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Understanding the local economic impacts of natural capital investment

AGRICULTURE, ENVIRONMENT AND MARINE

social research

Contents

Glossary

Term	Explanation
Input-Output (I-O) Model	Input-Output (I-O) analysis is an empirical tool designed to analyse the interdependencies of economic sectors. The I-O table describes the flows of goods and services through an economy in monetary units for a given time period, usually a year. The I-O modelling approach can be used to estimate the effects on employment resulting from an increase in final demand for the product or service in a given industry. I-O models can estimate the economy-wide employment results from a given level of spending.
Multipliers	The ripple effects of spending on natural capital related activities can be estimated using multipliers. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. Multipliers are estimated by indirect means, using Input-Output (I-O) tables. They are calculated by using the estimates for direct, indirect and induced effects, which are also estimated from I-O tables: 1. **Direct effect:** defined as an increase in demand for the goods produced by any sector leading to an increase in the output of goods from that sector; 2. **Indirect effect:** as producers increase their outputs in any sector, their suppliers will also have an increase in demands for their goods, and so on. The shock of the increase in final demand for that good then ripples through the supply chain; and 3. **Induced effect:** as a result of these supply chain effects, the level of income in the economy will increase, and a portion of this income will be spent on other goods and services leading to further increases in demand. This is termed an induced income effect.
Standard Industrial Classification (SIC)	The UK Standard Industrial Classification of economic activities, abbreviated as UK SIC, is a five-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity.
Output effect,	The direct and indirect impact of any expenditure in the local economy (measured by multiplying financial cost of the intervention by the Type 1 output multiplier).
Employment effect	The impact on jobs attributed to just the direct financial expenditure of the intervention (measured by multiplying financial cost by the Type 1 Employment effect).
Employment effect (Direct + indirect)	The impact on jobs attributed to the Output effect of the intervention (measured by multiplying output effect by the Type 1 Employment effect).

Introduction

The Scottish Government, in partnership with NatureScot, commissioned WSP to undertake economic analysis to determine how local investment in natural capital can impact local economies and whether new multiplier values should be created for use in economic appraisal of future natural capital investment projects. The Project commenced in October 2021 and was completed in May 2022. This document is the Final Research Report for the project. It provides guidance for the Input-Output (I-O) models[1] generated and is best read in conjunction with the model.

Aims and objectives of the project

The aim of the project was to quantify the typical contributions to local economies, measured as output and jobs created, of four different natural capital investments, outlined below. These investments do not have standardised definitions but can be summarised as per the descriptions below:

The restoration of upland and lowland peatland: Referring to management measures that aim to restore the original form and function of peatland habitats to favourable conservation status. The principal activity involved is the return of the site hydrology to natural conditions. Depending on the starting point, peatland sites may need drain blocking to rewet them using a variety of techniques. Peatland restoration helps to control emissions of greenhouse gases such as carbon dioxide and support biodiversity.

Woodland creation and restoration: Projects that involve the permanent transfer of an area of land from non-woodland habitats to coniferous or broadleaved woodland. Although often undertaken for timber production or the sequestration of carbon to support offsetting schemes, the wider multiple benefits of schemes will often support recreation, biodiversity and landscape objectives. Projects involve planting of young trees in cleared areas and the ongoing management through the project lifecycle to support their continued development.

Regenerative agriculture: Referring to the transition from intensive agriculture techniques to a wide range of management practises designed to maximise plant diversity, develop more resilient soil and support a wide range of biodiversity. Key techniques including reducing the disruption to the soil substructure using no-till techniques, the planting of cover crops and the use of rotational agricultural systems.

Coastal habitat restoration: Projects that aim to provide additional protection from coastal erosion through the creation and restoration of habitats such as coastal saltmarsh. These projects are often delivered in combination with traditional hard coastal defences and can provide large benefits to biodiversity, carbon sequestration and storage and climate change adaptation.

The project also aimed to identify the relative importance of different factors in the design and delivery of natural capital investment that contribute to the magnitude of local economic impacts from this investment, for example, the scale and complexity of

[1] See Glossary for more details on I-O models.

the project, access issues and transport, the breadth of skills, materials, knowledge, and expertise required to deliver the project.

Contents of this Final Research Report

This document is the Final Research Report for the Scottish Government funded project concerning the Local Economic Impacts of Natural Capital Investment. It is intended to provide a comprehensive view of the research project's main findings as well as information on the methodological approach adopted. More detailed information on data, values, and model results are contained within the reference data provided within each I-O model, available as separate supporting documents to this report.

The report is structured as follows:

- This **introduction** chapter sets out the aims and objectives of the research and explains the purpose of this report and its structure.
- **Context for the research** sets out the context for the research including an outline of the policy context for natural capital investment.
- **Project Approach** explains the methodology adopted in the project, including data collection and the development of the Input-Output model.
- **Input-output model guidance** provides an overview on how to use the models developed as part of this project and how the results should be interpreted.
- **Case study results** present the outcomes of applying the Input-Output models to real world scenarios across three different intervention types.
- **Conclusion** discusses a summary of the main findings from the overall project, the key areas of learning and recommendations for further research.

Context for the research

Scotland's National Strategy for Economic Transformation (NSET) has emphasised the role of a natural capital approach in supporting a just transition to net zero, with the overall vision that by 2032 Scotland will be a wellbeing economy thriving across social, economic and environmental dimensions[2]. In recognition of the significant opportunity for Scotland, NSET includes a commitment to establishing a values-led, high-integrity market for responsible private investment in natural capital, supported by a national project pipeline for nature-based solutions.

As an early action to support the delivery of this NSET commitment, Scottish Government published a set of Interim Principles for Responsible Investment in Natural Capital[3]. The Interim Principles set out the Scottish Government's ambitions and expectations for a values-led, high-integrity market for responsible private investment in natural capital to communities, investors, land managers, land owners, public bodies and other market stakeholders.

Scotland has already recoginised that the transition to a nature-positive economy can generate millions in business value and jobs. The nature-based sector accounts for 195,000 jobs or 7.5% of Scotland's workforce in 2019[4]. It has also shown international leadership through international and national pledges. At COP26, the First Minister endorsed the Leaders' Pledge for Nature, an international commitment to reverse biodiversity loss and create a "nature-positive" world by 2030. The Scottish Environment Strategy sets out framework for this transition with emphasis on supporting responsible private investment in nature-based solutions.

The Green Finance Institute (GFI) Finance Gap for UK Nature Report[5] revealed that the investment gap to secure nature related outcomes in Scotland is between 15 and 27 Billion pounds for the current decade. In addition, there is interest in understanding the types and numbers of jobs likely to be created by increasing natural capital investment.

Given the investment, especially from the private sector, required in the restoration of natural capital and the Scottish Government's commitment to a just and fair economy, a better understanding of the business case for investment and economic contribution of natural capital investments into local economies is needed to support decision-making.

Currently the Scottish Government Input-Output (I-O) tables aren't able to accurately reflect the full local economic impacts (including capital expenditure and jobs) of different types of economic activities linked to investment in natural capital, such as peatland restoration or woodland planting for non-commercial reasons. This lack of

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[2] Scottish Government webpage where Scotland's National Strategy for Economic Transformation (NSET) can be downloaded: Scotland's National Strategy for Economic Transformation - gov.scot (www.gov.scot)

[3] Scottish Government webpage where the SG's Interim Principles for Responsible Investment in Natural Capital can be viewed: Interim Principles for Responsible Investment in Natural Capital - gov.scot (www.gov.scot)

[4] NatureScot webpage where NatureScot's report on nature-based jobs and skills can be downloaded: NatureScot Research Report 1257 - Supporting a green recovery: an initial assessment of nature-based jobs and skills | NatureScot

[5] Green Finance Institute (GFI) webpage where GFI's Finance Gap for UK Nature Report can be downloaded: Finance Gap for UK Nature Report (greenfinanceinstitute.co.uk)

evidence makes it difficult to understand the impact of natural capital investment, which in turn means it's difficult to assess natural capital investments on par with other investments which are better evidenced. These challenges also mean that it is difficult to create the right training and skills development programmes to ensure economic opportunities do not leak out of regional economies.

The lack of information around natural capital investments has led to an increased risk that the degradation of nature is not fully accounted for within investment strategies. In addition, there is a chance that opportunities within natural capital investments are missed because the potential benefits are not fully known. Better information will allow financial institutions and companies to incorporate nature-related risks and opportunities into their strategic planning, risk management and asset allocation decisions. These principles are outlined in the latest Taskforce for Nature-related Financial Disclosures (TNFD) framework (2022)[6].

NatureScot and Scottish Government have developed this project to provide evidence and methods that will enable a better understanding and estimation of the local economic impacts of investing in natural capital, for use by those considering natural capital investments, including local authorities, enterprise agencies and the private and third sectors.

[6] Taskforce on Nature-related Financial Disclosures (TNFD) webpage with details of the TNFD beta release framework: Welcome to the TNFD Nature-Related Risk & Opportunity Management and Disclosure Framework » TNFD

Project Approach

A summary of the project approached used by WSP is provided in Figure 1. The project was broken up into four phases: (1) desktop review; (2) stakeholder engagement; (3) Input-Output (I-O) model development; and (4) case study trial assessment. Further detail of each phase is provided below in Figure 1.

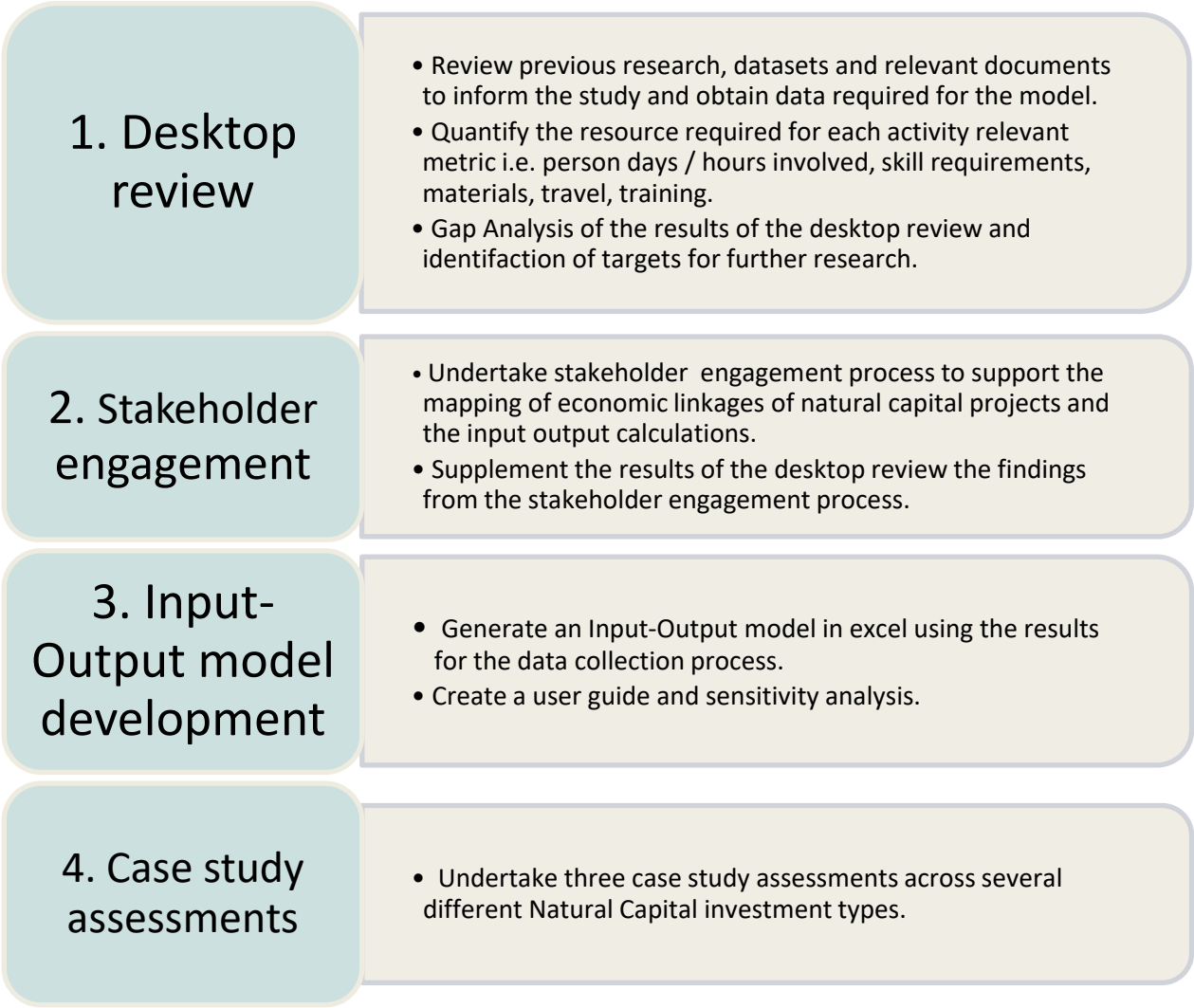


Figure 1: Overview of the project approach

Desktop review

To ensure the model incorporated the most appropriate data and costs a review of previous research datasets and relevant documents was undertaken. This review aimed to identify previous studies that undertook primary research that could be incorporated as part of this project, and help to classify the potential activities within each of the different natural capital investment types. The example data sources used within the desktop review include:

- Previous studies undertaken by Scottish Government and partners;

- Research by relevant government agencies such as Forestry and Land Scotland (FLS) and NatureScot and research institutes like the James Hutton Institute (JHI); and

- Guidance documents and project case studies produced by relevant experts within each of the natural capital investment types (e.g. NatureScot Peatland ACTION).

A full list of the different sources identified as part of desktop review for each intervention is provided in Appendix A: Desktop Literature Review Sources Sources.

The results of the desktop review were used to generate a list of the potential activities that might be undertaken for each natural capital investment type. For example, within woodland creation the potential activities ranged from the stocking of new areas of woodland to the installation of new land drainage. Where necessary potential activities were broken down into component activities to distinguish between different skills or labour and materials as shown in Table 1.

Table 1: Example of potential activities within Input-Output model

Primary Activity Type	Primary activity description	Component activity description	Economic linkage Category
Supply of trees	Labour required to carry out stocking of saplings across the site	Supply of trees for plant	Materials
		Planting of trees	Labour

Each of the potential activities associated with the natural capital investments were linked to a UK Standard Industrial Classification[7] (SIC) code that best represented the potential activity. This was undertaken to facilitate the I-O modelling[8] and demonstrate the link between the physical activity and the potential economic impact. The link was based of the type of activity (i.e. labour, materials, machinery, products) and who would be likely to carry it out under a normal scenario. This research allowed for the list of activities for each intervention to be broken down according to the economic linkage category:

- **Labour:** Activity requires particular type of skills and expertise, quantified in terms of hourly wages.

- **Materials:** Activity requires specific inputs, raw products, intermediate products linked to the supply chain and other complementary sectors, quantified by e.g. the cost of post and wire fencing per meter**.**

[7] Office for National Statistics (ONS) webpage with details of the UK Standard Industrial Classification (SIC) Hierarchy: UK Standard Industrial Classification (SIC) Hierarchy (onsdigital.github.io)

[8] See Input-Output section below for more details.

- **Transport & machinery:** Activity is dependent on utilisation of transport or other types of capital equipment, quantified by e.g. the length of time a 360 degree excavator is required.
- **Products:** Activities generate certain products which have clear economic value, quantified by e.g. the value of timber produced from harvesting.

The expected magnitude of each activity was also identified, linked to the characteristics of the overall natural capital intervention (e.g. size of the site, stocking density). For example, within the primary activity of stocking the number of person days required to stock a hectare of woodland at a set planting density was established in addition to the number of saplings needed depending on the planting density.

Where available a financial cost was also assigned to each activity, this was related to the magnitude of the labour and / or the material costs identified through the desktop review (see example in Table 2).

Table 2: Example of cost item data

Cost item Name	Units of Quantity	Cost per unit	Relationship with Scenario characteristics	Total cost
Supply of trees	per tree	£0.50	Number of trees required	£81,000

The desktop review was unable to identify all of the potential activities and their likely magnitude for each of the natural capital investment types due to the data available. To address this issue, a gap analysis was undertaken to identify where additional information was required to complete the I-O models. When the link between the potential activities and the SIC code was considered uncertain, the activities were also flagged within the gap analysis for further research. This gap analysis was used to guide the stakeholder engagement process and helped identify which stakeholders should be approached to provide insights to help address the identified gaps.

Stakeholder engagement

A stakeholder engagement process was designed to complement the desktop review and identify, as far as possible, all of the required information needed to successfully build the I-O model for each of the four natural capital investments considered. The stakeholders consulted for each of the interventions were identified through consultation with the Scottish Government steering group and through the results of the desktop review and case study analysis. The stakeholders consulted for each natural capital investment are provided in Appendix B.

The stakeholder engagement was undertaken through Microsoft Forms using separate online electronic surveys for each natural capital investment. Where required further follow up conversations with key stakeholders that had specific insights to the different interventions were undertaken. The results of the stakeholder consultation

were used to help fill in the gaps identified from the desktop review and finalise the list of activities under each intervention.

Input-Output model development

The I-O models[9] were generated in Microsoft Excel using the results of the stakeholder engagement and desktop review. The process used to generate the results for the I-O model is shown in Figure 2 below.

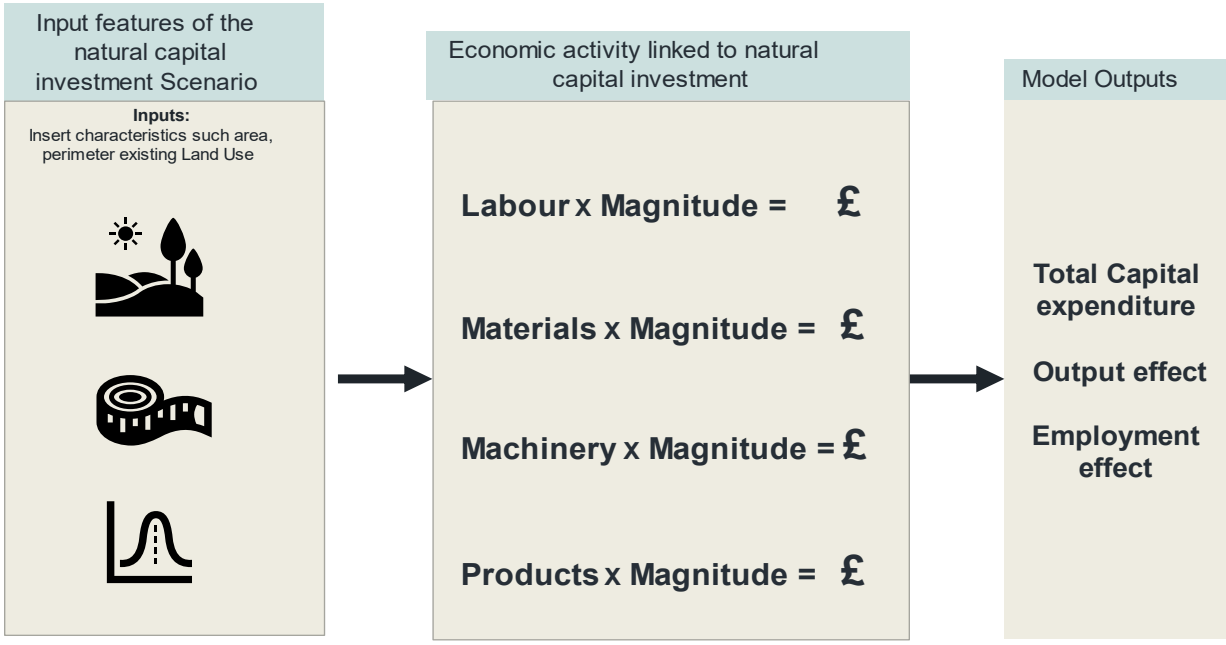


Figure 2: Input-Output logic chain

The potential activities for each natural capital investment identified through the literature review and stakeholder engagement were listed in the sequence that would be followed when developing a project. Each activity was assigned a standard cost that was identified from the literature and represents a best estimate for the average cost of that activity (e.g. 30p per tree planted in labour cost) or material (e.g. 50p per tree in material costs) across Scotland.

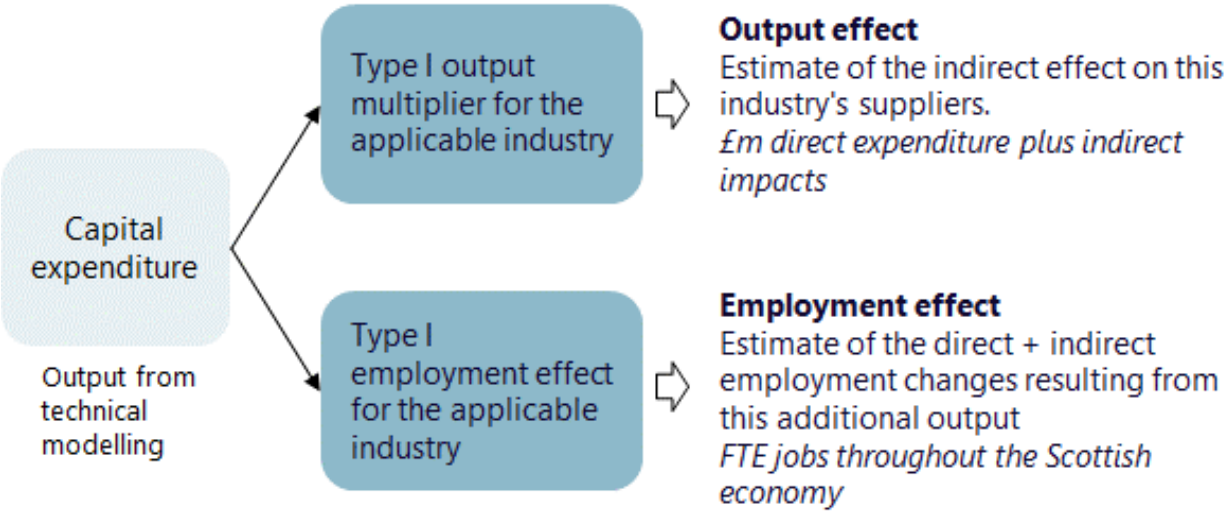
These costs were compiled in a reference sheet that contained a list of all the activities possibly required to carry out the four natural capital investments considered in the project. The site characteristics and the units for each activity were combined to allow the model to reflect the changes in scale associated with different site characteristics.

To allow the inclusion or exclusion of activities the “Required?” column was added which allowed users to select whether the individual component activities were considered within the final calculations or excluded from the assessment.

This process provided a final cost / expenditure for each activity, which was then combined with the relevant SIC code in order to assign the correct economic

[9] See Glossary for more details.

multipliers. This allowed for the Output effect, Employment effect and Employment effect (Direct + indirect)[10] to be reported for each activity, as shown below:



Case study assessments

To test the application of the I-O model and to gain an understanding of their sensitivity, three case study assessments were undertaken whereby the model was applied to real-life examples of natural capital investments. The case studies were identified from the stakeholder engagement process and collaboration with the Borderlands Inclusive Growth Deal: Strategic Proposition to deliver a Natural Capital Innovation Zone across the South of Scotland. The case studies chosen represented common scenarios for each natural capital investment type.

[10] See explanation of these terms in the glossary.

Input-Output model guide

Each Input-Output (I-O) model developed is unique to each of the four specific natural capital investments considered in this project, however they all follow the same structure and process to generate results.

The model contains five separate sheets:

1. An initial ‘readme’ instruction sheet;
2. A scenario summary;
3. The Input-Output model;
4. The model result sheets; and
5. The reference data.

Further information on the different elements of the model and how to interpret them is provided in the sub-sections below. Screenshots from the model have been included for illustrative purposes only. This part of the report is best read in conjunction with the models themselves, which are available as standalone supporting documents to this Final Research Report.

Readme instruction sheets

These provide an overview of the tool and its purpose and guides the user on how to carry out an assessment. The sheet includes guidance on the cells the user can edit and which should remain locked.

Figure 3: Read me instruction sheet

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Local Economic Impacts of Natural Capital Investment Model
Peatland Restoration
Version 1.0 April 2022

The purpose of this Databook is to quantify the typical contributions to local economies (measured as GVA and jobs created) of natural capital investments. It is aimed to enable policy makers to understand economic contribution of natural capital investments into local economies to support decision making. The tool utilises an input - output model which combines the activities and material required to carry out the proposed natural capital intervention with information from the Standard industrial classification (SIC): information (2007) and their associated economic multipliers.

This Databook is specifically focused on the natural capital investment: Peatland Restoration and is complemented by three other datebooks which focused on Woodland Creation, Regenerative Agriculture and Coastal Restoration

Important Notice
By using this Databook, you automatically accept and agree to the Model User Terms. Note that all Content is provided 'as is' for information purposes only and if you rely on it you do so at your own risk. Access to Third Party Content is subject to Third Party Terms and Conditions and copyright law. Access to the Databook is free of charge but you may have to pay to view and/or copy some Third Party Content.

This Databook includes 4 Tabs, each of which is focused upon a specific element of the impact to local economies model. The function and use of each tab explained below and in more detail within the Understanding the local Economic Impacts of Natural capital Investment report. Please read the following points carefully before you using the tool.

1. Scenario Summary Sheet - Allows the user to enter the general scenario information and specific intervention characteristics that will inform the Input - Output model

2. Input - Output Model - Breaks down the individual component activities required to complete the specific intervention and provides estimated costs depending on the Intervention characteristics. User are able to edit which activates are considered within the overall model.

3. Model Results Sheet - Report the outputs of the model according to value, linkage category and SIC codes

4. Reference Data - Contains the cost items, their relationship with the intervention characteristics and the sources of the information. This values are used to generate the overall model. Users are able to replace the default standard costs with site specific values if they are know.

Please only use the light green and yellow cells for data entry within this model all other cells are calculated Manually

Green cells are empty by default and require entry by the user to complete the assessment

Yellow cells have an existing value by default and but can be replaced by site specific values by the user if they are available

Natural capital investment scenario summary sheets

These sheets allows the user to input project specific information such as the assessment date and scenario name, location and description. They enable the user to input the site characteristics, such as intervention size, perimeter to be fenced and tree planting density. The characteristics entered will define the results of the modelling process.

Scenario Information Sheet

Please enter project details below

Assessment Date	05/04/2022	
Scenario Name	Borderland Inclusive Growth Deal Strategic Proposition: Woodland Creation	
	V1	
Scenario Location	South of Scotland - Galloway and Dumfries	
Scenario Description	900ha of Native mixed woodland is be planted with a focus on biodiversity and wider benefits. To achieve this trees are planted at a low density in small farm scale blocks. Forest support services provided by 2 full time staff members. The woodland will not be fenced for deer by young trees with be provided with required protect. minimum upfront advisory work is required due to small scale nature of the woodland.	
Site Characteristics		
Size (ha)	900	
Perimeter to be fenced (M)	0	[Only change if true value is known]
Planting density per hectare	900	

Figure 4: Scenario information sheet

Input-Output model

The I-O model sheet breaks down the individual activities and costs that are used to build up the model and generate the results. The cells within this sheet are mainly locked and for view only purposes. However, users are able to edit ‘Column I’ in order to include or exclude activities within their assessment scenario. This function allows users to ensure the model accurately reflects the intervention they are assessing. The

I-O model sheet also shows users information such as the economic linkage category of each activity and the relevant economic multipliers.

Model results sheet

The model results sheet shows users the results of the I-O model and breaks down the results into different categories to show clearly the impact of investment across these categories. The results of the assessment including the total capital expenditure of the intervention, the number of jobs potentially created and total output effect are broken down by SIC code and per economic linkage category (labour, materials etc). The sheet is read only and will update as the site characteristics and relevant activities are updated by the user.

Input - Output Model.

The breakdown activities and costs that build the model are show below
Users should only edit Coloumn I

Primary Activity and Component Activity description						Activity Quantity and Standard Cost Rates				
Primary activity code	**Primary Activity Type**	**Primary activity description**	**Total Capital cost**	Component activity description	Required?	Relevant Cost item	Cost	Units	Estimated quantity requirement (Days/ ha/ m)	Financial cost Capital (£)
WC01	Site selection, Woodland design and associated assessment/ consenting	Wide ranging inputs depending on scale/ location in terms of: (a) Design (e.g. planners, foresters, landscape architects, ecologists, ornithologists, hydrologists); (b) Regulation (e.g. Forestry and Land Scotland, NatureScot, SEPA) through consenting/permitting process, (i.e. Environmental Impact Assessment, Habitat Regulation Assessment); (c) Stakeholders engagement (e.g. Estates, NGO's i.e. RSPB etc)	£450.00	Specialist input from a planning consultant	No	Planning Consultant	N/A	N/A	N/A	N/A
				Specialist input from an Arboricultural consultant	Yes	Arboricultural consultant	£45.00	Per hour	5	£225.00
				Specialist input from a Landscape Consultant	No	Landscape Consultant	N/A	N/A	N/A	N/A
				Specialist inpu from an Ecologist	Yes	Ecologist	£45.00	Per hour	5	£225.00
WC02	Ground conditions and soil suitability assessment.	Expertise's required to undertake an initial Desktop review and a likely site survey on the site soil type and condition. Would inform the suitability for the type of woodland creation. Could include a peat depth survey depth on WC01.	£40,500.00	Specialist input from Drainage / ground specialist	Yes	Drainage / ground specialist	£50.00	Per hour	675	£40,500.00

Figure 5: Example extract of Input-Output model sheet

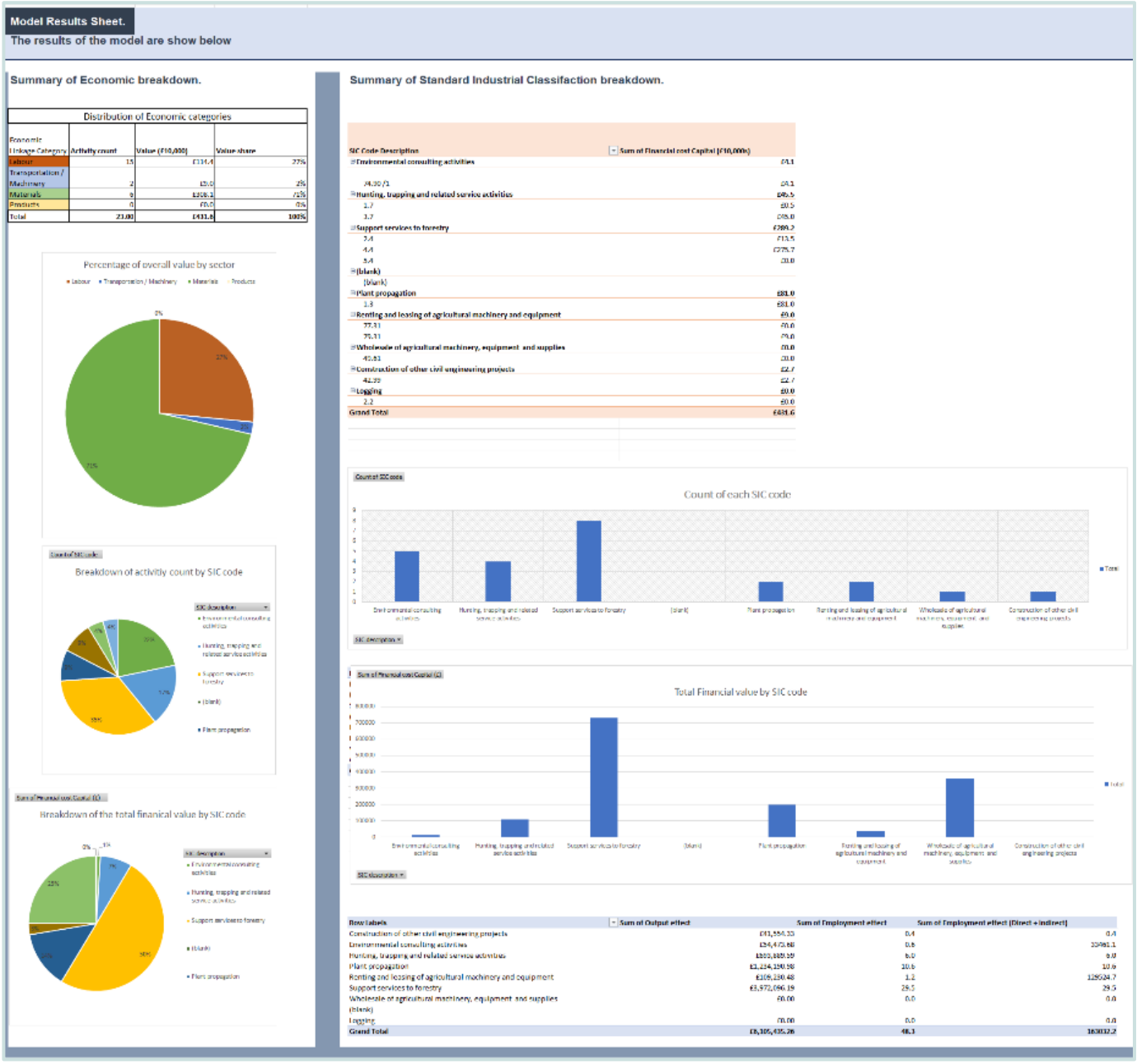

Figure 6: Model Result sheet

Reference data sheet

The reference data sheet provides the user with the sources for the standard costs used in the model and their relationship with the scenario characteristics. This sheet contains all of the activities referenced within the I-O model sheet and additional activities that may also be relevant to certain projects. The sheet enables the user to edit the existing references or include new activities when better sources of data are available. The purpose of the sheet is to enable users to tailor the assessment and the values used within it to suit their particular needs.

Reference Data.

The Standard cost rates and reference values used to generate the I-O model are shown below

Cost item Name	Units of Quantity	Cost per unit	Relationship with Scenario characteristics	Relevant quantity value	Total Cost	Source Data
Labour.						
Forest CraftsPerson	Per day	£150.00	N/A	900.00	£135,000.00	English Woodland Grant Scheme, Operations note 9, Standard costs (2011)
Fencing team	Per day	£150.00	Based off fenced area	20000.00	£10,000.00	English Woodland Grant Scheme, Operations note 9, Standard costs (2011)
Forestry Agent	Per hour	£50.00	N/A	5.00	£250.00	English Woodland Grant Scheme, Operations note 9, Standard costs (2011)
Tree Surgery team	Per day	£150.00	N/A	5.00	£750.00	English Woodland Grant Scheme, Operations note 9, Standard costs (2011)
Legal fees for buying and selling agricultural l	Fixed fee	£1,500.00	Set fee	1.00	£1,500.00	http://www.conveyancingpro.co.uk/agricultural/
Planning Consultant	per hour	£60.00	Based off Area	5.00	£300.00	Consultant market rates (2022)
Arboricultural consultant	Per hour	£45.00	Based off Area	5.00	£225.00	Consultant market rates (2022)
Landscape Consultant	Per hour	£45.00	Based off Area	5.00	£225.00	Consultant market rates (2022)
Ecologist	Per hour	£45.00	Based off Area	5.00	£225.00	Consultant market rates (2022)
Drainage / ground specialist	Per hour	£50.00	Based off Area	675.00	£40,500.00	Consultant market rates (2022)
EIA	Per hour	£50.00	Based off Area	5.00	£225.00	Consultant market rates (2022)

Figure 7: Example extract of the model reference data sheet

Model interpretation, accuracy and assumptions

In summary, the I-O model converts the capital expenditure on an area of land for natural capital investment into jobs. The capital expenditure was split by economic linkage category: labour cost; and expenditure on materials, products and transport. This direct expenditure into the local economy creates an output effect, which is defined as the ripple effect of the expenditure through the supply chain. This ripple effect is measured by multipliers from the I-O tables. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. For example, the contractor who installs deer fencing buys timber, the timber merchant buys new tyres for their trucks, all the firms' workers spend their wages on food or consumer goods, and so forth. Hence, the output effect captures the direct and indirect impact of any capital expenditure in the local economy. Direct and indirect jobs were calculated by multiplying the employment effect multiplier with capital expenditure and output effect respectively.

The I-O model was generated using the best available information and standard cost rates for Scotland. The values within the model represent an average of the cost for each activity across a variety of factors including the scale of the intervention, the geographical location and socio-economic context. Therefore the values used within the model will not always be the best fit for the specific local context in question. The model is anticipated to support early stage business cases and provide an initial estimate of the total capital expenditure, output effect and number of jobs created by natural capital investment. However, it should not be used to support full business case analysis of local level projects without additional information.

The I-O model allows the user to replace or supplement the existing reference data with local level information which would modify the relationship between the site characteristics and the magnitude of each activity. This will enable users to ensure the model is appropriate to the scenario they wish to assess. However, justification should be provided whenever elements of the reference data sheet are edited.

The model provides results to the nearest £ however it is advised that final values are rounded to the nearest £10,000 when reporting to give an indication of the level of accuracy. The desktop review and stakeholder consultation demonstrated a lack of information and agreed values for standard costs across many of the activities within the different intervention models, so there is a degree of uncertainty built into the model given the reference data used in this current iteration (May 2022). Initial comparison indicates that the model is in line with other tools. Comparison with the initial cost estimations within the Borderlands Inclusive Growth Deal Natural Capital Proposition show that the I-O model provides values in line with these estimations.

This lack of information should be addressed in order to improve the accuracy of future iterations of the I-O model and to allow more certainty in the results of the assessments. This information should be obtained through further consultation with stakeholders initially approached as part of this project including FLS and NatureScot Peatland ACTION. It is envisaged that the reference values within this model could be updated periodically to reflect the latest knowledge and information available.

Case studies

To ensure that the Input-Output (I-O) models are fit for purpose and to demonstrate their capabilities, three case study assessments were undertaken as part of this project. The case studies were identified during the desk top review process and through collaboration with the Borderlands Inclusive Growth Deal team. The case studies were chosen to represent common scenarios for each of the natural capital investments considered.

A summary of the case study results is provided in Figure 8 and Figure 9, and the main findings of the assessment are described below. The results include the project area of the case study and the total capital expenditure, which provide an insight into the difference in scale of the three case studies. The output effect is always greater than capital expenditure and represents the indirect impact of any capital expenditure on natural capital projects in the local economy. The potential number of jobs created by the capital expenditure and the output effect is shown as the direct jobs and direct + indirect jobs respectively.

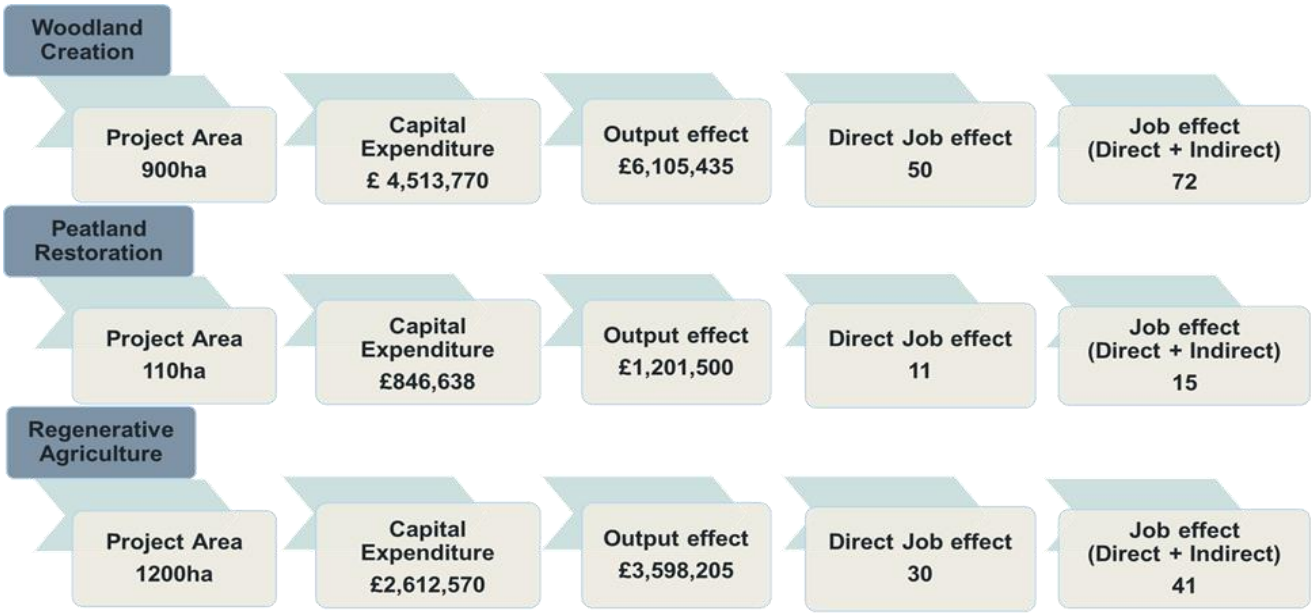

Figure 8 Summary of case study assessments

All three case studies require substantial labour inputs, which is a good indicator that they will support local jobs. However, some of these jobs require skilled workers so any future investments in these types of natural capital project should consider provision of adequate training and skills development, regionally and locally.

For the case study investments considered, the capital expenditure per hectare is around £5k, £7.7k and £2.2k for woodland creation, peatland restoration and regenerative agriculture respectively. This variation in expenditure per hectare should be taken into consideration on a site-by-site basis as the costs of the activities can vary significantly for the three different natural capital investment categories. The capital expenditure share is unique to the case study inputs and attributes and is likely

to change under different natural capital investment scenarios (e.g. in terms of stocking density in the case of woodland).

Expenditure per job is £36,998, £32,563 and £36,797 for woodland creation, peatland restoration and regenerative agriculture respectively, suggesting that for a given level of investment, the three case study projects would generate more or less similar numbers of jobs.

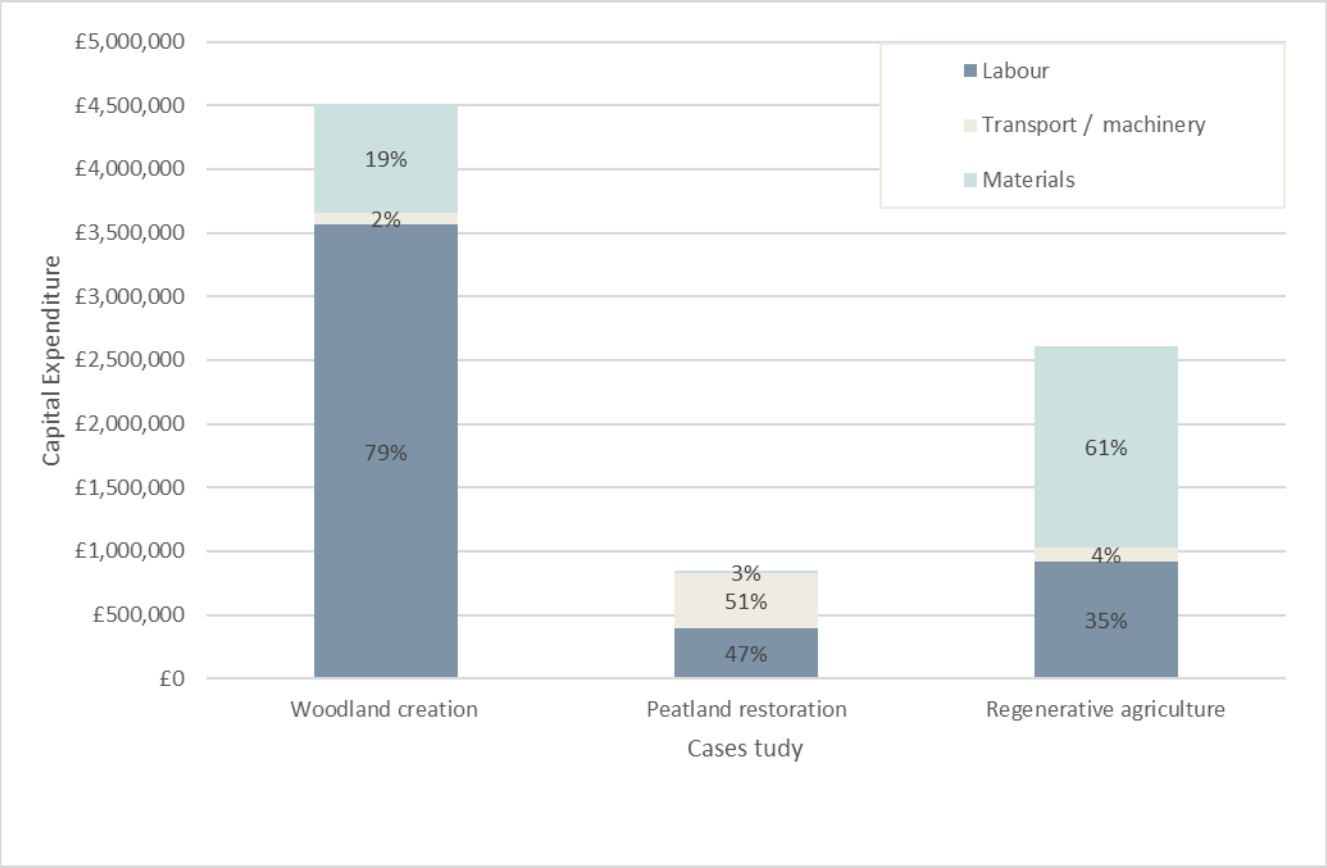

Figure 9: Breakdown of total capital expenditure by economic category

Woodland creation case study data inputs

The woodland creation case study assessment used a natural capital project in the Borderlands Inclusive Growth Deal: Strategic Proposition. The case study includes the creation of 900 hectares of woodland within currently unproductive farmland. The woodland would be created across several sites by a group of farms working collaboratively. The aim of project is to create a low density broadleaf woodland that provides profitability at the farm scale. As part of the case study there would be no additional fencing added to the perimeter of the woodland creation sites. The scenario characteristics used in the case study are shown in Table 3 below.

Table 3: Woodland Creation case study scenario characteristics

Site Characteristics	
Size (ha)	900
Perimeter to be fenced (M)	0
Planting density per hectare	950

Peatland restoration case study data inputs

The peatland restoration case study was based on a real life project in the Cairngorms. This multi-year project, aimed to restore over 110ha blanket bog within the region and assist in reducing organic sediment load in the Spey catchment, reverse carbon loss through erosion and improve habitat for biodiversity. The project used a number of techniques:

- Re-profiling of eroded gullies;
- Repairing areas of micro erosion;
- the installation of stone dams; and
- The use of mulch filled hessian bales.

The scenario characteristics used in the case study are shown below in Table 4.

Table 4: Peatland restoration case study inputs

Site Characteristics	
Size (ha)	110
Perimeter to be fenced (M)	0
Area requiring hand restoration (ha)	5
Number of dams to be installed	20

Regenerative agriculture case study data inputs

The regenerative agriculture case study assessment used a natural capital project in the Borderlands Inclusive Growth Deal: Strategic Proposition. The proposed project is a pilot to deliver a sustainable approach to agricultural production across 1,200 ha of land. Within the project, 300 ha of priority meadow habitat will be improved, and 120 ha of new woodland will be created. The rest of the study will be transition to conservation management techniques including no till ploughing and

rotational grazing. The whole project would require upskilling in regenerative agricultural land management techniques. The scenario characteristics used in the case study are shown below in Table 5.

Table 5: Regenerative agriculture case study inputs

Site Characteristics	Ha
Size	1200
Area of rotational grazing	350
Area of no till soil management	350
Area of cover crops	350
Area of wildflower planting	300
Area of wetland creation	0
Area of woodland planting	120
Area of Peatland Restoration	0

Summary of total economic impacts

A summary of the total capital expenditure estimated for each case study scenario is provided below (Table 6, Table 7, Table 8). The woodland creation scenario was estimated to have the highest capital expenditure of £4,514,000 with the peatland restoration case having the lowest at £846,638.

Across all case studies, the majority of the activities (by number) were classified within the 'labour' economic linkage category, however the 'materials' category contained the highest capital expenditure value for the both woodland creation and regenerative agriculture cases. It was noted that there were no products from any of the case studies due their characteristics (e.g. the lack of timber production within the woodland creation case study).

Table 6: Woodland Creation (900ha) case study capital expenditure

Distribution of Economic categories			
Economic Linkage Category	**Activity count**	**Capital Expenditure**	**Capital Expenditure %**
Labour	18	£3,568,770	79%
Transportation / Machinery	2	£90,000	2%
Materials	6	£855,000	19%
Products	0	£0	0%
Total	**23**	**£ 4,513,770**	**100%**

Table 7: Peatland Restoration case study overall capital expenditure

Distribution of Economic categories			
Economic Linkage Category	**Activity count**	**Capital expenditure**	**Capital expenditure %**
Labour	9	£394,210	47%
Transportation / Machinery	5	£429,000	51%
Materials	3	£23,428	3%
Products	0	£0	0%
Total	**17**	**£846,638**	**100%**

Table 8: Regenerative agriculture case study capital expenditure

Distribution of Economic categories			
Economic Linkage Category	**Activity count**	**Capital expenditure**	**Capital expenditure share**
Labour	15	£920,950	35%
Transportation / Machinery	5	£109,500	4%
Materials	6	£1,582,120	61%
Products	0	£0	0%
Total	**26**	**£2,612,570**	**100%**

The I-O model also provided a breakdown of the total cost (capital expenditure) for each SIC code in the economic linkage categories across the three case studies (Table 9). In the woodland creation and peatland restoration case studies, the majority of the cost was in the ‘support services to forestry’ SIC code (64% and 51% respectively). For the regenerative agriculture case study, the majority of the cost (57%) was in the ‘wholesale of agricultural machinery etc’ SIC code.

Other areas of higher cost (capital expenditure) across the case studies included: ‘environmental consulting activities’ in the peatland case (46%); ‘plant propagation’ in the forestry case (18%); and ‘support activities for crop production’ in the regenerative agriculture case (25%).

Table 9: Summary of capital expenditure per SIC code

Economic linkage category	SIC Code Description	Sum of Financial cost (capital expenditure)					
		Woodland creation	% of total cost	Peatland Restoration	% of total cost	Regenerative Agriculture	% of total cost
Labour	Environmental consulting activities	**£40,950**	1%	**£390,250**	46%	**£450**	0%
	Hunting, trapping and related service activities	**£455,400**	10%	**£660**	0%	**£0**	0%
	Support services to forestry	**£2,892,240**	64%	**£429,000**	51%	**£312,120**	12%
	Construction of other civil engineering projects	**£27,000**	1%	**£18,588**	2%	**£0**	0%
	Other professional, scientific and technical activities (not environmental consultancy)	**£0**	0%	**£0**	0%	**£25,000**	1%
	Support activities for crop production	**£0**	0%	**£0**	0%	**£652,500**	25%
Machinery / transportation	Renting and leasing of agricultural machinery and equipment	**£90,000**	2%	**£8,140**	1%	**£109,500**	4%
Materials	Plant propagation	**£810,000**	18%	**£0**	0%	**£28,000**	1%
	Wholesale of agricultural machinery, equipment and supplies	**£0**	0%	**£8,140**	1%	**£1,485,000**	57%
	Grand Total	**£4,513,770**	100%	**£846,638**	100%	**£2,612,570**	100%

The output from the I-O model also included the total output effect, employment effect and the Employment effect (Direct + indirect) for each of the SIC codes across the three case studies. Overall the woodland creation employment multipliers predicted that a total of 50 jobs would be created as part of the woodland creation case study (Table 10,

Table 11, Table 12). Model estimates suggest less jobs generated as part of the other case studies, particularly in the case of peatland restoration (11 jobs). The regenerative agriculture case was predicted to generate 30 jobs. Though as noted above, for a given level of investment, the jobs impact would be similar across all three case studies.

The woodland creation case study also had the largest output effect of £6,105,435 showing a larger contribution to the local economy than just the overall cost. This larger output effect than total captial expenditure was seen across all three cases studies.

Table 10: Woodland creation case study – multipliers result by SIC description

SIC Description	Sum of Output effect	Sum of Employment effect	Sum of Employment effect (Direct + indirect)
Construction of other civil engineering projects	£41,554	0.4	0.5
Environmental consulting activities	£54,474	0.6	0.8
Hunting, trapping and related service activities	£693,890	6.0	9.1
Plant propagation	£1,234,191	11.2	17.1
Renting and leasing of agricultural machinery and equipment	£109,230	1.2	1.4
Support services to forestry	£3,972,096	31.1	42.7
Wholesale of agricultural machinery, equipment and supplies	£0	0.0	0.0
Logging	£0	0.0	0.0
Grand Total	**£6,105,435**	**50**	**72**

Table 11: Peatland restoration case study – multipliers result by SIC description

SIC Description	Sum of Output effect	Sum of Employment effect	Sum of Employment effect (Direct + indirect)
Construction of other civil engineering projects	£28,608	0.2	0.4
Environmental consulting activities	£640,405	4.7	7.7
Hunting, trapping and related service activities	£1,006	0.0	0.0
Renting and leasing of agricultural machinery and equipment	£520,665	5.7	6.9
Support services to forestry	£0	0.0	0.0
Wholesale of agricultural machinery, equipment and supplies	£10,816	0.1	0.1
Grand Total	**£1,201,500**	**11**	**15**

Table 12: Regenerative agriculture case study – multipliers by SIC description

SIC description	Sum of Output effect	Sum of Employment effect	Sum of Employment effect (Direct + indirect)
Environmental consulting activities	£599	0.0	0.0
Plant propagation	£42,663	0.4	0.6
Renting and leasing of agricultural machinery and equipment	£132,897	1.4	1.8
Support services to forestry	£428,654	3.2	4.4
Wholesale of agricultural machinery, equipment and supplies	£1,973,182	16.0	21.2
Other professional, scientific and technical activities (not environmental consultancy)	£26,000	0.3	0.4
Support activities for crop production	£994,209	8.6	13.1
Grand Total	**£3,598,205**	**30**	**41**

Conclusion

This project has demonstrated that it is possible to quantify the typical contributions to local economies (measured as output effect and jobs created) of four different types of natural capital investment. This has been achieved through the development of a bespoke economic model using Scottish Input-Output (I-O) tables. Applying this model to the four natural capital investments considered should enable the increased inclusion of local economic impacts in business cases, investment strategies and policy decisions in the future. This will be vital if the anticipated investment in the restoration of natural capital across Scotland is to be achieved.

In addition, the project has highlighted current data caps and areas for further investigation which should allow the targeting of future research projects by Scottish Government to build upon the success of this project and unlock increased insight into the economic impacts and wider benefits of natural capital investment.

Next steps and recommendations

This project has shown that further collaboration will be required with the private sector in the future to improve the accuracy and resolution of the data and evidence available for future models. The feature within the model that allows users to update the reference values used within the model when more suitable values are available will results of to be incorporated.

The I-O model has been designed to allow for stakeholder engagement with private companies and those involved in the sector, who could provide much of the source information / reference data used within the models. This was particularly the case for the quantification of scale and cost associated with each activity.

An additional factor that was determined during the stakeholder engagement was that many of the skills needed to carry out the activities listed within the different interventions are underrepresented within the labour market. There is a requirement to review the required skills development programme linked to the activities within the different I-O models and ensure suitable upskilling programmes are available. In Scotland, this is currently being undertaken through initiatives such as the Skills Development Scotland (SDS) Climate Emergency Skills Action Plan (CESAP) 2020 – 2025[11] and the NatureScot Nature-based Jobs and Skills Action Plan 2021-2022[12].

The results of the I-O models have shown that improvements to the SIC code taxonomy maybe required if the multipliers are to be more representative of the actual activities undertaken. Certain natural capital investment types such as woodland creation and regenerative agriculture benefit from the SIC code directly relatable to the activity, (i.e. ‘Support Services to Forestry’ and ‘Mixed Farming’). However, for peatland restoration, where specialist civil engineering and plant operating skills are

[11] Skills Development Scotland (SDS) webpage where the Climate Emergency Skills Action Plan (CESAP) can be downloaded: climate-emergency-skills-action-plan-2020-2025.pdf (skillsdevelopmentscotland.co.uk)

[12] NatureScot webpage where the NatureScot nature-based jobs and skills action plan can be downloaded: Nature-based jobs and skills Action Plan 2021-2022 | NatureScot

required, these were not easily captured within the SIC codes. Both situations risk the true value of the activity being incorrectly measured due to inaccurate multipliers.

It is recommended that a review of the relevant SIC codes is undertaken following this project and where required new codes that specifically relate to natural capital investment projects developed. This should be undertaken in partnership with the private sector to maximise their experience.

According to Green Book guidance, job impacts should be assessed for additionality. The main additionality indicators are leakage, displacement, substitution and displacement[13]. A full additionality analysis was outside the scope of this study. However, we recommend that the job impacts are compared with the sector and skills profile of the region. Otherwise, any investment would lead to jobs leaking out of the region.

Finally, as, mentioned within the model assumptions section, the values within the I-O model are standard costs for the national scale. Further research and scientific adjustments can be undertaken to review case studies at various scales to improve the accuracy of the models and refine the costs within them.

[13] Leakage is the extent to which job effects 'leak out' of a target area into others. Displacement is the extent to which an increase in economic activity promoted by an intervention is offset by reductions in economic activity elsewhere. Substitution is a situation where firms or consumers substitute one activity for another as a result of intervention. Deadweight refers to outcomes that would have occurred without the intervention.

Appendix A: Desktop Literature Review Sources

Overall

Atterton J & McCracken D. (2021). Scotland's natural economy Putting rural areas at the forefront of green recovery

Bryden, D.M., Westbrook, S.R., Burns, B., Taylor, W.A., and Anderson, S. 2010. Assessing the economic impacts of nature based tourism in Scotland Scottish Natural Heritage Commissioned Report No. 398.

Hirst, A. & Lazarus, H. 2020. Supporting a Green Recovery: an initial based jobs and skills. NatureScot Research Report No. 1257.

PlaceFirst (2011). Agri-tourism in Southern Scotland. Scottish Natural Heritage Commissioned Report No. 463.

Putman, R. (2012). Scoping the economic benefits and costs of wild deer and their management in Scotland. Scottish Natural Heritage Commissioned Report No. 526

Rewilding Britain (2021) REWILDING AND THE RURAL ECONOMY

Scottish Natural Heritage (2020). Valuing our Environment The Economic Impact of Scotland's Natural Environment

Peatland restoration

Peatland restoration – a comparative analysis of the costs and merits of different restoration methods (2018) Artz et al
(https://www.climatexchange.org.uk/media/3141/peatland-restoration-methods-a-comparative-analysis.pdf**)**

Regenerative Agriculture

https://www.fas.scot/downloads/cover-crops-information-notes/

https://www.fas.scot/downloads/rotational-grazing/

https://www.fas.scot/downloads/starting-out-in-arable-agriculture-variable-costs-and-creating-a-budget-fact-sheet/

Coastal Restoration

eftec, ECNC, UAntwerp & CEEWEB (2017) Promotion of ecosystem restoration in the context of the EU biodiversity strategy to 2020. Report to European Commission, DG Environment

Haynes, T.A. 2016. Scottish saltmarsh survey national report. Scottish Natural Heritage Commissioned Report No. 786.

Hudson, R., Kenworthy, J. and Best, M. (eds) (2021). Saltmarsh Restoration Handbook: UK and Ireland. Environment Agency, Bristol, UK

Appendix B: Stakeholders consulted

Woodland creation	Peatland restoration	Regenerative Agriculture	Coastal Restoration
Forestry and Land Scotland (FLS)	Peatland ACTION (NatureScot)	NatureScot	Solway Firth Partnership – Borderlands Natural Capital Programme
Highlands and Islands Enterprise (HIE)	Cairngorms National Park Authority (CNPA)	Scottish Environment Protection Agency (SEPA)	Scottish Environment Protection Agency (SEPA)
Confor	Scottish Environment Protection Agency (SEPA)	James Hutton institute (JHI)	
Scottish Woodlands	James Hutton institute (JHI)	Scottish Enterprise	
Bunloit Rewilding	Scottish Enterprise	Borderlands Inclusive Growth Deal - Natural Capital Programme	
	Borderlands Inclusive Growth Deal - Natural Capital Programme	University of the Highlands and Islands	
	McGowan Environmental Engineering (private sector peatland restoration contractor)		
	University of the Highlands and Islands		

social research

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

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