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For the Love of the Sea: Technocratic Environmentalism and the Struggle to Sustain Community-Led Aquaculture

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Abstract

This article argues that sustainability governance in small-scale regenerative aquaculture arises less from formal regulation than from the relational, ethical, and temporal labour of practitioners. Based on an ethnographic study of Cär-y-Môr, Wales's first community-owned regenerative ocean farm, the research combines over 250 h of participant observation, 25 interviews, and document analysis with transdisciplinary humanities-informed sustainability science (THiSS). The study shows how technocratic environmentalism, reliant on auditing, reporting, and standardised procedures, often clashes with the shifting rhythms of tides, weather, and the embodied work of marine labour. Ethnography uniquely reveals the embodied knowledge, improvisation, and moral commitment through which practitioners continually remake governance, translating bureaucratic rules into ecologically and socially meaningful practice. The findings demonstrate that adaptive governance requires recognition of local and experiential expertise, proportionate regulatory frameworks, and protected spaces for experimentation and learning. Seen in this way, sustainability shifts from a fixed goal to a relational process. When governance learns from practice and care is recognised as a form of knowledge, it becomes more adaptive, situated, and responsive, revealing both the constraints of technocratic control and the possibilities of care-based policy and practice.

Keywords: aquaculture; regenerative ocean farming; embodied knowledge; technocratic environmentalism; participant observation; political ecology; transdisciplinarity

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1. Introduction

"You can't measure care with paperwork."—Owain, founder, June 2025.

Accelerating climate change is transforming marine ecosystems and unsettling how coastal communities sustain livelihood and belonging. Regenerative ocean farming, which cultivates seaweed and shellfish (Figure 1), is promoted as a means of ecological restoration and local economic renewal [1,2]. However, its promise depends not only on ecological performance or market viability but also on how governance recognises the small-scale innovations that emerge from practice itself. At Cär-y-Môr, Wales's first community-owned ocean farm, innovation arises through responsiveness to place, collaboration, and the lived temporalities, ethical practices, and affective commitments of those who work with the sea [3–5]. For regenerative aquaculture to thrive, governance must support such situated and relational forms of innovation, sustaining care for marine life rather than focusing solely on measurable outcomes.

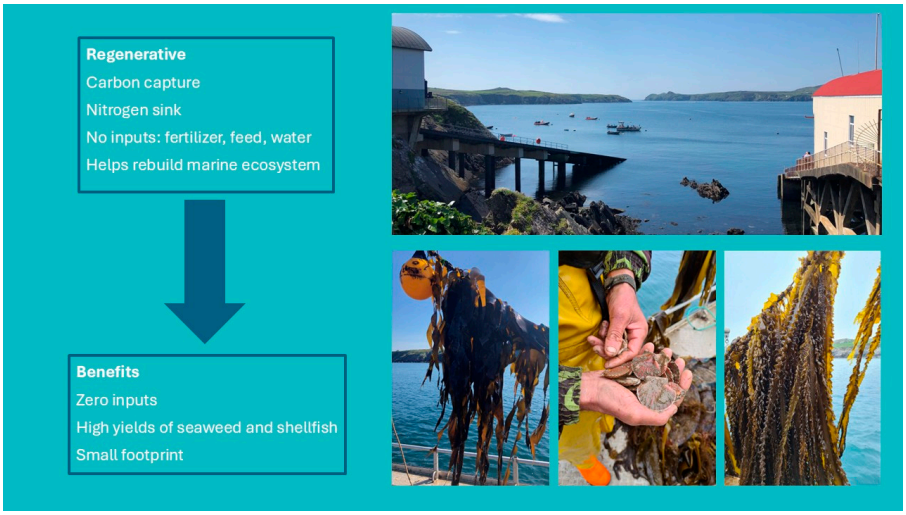


Figure 1. Regenerative ocean farming model, at Cât-y-Môr. Source: L. Steel, after Greenwave, https://canadiangeographic.ca/articles/qa-the-sustainability-of-regenerative-ocean-farming/ (accessed 15 September 2025).

Seen through the lens of technocratic environmentalism, understood as governance that manages ecological complexity through technical rationality, standardised metrics, and bureaucratic procedure [3,5,6], this paper examines how regulation and everyday practice meet within small-scale regenerative aquaculture. Technocratic systems present themselves as neutral and objective, yet shape experience through temporal and affective discipline [4,7]. Governance operates not only through rules but also through time, through audits, deadlines, and the licensing routines that structure how people act and adapt [4,8]. For those cultivating seaweed at Cât-y-Môr, sustainability begins as a practice of care rather than compliance, negotiated daily between living organisms, shifting weather, and institutional expectation. These negotiations expose the limits of bureaucratic order and the ethical and material labour through which care is sustained.

Most studies of environmental governance focus on policy frameworks rather than lived experience. Although scholarship on adaptive and participatory governance has expanded, it often remains at the level of design and theory, particularly within large-scale or state-led contexts [8–10]. Comparative research from Scotland, Australia, and Canada [7–9,11] shows that institutional reform alone is insufficient, as adaptive governance depends on how communities interpret and inhabit regulatory systems in practice. The Welsh case contributes to this discussion by capturing a formative moment of mutual learning, as community practitioners and regulatory institutions co-evolve through practices grounded in local ecological and social realities. Addressing this gap, the paper situates Cât-y-Môr as an ethnographic exploration of how technocratic systems and local practice intersect, showing how governance is continually made and reimagined through everyday work and care.

To address this conceptual gap, the paper turns to three questions that examine how governance is lived, negotiated, and reimagined in practice:

1. How does technocratic environmentalism shape the governance of regenerative aquaculture at Cât-y-Môr?
2. How do community practitioners negotiate bureaucratic demands while sustaining ecological and ethical care?
3. What forms of governance might better support adaptive, relational, and context-sensitive approaches to marine sustainability?

Together, the answers to these questions reveal how governance is lived from within, through negotiations between rule and care, procedure and practice. Governance falters not only through tensions between scientific and local knowledge but through deeper misalignments of temporal, procedural, and ethical systems of care [10,12]. Understanding these misalignments requires attention to how responsibility and authority are enacted and felt in daily work with the sea. Drawing on feminist and ecological theorists, the paper frames care as both ethical and material, a way of attending to the more-than-human world through reciprocity and responsiveness [13,14]. This perspective reorients sustainability as something produced through relationships rather than administration, while ethnography, as a practice of being alongside, traces these relations through gestures of work, waiting, and endurance [13–15].

Building on these insights, the paper argues that effective governance depends on regulation learning from practice, mutual adaptation between community and state, and support for small-scale experimentation [2,12,16]. Such approaches treat uncertainty as productive, linking bureaucratic oversight with the lived ethics of environmental work. The analysis suggests that regulation should remain proportionate to scale, grounded in local and embodied expertise, and open to iterative learning. In doing so, governance becomes an evolving process rather than a fixed design. Ethnographic and transdisciplinary methods reveal how sustainability takes shape through the labour, care, and endurance of those sustaining regenerative practice [3,13,14]. Adaptive governance, therefore, is not imposed externally but continually made and remade through the everyday relations that connect people, institutions, and ecologies. It emerges from the negotiations, compromises, and acts of care that link policy ideals to lived practice, where regulation learns to move with, rather than against, the rhythms of place [8,15].

2. Background

2.1. Technocratic Environmentalism and the Transformation of Governance

Environmental governance in marine and coastal systems is increasingly organised through technocratic regimes that translate ecological complexity into administrative control [3,5,17]. Jasanoff [17] calls this a "technology of hubris," where environmental protection is treated as a technical rather than a relational or ethical challenge. In this logic, sustainability rests on standardisation, quantification, and procedural compliance. Political ecologists and science and technology scholars show how this coupling of science and bureaucracy legitimises state authority and produces new forms of ecological power [3,5]. Turnhout [5] describes this as the "politics of environmental knowledge," where scientific representations define what can be governed and whose expertise counts. Technocratic environmentalism thus privileges measurable outcomes, procedural uniformity, and risk minimisation as the basis of care, often sidelining local, experiential, and relational knowledge and creating misalignments between bureaucracy and ecological reality.

Governance is not only written into policy but lived through everyday practice. Institutions depend on the improvisations and ethical judgements of those who work within them [3,18,19]. Understanding sustainability therefore requires attention to how people engage with, adapt to, and sometimes resist governance structures in their daily work. This is especially visible in marine policy, where licensing and assessment systems were designed for industrial-scale operations rather than small or community-based projects [9,20]. As Niner et al. [11] observe, such frameworks impose disproportionate costs and delays on small-scale restoration, creating a "policy–practice gap" that stifles ecological innovation. Sharma's [4] concept of "temporal governance" helps explain how this gap is reproduced, as bureaucratic pacing and sequencing place administrative time at odds with ecological process.

While quantitative assessments and spatial models reveal broad patterns, they can obscure the lived negotiations through which governance unfolds. Qualitative, ethnographic enquiry brings these processes into view, revealing the tacit practices, relational labour, and moral reasoning that sustain environmental care [3,14,21]. As Whatmore [22] and Ingold [15] remind us, such approaches make visible embodied and situated ways of knowing that technocratic systems often erase. In aquaculture, where regulation meets experiment, this becomes crucial: governance is continually co-produced through attention and care rather than imposed from above [23,24]. Studies across contexts echo this insight. Bush et al. [25] show that smallholder aquaculture fosters resilience when governance integrates collective action and local knowledge, while Msomphora [26] demonstrates how stakeholder perspectives expose challenges overlooked by regulation. Extending this argument, Partelow et al. [27] emphasise that the social, economic, and ecological dimensions of sustainability are best understood through participatory, context-specific research. Together, these studies affirm that qualitative enquiry reveals the subtle negotiations and relational ethics through which environmental governance is made.

These temporal and procedural tensions point to a deeper issue: not regulation itself, but the dominance of procedural rationality in defining what counts as good governance. As Li [3], Turnhout [5], and Stirling [28] each observe, this rationality privileges conformity and control over reflexivity and care, shaping how authority and responsibility are distributed. Research by Brugère and colleagues [29] shows how institutional boundaries divide ecological, economic, and social concerns, weakening coherence and accountability, while Cohen et al. [7] illustrate how Blue Growth strategies further entrench this fragmentation by valuing efficiency over justice and inclusion. Yet, as Stirling [28] reminds us, even technocratic systems rest on ethical commitments to fairness and transparency. The challenge, then, is not to abandon regulation but to make it proportionate, adaptive, and capable of learning. Where procedural reform alone cannot bridge these gaps, governance must be understood as a relational process through which sustainability is continually negotiated between institutional authority and the lived ethics of care.

Within restoration ecology and sustainability science, scholars such as Suding et al. [1], Aronson et al. [30], and Horcea-Milcu et al. [12] have reconceptualised governance as iterative and participatory, evolving through learning rather than control. Their work highlights the need for flexibility, with restoration goals adapting as knowledge deepens and conditions shift. Unsworth et al. [2] extend this argument by showing how industrial standards constrain regenerative projects across the UK, Australia, and the Philippines, proposing "permission to learn" mechanisms that authorise experimentation under monitored conditions. Similarly, Heckwolf et al. [16] call for regulatory sandboxes that balance accountability with adaptive learning. Collectively, these studies suggest that transformation arises less from institutional redesign than from the mutual adaptation of people, species, and environments, where uncertainty becomes a shared condition of practice.

Comparative research brings these dynamics into sharper relief. In Scotland, Niner et al. [11] describe how small-scale seaweed and shellfish initiatives are reshaping licensing systems initially designed for salmon aquaculture, making regulation more proportionate to local purpose. In Australia, Bell-James and Lovelock [9] show that reform becomes possible when governance frameworks recognise ecological and public value alongside commercial aims. Meanwhile, Indigenous-led marine enterprises in Canada, as documented by Cohen et al. [7] and Song et al. [8,31], integrate procedural accountability with cultural ethics of care, demonstrating that plural knowledge systems can coexist within statutory regimes. Across these examples, governance appears most effective when regulation functions as a shared ethical practice grounded in relationships of trust, care, and responsibility.

In Wales, where community-led aquaculture is still emerging and regulation is being adapted to small-scale and restorative practices, similar tensions between bureaucratic procedure and local initiative are beginning to surface [2,11]. As elsewhere, these efforts show that governance cannot be understood solely through policy but must be traced through its enactment in practice [3,19]. Ethnographic perspectives emphasise that institutions are continually made and remade through situated labour, ethical judgement, and relational work [14,15,32]. Welsh initiatives thus offer a lens for exploring how environmental governance unfolds as a lived negotiation between bureaucratic rationalities and the embodied practices that sustain marine life. This approach highlights the methodological value of ethnography in revealing how governance is performed, interpreted, and quietly transformed in everyday contexts, illuminating the creative, relational, and ethical work through which more adaptive and caring forms of governance can emerge.

2.2. Case Context: Cârr-y-Môr, a Community-Owned Regenerative Ocean Farm

Cârr-y-Môr ("for the love of the sea") is the first community-owned regenerative ocean farm in Wales, located within the Pembrokeshire Coast National Park off St Davids in the southwest. Although marine aquaculture in Wales remains small, with only thirteen registered mollusc production businesses in 2021 [33], Cârr-y-Môr represents a pioneering model of community-based and restorative practice. Its three-hectare sea site lies in Ramsey Sound, the tide-riven channel between the mainland and Ramsey Island, celebrated for its wild coastline and rich marine habitats (Figure 2). Situated within the Pembrokeshire Marine Special Area of Conservation, the site benefits from exceptionally clean Grade A waters, the highest classification for shellfish production in the United Kingdom. A nearby land-based site houses processing and storage facilities, along with a public hub for training, education, and community engagement, linking marine cultivation directly to local livelihoods and coastal regeneration.



Figure 2. Map of Wales showing location of Cârr-y-Môr. Source: NASA, Public domain, via Wikimedia Commons.

Established in response to environmental and socio-economic challenges affecting the region's marine industries, Cârr-y-Môr emerged after the collapse of a privately owned aquaculture venture. The organisation was deliberately structured to minimise financial risk through collective ownership and community governance, positioning itself as an intentional alternative to extractive models. Operated as a Community Interest Company

(CIC), it combines commercial activity with legal obligations to use assets and profits for community benefit. This "asset lock" prevents private sale or transfer, ensuring long-term accountability to local stakeholders and aligning aquaculture with ecological restoration and rural regeneration [34].

The farm follows principles of biomimicry, collective labour, and community-based management. It cultivates seaweed, oysters, mussels, scallops, and other native species in systems that support both ecosystem recovery and local livelihoods. Seaweed such as sugar kelp (*Saccharina latissima*), sea lettuce (*Ulva lactuca*), and oarweed (*Laminaria digitata*) grow on suspended ropes, while shellfish are cultivated through natural filter-feeding systems (Figure 3) [35]. Biomimetic design allows ecological processes to inform farm structure and management, exemplifying what Lebdioui [36] calls "nature-inspired innovation," where biodiversity itself becomes a source of sustainable development insight.



Figure 3. Ropes of seaweed and nets of mussels. Source: Gareth Thomas.

Beyond aquaculture, Cârr-y-Môr works with local pot fishers, purchasing crab and lobster for regional markets. While this trade remains its main income source, the long-term goal is to expand seaweed-based production, particularly bio-stimulant products derived from non-edible species. The organisation has grown steadily, employing around 12 people in 2022 and 22 by 2025, reflecting both expansion and its commitment to sustainable rural employment. In 2023, Cârr-y-Môr entered a major phase of development supported by £1.1 million from the UK Department for Environment, Food and Rural Affairs and a £250,000 Growth Guarantee loan [37,38]. This investment enabled the construction of seaweed processing units, cold storage, and expanded training spaces, increasing production and meeting compliance standards required by public funders. The introduction of formal operating protocols, including structured training and safety systems, marks a further step in the enterprise's professionalisation as it continues to balance local autonomy with institutional expectations.

3. Methodology: Ethnographic Research Design

Fieldwork at Cârr-y-Môr is part of Coastal TALES, an international research project that explores how traditional ecological knowledge and cultural heritage practices inform climate adaptation in northern coastal communities across Wales, Ireland, and Alaska [39,40]. In Wales, our focus is on inshore fishing and aquaculture communities in Ceredigion,

Carmarthenshire, and Pembrokeshire, where long-standing relationships with the sea are shaped by intergenerational knowledge, cultural practice, and ecological observation.

Methodologically, this research is grounded in transdisciplinary humanities-informed sustainability science (THiSS) [41–43], which offers an integrative framework for addressing complex sustainability challenges. Rather than applying this framework abstractly, our analysis develops directly from ethnographic engagement with Cât-y-Môr. Drawing on Kimmerer's concept of "braiding" knowledge systems [44], our use of THiSS brings diverse forms of knowing into relation without erasing their distinctiveness. This orientation shaped both the design and interpretation of the study, allowing us to understand the farm as a dynamic site where governance, ecology, and social relations are continually negotiated. It also provided a conceptual grounding for viewing sustainability as a lived and relational process rather than a purely technical or bureaucratic one.

Participant Observation

Our ethnographic methods followed anthropological fieldwork traditions of participant observation, inspired by Geertz's notion of "deep hanging out" [45]. This approach emphasised immersive engagement, listening, and learning from interlocutors rather than observing as detached outsiders [46]. We developed our relationship with Cât-y-Môr in 2023, conducting fieldwork through short visits and three extended periods of immersion between May 2024 and September 2025, totalling around 250 h of participant observation. Activities included seaweed harvesting, drying, shellfish gathering, training, storytelling, team meetings, and public workshops (Figure 4).



Figure 4. Embodied participant observation at Cât-y-Môr. Photo: Gareth Thomas.

Due to practical constraints, we adopted a "patchwork" approach [47–49], involving shorter but intensive fieldwork periods shared among team members. While this approach limited continuous immersion, it enabled sustained engagement with daily life and governance processes. Participant observation was complemented by 25 semi-structured interviews with farm members, directors, volunteers, Natural Resources Wales (NRW) and Welsh Government (WG) staff, and regulatory officials. Using purposive and snowball sampling, we ensured diverse perspectives across regulatory, operational, and community scales. Interviews continued until thematic saturation, helping to reveal how sustainability governance is negotiated among multiple actors.

We also analysed internal and public documents, including licensing applications, ecological assessments, funding bids, and compliance reports. Treating these as cultural

artefacts [50], we examined how they reflect evolving organisational identities, values, and communicative strategies, adding interpretive depth to the ethnographic record. Fieldnotes, transcripts, and documents were thematically coded in NVivo using combined inductive and deductive approaches. Initial open coding identified recurring patterns and tensions, refined through frameworks from situated knowledge, political ecology, and regenerative governance [32,38,51,52]. Key themes included technocratic constraint, regenerative labour, embodied ecological knowledge, and gendered coastal expertise. The analysis was further informed by anthropological and feminist literature on moral economies, informal labour, and infrastructural frictions shaping sustainability [53–55].

The rigour of this study lies not in data quantity but in interpretive depth achieved through sustained relational immersion. Ethnographic material served as the primary site of analysis, allowing us to trace how actors navigate mismatches between regulatory procedures and ecological practice. Observing how licensing timelines, risk protocols, and bureaucratic categories align or conflict with community rhythms of work and care enabled us to conceptualise governance tensions in action rather than from external critique. Our relational ethnographic framework emphasised collaboration and co-production with interlocutors and required continuous reflexivity on positionality and power. Acting as both observers and contributors provided access to tacit knowledge and embodied practice while raising risks of over-identification. These were addressed through reflexive journaling, mentorship, and team debriefing across 2024–2025. We approached subjectivity not as bias but as a methodological resource for tracing how knowledge is co-created through relationships, thereby strengthening ethical and interpretive rigour [56,57]. Ethical approval was granted by the University of Wales Trinity Saint David Faculty Ethics Committee in April 2024. Research followed ASA Ethical Guidelines [58]. Participants provided oral consent, and anonymisation protected confidentiality except where attribution was requested. All data were stored securely in compliance with GDPR and accessible only to the research team.

4. Ethnographic Narratives at Cârr-y-Môr

4.1. Regulations and Bureaucratic Burdens

At Cârr-y-Môr, the ocean is both a livelihood and a field of negotiation. Each tide and season brings a shifting rhythm of tasks, from tending seaweed lines to monitoring shellfish growth. However, this rhythm is repeatedly interrupted by institutional systems that move to a very different pace. Paperwork, audits, and funding reports impose a tempo that workers reported as being, out of step with the sea. "We're working with tides, but they want spreadsheets," one said. Another added, "You can't rush the ocean, but the government clock never stops." Such comments capture a wider struggle to sustain small-scale regenerative farming within governance structures designed for industrial production. What emerges is a negotiation between two ways of ordering time, one ecological and cyclical, the other procedural and linear.

Licensing was described by almost everyone as the most persistent obstacle to maintaining sustainable practice. Marine licences are required for both seaweed and shellfish, and although the cost is modest, the process consumes vast amounts of time. One worker, for whom licensing was only part of her role, recalled spending "three or four days a week chasing agencies, sending emails, waiting for replies." Another added, "It's not just the time, it's the uncertainty. You can't plan when you don't know if there's a future." Long delays erode morale. "Half the job is paperwork," one worker said, summing up the feeling that what began as a collective act of care had become a paper trail of compliance.

Cârr-y-Môr operates across three sites, each subject to distinct regulatory frameworks. In theory, Natural Resources Wales (NRW) coordinates the entire process by liaising with

the Marine and Coastguard Agency, Trinity House, and conservation bodies (The Marine and Coastguard Agency (MCA) reviews applications to ensure that proposed installations do not endanger navigation or maritime safety, while Trinity House advises on navigational aids and marking requirements to prevent interference with shipping routes or visibility. Conservation bodies, such as the Joint Nature Conservation Committee (JNCC) and CADW, assess potential impacts on protected habitats, species, and designated sites such as Marine Protected Areas, recommending mitigation measures where necessary to ensure compliance with environmental legislation). In practice, however, coordination is often more aspiration than reality. "Communication doesn't always flow the way it should," an officer explained. Each agency follows its own timetable and legal mandates, producing overlapping requests and duplicated work. "We try to join things up," "but the system's built to control risk." For small community farms, this often means that applicants become the de facto coordinators, chasing updates and clarifying contradictions. One worker described pursuing a marine exception licence for the shellfish only to find herself contacting every agency individually. "They all said they couldn't confirm, so we were stuck for months." What was meant to be a simplified process became a lengthy bottleneck.

From the regulator's perspective, this caution is understandable. NRW staff explained that even small projects can pose risks to fragile habitats such as reefs, seagrass beds, and seahorses. "We want to be enabling," one officer said, "but we're only assigned a few hours per case, and every hour has a cost." Limited capacity meant that, in practice, "the system was built for mitigation, not restoration." Many acknowledged that regenerative aquaculture sits uneasily within frameworks originally designed for extractive industries. Farmers, however, often experienced these interactions as one-sided. "You lose another day hosting people who don't get their feet wet," recalled one worker after an inspection. For them, the visit was remembered not as dialogue but as an interruption, another moment when the rhythm of the tide was overtaken by bureaucracy.

Workers often described the system as circular or stuck. "Nobody wants to say yes," one said, "so nothing moves." Another called it "death by procedure." Regulators admitted that progress depends more on persistence than design. "The system's meant to be flexible," one officer said, "but that flexibility comes from people, not paperwork." These experiences shape how workers understand their labour and their place within environmental governance. "A mate quit over it," one said. "He just couldn't face another round of paperwork." Others spoke of the fatigue of managing both the farm and half a dozen agencies. "You learn how to push an inflexible system forward, but you shouldn't have to".

Even minor technicalities can become barriers. A visual impact assessment was rejected with minimal feedback, forcing the team to consider hiring a consultant at a cost of £10,000. "If the parks don't like it, we'll have to pay someone to write what they want," a worker said. For a community enterprise, such demands are crippling. Others described reports dismissed on vague grounds. "They said our report was wrong but didn't say why. It's subjective but treated like science." These experiences reinforced the sense that institutional expertise discounts embodied, place-based knowledge. "I could show them in five minutes what takes a day to write up," another said, "but they only recognise what's on paper".

A recurring tension lies between regulatory timelines and ecological time. Governance follows cycles of audits and deadlines, while marine work depends on weather and tide. "You can't wait for permission when the sea's moving," one explained. On one visit in June when the weather was warm, a refrigeration unit failed overnight. The cook spent hours saving a batch of crab during the night before the heat spoiled them, then began again at three in the morning with a new delivery. By lunchtime, inspectors arrived to check logs

and forms. "The sea doesn't stop for paperwork," he told me later. Such moments capture the disjuncture between marine immediacy and bureaucratic rhythm, where each delay risks loss.

Cân-y-Môr's team remains committed to compliance but calls for proportionate, relational governance that acknowledges scale and context. "We're not anti-paperwork," one said. "We just want it to make sense for what we do." Their experiences suggest that sustainability governance cannot rely solely on procedural simplification. It must also create spaces for agility and where institutions and practitioners can learn from one another.

4.2. Embodied Learning and Practice Amid Bureaucratic Systems

If licensing distances people from the sea, daily labour restores that connection. The same hands that fill inspection forms also pull ropes and wash mussels. "You can fill in all the forms you like," one worker said, "but you only really learn when your hands are cold and wet." Knowledge at Cân-y-Môr resides in gesture and rhythm rather than manuals. The farm is a living classroom where learning occurs through proximity, repetition, and attentiveness to human and nonhuman cues. "You start to read work at sea," one explained, "like you read someone's face." This working culture values agility, responsiveness, and improvisation over hierarchy, with tasks shifting as weather and conditions change. Its success lies in attunement to a complex, evolving field of events that cannot be standardised. A morning might begin checking ropes, move to sorting mussels, and end with a school visit. Adaptability is seen as intelligence. A young worker called it "thinking with your body." Over time, people develop an ecological literacy, reading the tension in a rope or the sound of shells clattering in a basket. "If it rattles wrong, it's not clean," one said. Such embodied knowledge resists codification yet remains vital to maintaining quality and environmental care.

In this environment, learning is collective. New members shadow experienced colleagues, copying gestures before taking on tasks themselves. "You watch, you listen, and then you start to know," one worker explained. This apprenticeship unfolds through shared labour rather than instruction, and women play central roles in managing processing, logistics, and communication. "One day I'm fixing ropes, the next I'm talking to chefs," one said. Their authority rests on competence and care, not formal rank. "Respect comes from knowing what you're doing," another explained. Mutual reliance is the norm. "If someone's struggling, you just step in. That's how we keep going." This stands in sharp contrast to the culture of environmental management offices, where care is expressed through procedures and compliance rather than attentiveness. "It's all about getting the paperwork right," one officer said. "If something's missed, you go back to the start again." Within that system, procedural fairness is measured by consistency and traceability, not responsiveness, a logic that depends on generalised metrics often ill-suited to the particularities of place and practice. At Cân-y-Môr, care is relational and shared. The same ethic that shapes cooperation among workers extends to the sea itself. "If we look out for each other, we look after her too," one said. The sea is not treated as a resource but as a collaborator whose moods and movements guide the work. "The sea tells you what to do," one explained. "If the wind's wrong, you change the plan".

Generational difference also shapes how knowledge circulates. Older members teach through action rather than talk. "You learn more in a week watching them than in any course," one young worker said. When an older member demonstrated how to tie a line for winter, he explained, "You've got to feel the strain, not just see it." The seaweed too teaches patience. "You can't rush it," one said. "If you harvest too early, it doesn't grow back right." Such insights reflect an ethic of attention and reciprocity that forms the moral heart of regenerative aquaculture. "You carry the sea on you," another said, showing

calloused hands darkened by iodine (Figure 5). Cooperation reinforces this ethos. Work is rarely solitary. Repairing lines after a storm, one group moved in silence, each anticipating the others' movements. "You just know who's doing what," a worker said. Authority shifts fluidly with experience. Where bureaucracy seeks standardisation, the farm depends on trust and attentiveness. "If something breaks, you fix it, then figure out why," one said. "There's no manual for that." These practices stand as a counterpoint to procedural abstraction. Whereas governance fragments knowledge into documents and deadlines, labour reassembles it through embodied engagement. As one worker concluded, "It's not about being green on paper, it's about getting it right with the sea".



Figure 5. Stained hands, resulting from continued embodied engagement with seaweed. Source: Luci Attala.

4.3. Scaling and the Internalisation of Bureaucratic Care

As Cân-y-Môr has grown from a small experiment into a recognised model of regenerative aquaculture, scaling has brought both opportunity and strain. Growth has meant new grants, partnerships, and visibility, but also new systems of accountability that subtly reorganise care, fairness, and time within the cooperative. What was once guided by conversation and shared judgement is now shaped by reporting cycles and funding deadlines. Scaling is not only organisational but temporal. Bureaucratic care, grounded in documentation and proof, now overlaps with embodied care for the sea. In its early years, the farm ran on collective trust. Everyone earned the same hourly wage, and decisions were made informally, often while working. "We'd just talk it through on the quay," one worker recalled. "If it made sense, we did it." As new funding introduced monitoring requirements, equality became harder to sustain. Defined roles emerged, and accountability demanded visible structure. "We had to scale to survive," one worker said, "but once you scale, you start having to prove things instead of just doing them." The shift was felt in the rhythm of work itself. "You used to plan with the weather," another explained. "Now you plan with the spreadsheets".

Although the flat pay structure remains, the distribution of time and responsibility has shifted. Those managing grants and compliance described long evenings checking data and drafting reports. "The pay's the same, but the stress isn't," one said. "Some of us lift ropes, some lift paperwork." Within these new rhythms, fairness had to be actively maintained rather than assumed. Equality became a form of emotional labour, renewed daily through negotiation rather than shared physical work. Seasonal intensity deepened this strain. During harvest months, the same people who cleaned mussels in the morning stayed late to complete monitoring logs. "You can't leave the sea waiting," one said, "but you can't leave the reports either." Workers joked that "half the work's at

sea and half's at a desk." External visibility brought both pride and apprehension. Funders, journalists, and policymakers increasingly looked to Cär-y-Môr as a model of community-led regeneration. "People come here thinking we've got it all figured out," one worker said, "but most days we're just trying to keep things going." The language of impact and innovation, necessary for reports and publicity, often felt distant from the improvisation that sustained them. "We have to sound professional," another remarked, "but the sea doesn't care how polished our outcomes look".

The cooperative ethos persisted but became more deliberate. Experienced members began informally managing operations, taking on leadership without titles or extra pay. "Someone has to make the call when things go wrong," one said. Meetings became regular, minutes were kept, and risk assessments replaced informal agreements. For some, these changes signalled maturity, for others, a loss. "We used to fix things with a chat," one older worker said. "Now it takes a form and three follow-up meetings." Women, often responsible for coordination and communication, carried much of the administrative burden. "I'm always on the computer now," one said. "I miss being out on the water." Scaling also changed the sensory relationship to the sea. As regulatory and funding expectations grew, time at the shore diminished. "Some weeks," one said, "I know the spreadsheet better than the tide." Others described this as a quiet loss. "We used to know the sea like a friend," one said. "Now we check in when we can." Such reflections were common, expressing how bureaucratic time displaced ecological time. For many, the hardest challenge lay not in the work but in holding on to purpose amid competing obligations. The founding motivation, to restore the sea and create local employment, still guided their efforts but was now filtered through layers of administrative demand. "We're trying to prove regeneration in numbers," one said, "but the real proof is the people staying, the sea recovering, the community caring." This sentiment captures the paradox of scaling: as care becomes measurable, it risks losing the intimacy that first gave it meaning.

5. Discussion: Negotiating Governance Through Care, Time, and Practice

5.1. Reconnecting Governance and Practice

At Cär-y-Môr, governance is not a distant administrative structure but a series of daily negotiations that bind people, institutions, and environments in uneasy relation. Licensing procedures, reporting requirements, and regulatory templates shape the rhythms of work, translating ecological care into administrative labour. Yet these engagements expose the limits of technocratic rationality, where procedural legibility becomes the measure of control [3,5,17]. The ethnographic evidence here shows governance as continually made and remade through adaptation. Staff spend significant time navigating fragmented authority and contradictory rules, translating regenerative practice into bureaucratic form. This labour is more than compliance; it is interpretive work that sustains their relationship with the state. Each application, meeting, and extension becomes a negotiation where relational knowledge meets institutional norms. In these encounters, governance is reconstituted as members create new alignments between ecological responsiveness and administrative accountability, a process exemplifying institutional bricolage, where formal frameworks are continually reworked through practice, improvisation, and social relation [19].

This lived dimension of governance complicates the idea of regulation as purely restrictive. For those at Cär-y-Môr, engaging with bureaucracy is less resistance than persistence. Each report or application becomes part of how they sustain visibility and credibility within systems that rarely recognise small-scale actors, where legitimacy is earned through the moral labour of showing up, explaining, and adapting. Governance, in this sense, takes shape through the interplay of official procedures and the everyday ethics of those who sustain them.

Yet the asymmetries remain clear. The farm's experience reflects wider findings that small-scale aquaculture enterprises are disproportionately burdened by systems designed for industrial operations [10,11]. Each clarification and delayed response consumes energy that might otherwise support ecological care. This procedural drag exemplifies the dominance of control over reflexivity in environmental policy [28]. While documentation protects the system, it also constrains the adaptability that regenerative practice requires. In these conditions, Cär-y-Môr's engagement with regulators highlights the potential for dialogue to shape bureaucratic practice. Informal relationships with regulators often soften procedural rigidity, creating space for pragmatic accommodation. These small acts of understanding show how governance can move from command to correspondence, from oversight to shared interpretation. Therefore, what has emerged is not a rejection of regulation but an attempt to humanise it, making it more responsive to the fluid and unpredictable realities of sustaining a community enterprise rooted in ecological and social care.

5.2. Embodied Knowledge and the Politics of Care

Where the state relies on data, the farm relies on bodies. Knowledge at Cär-y-Môr arises through movement, repetition, and sensory attunement to the more-than-human world. This is not supplementary to science but a distinct epistemic register with its own authority and form of verification. Workers' ability to read the sea, to sense shifts in texture, sound, or weight, constitutes an embodied literacy that sustains the enterprise. Such practices affirm Whatmore's and Ingold's accounts of knowledge as emerging from active engagement with materials and environments rather than abstract cognition [15,22]. This understanding challenges the epistemic hierarchies of technocratic governance. Regulatory systems demand measurable proof, yet the farm's expertise is validated through care and responsiveness. As Puig de la Bellacasa [14] and Haraway [13] argue, care is both ethical and epistemic, requiring attentiveness to other beings and acceptance of partial knowledge. At Cär-y-Môr, this is visible in the rhythms of maintenance, harvesting, and repair, where caring for ropes, seaweed, and shellfish sustains the web of relations that make production possible.

Gendered and intergenerational relations further shape this epistemic ecology. Women occupy technical and managerial roles traditionally coded as masculine, while older fishers and craftspeople transmit tactile and observational skills through shared labour. These interactions illustrate feminist political ecology's view that sustainability is enacted through gendered and relational practices rather than abstract principles. Knowledge flows through proximity and repetition, in what Ingold [15] calls an education of attention, where the distinction between knowing and doing dissolves.

Kaltoft [59] and Urquhart et al. [24] note that in aquaculture governance, attention and care function as critical forms of regulation. The Cär-y-Môr team embody this dynamic: their practices of observation, maintenance, and adjustment constitute governance from within, providing checks and balances more attuned to environmental flux than external audits could ever achieve. Their everyday decisions, when to harvest, when to rest, when to repair, produce an ethics of care that rivals bureaucratic accountability. This embodied governance foregrounds moral reasoning as integral to environmental management. What becomes visible through this ethnography is that governance operates through multiple epistemic registers. Alongside the written and the procedural stands the sensory and the relational. These are not competing systems but overlapping modalities of accountability, each with its own temporal rhythm and evidential form. Recognising this plurality invites a broader understanding of what counts as expertise and how care itself might be institutionalised as a form of governance [60,61].

5.3. Temporalities of Governance

Cân-y-Môr also reveals how power operates through time. Bureaucratic systems move according to fixed sequences of consultation, review, and reporting, while marine work follows the fluid rhythms of tides, seasons, and weather. These contrasting temporalities continually collide. Time itself can act as a mode of governance, asserting control through pace and procedure [4]. For regenerative aquaculture, where ecological processes are unpredictable, such linear pacing can be restrictive. Seaweed growth, shellfish spawning, and storms rarely align with quarterly reports or annual milestones, creating a constant negotiation between ecological and bureaucratic calendars.

In practice, this negotiation becomes part of the work. Paperwork is done at night after hours at sea, or during bad weather when boats are docked. Administrative delays dictate when infrastructure is built or harvests processed. These improvisations reveal the ongoing labour required to keep two incompatible systems functioning together. The capacity to endure this misalignment depends less on institutional support than on moral commitment and persistence. Practitioners learn to anticipate administrative cycles while responding to the sea's demands, creating a dual temporality that is both exhausting and demoralising.

This produces what might be called a tidal temporality of governance, an oscillation between waiting and action, regulation and improvisation. It is a form of endurance that keeps bureaucracy and ecology in uneasy motion. Rather than overturning order, Cân-y-Môr's workers bend it just enough to keep the farm running, translating rigid procedures into workable routines that survive the sea's unpredictability. Governance here becomes what Li [3] describes as the everyday practice of improvisation, where compliance and care must coexist. The sea demands responsive flexibility, while bureaucracy demands consistency and proof. Between the two, practitioners face continual strain and uncertainty. Waiting for permits, chasing responses, and working against the tide are not neutral acts but experiences that test resolve and morale. These moments reveal the emotional dimension of sustainability; vigilance, fatigue, and persistence woven through daily work. For organisations monitoring sustainability, recognising the centrality of temporal rhythms and human labour is essential, or they risk becoming detached from the environments and communities they aim to safeguard.

5.4. Scaling, Labour, and Organisational Frictions

As Cân-y-Môr expands, its regenerative ideals encounter new pressures. Growth brings funding, infrastructure, and visibility, but also new hierarchies and bureaucratic demands. Scaling up requires not only physical capacity but managerial conformity, drawing the cooperative ethos toward the logics of audit and performance. This tension is well recognised in development studies, where the will to improve often turns flexible practice into procedural discipline [3]. The challenge for Cân-y-Môr is both organisational and moral. Their founding vision of collective ownership and equality must now coexist with uneven responsibility and administrative oversight. The flat pay structure remains, but workloads are uneven. Longer-serving members carry disproportionate administrative labour, while newer recruits rely on their experience and networks to navigate complexity. These dynamics produce what Berlant [54] calls cruel optimism, the pursuit of meaningful work that becomes compromised by the very systems that sustain it.

Even within these constraints, the team is finding ways to adapt. Administrative routines are adjusted, tasks informally redistributed, and paperwork repurposed to meet immediate needs. These adaptations are pragmatic rather than strategic, keeping work moving when procedures stall. They echo Cleaver's [19] notion of bricolage, the piecing together of institutional fragments to make systems locally workable. Such adjustments

do not transform bureaucracy into care but make it survivable, showing how regulated sustainability depends as much on persistence within constraints as on innovation.

Cât-y-Môr's experience shows that cooperative forms of labour are not immune to hierarchy or exhaustion. As the farm strives to preserve equality and shared purpose, the pressures of scaling coupled with heavy regulation have generated hidden asymmetries of time, energy, and emotional investment. Adaptability, often praised as resilience, can slip into endurance, a quiet survival within systems that offer little flexibility or recognition. Feminist political ecologists remind us that care-based labour is not inherently equitable; it must be supported through structures that acknowledge vulnerability, distribute responsibility, and allow renewal [21,32,62]. Without such scaffolding, regenerative enterprises risk reproducing the inequities they aim to resist. At Cât-y-Môr, sustaining cooperation amid these pressures demands continual ethical labour, where the everyday work of maintaining trust and care persists amidst fatigue and competing demands. Often invisible in managerial language, this labour endures through quiet gestures of solidarity, from covering extra shifts to meeting funding deadlines. Such acts show that sustainability is shaped as much by the moral and affective commitments that bind the community as by the regulations and policies that frame and limit their actions, revealing the tension between lived practice and institutional oversight.

5.5. Transformative Governance and Learning from Practice

The ethnography of Cât-y-Môr extends the idea of transformative governance from abstract ideal to lived reality. Transformation occurs not through policy reform but through everyday acts of translation, care, and endurance. The farm exemplifies adaptive restoration, where learning arises through iteration and reflection rather than prescription [1,30]. Its capacity for self-correction is evident in how bureaucratic demands are absorbed into its moral and ecological framework. Rather than resisting regulation, the team reshapes it from within, aligning compliance with community values. This reflects the experimental ethos of granting small-scale projects "permission to learn" under flexible oversight [2] and resonates with calls for regulatory sandboxes that balance accountability with experimentation [16].

What distinguishes Cât-y-Môr is the relational infrastructure sustaining this adaptive work. Governance is distributed across people, materials, and species in a network of mutual responsiveness. This aligns with research showing that aquaculture sustainability depends on inclusive, relational governance that integrates community knowledge and ecological feedback [25–27]. Comparative examples reinforce the point. In Canada, Indigenous-led marine enterprises combine procedural accountability with cultural ethics of care, showing that plural knowledge systems can coexist within statutory frameworks [7,8]. In Australia, adaptive blue carbon reforms demonstrate how recognising ecological public goods can make approval systems more proportionate [9]. These cases, like Cât-y-Môr, suggest that transformative governance arises not from deregulation but from reconfiguring relationships between institutions, practitioners, and environments.

Good governance, as Stirling [28] notes, is reflexive rather than prescriptive, grounded in humility and openness to learning. The people of Cât-y-Môr embody this through daily practice, turning governance into an ethical relationship that balances procedural rationality with moral responsibility. By placing care at the centre of both method and value, they offer a model for pursuing sustainability without severing social and ecological connection. Ultimately, Cât-y-Môr shows that governance need not oppose community. When treated as a living, relational process, it becomes a shared language through which collective ethics and ecological restoration can take form. The task for policy is not to simplify or scale this model, but to learn from its complexity and to recognise that transformation begins

in the quiet, persistent labour of those who hold institutions and ecosystems together through care.

6. Lessons from Cârr-y-Môr

6.1. Proportionate and Responsive Regulation

Regulation must become proportionate and responsive, calibrated to the scale, purpose, and ecological setting of community initiatives rather than constrained by frameworks built for industrial aquaculture. Cârr-y-Môr's experience shows that uniform procedures often inhibit innovation, consuming limited capacity through paperwork and delay. Proportionate regulation would acknowledge that small regenerative farms carry low ecological risk yet high social value. Some regions are already testing this approach, such as Scotland's adaptive licensing models for seaweed and shellfish projects, which make requirements more proportionate to project scale and impact [11]. These examples show that reform is possible when regulators value community initiatives as contributors to ecological stewardship and social cohesion, not only to economic activity.

6.2. Recognising Local and Embodied Knowledge

Governance must recognise qualitative and local knowledge as vital to co-creation between practitioners, institutions, and ecosystems [60]. The tacit and embodied expertise of those who work with the sea reveals ecological change long before it becomes measurable. Comparable approaches in Indigenous-led marine governance in Canada and New Zealand, and in participatory aquaculture monitoring across Europe, show that experiential knowledge can inform regulation and improve ecological outcomes [7,8,24,25]. At Cârr-y-Môr, such knowledge does not oppose regulation but translates it into practice through negotiation and care. Recognising this relational labour as governance would introduce humility, ethical reasoning, and place-based judgement into decision-making, allowing policy to evolve through dialogue rather than prescription.

6.3. Creating Space for Experimentation and Learning

Governance must create protected space for experimentation and creativity, the conditions through which new relations and practices emerge. For Cârr-y-Môr, the freedom to test, adjust, and learn has been vital to sustaining momentum amid uncertainty. Monitoring should function as a tool for learning rather than surveillance, enabling reflection and adaptation over time. Similar approaches are emerging in environmental 'sandboxes' and 'permission to learn' models in Europe and Australia, where regulators support experimentation under monitored, time-limited conditions [2,16]. Applying these principles to small-scale aquaculture would allow communities to innovate without fear of punitive response, recognising that regeneration depends on iteration and care rather than compliance alone.

7. Conclusions

The ethnographic case of Cârr-y-Môr demonstrates that sustainability is enacted as much through relational, ethical, and temporal labour as through formal regulation. Governance is lived in the daily negotiation between ecological responsiveness and bureaucratic demands, where embodied knowledge, iterative practice, and moral commitment translate abstract rules into actionable routines. These practices exemplify institutional bricolage, as small-scale aquaculture reworks formal frameworks to remain locally viable. However, enduring asymmetries arising from uniform procedures, administrative delays, and oversight systems designed for industrial-scale operations impose significant burdens, testing both equity and persistence. Three lessons emerge: regulation must be proportionate to scale

and ecological risk; local, tacit, and embodied knowledge must be recognised as a legitimate form of governance; and spaces for adaptive learning and experimentation are essential for innovation. Ultimately, Cârr-y-Môr shows that transformative governance arises not from deregulation but from reconfiguring relationships among institutions, practitioners, and ecosystems. Sustainability, therefore, is not a static target but a relational process built through continual negotiation between people, institutions, and environments. When bureaucracy learns from practice and care is valued as knowledge, governance becomes not only more responsive and effective but also more resilient and contextually attuned.

Supplementary Materials: The following supporting information can be downloaded at https://www.youtube.com/watch?v=UjWVuaXkSYc (accessed 15 September 2025), Video S1: Coastal TALES.

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Abbreviations

The following abbreviations are used in this manuscript:

ASA	Association of Social Anthropologists
DEFRA	Department for the Environment, Food and Rural Affairs
MCA	Marine and Coastguard Agency
NRW	National Resources Wales
THiSS	Transdisciplinary Humanities-Informed Sustainability Science

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