Effects of land use change for solar park development in the UK on ecosystem services

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EGU22 – Session ITS4.2/ERE1.11, 27th May 2022

Solar energy and ecosystem services

Solar energy in the UK has been increasing significantly…

- From < 100 MW in 2010 to > 14,000 MW in 2021

… mostly as **photovoltaic (PV) solar parks (SPs)**:

- Built on former agricultural land or grasslands
- **Extensive land take-up** (low energy densities)
- ≅ 13,800 ha of SPs in the UK in 2019

However, …
< 5% of land in SPs typically disturbed

Therefore, …
Considerable potential to enhance ecosystem services (ES)

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Aim & Methods




Aim: assess the impact of **land use change** for SP development in the UK on selected **ecosystem services**

Rapid Natural Capital-Ecosystem Service (NC-ES) protocol

- **One-day site visits** to collect empirical evidence

35 SPs surveyed in England & Wales in summer 2021

- Soil/vegetation data from **420 plots** (900 cm^2)

Land use **Treatments**

- **Under** solar panels
- **Between** arrays of solar panels and…
- … *control* areas
  - **Outside** solar panels (inside SP boundaries)
  - **Arable land**
  - **Pastureland**
  - Land **set-aside** for conservation

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Rapid NC-ES assessment protocol

NC	Ecosystem service	Indicator	Method	Rationale	Potential implications of land use for SPs	Potential for SPs to enhance ecosystem services
Soil	Climate change mitigation	Soil organic carbon (SOC)	Mineral-associated (MAOM) and particulate (POM) organic matter	Soil carbon sequestration and the true carbon intensity of the electricity produced	Changes to the photosynthetic potential of vegetation caused by PV arrays can affect carbon drawdown from the atmosphere and affect carbon allocation to soils	Agriculture is often associated with decreased soil carbon. Conversion to well-managed grasslands in SPs can lead to increases in soil carbon
Soil	Soil fertility	Mineral nutrients and pH	Ammonium, nitrate, inorganic P, total P, pH	Changes to soil fertility and potential to sustain agriculture after site decommissioning	Interception of solar radiation by PV arrays can alter plant-soil processes and biogeochemical cycling to affect soil health and fertility levels	Reduction in chemical inputs, as used for both arable land and pastureland, should lead to improvements in soil health. Well-managed SPs could simulate benefits of extended ley periods
Soil & biodiversity	Soil erosion control	Soil retention potential	Plant cover	Diffuse pollution, with consequences for nearby waterway quality and soil loss	Arable fields are key sources of diffuse pollution to waterways due to periods of bare soil and disruption of soil aggregates through farming. Construction of SPs can disturb soils	SPs are generally managed as grasslands, thus eliminating periods of bare soil and providing buffers for waterways. Well-designed and well-managed SPs can minimise soil erosion
Soil	Soil-atmosphere gas exchange	Soil bulk density	Core sampling	Compaction alters bulk density with implications for runoff and soil health	Land management practices like chemical spraying and harvesting can lead to soil compaction and negatively affect soil aeration that governs soil-atmosphere gas exchange rates	Conversion of intensive agricultural land to SPs can reduce disturbance and the need for regular treatment of fields
Biodiversity	Plant biomass production	Above ground net primary productivity	Destructive harvesting	Grazing potential	Plant biomass is highly responsive to land management and is an indicator of forage availability, grazing capacity and the potential formation of habitats	Forage potential will increase if previous land-use was arable. Areas directly under PV arrays may produce less forage potential, but anecdotal evidence suggests earlier growth
Biodiversity	Plant diversity	Diversity of plant functional types (PFTs)	Abundance of different PFTs	Soil health, carbon sequestration and grazing potential	Changes in PFTs can affect soil physical, chemical and biological properties with implications for soil health and carbon sequestration. In addition, it influences the performance of grazing animals	SPs can be managed to optimise PFTs for soil health, carbon sequestration and grazing

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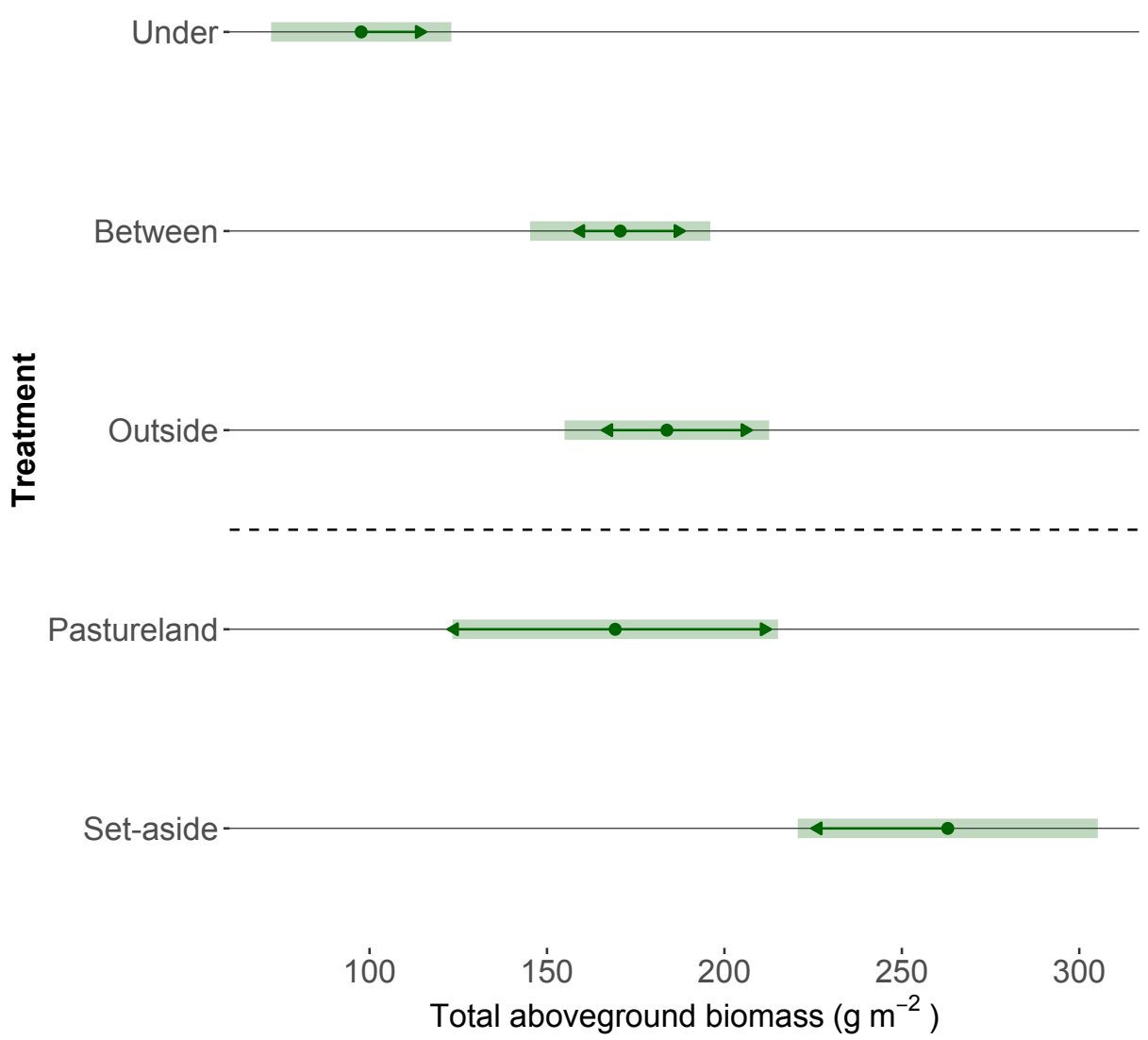
Plant-related variables



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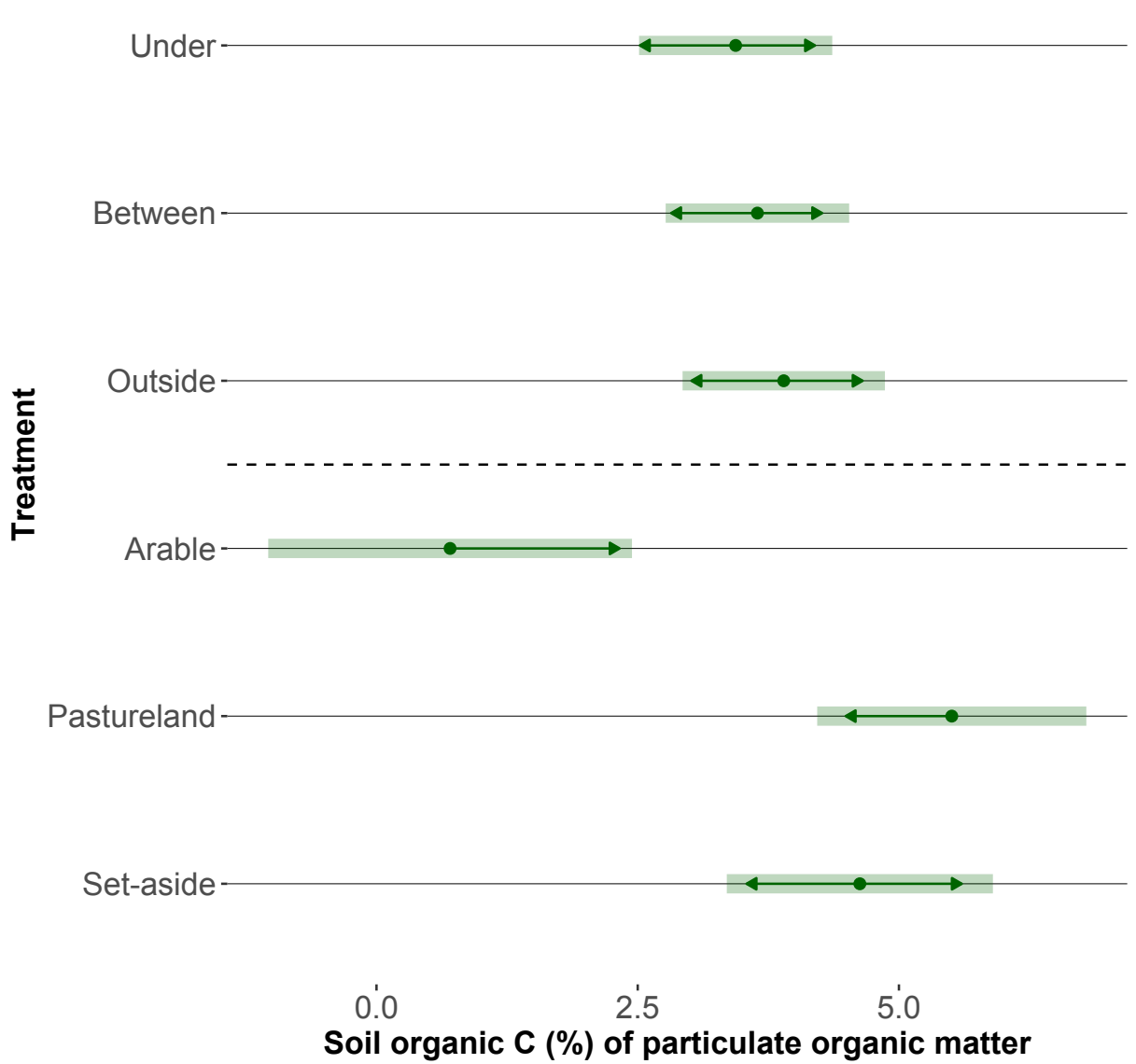
Soil-related variables



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Conclusions

- Land **Under** PV panels showed lower plant biomass than other land uses
- **Between** PV panels and **Outside** solar arrays were comparable to **Pastureland**
- PV arrays could be altering microclimate **Under** PV panels to impact plant-related ES

- SPs seemed to perform better than **Arable land** in storing labile pools of organic carbon
- Lower disturbance in SPs can result in enhanced soil-related ES than in intensive **Arable land**

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Energy-Environment Interactions

Watch the video on **EARTH ENERGY EDUCATION's** YouTube channel

SCAN ME

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