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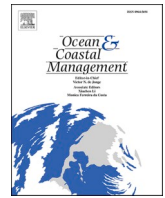
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Marinising a terrestrial concept: Public money for public goods

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ABSTRACT

Exiting the EU allows the UK to unilaterally change the frameworks that govern its environment and natural resources. This opportunity is timely given the urgent need to address the biodiversity and climate emergencies, and deliver the necessary policy changes to meet associated international agreements. The UK's divergence from EU environmental policy has already begun. The new Agriculture Act uses the concept of "public money for public goods" (PMPG) to seemingly revolutionise direct agricultural subsidies, replacing the much-maligned funding mechanisms under the Common Agricultural Policy and making the provision of their replacement dependent upon actions delivering societal gain. However, the potential benefits of transposing this concept to marine fisheries and aquaculture are yet to be recognised despite similar criticisms of funding mechanisms under the Common Fisheries Policy. This paper therefore considers the key distinctions between our use of marine and terrestrial environments and how PMPG could be applied to fisheries and aquaculture. The findings suggest that some forms of aquaculture are well-placed to benefit from a 'marinising' of the PMPG concept. Currently, capture fisheries, because they do not have ownership over marine space and interact with the marine environment in an extractive manner, have a greater challenge to adapt their business models to receive public money under this framework.

1. Introduction

On 1st January 2021, the United Kingdom (UK) became an independent coastal state following the end of the transition period of exiting the European Union (EU). In doing so, it regained the ability to make unilateral decisions regarding many of the policies that regulate how its environment and natural resources are managed. While EU-exit will impact the governance and management of many sectors of the UK economy, the agricultural and fisheries sectors will perhaps be most profoundly affected. Political saliency has been heightened as fisheries were at the forefront of the negotiations in the run up to the UK leaving the EU (Popescu and Scholaert, 2021). Importantly, EU-exit includes the withdrawal from the Common Agricultural Policy (CAP) and the Common Fisheries Policy (CFP), and the associated funding mechanisms that

determine how the corresponding sectors are financially supported. EU State aid rules no longer apply in the UK¹ and the UK Government has made clear that it intends to establish a new UK subsidy regime (Dept of BEIS, 2020; Dept of BEIS, 2021). The UK-EU Trade and Cooperation Agreement (TCA) ensures that the EU and UK will each have in place its own independent system of subsidy control (with neither being bound to follow the rules of the other) (EU and UK, 2020). It also offers the UK the opportunity to determine the principles that support how its natural resources are managed and how direct public payments, or subsidies, are provided to farmers, fishers and aquaculturalists alike - and to align with a more environmentally focused vision for the UK's future.

Opportunity for policy reform and simultaneous commitments by the UK government to seek a sustainable and environmentally focused future are timely. The climate and biodiversity emergencies are well

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¹ It is acknowledged that EU state aid rules still have a bearing to some extent in Northern Ireland due to the operation of the Northern Ireland Protocol to the Withdrawal Agreement - Cabinet Office (2020) *The Northern Ireland Protocol*. London, UK: Cabinet Office.

documented, prompting an urgent response by the government. Its obligations on the international stage under the Paris Climate Change Agreement and the Sustainable Development Goals of the United Nations (SDGs) further mandate this urgent need for reform (UN, 2015; UNFCCC, 2015). Adapting to and mitigating the impacts facing the UK requires an unprecedented response in pace and scale, in both terrestrial and marine environments. In addressing these obligations, consideration is required of how the UK's assets can support adaptation and mitigation; how this response is best implemented; how the balancing of the three pillars of sustainability (economic, social and environmental) will be achieved; and how to reform policy equitably and justly.

Such considerations of how terrestrial natural assets are best used to sustainably benefit wider society have already begun. The Department for Environment, Food and Rural Affairs (Defra), Command Paper on the future of food, farming and the environment included an entire chapter on PMPG, with environmental enhancement a priority (DEFRA, 2018c). The requirement for a domestic replacement for the CAP led to the Secretary of State for the Environment securing the incorporation of the PMPG concept into the proposed Environmental Land Management (ELM) scheme (DEFRA, 2020a), through which farmers will be paid for producing public goods (Lewis, 2021; DEFRA, 2020a). The Sustainable Farming Incentive is the first in a package of ELM schemes, which will provide a mechanism for farmers to be paid for producing public goods (identified as including cleaner water, cleaner air and carbon reduction) (Lewis, 2021). This is in stark contrast to the CAP 'basic farm payment' where landowners were paid by area, with few other conditions other than simply owning land. Payments therefore benefitted the largest landowners most, rather than supporting principles of equitable distribution (Bateman and Balmford, 2018; DEFRA and Government Statistical Service, 2018). To date, over £3.34 billion of public money has been spent securing environmental improvements in land management in 2019 (DEFRA et al., 2019). Following the reforms, direct agricultural subsidies will no longer incentivise land cultivation but will instead be repurposed to deliver public goods or public benefits; payments to landowners and farmers are transitioning over time to prioritise environmental considerations.

For decades, these direct public income support payments to the private agriculture sector were the topic of much debate. On the one hand, the European Commission argued their existence in the CAP provided vital financial safety nets that allowed the agricultural sector to continue to produce food and products, particularly for certain forms of farming (Rizov et al., 2013). On the other, the lack of meaningful environmental conditionality meant they were seen to be contributing to the ongoing environmental degradation of land and waterways (Kirsch et al., 2017; Pe'er et al., 2020). With a dichotomy of views, the debate for the removal, redirection or reform of support had been lengthy. Furthermore, these payments masked other financial problems and resulted in high subsidy dependence in industrial agriculture across Europe. Against this background PMPG has been introduced into UK agricultural policy. However, its introduction as a concept appears at least to have enabled the continued overall level of financial support to the sector (Conservative and Unionist Party, 2019), while seemingly supporting the government's commitment to leave the environment in a better state than which it inherited (DEFRA, 2018b).

As in agriculture, such subsidies have been at the centre of a long-standing sustainability debate in fisheries (Sakai et al., 2019; Sumaila et al., 2019; Tipping, 2016). Indeed, even Adam Smith raised concerns regarding the sustainability of public money being transferred to the private fisheries sector (Smith, 1999). Given the transboundary nature of fish stocks and the global nature of fishing fleets, these concerns are not only domestic; the international struggle to address harmful fisheries subsidies has been ongoing for more than two decades. During this time there have been several attempts to form multilateral agreements on their reform, most notably via the ongoing World Trade Organization (WTO) negotiations, the Aichi Biodiversity Targets, and the SDGs, which commenced in 2001, 2010 and 2015, respectively. Yet, reformed rules

for the provision of fisheries subsidies remain elusive, even though many of them have been shown to exacerbate environmental degradation and undermine biological sustainability within the EU (Skerritt et al., 2020).

In this light, this study suggests that the PMPG concept, as recently applied to direct public income support for UK farmers, should be explored and considered as a framework for reforming direct fisheries and aquaculture subsidies in the UK. Each of the fisheries administrations within the UK is responsible for developing their own domestic replacement to the European Maritime and Fisheries Fund (EMFF)² the current CFP funding mechanism for providing direct subsidies to the fisheries and aquaculture sectors. These new schemes and their future iterations provide opportunities to consider and incorporate PMPG. The ambition shown in the UK's course change from the CAP towards the ELM scheme could be mirrored in the UK's inevitable divergence away from the EMFF scheme of the CFP.

This article places the debate within the policy context of challenges and opportunities for fisheries, aquaculture and the marine environment in the UK. It then sets out what constitutes a *public good* in the context of the new UK Agriculture Act, before exploring what might constitute a public good in the marine environment. It then outlines the current forms of public money transfers under the outgoing EMFF and whether they could be considered to provide public goods, before outlining what the principles of fisheries and aquaculture subsidisation might look like under the concept of PMPG. Lastly, the paper discusses future policy, how the PMPG concept may be expanded, and how it can be implemented through a just transition. We discuss how this concept may be applied more broadly to address long standing concerns of how public money and natural assets are currently managed and whether they are done so for the benefit of all of society. Specifically, we suggest that the requirements for continued financial support under the replacements to the EMFF are reshaped and linked to the requirement to provide positive environmental outcomes and other public goods. Having commenced the exploration of PMPG in the marine environment we conclude by suggesting further areas of research.

2. Political context

EU-exit provides a unique opportunity to revisit environmental legislation and policy. In terms of the UK Government's current stance towards the environment, there is recognition that transformational change is required. The desire for the UK to be a world leader in the global response to the environmental crisis led to the Government introducing the legal requirement to achieve Carbon Net Zero (CNZ) by 2050, and subsequently a commitment to reduce carbon emissions by 78% by 2035 (compared to 1990 levels) (UK Gov, 2021a), the publication of the 25 Year Environment Plan (DEFRA, 2018b), and the successful bid to host the 26th UN Climate Change Conference (UK Gov and UN, 2021). Tackling climate change and preserving the planet's biodiversity forms one of the four priorities for the UK's G7 Presidency in 2021 (UK Gov, 2021b). From an international marine perspective, through its leadership of the Global Ocean Alliance, and as ocean co-chair of the High Ambition Coalition for Nature and People, the Government is championing the 30 by 30 target, which advocates for the protection of at least 30% of the global ocean within Marine Protected Areas (MPAs) by 2030 (which aligns with global protection of at least 30% of land by the same year) (UK Parliament, 2021).

This desire to lead is exemplified in the concerted effort the UK has taken to address its carbon emissions and take advantage of an extensive Exclusive Economic Zone (EEZ), with favourable bathymetry and meteorological conditions to become the global leader in the development of offshore windfarms (OWFs) (Prime Minister's Office, 2020). The

² The overall EU EMFF budget for 2016–2020 was € 6.2 billion, with the UK allocated €243 million (of which €92.1 million was allocated to England for that period) (MMO, 2016).

rapid expansion of OWFs and their demand on marine space is currently the most obvious facet of the UK's Blue Growth agenda and are an example of the changing appreciation and recognition of the high value of the UK's marine assets. With increasing pressures from greater use leading to growing competition for space, comes increased scrutiny of environmental impacts occurring in an already degraded ecosystem but also increased recognition around the important ecosystem services that can be derived from its inherent assets (Ruckelshaus et al., 2013). Recently there has been a shift in focus from the terrestrial to the marine environment regarding the extent that carbon sequestration occurs (Green et al., 2021). It is already being advocated that restrictions on bottom trawling are required to maximise the extent that this ecosystem service can be provided (Sala et al., 2021). As this will require restrictions on fishing activities, this further raises the question as to how the UK's assets (natural and financial) should, or could, be used to benefit wider society. The expansion of OWFs, has coincided with attempts to increase protection of the marine environment with the designation and management of MPAs being the most obvious manifestation of this (the UK MPA network now consists of 371 sites covering 38% of the UK EEZ (Pow, 2021)) the other being the development of the UK Marine Strategy.

The ambition and the legal requirement to improve the state of the UK's wider seas and to deliver Good Environmental Status (GES) of its waters (by 2020) is established within the 25 Year Environment Plan, the Marine and Coastal Access Act (2009) and associated UK Marine Strategy Regulations 2010 in addition to the Fisheries Act (2020) (Marine and Coastal Access Act, c.23, 2009; DEFRA, 2018b; DEFRA, 2019; Fisheries Act, 2020). The most recent status update regarding GES delivery was conducted in 2019 with eleven of the fifteen elements reported on were either Red (GES not being achieved) or Amber (GES only partially achieved) (DEFRA, 2019). This update stated that the predominant human pressures preventing GES being achieved include commercial fishing. The marine environment has been degraded through the act of fishing and climate change is exacerbating the pressures on both fish stocks and the wider environment. This status update is clearly at odds with the ambition set out within the Fisheries White Paper - Sustainable fisheries for future generations (the precursor to the Fisheries Act 2020) (DEFRA, 2018a), to develop 'world class' sustainable fisheries.

As a result, access to these stocks and fishing grounds was a key area of tension during the TCA negotiation. It is noteworthy that the TCA has 'carve outs' for subsidies applicable to both agriculture and farming and that the UK is consulting on a domestic subsidy control regime. The WTO agreement on subsidies and countervailing measures (ASCM) applies to fisheries subsidies, as there is currently no sector specific WTO agreement in place akin to the WTO Agreement on Agriculture. Negotiations for a fisheries agreement under the WTO are ongoing (WTO, n.d). The UK therefore has an opportunity to consider how to address long-standing concerns regarding subsidy application in both sectors. This opportunity also comes at a time when scrutiny around the use of public finances will increase as the UK plans its economic recovery post-COVID-19 ('build back better' (HM Treasury, 2021) and establishes new policies and regulations following EU-exit.

Alongside traditional fisheries, the UK has natural conditions to support aquaculture (including the farming of oysters, mussels, scallops, and clams, using various techniques) while at the same time providing ecosystem services such as water filtration that can aid the delivery of GES. While the provision of ecosystem service benefits, from water purification to habitat creation and carbon sequestration have been widely documented (Brumbaugh 2008, Northern Economics Inc, 2009; National Research Council 2010), there are also instances where ecosystem services may be lost by an expansion of bivalve shellfish aquaculture, e.g. through loss of soft sediment habitats and food resources for wading birds (Herbert 2016). Some of the ecosystem services provided are dependent on-site specifics, bivalve species selected and life stages, making trade-offs (Sequeria, 2008) a key consideration. The shellfish

aquaculture sector already contributes around £35.6 million annually to the UK economy (Hambrey et al., 2016). However, this sector is facing considerable spatial constraints including from the MPA network, issues with water quality in some sites, threats from disease and/or invasive non-native marine species (INNS) in some locations (e.g. Wales (Jenkins 2021) and the Solway Firth (Solway Firth Partnership 2017)), and opposition from commercial fishers where the public right to fish is perceived to be impinged by the consenting of aquaculture sites (Hambrey et al., 2016; Black and Hughes, 2017; MMO, 2020).

Increasing demand for marine space and the opportunity to establish a new fisheries/aquaculture legislative framework and management regime coupled with a desire to improve not only the state of the UK's marine environment but to provide global leadership provides an opportunity for new concepts and principles to be debated and developed. In looking for solutions to support fisheries and provide the economic and social goods, one may look to how complex ecosystems and environmental impacts have been addressed on land. Acknowledging the apparent success in farming (in that the concept seems broadly accepted and supported by a diverse range of stakeholders (NFU, 2021; Sustain, 2021; Woodland Trust, 2018)), it is here proposed that PMPG should be debated as a central tenet of marine governance, and specifically in the reform of fisheries and aquaculture.

3. Public goods

3.1. What are the public goods in UK agricultural policy?

Despite its widespread usage in agricultural policy discussions, there is considerable ambiguity regarding the definition of public goods with at least three distinct concepts evoked in different instances: how goods can be accessed and depleted, whether goods have beneficial outcomes that are widely enjoyed, and the ownership of goods.

The definition of a public good used in economics, first proposed by Paul Samuelson (1954), is a good (i.e. something that provides utility) that cannot be easily depleted (i.e. it is non-rivalrous) and is difficult to prevent others from accessing (i.e. it is non-excludable). This is the definition used in key government technical documents, for example in HM Treasury's Green Book for Central Government Guidance on Appraisal and Evaluation (HM Treasury, 2020). Private goods have the opposite characteristics (i.e. they are rivalrous and excludable) while common goods (non-excludable but rivalrous) and club goods (non-rivalrous but excludable) share one but not both features.

Outside of economics the term public goods is often used in a less technical and more generalised sense to refer to goods that are enjoyed by a broad population (sometimes referred to as *the public good* or the common good) or in other instances to goods with non-market benefits (i.e. a *public benefit* or externality). These two generalised uses may overlap in some cases but not all.³ A third use of the term public goods relates to ownership, particularly in the case of marine resources where some goods are referred to as *public assets*. However, a public good (under either the technical or the general definition) need not imply public ownership, nor does a private good imply private ownership.⁴

³ For example, a gift of flowers to a friend is a positive externality with only a single beneficiary (Holtermann, S. E. (1972) 'Externalities and Public Goods', *Economica*, 39(153), pp. 78–87.) and a beautiful sunset has many beneficiaries but is not an externality as no economic agent was involved in its production (Reddy, S. (2015) 'Externalities and Public Goods: Theory OR Society', Available: Institute for New Economic Thinking. Available at: <https://www.inetecconomics.org/perspectives/blog/externalities-and-public-goods-theory-or-society> (Accessed 26th March 2021).

⁴ These three definitions do not constitute an exhaustive list, merely the most common uses. For example, Timmermann (2018) describes three additional variations of the term: a *normative* public good, a *visible* public good, and *joint action* public good.

While the multiple uses of the term public good refer to distinct concepts, it is common for articles on agricultural public goods to define public goods according to the technical economic definition but then apply the generalised definition that covers a much wider range of potential public benefits, only some of which are technically public goods. In some cases, this shift in definition is subtle (Global Justice Now, 2017; Hird, 2021; Sustain, 2021), while in other cases it is more explicit, for example, by arguing that all goods are situated on a spectrum of “publicness” (Cooper et al., 2009), or acknowledging the technical definition but questioning its relevance (Kipling, 2019).

One potential reason for retaining the link to the technical definition of public goods is that in welfare economics, public goods are viewed as a valid reason for government intervention and could thus justify public money being spent. However, this link between public goods and government intervention is disputed, with critics noting that there can be non-governmental solutions to public good problems (Cowen, 1992), or alternatively, that public spending need not require the identification of a public good (Devlin and Wheatley, 2017, p.19). Many economic theorists have questioned the use of public goods theory in welfare economics altogether as the public goods concept combines multiple dimensions (Woolley, 2006), neither of which are ‘natural’ properties but rather determined by a mix of evolving factors such as institutions, ideology, technology and costs (Cowen, 1985; Goldin, 1977; Vivero-Pol, 2017; Sheng, 2020). Despite these critiques, public goods theory continues to be promoted and its flexible use in practice has placed it at the heart of UK agricultural policy reforms with the support of diverse stakeholders.

In the 2020 Agriculture Act, the twelve identified areas for financial assistance appear to use the generalised definition of public goods as *public benefits* (Agriculture Act 2020 c.21). No explanatory note is provided to justify the areas of financial assistance and despite the term ‘public goods’ appearing frequently in consultations in the various stages of the Bill and in the 25 Year Environment Plan (DEFRA, 2018b), the term does not appear in the Agriculture Act itself.

The twelve areas for financial assistance range from environmental issues, to animal welfare, to health and well-being. Although not included in the Act, several other areas of potential financial support have been identified as public goods such as beautiful landscapes (Bateman and Balmford, 2018; Cooper et al., 2009; DEFRA, 2018c; OECD, 2015; Vojtech, 2010), to rural vitality (Cooper et al., 2009; DEFRA, 2018c; Global Justice Now, 2017), to employment (DEFRA, 2014; Gerrard et al., 2011; Global Justice Now, 2017), to public health (Hird, 2021; Sustain, 2021), and to democratic accountability (Global Justice Now, 2017). Some of these areas were mentioned in Defra consultations (DEFRA, 2018c) and in the initial development of the ELM (DEFRA, 2020a) but do not appear in the Act. While the production of food (sometimes with qualifiers like ‘healthy’ or ‘secure’) was frequently proposed as a public good (DEFRA, 2014; Gerrard et al., 2011; Global Justice Now, 2017; Hird, 2021; NFU, 2018a; NFU, 2018b; Timmermann, 2018; Vivero Pol, 2013; Lochhead, 2009 cited in Almas, Campbell and Marsden, 2012) other authors have specifically noted that food production is not a public good as it closely fits the definition of a private good (Bateman and Balmford, 2018) and has a weak link to consumption outcomes due to many subsequent stages of the supply chain and international trade (Bateman and Balmford, 2018; Helm, 2016). Furthermore, while food is certainly an important good, if producing something desirable is a public good deserving of public money than other sectors from residential construction to energy generation would be equally deserving (Carpenter, 2018), as would all other actors in food supply chains from farm equipment manufacturing to supermarkets (Helm, 2016). Another contrast between the Act and earlier consultations is that the areas for financial assistance identified in the Act refer to processes rather than outcomes, for example *improving* the quality of soil, rather than the *outcome* of a specified soil quality metric.

3.2. What are the public goods in the marine environment?

The areas of financial assistance in the Agriculture Act can serve as a model for what constitutes public goods. Many of these identified public goods in agriculture are directly applicable to fisheries and aquaculture, stemming from the fact that both these sectors impact on, and are impacted by, the natural environment and have significant government financial inputs and oversight (Agriculture Act 2020 c.21). The areas of financial assistance of an environmental nature can be reinterpreted in the marine context while the areas of animal welfare, health and well-being are directly applicable (Table 1). In some cases, there is alignment between the areas of financial assistance in the Agriculture Act and areas of financial assistance in the Fisheries Act, although the latter were developed based on a different, unstated concept.

Climate change mitigation and animal welfare are included as areas of financial assistance in the Agriculture Act but neither appears in the areas of financial assistance in the Fisheries Act despite its direct relevance. These public benefits are less developed in fisheries and aquaculture than in terrestrial agriculture, although the Fisheries Act does contain a climate change Fisheries Objective. Conversely, three areas of financial assistance in the Fisheries Act that are not included in the Agriculture Act are: personal expenses of workers, the health and safety of workers, and the training of workers. This difference may indicate that consideration of workers is further developed in fisheries and aquaculture than in terrestrial agriculture.

While this comparison indicates a substantial overlap in the areas of potential financial assistance between agriculture, aquaculture and fisheries, how that financial assistance is justified and implemented diverges significantly. These differences also explain some of the different sector experiences with public funding to date with direct public income support forming a significant portion of farm income but with direct support rarely used and in smaller amounts in the fisheries sector.

Unlike the relationship between farmers and agricultural land, fishers do not actively manage the marine environment.⁵ Much of this difference is explained by feasibility. While farmers can take actions to improve agricultural land, fishers cannot actively restore the marine environment and certainly not in the magnitude to prevent natural disasters. This is not to say that fishers cannot have a large impact on the environment – they do – only that the impact is to the detriment to the marine environment compared to taking no action (i.e. not fishing). By its very nature, fishing is an extractive activity that kills fish, can result in bycatch, damage habitats and affect food webs. While minimising impact (e.g. switching to lower-impact fishing gear) can still improve the state of the marine environment compared to current fishing practices, there is not the same support for the principle of “public money to erode public goods to a lesser extent”. Under some interpretations of public goods, the financial flows should be in the opposite direction with fishers paying penalties for the creation of negative externalities (Ryan et al., 2014). There are some limited exceptions where the act of fishing is beneficial to the environment (removal of invasive species, litter, as in Table 1). This challenge to apply PMPG to capture fisheries is not nearly as acute in bivalve or algae aquaculture where careful management can lead to additional public benefits in the form of water quality improvements, habitat creation and climate change mitigation.

Another key difference between payments for public goods in terrestrial and marine contexts is the ownership structure of the resource. While the degree to which fishers fully own fishing opportunities (e.g. licences, quota) is an area of active debate (Appleby et al., 2018), they do not generally own the marine resources themselves (e.g.

⁵ Aquaculturists who lease areas of the seabed from the Crown Estate under Regulating and/or Several Orders share features with both farmers and fishers (e.g. Historically, native oyster fishers have sometimes actively managed the environment in question by harrowing the beds and/or laying cultch. This harrowing is conducted to keep the cultch clean for spat settlement).

Table 1

Areas for financial assistance specified in the Agriculture Act and their possible marine equivalent (Fisheries Act clause identified where relevant).

| Agriculture Act Clause | Examples given in the Explanatory Notes | Marine equivalent ^c | Capture fisheries examples | Aquaculture (AQ) Fisheries (F) | Aquaculture |
|--|--|---|---|--------------------------------|---|
| 1. a) protects or improves the environment | tree planting | conservation, enhancement or restoration of the marine and aquatic environment (Fisheries Act 33. 1. a) ^a | shift to lower-impact fishing gear (Williams (2019)), removal of marine litter and fishing gear | Applies to both AQ + F | benevolent habitat forming shellfish aquaculture (Madricardo et al., 2020; Fodrie et al., 2017) |
| 1. b) supporting public access | facilities for educational visits ... share information about agroecology | promotion or development of recreational fishing (Fisheries Act 33. 1. i) | recreational fishing policy, facilities for educational visits, data collection | Applies to both AQ + F | |
| 1. c) restores or enhances cultural heritage or natural heritage | maintenance of historic farm buildings, dry stone walls and conservation of limestone pavement ... contributing to research, education, recreation and tourism | cultural heritage in coastal communities | maintenance of historic fishing vessels and portside infrastructure (van der Schatte Olivier et al., 2020), natural heritage, traditional fish related festivals, education around local fish and how to cook them (Everett and Aitchison, 2008; Michael Hall and Sharples, 2008) | Applies to both AQ + F | |
| 1. d) mitigate or adapt to climate change | peatland restoration | blue carbon sequestration ^a | habitat forming shellfish aquaculture (Fodrie et al., 2017), fishing less to restore natural carbon sinks (Sala et al., 2021) and to let biomass sink (Mariani et al., 2020) | Applies to both AQ + F | |
| 1. e) reduce or protect from environmental hazards | improving soil porosity | restoration of natural features for storm protection | shift to lower-impact fishing gear (Williams, 2019) and areas away from inshore features that provide flood protection, nutrient cycling, erosion protection, sediment stabilisation in aquaculture (van der Schatte Olivier et al., 2020) | Applies to both AQ + F | |
| 1. f) protecting or improving the health or welfare of livestock | participation on health or disease control schemes animals have access to materials that allow them to express their natural behaviours | health and welfare of fish through reduced bycatch and increasing survivability of bycatch which is discarded ^a | shift in species (e.g. bivalves), shift to lower-welfare impact fishing gear (Waley et al., 2021), lower stocking densities in aquaculture | Applies to F | |
| 1. g) conserving native livestock, native equines or genetic resources relating to any such animal | rearing rare and native breeds or species | Conserving native species, removal of Non-Native Invasive Species (NNIS) | encourage the targeted removal and commercial and/or recreational utilization of dead NNIS, removal of NNIS (Giakoumi et al., 2019; MacLeod et al., 2016), restocking schemes: oysters (Native Oyster Network, 2021), sturgeon (Blue Marine Foundation 2021). | Applies to both AQ + F | |
| 1. h) protecting or improving the health of plants | reduce the risk of introduction and spread of harmful plant pests and disease | conservation, enhancement or restoration of the marine and aquatic environment (Fisheries Act 33. 1. a) ^a | shift to lower-impact fishing gear (Williams (2019)). | Applies to both AQ + F | |
| 1. i) conserving plants grown or used in carrying on agricultural, horticultural or forestry activity, their wild relatives or genetic resources | conserve and utilise crop wild relatives | no equivalent, plant nurseries are a different sector ^b | not applicable | Could potentially apply to AQ | |
| 1. j) protecting or improving the quality of soil | Assistance for soil monitoring and research ... practices which protect and enhance soil health | conservation, enhancement or restoration of the marine and aquatic environment (Fisheries Act 33. 1. a) ^a | shift to lower-impact fishing gear (Williams, 2019), water quality improvements in shellfish aquaculture (van der Schatte Olivier et al., 2020) | Applies to both AQ + F | |
| 2. a) starting, or improving the productivity of, an agricultural, horticultural or forestry activity | precision application equipment for slurry | the promotion or development of commercial fish or aquaculture activities (Fisheries Act 33. 1. b) the reorganisation of businesses involved in commercial fish or aquaculture activities (Fisheries Act 33. 1. c) improving the arrangements for the use of catch quotas or effort quotas (Fisheries Act 33. 1. h) | participation in scientific research (e.g. gear trials to reduce bycatch) | Applies to both AQ + F | |

(continued on next page)

Table 1 (continued)

| Agriculture Act Clause | Examples given in the Explanatory Notes | Marine equivalent ^c | Capture fisheries examples | Aquaculture (AQ) Fisheries (F) | Aquaculture |
|---|--|---|--|--------------------------------|-------------|
| 2. b) supporting ancillary activities carried on, or to be carried on, by or for a producer | activities carried on by a producer ... or someone acting for them | the economic development or social improvement of areas in which commercial fish or aquaculture activities are carried out (Fisheries Act 33. 1. g) | improvement of launching facilities for recreational vessels | Applies to both AQ + F | |

^a Fishers can only minimise or reduce their own harm rather than taking a beneficial action.

^b Fishers cannot have a significant impact.

^c Includes the catching sector, the aquaculture sector, and recreational fishing.

fish stocks, marine habitat). Aquaculture is situated in between the two where ownership can be in the form of a lease of areas of seabed which can provide a financial return to the state to support management and data collection.

Following from this difference in ownership, the justification for direct public income support in the agricultural sector to influence how owners use their private property is absent in the fisheries sector. As the marine environment is owned and managed on behalf of the public, the government can more easily legislate a change to how marine space is used compared to an area of terrestrial land under private ownership. Thus, a change in policy regarding resource use can be achieved in the marine environment both at scale and at a faster pace than would be the case in the terrestrial environment. Still, public payment is a powerful tool and this key difference in ownership may lead to different forms of public payment rather than a forgoing of public payments entirely.

4. Do public payments to fisheries and aquaculture deliver public goods?

There are three broad arguments for transferring public money to the private fisheries and aquaculture sector that may deliver public goods in their broadest sense. The first is to incentivise sectoral development in a manner that may not otherwise occur. Such support was integral to the post-war expansion of fisheries (Schrank, 2003; Tickler et al., 2018) and more recently for developing nations' fisheries (Cisneros-Montemayor et al., 2013; Espinoza-Tenorio et al., 2011). The second is to address distributional and social equity issues, such as to improve the conditions of marginalised groups (Harper and Sumaila, 2019; Schuhbauer et al., 2020). The third is to address conservation concerns such as limiting carbon emissions or undoing harm previously caused (Balmford and Whitten, 2003; Cullis-Suzuki and Pauly, 2010).

Over the past two decades, much of the subsidisation of EU fisheries and aquaculture was provided with the intention to incentivise development (Skerritt et al., 2020). While such development was once an important policy for increasing food production, fears of food shortages in the EU have largely receded and many exploited fish stocks have reached or exceeded their ecological limits (a recent audit of 104 UK fish and shellfish stocks found that only 36% were healthy in terms of stock size (Guillen, 2021)). As such, subsidy provision to increase capacity is no longer necessary, particularly as fishing capacity is estimated to increase by 2–4% annually through technological advancements alone (Palomares and Pauly, 2019; Munro and Sumaila, 2002; Eigaard et al., 2014).

However, many fisheries subsidies continue to enhance fishing capacity (Skerritt et al., 2020; Sumaila et al., 2019). Such subsidies have been shown to cause harm by distorting markets, contributing to unfair trade practices and unequal competition within countries (Schuhbauer et al., 2020), and, importantly, they undermine the natural resources that the sector relies upon by encouraging overcapacity, overproduction and subsequently overfishing (Sakai et al., 2019; Schuhbauer and Sumaila, 2018). This has led to the pervasive view that the continuation of subsidies to the fisheries sector are now intended to lower fishing costs to offset declining catches (Sumaila et al., 2019), rather than to

deliver public goods *per se*.

However, not all fisheries subsidies are damaging. Sufficient evidence exists to classify certain forms of subsidies based on their likely impact on fish stock and environmental sustainability, noting that the status of the resource (Arthur et al., 2019), characteristics of recipient fisheries (Quinn and Ruseski, 2001), and cultural and institutional differences (Sakai et al., 2019), have all been shown to alter the observed impact a particular subsidy may have. Certain subsidies can have positive, or at least neutral, impacts upon environmental sustainability and may even provide direct public goods. Indeed, the EU has made steady progress towards redirecting many damaging forms of subsidies towards less damaging, potentially beneficial, forms of support (Skerritt et al., 2020). These beneficial subsidies are thought to act as an investment in natural resources while also conferring sectoral benefits. For example, the UK is currently investing in the establishment and maintenance of MPAs that intend to directly conserve portions of the marine environment (UK Parliament, 2021), which may result in benefits to the sector through spill-over effects (Halpern et al., 2010; Lenihan et al., 2021).

While the nature of fisheries subsidies is the subject of much research, few studies have quantified aquaculture subsidies (but see Guillen et al., 2019; Love et al., 2017) - despite significant public money being transferred to the sector annually, especially in the EU where EUR 1.17 billion was transferred between 2000 and 2014 with the key aim of developing the aquaculture sector (Guillen et al., 2019). However, unlike wild capture fisheries, increasing aquaculture production does not necessarily have direct negative environmental impacts, and may even provide public benefits in the case of bivalve or algae culture.

While reducing the impact of fishing on the marine environment has been a clear policy goal in the UK, the opportunity for habitat restoration and creation through bivalve shellfish aquaculture, for example, has not been the focus of specific policies or subsidies. The PMPG approach to subsidies however opens this realm of possibility. Specifically, subsidising excess production or 'set aside' areas on leased shellfish beds (through Several or Regulating Orders - where public authorities can lease areas of seabed for cultivation of bivalve shellfish) can generate public goods (e.g. climate change mitigation, water purification, enhanced biodiversity, food for wading birds and other wildlife (National Research Council, 2010; Grabowski et al., 2012; Herbert et al., 2016; Herbert et al., 2012; Northern Economics Inc, 2009; Rodriguez-Perez et al., 2019; Watson et al., 2020; Williams and Davies, 2018)) without the corresponding risk of distorting markets or supporting specific companies or sectors unfairly. Care must be taken to ensure that overall environmental degradation does not happen by trading one set of ecosystem benefits for another. The approach could consider an ELMs-like approach to delivering multiple co-benefits in the public interest through supporting bivalve shellfish aquaculture if well situated and regulated to consider possible trade-offs (Rodriguez-Perez et al., 2019).

Clearly, the environmental outcomes of fisheries and aquaculture subsidies are complex, and policy interventions in the marine environment can lead to unexpected, or unintentional (and potentially perverse), outcomes, not least because increasing fishery production directly puts pressure on fish stock sustainability and leads to increased

environmental degradation, simply through the action of increased fishing activity. With this nuance in mind, we outline the types of direct public payments that the UK fisheries and aquaculture sectors were known to receive via the EMFF and, to the extent possible, describe whether they are likely to provide or undermine public goods. Each relevant form of public payment via the EMFF was categorised as either having positive (+ve), negative (-ve) or neutral (0) impacts on public goods. The definitions in the regulations of what the public payments set out to achieve, or to the extent possible the types of projects that were funded under each payment type, were used to inform this categorisation. Our definition of a public good is taken from the proceeding section of this paper, and as such does not consider the production of food or jobs in its definition. The likely outcome in terms of providing public goods and supporting arguments are provided (Table 2).

The UK's specific objectives for transfers of public money via EMFF were defined by four main policy goals: 1. To transition the fleet to sustainably managed and discard-free fisheries; 2. To foster growth potential across the fisheries, aquaculture and processing supply chains; 3. To support the efficient use of natural resources; and 4. To fulfil the UK's enforcement and data collection obligations. Although some public goods are reflected in these broad goals, they tend to focus on growth, efficiency and management of the current sector, rather than on providing direct public benefits.

These overarching goals are reflected in the likely environmental outcomes of the specific EMFF public payments. We determined that five EMFF payments provided clear public goods, including two directed specifically towards fisheries; one focuses on the removal of litter and ghost fishing gear, the other provides life jackets to fishers and crew. However, the majority were considered to have neutral effects. This is probably because fishers, unlike farmers and landowners, cannot easily restore the marine environment, but can only erode the natural environment to a lesser degree. As such, any subsidy that enhances fishing capacity, by its nature will be increasing environmental degradation and pressure on fish stocks, and therefore some of the EMFF payments clearly deliver negative impacts.

Some of the subsidies identified that do intend to provide benefits only go as far as aiming to reduce the impact that fishing or aquaculture have on the environment, rather than remove it or undo its impact altogether (restoration). This includes public payments that aim to reduce incidental mortality of commercial and non-commercial fish, broaden participation in environmental decision-making, and improve energy efficiency. The reality of these subsidies is that they reduce the impact of fishing on the marine environment, rather than remove the impact or begin to undo the harm previously caused. This contrasts with the Agriculture Act Clause 1.a, which aims to protect or improve the environment by actively planting trees, rather than to reduce the process of cutting down trees.

Furthermore, public money for new equipment including vehicles, ice machines, power generators and more efficient engines on fishing vessels, have been shown to potentially lead to increases in fishing capacity and therefore can lead to further fishing and further environmental degradation (Sumaila and Pauly, 2006). This is particularly true for the replacement of vessel engines, or any modernisation that increases a vessels ability to find, catch or store fish, which has been shown to increase fishing effort (Palomares and Pauly, 2019), even in non-open-access systems (Munro and Sumaila, 2002). The intention is to increase efficiency but not capacity, however, the contradiction of providing funding for vessel modernisation while simultaneously requiring these investments not to increase the vessel's ability to catch fish was highlighted by the European Court of Auditors (European Court of Auditors, 2011) and the European Commission now recognises that vessel modernisation without increasing fishing capacity is not always achievable (European Commission, 2019).

Findings that public money spent via the EMFF largely have a neutral or negative impact on delivering public goods is reflected, to some degree, by a recent evaluation of the environmental benefits flowing from

Table 2

Types of support provided to UK fisheries and aquaculture allocated from the European Maritime and Fisheries Fund (EMFF), and whether they likely provide public goods (+ve), undermine them (-ve), or are neutral (0) in their outcome.

| Stated subsidy intention | Specific public payments | Example(s) from allocated EMFF funds in the UK | Likely outcome on providing public goods |
|--|--|---|---|
| Fisheries | | | |
| Reduces impact of fisheries on the environment, including avoidance and reduction of unwanted catch. | Design and implementation of conservation measures. | Develop knowledge of live wrasse fishery to inform management and development. | -ve Fishery development adds additional pressure to environment. |
| | Limit impact of fishing on environment and adapt fishing to protect species. | Replacement fishing gear to reduce by-catch or gear loss. Replacement nets with larger mesh sizes to improve selectivity. | 0 May reduce impact on fish stock, but not wider environmental impacts. Replacing gear can potentially increase fishing capacity. |
| | Innovation linked to conservation of marine resources. | Determine effects of offshore aquaculture installations on fisheries. | 0 May limit impact but does not offer benefit. |
| | Protection and restoration of marine biodiversity – collection of lost gear and litter. | Fishing 4 Litter aimed to remove 25 tonnes of litter from Cornwall and reduce wildlife fatalities. | +ve Removal of litter. |
| Protection and restoration of aquatic biodiversity and ecosystems. | Protect and restore marine biodiversity. | Establish sustainable seaweed farming. Collecting seabed data so impacts of fishing can be monitored. | 0/-ve Fishery development adds additional pressure to environment. |
| | Enhancing competitiveness and viability of fisheries and improving safety or working conditions. | Advisory services. | 0 May lead to reduced impacts but does not offer benefit. |
| | Health and safety. | New machinery, safety equipment, crew comfort. | 0 Could deliver benefit or increase fishing capacity. |
| | Added value, product quality and use of unwanted catch. | Updating refrigeration systems. | 0 If food is not considered a public good, there is no clear benefit. |
| | Improving fishing ports, landing sites, auction halls and shelters. | Upgrading fuel systems and LED light retrofit to reduce electricity consumption. | 0 Could deliver benefit or increase fishing capacity. |
| Support to strengthen technological development and innovation. | On board investments. | Replacement of anti-fouling paint with copper coat. | 0 Could deliver benefit or increase fishing capacity. |
| | Replacement or modernisation of engines. | New engines to reduce fuel consumption. | -ve (net) Potentially less CO ₂ but likely to increase fishing capacity. |
| Professional training, new professional skills and lifelong learning. | Training, networking, and support to spouses. | Supply of lifejackets and training. | +ve Provision of lifejackets 0/+ve Training (for alternative professions as this removes fishing effort). |

(continued on next page)

Table 2 (continued)

| Stated subsidy intention | Specific public payments | Example(s) from allocated EMFF funds in the UK | Likely outcome on providing public goods |
|--|---|---|---|
| Development and implementation of the Integrated Maritime Policy. | Protection of environment and sustainable use of resources. | Development of North Devon Marine Natural Capital Plan. | 0 May limit impact but does not offer benefit. |
| Improved knowledge and data collection. | Data collection. | Data collection framework national correspondent. | 0 No clear benefit. |
| Promoting economic growth, social inclusion and job creation. | Local development strategies. | New equipment including vehicles, ice machines, quays, power generators and chillers. | -ve Likely to increase fishing capacity. |
| Aquaculture | | | |
| Support to strengthen technological development, innovation and knowledge. | Innovation. | Feasibility of UK scallop hatchery and Black Soldier Fly meal as a replacement to fish meal. | +ve |
| | Management and advice for aquaculture. | Benthic survey equipment. | 0 May limit impact but does not offer benefit. |
| Enhancing competitiveness and viability of aquaculture. | Investments in aquaculture. | Increasing mussel farm capacity. | +ve May reduce pressure on fish stocks and the wider environment from fishing. |
| Promotion of aquaculture having high level of environmental protection, and animal health and welfare. | Promoting human capital and networking. | Fish health training course, upgrading management skills and knowledge, employee training and upskilling. | +ve |
| Fisheries and Aquaculture | | | |
| Investment in processing and marketing | Processing of fisheries and aquaculture products. | New fuel-efficient vans, ice machines and solar panels. | -ve Likely to increase fishing capacity. +ve Reduction in CO ₂ emissions |

the EMFF to fishing and aquaculture in England (Arthur et al., 2019). This report demonstrated that of the 1172 projects funded at the time of its publication, 396 projects, or a third, were classified as having overt intentions of providing environmental benefit. While the report identified some direct positive outcomes from the EMFF, including reductions in CO₂ emissions and unwanted catches from fisheries, projects that aimed to address environmental concerns in less direct ways, e.g. through research or participatory planning processes, were more difficult to identify.

Regarding aquaculture subsidies, the evaluation found that bivalve shellfish aquaculture systems likely provided some environmental benefits (acting as artificial reefs, or to protect/create habitats). The evaluation also sought to capture additional, and sometimes unintended impacts which could be termed public goods as they go beyond food production, income and employment (which are private benefits). The environmental benefits of EMFF funded habitat forming aquaculture projects in England were focussed on shellfish, with 13 'habitat forming' projects on mussel, native oyster, or seaweed aquaculture reported (Arthur et al., 2019). While the habitat forming aquaculture projects were successful in increasing Natural Capital and generating employment and income, the potential to scale up is often limited by the extent and availability of suitable habitats and existing poor water quality. As bivalve stocks increase, initial benefits e.g. improved water quality,

could later result in dis-benefits resulting from density-dependent factors.

Overall, public money currently used to support the UK fisheries sector at best have a neutral impact on delivering public goods, and at worst appear to work to undermine public goods. Those that support the aquaculture sector are less clear cut, and, particularly for bivalve shellfish aquaculture production may indeed provide clear public benefits, such as cleaner water and carbon sequestration (however, the research into the impacts of these subsidies lags that of the agricultural and fisheries sector considerably).

This exploratory analysis does not mean that the concept of PMPG cannot work in the marine environment, but the question persists of how we build upon those subsidies that provide public goods, or are at least are neutral in their outcome, and how do we redirect those that are likely undermining this concept. The concept of PMPG questions what payments are made to whom and for what outcome, and provides a framework for that debate. It provides a philosophy that underpins the design of those subsidies and potentially helps answer that question.

5. Discussion

5.1. The concept

We have highlighted that payments via the EMFF often had neutral and at worst negative impacts on providing public goods. As a result, it was arguably negative in the mid to long term for the future of the marine environment, socially and economically. We have shown that the PMPG concept applied to land, will apply differently in the marine environment, mostly because of the public assets being utilised (i.e. space, fish) and the ownership of those assets, but there are parallels with the possibilities for ecosystem improvement as well as addressing how space is most advantageously used.

PMPG does not provide a prescriptive answer of what public payments should look like, but it does provide a philosophy for how those payment policies could be designed. In this section we explore this further by considering the impact of the concept on future policy, how the concept can be expanded, the key gains that can be achieved and how it can support a just transition.

5.2. Future policy

With the UK revisiting its subsidy control scheme and the development of domestic replacements to the EMFF (noting that the PMPGs concept was not included in the first iteration of the Fisheries and Seafood Scheme for England when launched in April 2021 (MMO, 2021)), it is incumbent on the government to re-evaluate what the public pays for and what private industry should deliver in return for the funding received. The concept of PMPG could be incorporated into the policy statement on the application of five environmental principles emanating from the Environment Bill.⁶ Further still, it has been argued it could be incorporated in itself as an additional subsidy control principle (Natural England, 2021). Application of the environmental principles is open for debate, as these principles will post date the enactment of the Fisheries Act. Express consideration of how these principles may be applied to a future fisheries management framework remains live. For example,

⁶ The five principles of the Bill being - integration, the adoption of the 'prevention principle', which means policy should prevent, reduce or mitigate harm, the 'polluter pays principle', the rectification at source principle and the 'precautionary principle', which states that a lack of scientific certainty on the potential environmental damage of an activity should not postpone measures to prevent it (DEFRA (2021) 'Consultation Launched on Environmental Principles', [press release], Available at: <https://www.gov.uk/government/news/consultation-launched-on-environmental-principles> (Accessed 22nd March 2021).

commercial fishing is an anomalous marine industrial sector as the application of the polluter pays principle is not currently applied to this in any meaningful way – fisheries that damage the marine environment are not required to restore or provide compensation. Fishing is a specific case in that we already subsidise the damage of a public good or at least fail to manage fisheries strictly enough to prevent damage (e.g. through the funding of the supporting regulatory/management framework and reduced red fuel duty). Consideration of how to move to a point whereby the industry pay for damage caused to the marine environment and the management costs incurred by wider society to enable it, is warranted. It is notable that section 38 of the Fisheries Act does enable secondary legislation to be introduced that allows the imposition of charges for fisheries management upon fishers (Fisheries Act, 2020 c.22 s.38). PMPG could be used in designing a charging regime.

The application of the PMPG approach is not just relevant to the UK but has wider resonance. Were the UK Government to introduce the concept fully, it would be well placed to further this concept internationally because of its increased engagement in international fora and the wider geographical footprint of the UK provided through the Overseas Territories. Whilst the UK is uniquely placed to explore and operationalise this concept because of the requirement to revisit its legislative frameworks in full, this may be significantly more challenging for other countries to achieve, or for Areas Beyond National Jurisdiction where international collaboration and qualified majority decision making adds complexity.

5.3. Expanding the concept

The application of the PMPG in English agriculture has some particularities that have shaped the present analysis. First, the public goods concept was applied to agriculture in a very general sense (Table 1), referring to what may loosely be termed ‘public benefits’, although four of the twelve areas have a much stronger private element than public benefit (animal welfare, productivity, ancillary services and perhaps soil quality too). This form of application has thus shaped the equivalent application of the PMPG concept to the marine environment (Section 3).

Second, because the PMPG concept is currently only being applied to direct financial support for agriculture, the scope of the analysis for fisheries and aquaculture was likewise limited to direct support (Section 4). A wider application of PMPG could be considered, however, and there is even the potential for the discussion of PMPG in the marine environment to leapfrog its application in the terrestrial environment by considering indirect support too.

One prominent example of indirect support is the red diesel tax rebate which is received by both the agricultural and fishing/aquaculture sectors. In sharp contrast to the UK Government’s climate ambitions, this subsidy reduces the incentive to reduce CO₂ emissions and distorts relative prices in favour of the most carbon-intensive fishing methods such as scallop dredging. This indirect subsidy comes at a significant public expense. Based on data provided by Seafish for 2019 (Motova, 2021), there was nearly 107 million litres of fuel consumed by the English fleet over the year. Whilst this figure does not distinguish between types of fuel consumed, the potential benefit to the sector is considerable. The current full tax rate for diesel being nearly 58p per litre as opposed to the effective rate after rebate on red diesel of around 11p per litre (HMRC, 2021).

A second example, unique to the fisheries sector, is the allocation of access rights such as fishing quotas. While not traditionally viewed as a subsidy, the free allocation of access rights to a publicly owned resource functions as a benefit in kind and contrasts with systems of auctions or royalty payments that are used for other resources in the UK (e.g. forestry, aggregate extraction, water abstraction) as well as the allocation of access rights in some international fisheries (e.g. Iceland, the Faroe Islands, Australia, New Zealand and regions of the US). This consideration is particularly relevant as the TCA resulted in EU quota shares (considered to represent 25% of the value of the EU landings from

UK waters) to be gradually transferred to the UK over a 5.5-year period (ABPmer, 2021; Popescu and Scholart, 2021). A PMPG approach could consider tying the allocation of fishing quotas to the delivery of public goods i.e. lowering the impact of fishing could be the basis for preferential allocation of fishing opportunities and public money in support of this. Indeed, a Government consultation on quota allocation during the development of the Fisheries Act found widespread support for “criteria-based allocation” (DEFRA, 2020b).

Just as the application of PMPG could be expanded to include indirect support, there is also the potential to expand its use beyond food-based applications in the terrestrial and marine environments to a more universal application to any sector receiving public money. Such an expansion of the concept would align with the Government’s ambition to establish the five principles of environmental governance. An expansion would also align with the recognition during COVID-19 support programmes that public money should be conditional to leverage resources to tackle the biggest challenges of our time and ‘build back better’ (HM Treasury, 2021b).

5.4. Key gains

Under the EMFF, Table 2 suggests public good can be achieved through payments supporting activities such as litter removal, aquaculture research and development and training. Cross referring with Table 1, there is further potential for PMPG to support lower impact fishing gear (Williams, 2019) (whilst addressing issues of the potential to increase capacity), encouraging a shift in species selection, education in marine systems (education and public engagement being a key requirement under the Dasgupta report (2021)), engagement with scientific research, exploration of blue carbon sink potential and maintenance of portside infrastructure, amongst others. With a PMPG lens, funding towards algae or bivalve shellfish aquaculture also has significant public good potential in terms of nutrient cycling, water quality, habitat creation, biodiversity and sediment stabilisation. This alongside switching gear came up repeatedly in Table 1 suggesting a potential focus for subsidy policy.

Environmental and social gains are not only made by decisions on where money is paid, but also where it is not. Using a PMPG lens several existing payments or concessions are difficult to justify particularly around fuel and funding more efficient fishing equipment (linked to increased capacity and subsequently overfishing). Unless these payments can be supported through other government agendas, they are difficult to defend.

5.5. Just transition

Just as with the terrestrial environment it is hoped that reformed financial support will bring about the transformational changes needed. However, transformational change that impacts the fishing sector must not threaten already disadvantaged coastal communities; areas where the government is already seeking to ‘level up the economy’ (HM Treasury, Ministry of Housing Communities and Local Government and Dept of Transport, 2021).⁷

The need for a ‘just transition’ is enshrined in the Paris Agreement (UNFCCC, 2015) and reflects that in addressing the needs of the environment, the transition towards a more sustainable world needs to be equitable and just. In other words, in bringing about the change needed to deal with the marine environmental crisis, the social and economic impacts on fishers and communities affected by the change need to be considered, with the aim to ‘leave no-one behind’ (UNFCCC, 2015). PMPG provides an opportunity to not only expand the concept to include

⁷ Coastal communities are expressly referred to in the UK Government’s levelling up campaign as regions requiring support in the strive to address economic differences and inequalities across the country.

indirect support and quota allocation reform but also to address distributional inequalities. It is important that the 'PMPG' concept can be used to support these wider goals and help drive a just and equitable transition (rather than working against it).

To support that drive, what is considered a public good worthy of payment and how benefits and burdens should be distributed, should be rooted in participatory processes through procedural justice principles. As such, it is not for the authors to dictate what PMPG should look like for a specific region in detail; what PMPG should do is kick-start that debate and ensure all interested parties are at the table. Respect and recognition of all interested parties should underpin environmental policymaking (Schlosberg, 2007a, 2012) and the application of PMPG is no different. In addressing distributional inequalities, that fishers should be engaged and respected in that process is a given. One of two key concerns raised by fishers and other interested groups in a recent study in Newfoundland was the issue of engagement and participation in the changes being suggested (Kahmann et al., 2015), the lack of buy-in being the consequence of a failure to address those concerns (alongside wider issues over the efficacy of policies that do not take into account those viewpoints (Hart, 2021)).

But if fisheries are a public asset, then those participatory processes should also actively engage with the public and wider society (including future generations) who may be the silent majority of beneficiaries, and perhaps removed from and unaware of the nuances within marine governance. Taking this one step further, it is arguable that as a public asset, the wider societal needs should take precedence (Bean, 2020) including decisions over how that marine space is used. This is undoubtedly difficult but not impossible and the balancing of competing interests is not a tension solely experienced by this concept as attested to by the general principles and applicability of Aarhus (UNECE, 2018). There are provisions both in the EU-exit agreement and the Fisheries Act for wider participation, although of course it remains to be seen how that is implemented and whether this is successful.

Who is represented at the table and how is a contentious and complex issue. How future generations should be represented is a matter of current debate. In England, in the House of Lords, the Well-Being of Future Generations Bill stalled (House of Lords, 2020) and at the time of writing the Parliamentary website notes no date is set for a second reading of Bill No2 in the House of Commons (House of Commons, 2020). The Bills follow the introduction of the Well-Being of Future Generations (Wales) Act (2015) which, amongst other matters, requires public bodies to consider the long-term impact of their decisions (Well-being of Future Generation (Wales) Act, 2015 anaw 2) – in effect considering the effects on future generations and providing them with a proxy seat at the table. The effectiveness of the Welsh Act in practice remains a matter of debate (Dickins, 2018), although is commendable for its attempts to grapple with this complex issue. Again, this is not simply an issue for PMPG. However, if PMPG is at the foreground of thinking, it is possible some of these concerns can be addressed, for example, through the application of the sustainability and climate change objectives in Fisheries Act, thus integrating PMPG with those objectives.

How non-human life can 'participate' or be represented at the table is also complex and contentious. There is increasing acceptance that human and non-human life are interconnected and human life, including economic prosperity, is dependent on ecosystem health (Dasgupta, 2021) (although, the rights of non-human life that conflicts or are not overtly connected to human prosperity is more difficult (Holland, 2014)). Either way, how non-human life and interests are given a seat at the table (albeit and inevitably by 'proxy') remains an unresolved issue (Schlosberg, 2007b). At a bare minimum, the authors suggest that PMPG policies are drafted that include and build on the collection of scientific data on the state of the environment and ecosystems and that learn, reflect and adapt to that data. In other words, a policy that is not static but allows for learning or is reviewed when certain metrics are achieved (or not). This is an example of good,

adaptive governance in any event (and could and should be extended to social as well as environmental goals) (Akamani, 2016) as well as arguably a form of 'communication' or at least feedback, from non-human life.

A 'just' transition requires consideration of how assets and burdens are distributed between societal groups, regions, non-humans and intergenerationally. It requires that consideration be undertaken with principles of participatory justice, respect and recognition in mind. As with governance of any complex system it requires feedback mechanisms through data gathering for responsive adaptive governance. It also requires those concepts to be applied with a view to enhancing the well-being of living things. PMPG is a tool that can help focus attention and address those issues. It forces open dialogue on distribution (of public money) with a view to enhancing the ecosystem's ability (which by definition includes human and non-human) to flourish as a public good.

5.6. Conclusion and areas for further research and debate

Applying PMPG to the marine environment is a departure in current thinking that could aid transformational change in the appreciation and use of the marine environment. It is a framework that can guide that change. It is accepted that the marine environment is a complex system and as such impacts are not always predictable or linear and can be contested. The authors hope to start a healthy debate and garner perspectives on the use of our marine environment and payments made to support it.

In considering the three broad reasons for public money to be paid 1) development, 2) distributional and social equity issues, 3) conservation issues, the following research and debate areas are suggested:

- How can we incentivise sustainable sectoral development using PMPG as a concept, supporting diversification and innovation that would not otherwise take place, and how do we do so without increasing (or even by reducing) capacity?
- How can PMPG support the future, sustainable prosperity of our coastal communities, and to what extent would such objectives be an appropriate and efficient use of either fisheries or agricultural policy budgets, as opposed to targeted, means-tested social security support?
- How can fishers enhance ecosystem services and are there other public goods they provide that are currently unrecognised? Research and data collection linking enhancement or reduction of ecosystem services to specific marine habitats and the impacts of fishing on these are a key area for the future.
- How can changes in the marine environment be attributed to the actions of individual fishing operations seeking subsidies given the shared nature of the marine space?
- If the current marine regulatory regime (licencing and marine planning) precludes fishers from leasing marine space (unlike those engaged in aquaculture), could this be considered to foster stewardship through the application of the PMPGs concept?
- How are the benefits of aquaculture subsidies captured (including habitat restoration and creation), how are unintended outcomes monitored, and how can PMPG support positive overall outcomes?

And more generally:

- How can we build upon the public subsidies linked to the provision of public goods (and how can we replace those that do not)?
- How can we integrate science and data at the start of PMPG policy making, what indicators for success should there be, what measurable outcomes and outputs should flow from the application of this concept?
- How can the concept of PMPG be used to continue supporting the fishing industry (and the UK's coastal communities that rely upon

this sector) without exacerbating negative environmental impacts resulting from fishing?

- How can we engage, and where necessary educate, the wider public to form a vision for the future use of direct and indirect public subsidies impacting our oceans, and how can PMPG be used to support that vision?
- How can PMPG be utilised and expanded into other spheres, beyond food production?
- Could PMPG be applied on the international stage to support the recovery of marine ecosystems as global public goods?

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