to Scotland's economy and biodiversity". The focus of the announcement was 'driven grouse shooting'. A Programme for Government (2017-2018) commitment also stated that research would be commissioned to "examine the impact of large shooting estates on Scotland's economy and biodiversity". The first phase of this research was conducted in 2018 by SRUC (Scotland's Rural College) and the James Hutton Institute. A summary report and three detailed reports are available here. Further work is now underway, with the following aims:

1. Examine the extent and impact of economic connections between grouse shooting estates and surrounding businesses and communities.
2. Evaluate the socioeconomic impacts of alternative land uses for moorland and how they compare against land used for grouse shooting.
3. Understand the employment rights and benefits available to the gamekeepers involved in grouse shooting, as well as their working conditions, attitudes, behaviours and aspirations for the future.
4. Provide a more up to date assessment of the area of grouse moors in Scotland under management for driven grouse, mapping clearly the areas of moorland that are actively managed for grouse and the intensity of current management regimes.
5. Understand further the impacts of driven grouse shooting on biodiversity, making use of more up to date estimates of grouse moor management intensity and linking it with the best available biodiversity data.

Moorland land use case studies

The **moorland land use case studies relate to aims 1 and 2 above.** Through carrying out case studies with 16 landholdings across relevant regions of Scotland, this work will profile investment, revenue and expenditure streams from: (a) driven grouse; and (b) alternative moorland land use activities. Case studies will be undertaken of: (i) walked-up grouse; (ii) driven grouse; (iii) renewable energy; (iv) deer stalking; (v) sheep farming; (vi) afforestation; and (vii) rewilding/conservation.

What we would like to obtain from you

The main element of the case studies will involve participants completing a spreadsheet with support from the researchers. The focus will be on the specific land use of interest on your landholding (e.g. driven grouse, renewable energy, sheep farming etc.) as opposed to the finances of all estate activities. In general, for expenditure and revenue, we ask that you provide your best realistic estimate, based on a retrospective average over the last three years (2016-2018). For capital expenditure, an average is not required. Instead, you will be asked to think about specific incidences of capital expenditure since 2014 (the last five years) where it is feasible/possible to capture this expenditure. The data collection covers five main areas:

i) General information about the landholding (ownership, size, moorland area, main activities, tenancies etc.) and some outline information for the land use in focus (e.g. number of shooting days and brace shot if the case study is focused on grouse shooting or area of new planting if focused on forestry etc.).

ii) Capital expenditure: to cover investment-related expenditure (related wholly or partly to the land use in question) over the last five years, broken down where possible to specific areas of investment,

e.g. buildings, vehicles, equipment etc.). To include the regularity/frequency, amount, source of the finance and location of supplier where possible and what approximate % relates directly to the activity (e.g. 50% of investment in buildings relates to grouse shooting/management activity).

iii) Recurrent expenditure: to cover recurrent expenditure using an estimated three-year average (2016-2018) broken down where possible to specific areas of recurrent spending (overheads, tax, hospitality, consultants, maintenance, vehicle servicing etc.). To include the estimated amount and frequency for each area of expense, the source of the finance, the locality of the spending/location of supplier where possible and what approximate % relates directly to the activity (e.g. 50% of spending on vehicles that relates directly to the land use in focus).

iv) Employment and related costs: the number of full-time/part-time staff employed to work on the land use in focus, their job roles, average wage for each role and an estimate of the % of their time which is spent on the land use in focus. To include estimates of casual and seasonal staff employed.

v) Revenue: to include revenue based on an estimated three-year average (2016-2018) broken down where possible into different categories of revenue (e.g. sales of game meat, paying customers/clients, support payments/grants etc.).

Interview questions

The main topics we would like to discuss after completion of the data template include:

i) The main objectives for the landholding and the main underlying motivations and drivers for these objectives;

ii) The specific objectives and motivations/drivers for the land use in focus (e.g. sheep farming, grouse shooting etc.);

iii) Any relationship(s) with tenants or arrangements in terms of sporting/agricultural tenants, outright ownership and in-house management, etc.;

iv) The importance of profitability and revenue generation across all activities on the landholding, variability in the profitability of different estate activities, and importance of profitability of the land use in focus;

v) The importance of long-term investment in the estate as an asset within the management/objectives of the estate and for the land use in focus;

vi) Linkages and trade-offs between the land use in focus and other activities on the landholding;

vii) The perceived impacts on the local community and local economy of the estate and the land use in focus, including visitor numbers to the landholding;

viii) Key changes in relation to the land use in focus / area currently being managed for this activity over the last 5-10 years and in the future including;

- Key potential changes in related spend, employment etc. in the next 5 years;
- Key challenges (and confidence levels) faced in relation to the specific land use (e.g. in terms of retaining or changing the activity);
- Key perceived opportunities for the future in relation to the specific land use.

Appendix B. Data collected for each estate

<table>
<tr><th colspan="2">1. General information</th></tr>
<tr><td colspan="2">Short description
Estate size (ha)
Area managed for grouse/moorland area (ha)
Let land (area)
Length of ownership
Grouse shooting activity (three-year average)
– Walked-up days
– Walked-up brace
– Driven days
– Driven brace
Grouse split (family/commercial, typical year)
– Let (commercial) driven days
– Private/family driven days
– Let (commercial) walked-up days
– Private/family walked-up days
Deer stalking activity (three-year average)
– Stag stalking days
– Number of stags shot
– Hind stalking days
– Number of hinds shot
Deer split (family/commercial, typical year)
– Let (commercial) stag days
– Private/family stag days
– Let (commercial) hind days
– Private/family hind days
Use of sheep as tick mops
For forestry/woodland case studies:
– Total area of forestry/woodland
– Total area of forestry/woodland within the moorland zone
– Area of commercial/multi-purpose forestry
– Area of native/conservation woodland
For sheep case studies:
– Number of grazing cattle
– Number of breeding ewes
– Number of lambs
For renewable energy generation:
– Megawatt hours produced per year
– Number and size of installations</td></tr>
<tr><th colspan="2">2. Capital expenditure</th></tr>
<tr><td>Five-year totals for the following grouped categories (2014-2019):
– Buildings
– Equipment
– Infrastructure
– Land management
– Office</td><td>Information noted for each item of capital expenditure:
– Description
– Last time investment made
– Frequency
– Locality (% local, regional, national)
– Postcode of supplier (if available)</td></tr>
</table>

– Vehicles	– Extent (cost) – % used by the activity – Source of finance
3. Recurrent expenditure	
Three-year average for the following grouped categories (2016-2018): – Agents/contractors – Buildings – Hospitality – Land management – Office – Other running costs – Tax – Vehicles	Information noted for each item of recurrent expenditure: – Description – Frequency – Locality (% local, regional, national) – Postcode of supplier (if available) – Extent (cost) – % used by the activity – Source of finance
4. Employment	
Three-year average of data relating to people employed in relation to the activity (2016-2018): – Staff positions (job titles) – Number of staff in each position – % of time spent on the moorland activity – Average wage for each position – Nature of employment (full-time, part-time, self-employed, freelance) – Casual staff positions – Number of casual staff days and average daily cost – Seasonal staff positions – Number of seasonal staff days and average daily cost	
5. Revenue	
Three-year average revenue related to the activity in grouped categories (2016-2018): – Rentals – Sales – Destination (tourism) – Direct support payments – Other grant income – Owner contributions	Information noted for each item of revenue: – Description – Frequency – Locality (% local, regional, national) – Extent (amount) – % attributable to the activity

Appendix C Strengths, opportunities and constraints relating to different moorland land uses from participant perspectives

	Walked-up grouse	Driven grouse	Forestry/new woodland creation	Conservation	Deer stalking	Sheep farming	Renewable energy
Strengths and opportunities	• Lower costs than driven grouse • Low public subsidy reliance • Low intervention management • High land use compatibility • Strong marketing addition for mixed sporting enterprises	• Recent increased investment/job creation • Low public subsidisation • Sustained market demand/high returns • Professionalisation/ modernisation • Improved parasite control (tick mopping, medicated grit) • Compatibility with other land uses (sheep, deer, renewables)	• Increasingly competitive grants/annualised returns • High policy relevance • Carbon markets improving - high additional carbon value potential • Potential high level of public goods delivery (native woodland)	• High public goods potential • High potential for public funding • Compatible with other land uses (scale/activity-dependent) • Future payments for ecosystem services • Employment diversification opportunities • Potential to offset costs with tourism/ renewables	• Low subsidy dependence - stalking subsidising deer management • Complementary activity/staff working across land uses • Collaborative working/ professionalisation • Potential new hunting models (e.g. community stalking) • Increased Habitat Impact Assessment/adaptive management	• Low capital/set-up costs (new entrants potential) • High potential complementarity (tick control, conservation grazing) • Increasing efficiency through advice and benchmarking • Systems improvements to enhance outputs (breeds, rotational grazing) • Adding value and diversification	• High revenue and (long-term) profitability • High potential for offsetting costs from other land uses • High economic impact during build phase • Community benefit funds (wind farms) • Compatible with other estate land uses • Potential for increasing estate access • Future extension/expansion potential
Constraints	• As for driven grouse • Minimum (substantive) investment/spend required • Low revenues and low viability as a standalone land use	• Grouse population reductions (decline) • Land use change (heather loss) and low compatibility with woodland expansion • Climate change and parasite burdens • Revenue fluctuations • Reduced sector confidence and perceived political pressure (uncertainty/ conflicts)	• Very long-term investment/uncertain ongoing costs • Long term loss of ground to other uses • Challenging environmental factors • Owner liability to repay grants if scheme fails • Low timber returns for biodiversity planting • High level of public subsidisation • Uncertainty around carbon markets	• Limited income potential/low profitability and high level of owner investment required • Potential conflicts with other land uses/landowners (e.g. deer stalking) • High level of public subsidisation	• High ongoing costs/ staffing needs and low returns • Low public funding availability • Increasing admin/ regulatory obligations • Potential for conflicting objectives (e.g. access, woodlands) • Public perceptions of stalking/management	• Low profitability, high reliance on subsidies • Future market/support uncertainty (Brexit, Covid-19) • High recurrent costs relative to returns • Livestock losses (seasonal mortality, predation) impacting profit • Loss of grazing land to other land uses (e.g. forestry)	• High capital investment costs (borne by developer for wind farms) • Some leakage of economic impact outside region • Potential planning constraints/conflicts • Landscape and environmental impacts • Installation time and carbon losses from build