



# Distributional issues in natural capital accounting

## An application to land ownership and ecosystem services in Scotland



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### Introduction

Natural capital accounting (NCA) describes a body of statistical work to construct better metrics of nature for policy. A core of NCA has focused on ecosystems, which for practical purposes refer to broad habitat types.

A growing number of countries have set statistical processes for ecosystem accounting<sup>[1]</sup>. This aims to provide important information about natural capital to support public policy and land-use or management decisions.

Our contribution to the NCA literature is two-fold. First, we show the relevance of distributional issues with regards to accounting for ecosystem assets and services. To the best of our knowledge, this is the first paper to make this connection to NCA. Secondly, we demonstrate the empirical significance of these concerns using an application to Scotland. Specifically, we account for the distribution of two ecosystem services (ES) (carbon sequestration and air pollution removal) across private and publicly held land on which natural capital is located.

Land on which ES production takes place may have an institutional owner, be these businesses, public bodies or households. But the output of ES is typically unpriced, with no corresponding income paid as compensation to the landholder. NCA then can be viewed as part of the statistical architecture needed to construct policy responses given this distributional mis-match between users and owners of natural capital. Distributional issues within these groupings are also of considerable interest for anticipating the distributional consequences of natural capital policy interventions.

### Methods

#### Framework for natural capital accounting

A natural development of ES flow accounts is a Supply and Use Table (SUT). A SUT describes the supply of different goods and services from producers and its allocation between intermediate and final users<sup>[2]</sup>. In a typical SUT for ES, producers are characterised as ecosystem types (i.e. broad habitats)<sup>[3]</sup>. Our contribution looks additionally at how landholders, in effect, supply ES on land they own or manage where natural capital is located.

#### Distribution of land ownership

Our empirical focus is on the physical and monetary flow of ES disaggregated to look at distributional issues surrounding land ownership. This picture of landownership distribution is partial, due to gaps in public records on ownership of rural land in Scotland. We use Andy Wightman's *Who owns Scotland* map<sup>[4]</sup> to analyse spatial aspects of land ownership distribution, along with other additional data sources<sup>[5,6]</sup> (Fig. 1).

#### Distribution of carbon sequestration and air pollution removal services

Recently published Scottish natural capital accounts<sup>[3]</sup>, indicate woodlands provide more than 70% of physical and monetary values associated with carbon sequestration in Scotland. Woodland and other broad habitats including enclosed farm, mountainous and moorlands areas, and semi-natural grassland make a similar contribution to air pollution removal services. We consider additional information sources to disaggregate these values spatially, and analyse the contribution of different types of land holdings (publicly owned land and private properties by size)<sup>[7,8,9,10]</sup>, using the *Who owns Scotland* map<sup>[4]</sup>.

### Results

The Wightman's *Who owns Scotland* map<sup>[4]</sup> covers about 3.9 million hectares of land, representing nearly half of the total land mass in Scotland, and about 60 percent of the estimated privately-owned land. Public land mapped using additional data sources<sup>[5,6]</sup> accounts for about 75% of total public land. Fig. 1(a) provides a partial picture of private and public land distribution in Scotland. Fig. 1(b) maps 2,575 private properties classified according to 5 broad sizes (reduced to 3 for Table 1). Those properties belong to 1,735 distinct institutional owners: households, business, and other private entities.

Table 1 provides a partial view of the relative contribution of private land by size and public land in the provision of the two ES analysed. Fig. 2 shows the spatial distribution of the estimated monetary values associated with air pollution removal and carbon sequestration services. In the former, higher values occur close to more populated areas, where smaller to medium size farms seem more common. About 81 % of net carbon sequestration by woodlands occurs in private forest areas, with a large portion of this carbon sequestration (56%) apparently occurring in medium to very large properties.

A caveat of our work is that available data sources focus on larger properties, omitting land property distribution in arable land dominated areas in the Grampians, the Central Belt or Ayrshire. More research is needed in order to complete the landownership and usership data base in Scotland.

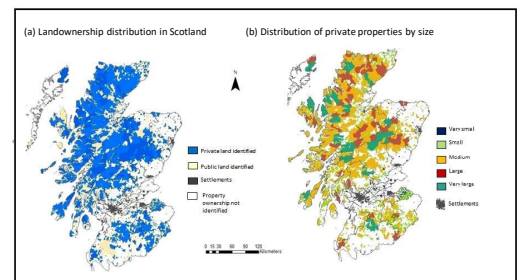


Fig. 1 Landownership distribution and characteristics in Scotland (partial)

Table 1. Type of landholding and delivery of ecosystem services (%)

| Ecosystem service (monetary values) | Private land (according to the property size) |                        |                  |               | Public land (total) |
|-------------------------------------|---|------------------------|------------------|---------------|---------------------|
|                                     | Small <1,000 ha                               | Medium 1,000-10,000 ha | Large >10,000 ha | Total private |                     |
| Carbon sequestration                | 8   | 36                     | 20               | 64            | 36                  |
| Air pollution removal               | 35  | 40                     | 1                | 77            | 23                  |

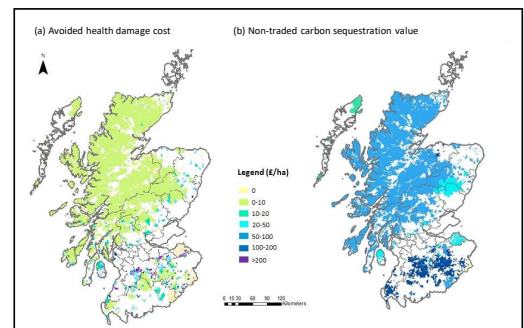


Fig. 2 Estimated monetary values for air pollution removal and carbon sequestration in Scotland (in GBP/ha year 2016, partial cover)

### References

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### Conclusions

- How natural capital is distributed matters: e.g. how ecosystem assets are distributed spatially and how underlying land is owned by institutional actors (e.g., business, households).
- Our Scottish case study highlights this relevance, for two ES. For carbon sequestration, there is a concentration of ES supply in larger properties. For air pollution removal, what is important is ownership of land close to urban population centres – this is where smaller properties are more frequent.
- Understanding these distributional issues in NCA might help, in turn, anticipate wealth (re)distribution consequences of policy interventions.