Extended Abstract
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Paper/Poster Title	**Fostering forestry contribution to climate change mitigation: analysing the economics of planting trees on marginal agricultural land in Scotland, and beyond**

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***
This paper presents the economics of climate change mitigation by afforestation in the UK and several other countries and highlights the necessity of reconciling carbon sequestration forest policy initiatives with sustainable development. Climate change is widely recognised as the most serious environmental threat, which might have diverse local, regional, and global consequences. Many climate policy and research projects that focus on carbon sequestration are directed towards woodlands expansion and using of wood as a substitute for fossil fuels, and/or in wood products. However, there is a knowledge gap with respect to socio-economic aspects of climate change mitigation land use policy decisions. It is important to identify projects, which will be coherent, effective, efficient, widely acceptable by the public, and consistent with other aspects of sustainable development. Having the primary focus on Scotland, we present selected results of the economic analysis to define existing climate policy priorities, regarding the activities that involve tree planting on bare and marginal agricultural land. We assess the carbon sequestration potential of (re)afforestation and compare how different climate change mitigation options are included in policies (at each national level), as well as internationally.	
Keywords	Cost benefit analysis, cost effectiveness of afforestation, woodland expansion, natural resource economics, Scotland
JEL Code	Renewable Resources and Conservation: Forestry see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***
Forestry has traditionally been a sector of economy, which primary objective was to maximize profits from timber production. However, woodlands contribute to carbon budget, provide regulatory, cultural, and other services, and can support local entrepreneurial opportunities, outdoor recreation, and rural livelihoods. The recognition of a range of ecosystem services offered by woodlands is the mainstream of changes in contemporary policies. Accordingly, economic valuation of (re)afforestation has changed. Assessing the contribution of woodlands to climate change mitigation is among research priorities in many countries, including the UK, and we believe that our paper is thus timely and highly relevant.	

Methodology	***100 – 250 words***
An extensive review of the literature in the field was conducted and empirical evidence collected and analysed to estimate present value (PV) costs per tonne of carbon sequestered through the creation of new forests. A static comparative analysis, aiming to show the influence of key variables on the costs was carried out. In consideration of uncertainty, time preference and intergenerational equity, the traditional cost-benefit analysis framework was challenged with regard to the discounting/non-discounting of carbon uptake benefits, and because it usually uses a constant and positive discount rate. We investigated the influence of various discounting protocols on the outputs of economic analysis for the UK and Ukraine. Moreover,	

in addition to tree planting for climate change mitigation (CCM), we conducted an economic analysis of afforestation of marginal lands in Ukraine for timber production and erosion prevention. A methodology combined an econometric analysis, simulation modelling, and linear programming. The modelling approach is straightforward and practical. It could be easily modified, refined, and applied to other cases and in other countries to review existing evidence and the opportunities available with respect to the delivery of multiple services from land use policy decisions by assessing existing forest management options and identifying new ones.

Results

100 – 250 words

Opportunities and challenges of moderating carbon emissions through afforestation were identified, and empirical evidence of the cost-effectiveness (CE) of establishment forest plantations in the UK for CCM provided, across different locations. The results indicated whether, where and how forestry could offer a low-cost opportunity for carbon uptake. Afforestation with relatively fast-growing tree species (e.g., Sitka spruce) on low grade agricultural land (e.g., used for sheep grazing, in Scotland) could be cost-efficient. We showed the influence of land uses, opportunity costs of land, yield classes and timber prices on economic cost. PV cost estimates of carbon sequestration were derived for cross-comparison analysis. The choice of location, tree species and management regimes to be applied appeared to be important factors, along with discounting protocols, having a dramatic impact on the economics of CCM forest policy options. The results indicate that an individual scope for carbon forestry will likely be driven by land available (and where opportunity costs are least), while the imposed costs will likely be increasing over time. Therefore, CCM through forestry should rely on strategies pre-determined by long-term stabilisation targets that account for dynamic and scale effects, and consider both, potential dis-benefits/ benefits of the changing climate, and co-benefits associated with mitigation-adaptation linkages. The optimum solutions will likely be those, placing carbon forestry in the general context of rural land use, linking long-term carbon sequestration objectives to long-term substitution opportunities (e.g., of wood for fossil fuel) and bridging existing gaps between climate policy priorities and those of sustainable rural development.

Discussion and Conclusion

100 – 250 words

In discussion, among other relevant studies, we bring in results from our previous research. We refer to the estimated CE of afforestation for carbon uptake in Ukraine (including for scenarios of using wood for fuel and in wood products), Slovakia, the Netherlands, and the CE of multifunctional afforestation. We introduce the simulated (using an agent-based GEM, Dyer and Nijnik, 2013) scenarios deconstructing the sources of leakage and livelihood outcomes of reforestation in central Mexico. By adapting a holistic model (van Kooten et al., 2019) for British Columbia, we answer the question of whether carbon accounting can promote economic development in forest-dependent indigenous communities. Social and institutional aspects of the creation and trading of carbon offsets (under the CDM and REDD) are also introduced.

Afforestation for carbon sequestration alone (e.g., with no consideration of using wood and land) can hardly be a long-term solution. Terrestrial carbon sink is temporary. This merits attention, along with the issues of tenure rights, equity, uncertainties, leakages, perceptions, behaviours (e.g., uptake of tree-planting), others. Someday, there may be no more land available for afforestation. However, today, woodland expansion is competitive with other means of removing carbon from the atmosphere. There is a case for forestry in the UK to contribute to CCM. In specified cases and locations, carbon forestry can be effective, efficient, and socially desirable. It may allow time for adaptation, learning, innovation, the delivery of multiple ecosystem services, while the use of timber could promote technological advance, offer employment, market opportunities, steering sustainable development.