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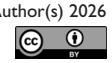

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Soil carbon markets for climate change mitigation? Pragmatic economists and matters of concern

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Abstract

Soil carbon markets are increasingly promoted as climate mitigation instruments, yet their emergence is uneven, contested, and shaped by complex socio-technical configurations. Through comparative research in Taiwan and the United Kingdom, this paper examines how these markets are actively constructed rather than pre-given, highlighting the critical but often overlooked role of mediators whom we conceptualise as pragmatic economists. Drawing on interviews, workshops, and stakeholder mapping, we show how pragmatic economists translate scientific and metrological knowledge, assemble infrastructures for measurement and certification, and align agricultural, policy, and commercial interests. Their practices extend but also complicate Callon's concept of economists in the wild, revealing marketisation as a situated, relational, and performative process. Across both sites, we identify key matters of concern, including scientific simplification, fragmented governance, unequal power relations, and new dependencies between farmers and mediators. By foregrounding pragmatic economists, the paper advances debates on the political economy of environmental markets and underscores the need for more reflexive, ecologically attentive, and socially just approaches to governing soil carbon within wider decarbonisation strategies.

Keywords

pragmatic economists, matters of concern, soil carbon markets, marketisation, environmental markets

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Introduction

In response to escalating global temperatures and the ongoing planetary climate crisis, scientists and policymakers have proposed a range of nature-based and geoengineering solutions. Although agriculture has long been a significant contributor to greenhouse gas emissions (Shukla et al., 2019; Simmonds et al., 2025), it is increasingly reframed as a potential part of the solution (Cusworth et al., 2022; Leach et al., 2012; McGregor and Houston, 2018). Soil carbon sequestration has gained particular attention as a strategy for transforming agriculture into a net absorber of emissions (Black et al., 2022; Bossio et al., 2020). Initiatives like the "4 per 1000" introduced at COP 21 (Global Climate Action, 2023; Jian and Lin, 2023) and subsequent policies across national and EU levels (European Parliament, 2024) promote sequestration as a mitigation option. In response, voluntary soil carbon markets (VCM) have emerged as key instruments to generate new revenue streams for a range of supply chain actors, financial institutions, and farmers. These are part of a nascent soil carbon economy which operates through private and public mechanisms (Keenor et al., 2021) and is shaped by a complex offsetting and insetting landscape[1] (Buck and Palumbo-Compton, 2022; Ingram et al., 2025; Reed et al., 2022; UNEP, 2021).

From a neoclassical economic perspective, excess carbon—like other environmental externalities—is best managed through market-based solutions (Bigger, 2018; Sullivan, 2013). This view sees the market as an abstract space where independent agents make rational decisions based on available information. Callon (2021) refers to this as the "interface market model," in which transparency and rationality enable effective transactions. It assumes a pre-existing arena in which autonomous buyers and sellers compete, with the success of climate mitigation depending on whether agricultural actors behave as *homo economicus*, that is, operating as rational, objective individuals, calculating in this case the costs and benefits of soil carbon market opportunities for their own self-interests.

However, critics argue that this abstraction overlooks how markets function in practice. Marketisation is a contingent, contested, and negotiated process rather than the execution of a pre-existing system (Berndt and Boeckler, 2023; Bigger, 2018; Callon, 2021; MacKenzie, 2009; Ouma et al., 2018). Scholars working in Social Studies of Economisation and Marketisation (SSEM) stress the importance of studying "actually existing markets" and the role of what Callon (2007) called socio-technical *agencements* (STAs; Berndt and Boeckler, 2023; Bigger, 2018; Ouma et al., 2018). Callon (2007: 320) notes that the French term *agencement* shares its root with "agency" and refers to dynamic, heterogeneous configurations. Unlike the English term *assemblage*, it emphasises that agency can take multiple forms, shaped by the specific configuration of the *agencement*. For Callon (2021), an agencement cannot be understood merely as a complex assemblage of interconnected elements; it is, above all, an active configuration that produces effects. This SSEM-inspired view of markets usefully challenges the underlying assumptions of the interface market model, arguing that competition can take multiple forms, that the interactions between supply and demand must be deliberately organised, and that markets are complex socio-technological assemblages of knowledge, tools, and actors.

Soil carbon markets vividly illustrate these complexities and form the starting point of this paper. In Taiwan, for example, one of our two empirical anchor points, we have observed new market actors or agricultural entrepreneurs becoming prominent in emerging voluntary carbon markets and actively enrolling farmers in soil carbon projects certified by different organisations. This observation prompted a series of research questions: Why are farmers willing to participate in such projects? How is an invisible entity like soil carbon rendered measurable and tradable—particularly given that, unlike emissions from fossil fuels, soil carbon derives from biochemical processes such as nutrient cycling and microbial activity, which remain poorly understood (Baldrian, 2019; Fierer, 2017)? How are these metabolic circulations made calculable and governable to enable market participation (Barua, 2024; Cusworth, 2023)? What roles do emerging market actors and government officials play in market building, and how do they reshape agri-food governance?

In the UK, we identified parallel developments in the agricultural landscape, suggesting a cross-regional comparative approach would be valuable. Here, new market actors—such as project developers, consultants, and certification bodies—are playing equally pivotal roles in shaping the nascent soil carbon market. These similarities prompt questions on how knowledge, policies, and market practices move across borders, and how transnational linkages reshape the local political economy of carbon farming. They also bring into focus pressing questions about the social and environmental consequences—and potential inequalities—associated with the marketisation of soil carbon.

Informed by what Callon (2021) terms "matters of concern," this paper engages with the questions and issues arising in both contexts—such as the scientific debate over soil health and the regulation of markets—and contributes to the literature on marketisation (Callon, 2021; Cooper, 2015; Lovell and MacKenzie, 2011). Our methodological strategy is informed by innovations in comparative studies (see McCann and Ward, 2012; Robinson, 2016, 2022), in this case through a comparative case study analysis of Taiwan and the UK. Rather than adopting the traditional scientific model of comparative analysis—typically grounded in variation-finding strategies—our approach traces the connections and circulations within and between these cases.

Utilising this comparative and data-driven inductive approach, the paper makes two contributions to the literature on marketisation. First, following Callon, we identify "matters of concern" in the soil carbon marketisation process (Callon, 2021; Latour, 2005), including uneven benefit distribution, the exclusion of certain farming communities, the privileging of scientific knowledge over local expertise, and uncertainties surrounding long-term carbon storage. These concerns challenge the notion of soil carbon markets as a straightforward or universally beneficial climate solution and highlight the need for critical, empirically grounded analysis. Second, through our examination of soil carbon markets in the UK and Taiwan, we highlight the pivotal role of mediators—often without formal economic training—who actively shape these emerging markets. Distinct from intermediaries, which transmit meaning without transformation, mediators transform relations and produce contingent, unpredictable outcomes—thereby becoming themselves a source of concern (Callon, 2021; Latour, 2005). These actors differ from those identified in other carbon markets, such as forestry and regenerative agriculture (Bless et al., 2025; Carton, 2020), and call for further conceptualisation, extending marketisation theories of "economists in the wild" (Callon, 2007).

The paper proceeds as follows: the next section outlines the research methodology, including further explaining the rationale and procedures for the comparative research design. The third section presents findings from Taiwan and the UK, focusing on how soil carbon markets are constructed and the matters of concern that emerge. The findings and discussion section discusses the theoretical and empirical contributions, with particular emphasis on the concept of the "pragmatic economist," as well as the social and environmental implications of soil carbon marketisation. Using these case materials as data-driven reference points, the paper argues for a conceptualisation of pragmatic economists as diverse actors that through practical actions not only shape, frame, and civilise markets as transition mediators but create niches themselves, evolving with the market to make it work and become more established. The conclusion reflects on the broader implications of these insights for climate policy, environmental justice, and the future governance of soils.

A comparative approach to soil carbon marketisation in Taiwan and the UK

This study draws on comparative research in Taiwan and the UK. Following postcolonial critiques of comparative studies, we reject quasi-scientific case selection—whether by controlling for national differences or restricting comparability to fixed territorial units. The widely used "variation-finding" method, often framed as more scientific, operates through a *deductive logic* in which theoretical categories and hypotheses are formulated prior to engagement with the research field and subsequently

tested through empirical observation. This approach assumes a fundamental incommensurability between places and privileges the selection of the most similar cases—typically affluent countries or cities—while minimising variation in other factors. This approach reinforces a direct link between existing theory and hypothesis formation (Robinson, 2011, 2022), allowing locally derived conclusions—often from the Anglophone world—to circulate as universal knowledge (Gkartzios et al., 2020), and narrowing inquiry to variables defined within privileged sites of theory production. Using Taiwan and UK soil carbon market case studies, here we work instead to purposely hold together interconnectedness (of carbon market-making) and geographical difference (due to contextual factors) as relational processes. Thus, we trace connections and circulations between cases, examining how flows, linkages, and interactions shape marketisation. This approach treats outcomes as contingent, path-dependent, and multiply determined (McCann & Ward, 2012; Robinson, 2022), resisting reductive explanations and fostering theoretical cultures that acknowledge their situated origins, engage with diverse traditions, and remain open to revision (Baker and McGuirk, 2017; Savage, 2020). In this view, conceptualisation can begin from any location, drawing on insights from a wide range of contexts while recognising the situated nature of theory (Robinson, 2016).

Building on the comparative strategy outlined above, our empirical research is inductive, in which theoretical categories emerge from empirical data. Guided by this data-driven analysis, we examine the marketisation of soil carbon in Taiwan and the UK. The selection of participants and the interview schedules and workshop programmes were steered by the broad themes of marketisation and aimed to include current and new market actors.

Before turning to our empirical analysis, it is important to note that in Taiwan, marketisation is in the early stages of development but has strong certification bodies and close collaboration between the government and the private sector in place. In the UK, by contrast, the market is still nascent, fragmented and still in the process of standardisation, shaped by ongoing debates over measurement and assessment (see Smith et al., 2020). These divergent configurations produce distinct matters of concern and position market mediators differently, providing fertile ground for theorising how market devices, actor networks, and policy ideas travel and transform across contexts. Reflecting these national contexts, in Taiwan we study selected programmes with a focus on farmers' experiences while in the UK we study stakeholders across the emerging market landscape. Below, we further elaborate on our methods for each national case.

Taiwan

Two certification programmes were studied: the government-funded BSI (British Standards Institution) programme in central Taiwan (G1) and a privately operated programme in eastern Taiwan (G2). Their participation in distinct certification schemes and their successful attainment of certification make them ideal research cases. Farmers in G1 are mainly vegetable growers, while G2 farmers cultivate rice. G1 is organised by local government officials, while G2 was initiated by a private entrepreneur. In G1, government subsidies covering certification fees serve as the primary incentive for farmers' participation, whereas in G2, farmers are motivated by the prospect of enhancing the marketability of their agricultural products. Fieldwork involved participation in two workshops on soil carbon management and certification development, and semi-structured interviews. Eleven interviews were conducted with G1 farmers and seven with G2 farmers, exploring their motivations for market participation, perceived changes in farming practices, and interactions with mediatory actors. Most interviewed farmers were smallholders (under 10 hectares), reflecting the limited roll-out of certification programmes at the time. Workshop participants were selected based on their willingness to be involved in this research project (Table 1).

Four mediators (M) were identified in each programme, based on interviews and publicly available data. M1, a county government official, coordinated farmer enrolment in G1. M2, a private-sector

Table 1. Interviewees (Taiwan).

Name (pseudonym)	Group	Crop	Length of time in programme
F1	G1	Vegetable and Rice	1–2 years
F2	G1	Vegetable and Rice	1–2 years
F3	G1	Vegetable and Rice	1–2 years
F4	G1	Vegetable and Rice	1–2 years
F5	G1	Farm worker	1–2 years
F6	G1	Farm worker	1–2 years
F7	G1	Farm worker	1–2 years
F8	G1	Farm worker	1–2 years
F9	G1	Farm worker	1–2 years
F10	G1	Farm worker	1–2 years
F11	G1	Farm worker	1–2 years
F12	G2	Rice	3–4 years
F13	G2	Rice	3–4 years
F14	G2	Rice	3–4 years
F15	G2	Rice	3–4 years
F16	G2	Rice	3–4 years
F17	G2	Rice	3–4 years
F18	G2	Rice	3–4 years

entrepreneur, recruited farmers into G2 and assembled the socio-technical infrastructure for certification. Field visits during these interviews revealed the everyday negotiations shaping farmer–market mediatory relationships. Interviews lasted 1.5–2 hours, were recorded, and transcribed. Additional interviews were conducted with five soil scientists (ST1–ST5) engaged in soil carbon experimentation. Two Japanese scientists (ST2, ST3) collaborated with a Taiwanese counterpart (ST1) to conduct in-situ soil experiments in a mountain village, which we observed in October 2024. These experiments examined carbon dioxide sequestration under varying spatial and temporal soil conditions. Discussions illuminated how scientists assess soil health and sequestration capacity, as well as their concerns over market impacts on long-term soil sustainability.

The United Kingdom

Data used to understand the matters of concern produced by the framing of the soil carbon market came from 17 online semi-structured interviews conducted with a range of stakeholders selected from the emerging soil carbon economy landscape in the UK.

A range of individuals, market entities, and organisations are involved in various aspects of soil carbon markets. Reed et al. (2023) identified 11 main categories for nature-based solution markets: policy makers, carbon markets, NBS investment community (major carbon offsetters, major carbon insetters, companies interested in investing in natural capital or ecosystem services for return on investment), land owner/managers, communities and their suppliers of NBS projects, advisers and mediators (land agents, NBS project developers, financial advisers), and researchers. This work was adapted in a stakeholder map for soil carbon to provide a sampling frame for interviews. From this mapping, 17 stakeholders across the soil carbon economy landscape were identified and interviewed.

The semi-structured interviews were conducted using the NetMap methodology, in which participants were asked to help create their own stakeholder map of UK carbon markets. This was done online using the platform Miro, took approximately 60 minutes per interview, and included three

Table 2. Interviewees (UK).

Type of stakeholder	Number of interviewees
Farmer cooperative representatives	2
Farm advisers/land agents	2
Project developers	3
Ibrokers	1
MRV chain actors	3
Buyers	1
Policy makers/experts	3
NGOs	2
Total	17

phases. In the "Actors" phase, participants identified the main stakeholder groups involved in UK carbon markets and these were added to a blank Miro board in circles. In the "Links" phase, participants were asked about the connections between the actors they had identified, which were represented as colour-coded arrows. The specific links we asked about were money, MRV data, knowledge and advice, and disruption and disturbance. In the final phase, "Power," we asked participants to score each stakeholder group based on their ability to influence or control the emergence of UK soil carbon markets. As well as eliciting varied maps, this method encouraged detailed and rich qualitative data, which underwent thematic analysis in NVivo to understand the matters of concern regarding the market emerging for soil carbon and the role of the diverse set of mediators. The types of participants are detailed in Table 2.

Constructing soil carbon markets in Taiwan and the UK

In both Taiwan and the UK, the agricultural sector has launched programmes focused on reducing greenhouse gas emissions. We analysed how policymakers, market actors, and farmers are involved in building soil carbon markets in Taiwan and the UK separately.

Taiwan: The emerging role of entrepreneurial brokers in market-making

In Taiwan, positioning soil as a carbon credit source for the manufacturing sector has become a primary strategy for encouraging behavioural changes among farmers. In response, environmental NGOs, conservationists, and advocacy groups in Taiwan have launched campaigns to promote soil as a method of greenhouse gas mitigation (The Liberty Times, 2024). Initially, these groups engaged with farmers practising conventional agriculture as a way to encourage participation in soil carbon sequestration projects. However, their discourses and sharing of scientific knowledge, which were limited by the constraints of advertisements, flyers, and documents, were insufficient to attract meaningful farmer participation or behavioural change. Matters began to shift when certain market agents identified an opportunity. Mediators emerged as pivotal figures in this transformation, bridging the gap between scientific advocacy and agricultural practice, and playing a crucial role in translating market concepts into locally meaningful actions.

In Taiwan, two prominent international certification bodies, the British Standards Institution (BSI) and the Gold Standard (GS), play significant roles in this. Participating farmers and cooperative managers were involved in different certification processes, the latter coordinating the Taiwanese government's funding of farmers' participation in certification. Supported by a market mediator (M1), who was a government official, three farmer cooperatives earned carbon certifications that, according to

one cooperative manager, served as an initial step by documenting the cooperatives' total carbon emissions over a year. Although he acknowledged the long journey ahead, he was optimistic that this would open up opportunities for selling carbon credits in the near future. However, interviews with farmers and farmworkers in this group (G1) revealed scepticism: two vegetable farmers stated, "We were reluctant to rejoin the project since the cost of involvement was too high, and the benefits were unpredictable."

While the government-funded soil carbon project (G1) is still in its developmental stages, the privately operated initiative (G2) is more established and is thus more appealing to farmers. A market mediator (M2), acting as an entrepreneur, successfully enlisted farmers for his soil carbon project, assembling the necessary socio-technical infrastructure to generate carbon credits, though the project is currently under review by an international certification agency. Despite differences in their agricultural products (e.g. rice, vegetables, and garlic), farmers from both G1 and G2 expressed unfamiliarity with the soil carbon project and a degree of conservatism during interviews. This raises an important question: why were these farmers willing to participate in the project?

From an SSEM perspective, farmers' ability to engage in market calculation depends on the mediation of socio-technical devices. In this case, M2 acted as a mediator between the more abstract metrological knowledge and farmers. As a farmer in the G2 remarked, "We do not need to understand the complicated carbon metrological system . . . He (M2) told us we would have carbon credits by joining his project." Another rice farmer in the G2 added, "We do not know anything about the carbon market, let alone joining the project . . . but M2 signed a contract with us and bought a few tonnes of our rice . . . Before we could benefit from soil carbon credits, he provided an outlet for our rice . . . We trusted him!" Rice farmers from this group consistently expressed that involvement in the soil carbon project can help them market their agricultural products. By translating the abstract and uncertain aspects of soil carbon credits and metrological systems into immediate economic opportunities and vernacular language, M2 was able to win the trust of farmers and encourage them to join his project. This highlights the importance of a trusting relationship, and that the translation of metrology is crucial in facilitating soil carbon marketisation. Evidenced by the fact that, according to M2, over 300 smallholders, with 300 hectares, joined the project in 2023, he aims to increase the certified area to 1,000 hectares in the future. Yet, the deepening ties between mediators and farmers also signal a shift in agri-food governance, as farmers' reliance on mediators grows amid rapid changes in agricultural production. As one farmer remarked: "This is a good market outlet for us compared to others or the state procurement program . . . We follow his (M2) instructions to change our farming practices as he asks."

Once metrological systems are in place and farmers have agreed to participate, one key question persists, however: how can carbon stocks in the fields be monitored, increased, and converted into certified carbon credits? Both BSI and GS certification standards require farmers to report on soil carbon status when they first join the programme, a procedure known as establishing a temporal baseline in the field—that is, defining the reference level of carbon storage prior to project intervention. This involves periodic assessments, during which farmers can apply selected farm practices to enhance their soil's carbon-sequestration capacity. However, these assessments can be time-consuming and resource-intensive, potentially deterring farmers from participating. As one vegetable farmer from G1 stated in an interview, "It takes a lot of time to determine the organic content in my fields . . . Improving soil health is both time-consuming and expensive." A government official supporting farmers in obtaining carbon certificates echoed this concern, saying, "Most farmers are not interested in renewing their certificates since the process is costly."

To overcome these challenges, M2 partnered with agricultural research agencies to create materials and technical tools that reduce the burden on farmers, facilitating the separation of soil carbon from its environmental context. For example, to simplify soil measurement for interested farmers, M2 designed a mobile application that enables users to photograph sampling sites, after which the

company collects physical soil samples to analyse carbon sequestration levels in the laboratory. By streamlining these processes, market mediators can better align farmers' interests with their own objectives. In addition, M2 informed the interested farmers about practices to boost organic carbon levels, such as minimise tillage, increase the use of green manure, reduce chemical fertiliser reliance, and increase the use of organic manure (such as chicken manure) to enrich soil organic matter.

The birth of the soil carbon market intensified the importance of calculability for agricultural management. The marketisation of soil carbon thus produces a mode based on "farming by numbers" (Krzywoszynska, 2024) for agricultural governance. This quantification of the agri-environment also reshapes farmers' identities and subjectivities, causing them to behave like entrepreneurs in terms of calculating and managing the quantities of soil carbon. This shift is evident in the words of a farmer from G2, who stated, "We have to spread chicken manure with fertilisers in the fields before planting and collect samples before harvest . . . Now, I have 3 hectares of certified farmland . . . If this method proves effective, I'll enrol all 12 hectares in the programme!"

Once the various socio-technical challenges are addressed, soil carbon becomes a measurable and tradable commodity. However, without buyers and market designs, carbon credits will hold little value, and farmers' interests will not be aligned with the soil carbon market. Creating opportunities for transactions between farmers and buyers is thus a crucial step in building the carbon market framework. Notably, M2 recognises that potential earnings from the carbon market per unit area are not yet substantial enough to incentivise farmers to participate in soil carbon trading. This is partly due to the small and fragmented nature of farmland. For farmers in both G1 and G2, agricultural production remains the primary concern, with carbon credits being a secondary consideration. To address this, M2 helped establish an agricultural alliance to reduce certification costs and increase economic benefits for farmers. Additionally, carbon credits can serve as a *mediator* by connecting farmers with potential buyers. To attract such buyers, M2 has created an online platform to promote farmers' products, using labels to align products with the UN's sustainable development goals. Instead of directly profiting from soil carbon credits, farmers and mediators thus generate income by selling branded agricultural products. As with other alternative food networks, this approach to soil carbon marketisation enables farmers to secure premium prices for their products (Guthman, 2004; Maye et al., 2007). Thanks to the efforts of this pragmatic economist, carbon is thus cut from its environment,[2] market agents' interests are aligned, and the soil carbon market is thereby framed in their favour.

The UK: Mediators as translational agents in contested markets

Voluntary carbon markets are growing in the UK; however, there are concerns about their governance, varying standards, and ensuring market integrity. There is a range of companies providing agricultural soil carbon credits with their own proprietary MRV methods, registries, and associated standardisation processes. Reed et al. (2023) documented at least eight companies offering agricultural soil carbon credits. The proliferation of these markets in general led the UK's Committee on Climate Change (2022) to recommend that any expansion of carbon markets into new land uses and habitats should be limited until their integrity can be ensured. Government[3] efforts are underway to standardise methodologies and establish minimum requirements for agricultural soil carbon (Black et al., 2022; BSI, 2025; DEFRA, 2023).[4] Once standardised, it may be possible to accredit codes and allow investors and farmers to work with the most reputable standards, although uncertainties about high variability, additionality, and permanence remain. Additionality refers to carbon benefits that would not have occurred without the project, while permanence concerns how long those benefits are maintained and the risk of their reversal over time (Oldfield et al., 2022). It is important to note that soil scientists in the UK have conducted a series of critical appraisals of the mitigation potential of selected farming practices that sequester soil carbon (e.g. Powlson et al., 2011), whilst farming advisory services and the farming press continue to caution farmers about selling soil carbon.

The data analysis revealed four key stakeholder groups in relation to the role of market mediators. These were project developers, farmer clusters, farm advisers, and supply chain insetters. They collectively play a key role in supporting UK soil carbon markets, such as initiating new projects, providing advice or capacity and network building functions that extend beyond interface market models of marketisation.

Firstly, the role of the project developer was seen to be critical in enacting marketisation on the ground, for example: "You need project developers, service providers, whatever, to be out there making this investable" (Interview 6, mediator). These market mediators work to metricise soil carbon on behalf of farmers to frame the market and cut soil carbon from its ecological context. As one mediator (4) explained, "You need a project developer who basically does the work on behalf of the farmer of understanding the science, the methodology, and dealing with the auditors." Project developers therefore understand how to translate carbon metrics for the farm context. In the UK, they are most likely to be selling carbon credits or certificates to inset buyers rather than offset buyers, as insetting dominates the UK soil carbon landscape. They therefore adapt their processes to the needs and requirements of the buyer, whose requirements in terms of integrity of credits are likely to vary.

There are a broad range of methods and approaches being implemented by project developers in the UK. Currently project developers have significant freedom to shape the market using their preferred methods and standards; however, participants noted that once a government endorsed standard is implemented, some models may be less attractive. This aligns with mediators' emphasis on practical applications suited to the context: they do the work and are reactive to opportunities, but do not engage in the underpinning scientific thinking. The diversity of methods employed by project developers was contributing to farmer perception of soil carbon markets still being a "Wild West" in the UK, and therefore presenting a barrier to farmer involvement, and thus market growth. Furthermore, models which involved project developers providing in-house MRV (monitoring, reporting, and validation) were viewed by many participants as having a conflict of interest. Trust from the farming community in the governance of soil carbon markets was therefore a challenge for mediators in the UK.

Secondly, farmer clusters also play a role as mediators in the UK, although less so than project developers. The emergence of farm clusters focused on natural capital markets is ". . . partly a reflection of the fact they want to take better control over the process and partly a reflection of the fact that it's only really when you bring a lot of farms together at scale that you can start to deliver the impact needed" (Interview 11, farm adviser). There was a sense that by acting collectively and pooling their natural capital, farmers wouldn't have to deal with other mediators who they considered ". . . unscrupulous traders trying to sort of, you know, corner individual farmers and pay them less than what perhaps it was worth to the end user" (Interview 3, Farm cluster member). However, some stakeholders highlighted that farmer clusters still often worked with project developers, because they did not have sufficient resources in terms of time and expertise on carbon metrics. This lack of expertise does not mean they avoided engagement with the market—rather, they found ways to do so that collectivised their bargaining power, and sought to develop an alternative income stream. We therefore suggest that some farmer groups are acting as mediators and actively shaping the market in the UK, and they often involve other mediators to achieve their ambitions.

Thirdly, the role of trusted adviser/farm consultants and agronomists acting as mediators was discussed. Some interviewees regarded them as "very well positioned to become project developers, you know, because they already have financial knowledge, they already have economic knowledge, and it's just a matter of learning a bit more about methodologies and science" (Interview 4 mediator). They are also relatively unbiased while commercial mediators are seen to have a conflict of interest. However, the role demands expertise which not many farm advisers currently have: "with the level of trust farmers place in their advisers, they have quite a lot of influence, but the majority of farm advisers don't have the specialist knowledge required to be able to advise on carbon markets effectively"

(Interview 7). As noted in the next section, they are protective of farmers' interests, cautioning them to think carefully about the consequences of selling their carbon into the market. They also see a conflict between reducing the focus of advice down to a single carbon metric, seeing it as negating more systemic thinking about soil health. Overall, this group were considered to have a significant influence on farmers, particularly in highlighting the risk involved, thus having a somewhat negative influence on the ongoing development of soil carbon markets, and having potential to positively influence development of soil carbon markets in future.

Finally, insetting is a defining feature of the soil carbon economy in the UK (3Keel Ltd, 2025). Insetting works as a form of quasi-market arrangement, whereby emissions reductions are formalised into internal certificates. Unlike conventional, external offsetting, these projects are funded by the company itself and implemented within their own supply chain, often by-passing public registries (3Keel Ltd, 2025). This can take multiple forms, including premium payments for farm products produced using emission reducing practices, and the generation of (often low integrity) carbon certificates via a mediator which can be purchased by the agri-food company. There are concerns among farmers that companies in agri-food supply chains may in future mandate soil carbon removals as a condition for access to food and beverage markets. In this arrangement supply chain actor mediators liaise with farmers and monitor reporting and compliance with any production standards. They tend not to be trusted to the same extent as the other mediators; there are also issues of power imbalances. Together, these themes illustrate how different actors in this fragmented landscape negotiate different mediatory roles and levels of legitimacy. Generally, market mediators offering higher integrity certificates, credits, and schemes were more trusted by other stakeholders.

These empirical accounts from Taiwan and the UK, grounded in both deductive reasoning and emerging inductive analysis, illustrate the diversity of actors, practices, and governance challenges shaping the framing and emergence of soil carbon markets in each context. While the institutional settings, market maturity, and farmer engagement differ, both cases reveal the central role of mediators in translating abstract carbon metrics into actionable farming practices and economic opportunities. Building on this comparative evidence, the next section develops an analysis of these mediators as "pragmatic economists," examining how their roles, strategies, and relationships diverge and help to extend Callon's notion of "economists in the wild" and, in turn, how they navigate the matters of concern unique to each national context.

Findings and discussion: Pragmatic economists and matters of concern

Pragmatic economists: A comparative study between Taiwan and the UK

The emergence of carbon markets is frequently perceived as providing solutions to human-induced planetary crises (Callon, 2009). Our UK and Taiwan comparative study indicates that rather than being self-contained, pre-existing entities, as suggested by proponents of the interface model, carbon markets are ongoing collective experiments where "everything needs to be invented" (Callon, 2009: 539). From the SSEM perspective, a carbon market is an assemblage of heterogeneous entities, including economic knowledge, technical devices, scientific knowledge, metrological systems, and the competencies embodied in living beings (Çalışkan and Callon, 2010). Markets are thus socio-technical *agencements* (STAs) that act in different ways depending on their specific arrangements (Çalışkan and Callon, 2010; Callon, 2007, 2021). Building on these insights, our analysis and comparison of soil carbon market-making in the UK and Taiwan draws attention to the pivotal role of mediators, whom we conceptualise as pragmatic economists. In what follows, we elaborate on this concept, extending Callon's notion of "economists in the wild" and examining how these two categories diverge in practice.

Callon (2007) emphasises that economic models do not merely describe reality—they also participate in shaping it. The development of European carbon markets demonstrates that markets cannot emerge without the creation of metrological systems and accounting practices for emissions (MacKenzie, 2009). These models must be enacted through socio-material *agencements*. Carbon markets, therefore, rely on framing processes that disentangle goods from their ecological ties, stabilising them for exchange. However, market formation depends not only on economic models and devices but also on the work of diverse mediators. Callon's "economists in the wild" concept includes market professionals, engineers, and consultants who construct markets using their own tools, networks, and expertise. These actors design and enact markets and, crucially, are not purely economists but rather engineers, statisticians, and life scientists, working to translate economic models into workable *agencements*.

We observe these market-making attributes in the UK–Taiwan comparative cases through the key roles of market mediators and conceptualise them as "pragmatic economists." We propose this term firstly because these actors often operate without formal academic training in economics—but they nonetheless play pivotal roles in shaping and configuring soil carbon markets. These actors, including policy entrepreneurs, government officials, knowledge brokers, and grassroots innovators, act as Latourian "mediators" (Latour, 2005: 39), by which we mean they actively transform complex scientific and technical knowledge into accessible, vernacular terms for farmers, policymakers, and other associated stakeholders. In doing so, they not only communicate but also actively reconfigure market rules, infrastructures, and participation incentives. Our analysis shows that their interventions are more decisive in the emergence of soil carbon markets.

The Taiwan–UK comparison illustrates how pragmatic economists shape soil carbon markets in distinct ways. In Taiwan, they acted as entrepreneurial brokers embedded within local agricultural networks. One such actor (M2) built the socio-technical infrastructure required for certification—developing a soil-sampling app, streamlining reporting procedures, and forging marketing alliances—while also offering trust-based incentives by purchasing farmers' rice before carbon credits generated returns. Here, market entry was framed less as a climate mitigation strategy and more as a product-marketing opportunity, aligning farmers' immediate commercial interests with participation in a developing market. The focus was on building credibility, reducing technical barriers, and leveraging certification to access premium food markets. However, our analysis also warns that as agriculture becomes increasingly subject to carbon marketisation, governance of the agri-food sector is shifting: pragmatic economists are gradually acquiring greater influence over farmers. Emerging trust-based relationships between farmers and these actors risk creating new forms of dependence. While soil carbon markets are still evolving, the mutual-benefit strategies employed by pragmatic economists may ultimately undermine farmers' autonomy if they come to dominate the interpretation of soil carbon knowledge, control market outlets, and rebrand agricultural products.

In the UK, pragmatic economists encompassed project developers, farmer clusters (particularly those with organisational roles), trusted advisers, and supply-chain mediators, all navigating a fragmented and emergent marketplace lacking a unified standard. Project developers translated carbon metrics into farm-level practices but faced scepticism over potential conflicts of interest. Farmer clusters aggregated natural capital to improve bargaining power and avoid engagement with less-trusted mediators. Advisers leveraged established trust to caution farmers, weighing carbon metrics against broader soil health considerations. Supply-chain mediators monitored compliance with standards and enacted the conditions required for major food companies to meet Scope 3 targets. However, they are also often confronted with deep-seated mistrust rooted in historical structural inequalities.

In theoretical terms, pragmatic economists extend Callon's "economists in the wild" in two key respects. First, while "economists in the wild" are typically market professionals with technical or scientific expertise who operationalise economic or scientific models and tools in practice to make the market work, pragmatic economists are often non-market professionals who mobilise partial technical knowledge alongside local networks, commercial opportunities, and trust-based relationships. These individuals are not formally trained economists, yet they navigate across disciplinary boundaries to

engage with local environments and respond to evolving social, ecological, and economic relations. Ultimately, their efforts are directed toward making markets real. Second, their market-making activities are not merely about enacting pre-existing models but about creatively reworking those models to fit situated needs, reframing participation incentives, and embedding market devices within everyday economic and social practices. The functions pragmatic economists perform are therefore translational and specific, evolving with the market, as demand for knowledge brokerage expertise increases. Socio-technical system configurations also lead to the formation of new pragmatic economist roles (see also Kivimaa et al., 2019; Moss, 2009), evolving *with the market* as it opens to make it work and become more established. In short, whereas economists in the wild extend economics into practice, pragmatic economists remake economics on the ground, producing market configurations that are as much about the product of vernacular ingenuity as of formal economic reasoning.

Matters of concern in Taiwan and the UK regarding soil as a carbon sink

Structured by the market framing mechanisms discussed above, market *agencements* are designed to establish and facilitate reliable solutions to the strategic challenge of creating and expanding bilateral commercial transactions. However, as Callon (2021: 373) noted, "market *agencements* . . . are in constant motion . . . framings produce matters of concern . . . Entities that participate in different courses of action always at least partially escape the predictable and disciplined behavior one would like to impose on them." As our case studies show, pragmatic economists, acting as mediators, intervene in multiple ways, reshaping and sometimes contradicting established roles (Latour, 2005). In doing so, they engage with evolving matters of concern, with effects that may be either enabling or constraining, depending on the configuration of socio-technical agencements. Callon thus maintains that all market framings cannot avoid overflowing (Callon, 1998, 2021). Taiwan's scientific community is thus currently debating the use of an oversimplified view of soil health, while the UK's carbon markets are even more contentious, grappling with issues of additionality and permanence alongside concerns over lack of transparency, equity and fairness, and scepticism over mitigation being achieved (Ingram et al., 2025; Reed et al., 2023). We suggest that these challenges underscore the risks within the soil carbon market, casting doubt on its effectiveness with respect to tackling climate change.

Taiwan matters of concern (1): Scientific debates. While the emergence of the soil carbon market in Taiwan promised to offer a nature-based solution to the planetary crisis, it failed to confront the dominance of anthropocentric temporalities, overlooking the spatial and temporal complexities inherent in soil dynamics and neglecting the soil degradation resulting from current industrial agricultural practices. The emergent soil carbon market requires farmers to document land use history, including soil type, natural disasters, and fertilisation practices, to establish a baseline for organic carbon levels. However, this approach is based on a human-centric, linear view of soil that treats it as a static "enduring box" (King et al., 2018). As a result, farmers in Taiwan are incentivised to maximise short-term carbon sequestration through chicken manure application, overlooking the non-linear and complex processes essential for soil carbon sequestration (Krzywoszynska, 2019). When the lead author interviewed soil scientists (ST1 and ST2) in their experimental fields, they expressed serious concerns about this simplified understanding of soil health. According to ST1, carbon sequestration rates reach a plateau over time as soils achieve a new equilibrium, reiterating scientific analysis (Smith et al., 2020), highlighting soil's temporal complexity, which arises from interactions among microorganisms and chemical compounds. Increased biodiversity can even enhance carbon decomposition, raising atmospheric carbon levels, and while pragmatic economists advocate the addition of animal manure for carbon cycling, this linear approach ignores the priming effect whereby additional organic matter (particularly nitrogen rich chicken manure) accelerates decomposition of existing soil carbon, again increasing emissions (Feng et al., 2021; King et al., 2018; Kuzyakov et al., 2000). ST1 further emphasised this challenge, stating, "This is why we need to set up multiple instruments, including soil

moisture sensors and rain gauges, to analyse the specific qualities of soil in this region across different temporal scales. It is a complex and time-consuming scientific process . . . Without a proper understanding of soil properties, I seriously doubt the effectiveness of using animal manure to enhance the soil's ability to absorb carbon in such a short period!"

Taiwan's soil carbon markets also simplify soil to form a homogenous commodity, ignoring geographic heterogeneity (Minasny et al., 2017). Reflecting the work of Minasny et al. (2017), ST1 further noted in the interview, "soil sample properties vary significantly, even across those taken in close proximity, as they are significantly influenced by local factors such as water, air, and vegetation." While establishing baseline carbon content is essential to meet market standards, the broad soil classifications used (e.g. clay, sand) obscure this diversity, hindering accurate assessment. Although certification methodologies remain the subject of ongoing scientific debate worldwide, pragmatic economists (PEs) and Taiwanese policymakers have adopted them without hesitation. This readiness reflects Taiwan's dependence on an export-oriented economy, which requires rapid compliance with European regulatory requirements (Liu, 2023). Consequently, European certification bodies such as BSI have become influential actors in the country's soil carbon governance, and scientific debates do not significantly disrupt market framing. Taking a comparative approach to trace connections between Taiwan and the UK reveals divergent trajectories of market evolution and decarbonisation.

UK matters of concern (2): Confusion, regulations, and soil health. In the UK, as noted above, the main matters of concern relate to weak governance and market integrity. This is reflected in low confidence and uncertainty amongst farmers and agri-food actors in the governance and market complexity of carbon farming. As such, land agents and farm advisers are advising farmers to "wait and see" and act cautiously (Farm Carbon Toolkit, 2025). They perceive a risk that selling credits will harm farmers' own decarbonisation efforts and penalise them when supply chains start to require net zero farm status for their own insetting targets, as noted by other commentators (Elliott et al., 2020).

Addressing these concerns, the UK's BSI standards programme is creating a high-integrity framework for nature markets, including soil carbon. The approach goes beyond merely carbon sequestration to explicitly consider and integrate the broader concept of soil health. Stakeholder consultations and government funding are driving the development of these robust standards. For market participants, this means that soil carbon projects must demonstrate broader environmental benefits and avoid negative trade-offs. In contrast to Taiwan, this intervention in the market's construction to "civilize the market" is intended to manage its overflows, particularly the social and ecological consequences that were initially "framed out" in market development (Callon, 2009).

The dominance of insetting in the UK soil carbon market where agri-food supply chains are driven by their Scope 3 targets represents a further matter of concern. These companies are powerful and their activity influences the development of the market. Stakeholders suggested that it is "the 20% large companies in the food and drink sector that are primarily driving this market. They have shareholders who want evidence that (. . .) they're progressing towards a net zero target" (Interview 7). These companies are the subject of distrust among farmers due to pre-existing unequal relationships. They generally felt that "They're gonna try and get away without paying for it, and so what they'll end up doing is they'll impose certain production standards upon their suppliers" (Interview 3, Farmer). In some cases, this provided motivation to engage preferentially in the offset market.

Conclusions

This paper has examined the complexities of soil carbon marketisation through the lens of pragmatic economists, uncovering the intricate socio-technical agencements that shape and reconfigure the soil carbon economy. By analysing the cases of Taiwan and the UK, we show that soil carbon markets do not naturally exist but are actively constructed through continuous interactions among heterogeneous actors. While our analysis initially focuses on the formation of soil carbon credit markets, it ultimately

adopts a broader perspective on the soil carbon economy, encompassing a wider range of socio-technical practices that extend beyond the trading of credits alone. These findings challenge the conventional neoclassical assumption of a self-regulating market, as described in Callon's (2021) interface model. A key contribution of this study is to illuminate the role of pragmatic economists as mediators in the emerging soil carbon economy. We advance the notion of pragmatic economists—ranging from government officials to private entrepreneurs—who engage in market-making by translating scientific knowledge, organising socio-technical infrastructures, and fostering relationships between farmers and buyers. Their performative work extends beyond economic calculation; it involves shaping farmers' subjectivities, aligning diverse interests, and stabilising the inherently volatile nature of soil carbon. In doing so, they bridge the gap between abstract market theories and the material realities of agricultural landscapes.

However, the process of marketisation is fraught with concerns. In Taiwan, the simplification of soil's ecological complexity into a quantifiable unit has raised debates about the accuracy and reliability of soil carbon measurements. The emphasis on short-term sequestration incentives may overlook the complexity of soil health and soil microbiomes, while geographic heterogeneity challenges the feasibility of standardised metrics. In the UK, concerns take a different form. The absence of a unified regulatory framework has led to fragmentation and a proliferation of private certification schemes, resulting in farmer scepticism. Questions of additionality, permanence, and fairness remain unresolved, while limited oversight undermines trust in carbon claims. Although efforts to "civilise" these markets are ongoing through consultative processes, significant uncertainties remain.

These results prompt a critical reassessment of Callon's concept of marketisation. While it provides a strong conceptual foundation, it does not sufficiently address ecological and social dimensions. We therefore call for a "slow" approach to soil carbon governance (c.f. Stengers, 2018), one that moves beyond narrow quantitative logics and recognises soil's ecological and social complexity. This requires stronger interdisciplinary collaboration among scientists, policymakers, farmers, and civil society, alongside regulatory interventions to ensure transparency, equity, and accountability. At the same time, we caution against emerging power asymmetries between pragmatic economists and farmers. The concentration of expertise and control risks undermining farmers' autonomy and eroding situated ecological knowledge, raising doubts about the capacity of such markets to deliver meaningful climate solutions—an issue long recognised in critical agrarian studies examining tensions between expert and farmer knowledge (Morgan and Murdoch, 2000; Van der Ploeg, 2008).

In conclusion, while soil carbon markets present a promising avenue for addressing climate change, their implementation reveals significant complexities and limitations. The concept of pragmatic economists offers a valuable lens for understanding the performative and contingent nature of these markets and their intersection with matters of concern, highlighting the role of mediators in shaping economic realities. However, soil carbon marketisation remains a contested process that requires ongoing critical reflection and adaptive governance to ensure it contributes meaningfully to both climate mitigation and sustainable agricultural futures.

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Notes

1. Offsetting is where buyers purchase credits from outside their supply chains; reductions are converted into tradable, external carbon credits. Insetting is where companies aim to reduce emissions within their supply chains and produce internal, quantifiable carbon benefits that are reported as direct improvements to the company's Scope 3 emissions.
2. For Callon (2021), an object becomes a commodity only when it is detached or disentangled from its original social relations and material contexts. A gift, for example, is not a commodity because it remains bound to the giver. While farmers also measure and calculate soil components, they often do so in speculative ways embedded in relationships of mutual benefit.
3. It should be noted that there is regulatory divergence between different nations within the UK.
4. Defra's Nature Markets Policy Framework (DEFRA, 2023).

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