Chapter 6
Payments for Ecosystems Services—Their Role in Creating Rural-Urban Synergies

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Abstract In this chapter, rural-urban synergies are examined in the context of land and water management interventions and how these are stimulated by payments for ecosystems services (PES). A review of PES literature highlights, by drawing on 10 European case studies, that PES are based on core principles of (i) the recognition of both ESS suppliers and users; and (ii) that payment is conditional on ESS improvements flowing from ESS interventions. Key findings from the analysis include that the most successful PES schemes are cross-sectoral and multi-scalar in their impacts and may represent a correction of prevailing market relations of subsidy dependencies. The opportunities to combine the valorisation of rural distinctiveness with the enhanced opportunity for urban ESS delivery should be an ambition of PES schemes. Such objectives demand clear compensations for lost earnings in PES schemes, a flexible (or ESS-centric) territorial approach to developing PES partnerships and a greater understanding of public-private blended finance to devise PES innovations.

Keywords Rural-urban synergies · Payment for ecosystem services

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6.1 Introduction

In this chapter, rural-urban synergies are examined in the context of land and water management interventions. Of particular interest is how such interventions are stimulated by payments for ecosystem services (PES). Ecosystem services (ESS) are the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems (e.g. Costanza et al., 1997; Ferrier et al., 2016; Schröter et al., 2019).

The connection between PES and rural-urban synergies emerged from the ESS Community of Practice within ROBUST, comprising seven of the project's Living Labs that had selected ESS as one function of rural-urban relations. The aim of the COP was to identify, map and integrate the key functional relationships of ESS in:

- spatial and sectoral planning,
- contributing to a redefinition of rural-urban relations,
- associating ESS use and delivery to planning instruments and governance models at multiple scales,
- exploring the role of ESS in enhancing rural-urban synergies.

PES is one tool in illuminating how payment/compensation schemes for ESS in European contexts reveal both public and private sector motivations within urban and rural contexts. Healthy ESS are a key condition for rural-urban synergy, and key findings from the analysis include that the most successful PES schemes are cross-sectoral, multi-scalar in their impacts and may represent a correction of prevailing market relations of subsidy dependencies. The opportunities to combine the valorisation of rural distinctiveness with the enhanced opportunity for urban ESS delivery should be an ambition of PES schemes where appropriate.

The chapter proceeds by revisiting the PES concept in the literature before outlining ten European PES schemes in different settings. The discussion builds on the characteristics of PES to highlight the integrative rural-urban potentials of PES.

6.2 Concept

Payments for Ecosystems Services (PES) are payments made to land or other natural resource managers, in return for the provision of specified ecosystems service (ESS) that may not be achieved without the payment (Smith et al., 2013). PES schemes tend to rest on two core ideas. The first is that there are two principal actors, namely the suppliers and the users of ESS. In considering these two types spatially through the rural-urban context, it can be understood that food and other rurally-produced materials are sent to the city in exchange for urban based-services, such as manufactured goods and governance (Gutman, 2007). This basic historical perspective (see Fig. 6.1, below) implies that ESS suppliers could include farmers and other types of rural land managers, while urban residents in the main are users

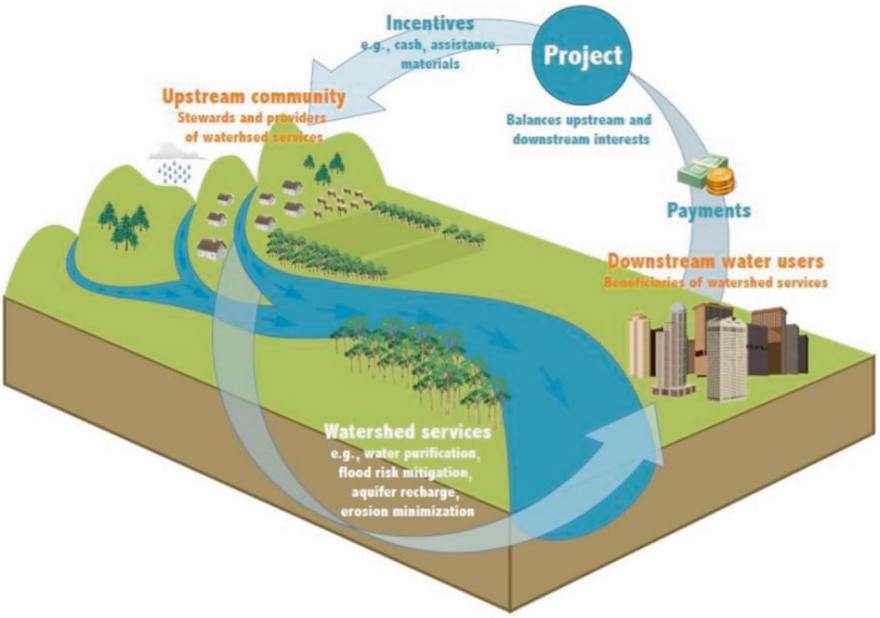

Fig. 6.1 PES model indicating rural-urban relations for water quality (Smith et al., 2013)

of rural ESS. In fact, the latter can be beneficiaries of ESS in both places, for example when visiting the countryside for leisure; or in the city, as consumers of clean water. Similarly, urban organic waste matter can be processed and returned to rural areas for example as composted soil conditioner (Eldridge et al., 2018; Hodson et al., 2021). The second core idea behind PES is conditionality, namely that payment is given (and can be withdrawn) as long as improvement results from the intervention for which payment is provided.

This exemplar illustration focuses specifically on the rural-urban ESS relationship of water quality. Here, city ESS 'users' invest in a project which incentivizes upstream land managers to improve water quality, thereby supplying direct urban benefits such as flood risk management and clean water. The investment (left unspecified in the diagram) might take the form of tax revenue or re-directed consumer income by water companies, for example. In practice, the rural benefits of the PES scheme are likely to be multiple and varied, including biodiversity, erosion control and jobs. The two core pillars of ESS (suppliers-users, and conditionality) mask a range of functions, contexts and motivations behind PES, including the relative relationships between suppliers and users, which may be arranged between combinations of multiple or single suppliers and users. PES schemes are also distinguished by the types of financial backers, including the state (for example through subsidies), private companies (through cost-benefit payments) or a combination of both (blended finance).

Within ROBUST, which aimed to better understand rural-urban synergies and introduce governance innovations to achieve these, questions arose which offer new pathways to explore PES, including:

- What recent PES schemes have arisen in Europe?
- Which theoretical models help to understand PES and its potentials?
- Which governance arrangements prevail in European PES and do these enhance rural-urban links?

These questions will be illuminated in the following sections. The chapter begins by discussing the key concepts behind PES schemes and their characteristics and functions. Examples of PES schemes in Europe are then explored to reveal PES schemes in different land and marine settings. Knowledge gaps are identified, along with key learnings linked to PES and links between rural and urban areas. While it is emphasised that PES literature and operations cover many different scales and places, the focus here is on local/regional ESS scales, reflecting ROBUST's place-based focus (via Living Labs), although some dispersed or supra-local rural-urban relationships are also highlighted.

Scientific Literature

In the literature, a range of different interpretations are linked to PES schemes, depending on the type of ESS being targeted. These include Payments for Watershed Ecosystems Services, Land Management Contracts and Compensation for Ecosystems Services. ESS payment schemes have been widely applied in both south and north-world contexts and became especially associated in the post-Brundtland/Rio Earth Summit period after 1992 with efforts to link environmental conservation with attempts to tackle poverty. As a consequence of this diversity, the types of actors involved in designing, monitoring, delivering and paying for compensation schemes also varies. An example of this is the distinction between contractual agreements to manage land to generate '*private* good-type services' such as food and raw material products, and the '*public* good-type services' such as biodiversity and landscape protection, a distinction outlined by Schaller et al. (2018). The realisation of public vs. private ESS thus requires different types of compensation sources including corporate incentives and government or quasi-public payments (for example from water companies) who 'invest' in ESS delivery on behalf of tax payers or essential service users.

A generic label of PES schemes is that they are '*financial incentives given directly to landholders to compensate them for implementing good land management*' (Capodaglio & Callegari, 2018)—implying that the introduction of ESS supporting management may be financially disadvantageous by incurring additional land management costs. However, this antithetical framing is especially associated with agri-environmental land management and somewhat underplays the link between beneficiaries and suppliers of ESS (Morrison & Aubrey, 2010).

Sven Wunder is a source of conceptual and operational insight into ESS (especially in relation to the global south), suggesting that:

> *The core idea of PES is that external ES beneficiaries make direct, contractual and conditional payments to local landholders and users in return for adopting practices that secure ecosystem conservation and restoration.* (Wunder, 2005:1)

Values have been assigned to natural capital and ESS in order to encourage decision-makers to carry out and advocate cost-benefit calculations of improving land and natural resource management practices. Wunder's description of PES indicates that the transactional arrangements for PES are between two types of people, namely (i) those (internal) land managers whose practices affect the quality of ecosystems, and (ii) the ecosystem users, who are external and potentially geographically removed from the area being managed. This is a rather linear relationship and risks masking numerous indirect beneficiaries of ESS, such as urban dwellers whose air quality may be enhanced through peri-urban forestry management designed to support biodiversity.

Who pays land managers for the realisation of beneficial outcomes is another possible variable of PES schemes. The state may be a direct payer, acting on behalf of ESS beneficiaries from whom taxes are collected. Private schemes may make the relationship between payer and beneficiary more direct, if these benefits accrue from specific localised services.

Wunder goes on to characterise PES in five distinct ways, suggesting:

> *A PES is:*
>
> 1. *a voluntary transaction where*
> 2. *a well-defined ES (or a land-use likely to secure that service)*
> 3. *is being 'bought' by a (minimum of one) ES buyer*
> 4. *from a (minimum of one) ES provider*
> 5. *if, and only if, the ES provider secures ES provision (conditionality).* (Wunder, 2005:3)

Wunder's list hinges PES on the idea that incentivisation for ESS suppliers is adequate compared to other proposed activities, and that any payments must be contingent on actually achieving contracted ESS improvements, underlining the need for bench-marking and monitoring results.

Smith et al. (2013) have extended this list to suggest that ESS provision should continue through permanent interventions, and, significantly, that PES should not achieve ESS in one area at the expense of another area, or one ecosystem to the detriment of another. This extension thus reiterates a critical engagement with Wunder's transactional relationship between a discreet provider of a particular ESS supplied to the benefit of identifiable end-users. In reality, ESS may have multiple, complementary (or even conflicting) functions with known as well as defined/undefined beneficiaries.

Incentives for ESS buyers include the costs associated with replacing ESS with fabricated services (for example, sewerage engineering in the case of water quality) or the level of avoided costs which might otherwise have been incurred without a PES (Capodaglio & Callegari, 2018). Some authors have estimated the total value of global ESS to be roughly double the Gross World Product (Costanza et al., 2014), providing the estimate of the worth of ESS to society, generated outside and beyond

the markets. This implies potential for financial mechanisms to stimulate ESS provision for the improvement of societal well-being.

The voluntary nature the transaction suggested does not mean that environmental improvements are made without financial compensation, but relate to practices which are unregulated or inadequately regulated, and in fact for a PES to be effective '*the scheme should be more cost effective than alternative mechanisms*' (Capodaglio & Callegari, 2018) including regulation. This facet of PES is an incentive to engage private land managers (i.e. those who intervene in ecosystem management) as well as community networks which have some say over land management (such as NGO networks or commoners). It is also associated with the limited success of some imposed or regulated schemes for environmental protection where public funding has been time-limited, or implementation monitoring and impact evaluation are inadequate. Nevertheless, PES schemes may well include governmental, civic or municipal 'ESS buyers', in Wunder's terms, because they act in the interests of taxpayers who may not have a choice in whether or not to join the PES (Russi et al., 2011). Examples of PES schemes might, in other words, include the income derived from fees or profits from tourism (as in the case of the Hoge Veluwe Forest in the Netherlands (Hein, 2011)), payments from quasi-public agencies such as water companies or wholly private companies (see case studies below).

Despite its proliferation, PES is also critiqued, particularly within ecological economics, and included within analyses which argue that caring for nature demands a post-humanist and relational perspective of the environment; that an instrumentalist, neo-liberal commodification of the environment denies the intimate symbiosis between people and nature exhibited, for example, in some indigenous communities (Singh, 2015). It is also increasingly understood that regulating (intangible) cultural ESS are less effective or commonly recognised and rewarded through commercial or market transactions (Ten Brink et al., 2009).

Others suggest the very basis of assigning a financial value to complex biophysical systems is flawed. The process assumes, for example, that if transaction costs for incentivising environmental practices are low enough, PES becomes a feasible market-based solution in situations where the ESS would be under-provided without outside intervention, or would be too costly to be provided through other methods or solutions. This may risk that PES becomes proposed as a market-based solution for intrinsic market failures (Muradian et al., 2010) with all the insecurities and inequalities linked to land ownership that entails, especially in places where subsistence land use is not tied to formal land ownership but to the use of common and shared resources. The framing of complex ecosystems, and biodiversity in particular, into graspable policy objectives is supported by pragmatic ecologists through valuation mechanisms. However, it is also proposed that this pragmatism risks overlooking the multi-faceted (including negative) motivations of some policies and institutions, while simplifying the richness of public discourse about the social importance of the environment. To avoid that possibility and to reverse existing problems, better participatory governance techniques are called for (for example by Spash and Aslaksen, 2012).

These critical and political interjections are associated with social justice aspects of ESS management, especially market-based (i.e. private) PES initiatives often relying on experimentalist governance (Eckert & Börzel, 2012), including quadruple helix stakeholder approaches (Voytenko Palgan et al., 2015). In other words, PES indeed may be developed outside, but not in isolation from regulatory frameworks or multi-stakeholder configurations, where shared and inter-related outcomes can be generated from the PES. This may require the inclusion of transparent governance and/or advisory measures to connect the management of the PES to such external agendas.

European PES Case Studies

In this section, a selection of European PES case studies are presented. The schemes described encompass different ESS and supplier-user configurations, however they are predominantly private sector schemes. The cases cover water quality, food production, biodiversity and leisure, and - albeit to different degrees - their integration, and have been selected to illustrate different payment models and opportunities.

(i) *Vittel and Volvic Mineral Waters (France)*—The Vittel study is well-documented in PES literature (for example, Capodaglio and Callegari (2018)) and a very similar case study is listed in the H2020 project Pegasus (Grant agreement ID: 633814). Vittel is an internationally marketed mineral water brand drawn from a specific underground source in northern France. The water quality and integrity relies upon a stable composition over time and must be bottled at source. Increasing nitrate traces in the source were recorded and linked to agricultural pesticides seeping into the limestone bedrock. The pesticides were linked to intensive maize production and overstocking of livestock, threatening the Vittel brand. The Vittel company offered farmers financial incentives to reduce their nitrate and adopt alternative pesticide application practices, although it took ten years to develop a mutually acceptable agreement. The subsequent compensation package needed to be higher than the cost of management changes on the part of the farmers, while the upper limit had to reflect the value of water composition to Vittel. A package including land acquisition by Vittel (which was then able to stipulate land use in agricultural tenancy contracts), guaranteed minimum payments to farmers participating in a pesticide transition phase. Results included a reduction in maize production by 1700 ha across 26 farms and 92% of the sub-basin was protected, leading to enhanced water quality.

(ii) *The Upper Thames metaldehyde scheme (UK)*—Obligations under the Water Framework Directive, as well as the legal requirements placed upon the utility company Thames Water, led to a system of PES that was instituted in the Upper Thames catchment. A key motivation was to encourage agricultural land managers to adapt their practices and substitute the use of pesticides containing the chemical compound metaldehyde for an alternative product containing ferric oxide. This replacement was devised to prevent watercourse pollution linked to agricultural run-off resulting in sediment pollution, and

ground-water contamination. Metaldehye is extremely difficult and costly to remove once it is dissolved in water. Thames Water, working with the national Environment Agency, the local branch of the NGO Farming and Wildlife Advisory Group and several local parish councils, funded a 5-year project to compensate and incentivise land managers. Of particular interest is the payment penalty—if the water quality as measured at the downstream extent of the catchment dips below a specified point in a two-week period, the land managers in the scheme collectively lose a proportion of the agreed payment. This distinguishes it from some other area-based PES schemes linked to localised impact. Other activities associated with this initiative included the introduction of natural flood management techniques to slow the flow of winter flood waters in the Upper Thames.

(iii) *'Farmer, Beer and Water' (Netherlands)*—FBW is a scheme for rural actors located in Lieshout, in the Dutch North-Brabant province. The scheme involves a brewery (Bavaria), over 50 farmers, and other stakeholders including the regional water board, the municipality, and the government of the province of North Brabant. The scheme aims to improve the quality and availability of groundwater in the area which is used by Bavaria Brewery for beer production but also by farmers for irrigation. The initiative in this project is primarily taken by the private stakeholders. The main goal of the scheme is to achieve and maintain a sufficient quality and quantity of groundwater in the area. Bavaria Brewery extracts 2.5 million cubic metres of groundwater for its brewing process each year, which causes water risks in agriculture in the summer period (droughts). At the same time about 1.5 million cubic metres of rinse water per year is discharged into a small river (the Goorloop) and finally leaves the area. A critical success factor is that all participants are either dependent on the groundwater for (part of) their economic activities, e.g. farmers and the brewery, or value the sustainability of the resource (municipality, regional water board).

(iv) *Greystones Single Gloucester Cheese (UK)*—Single Gloucester is a PDO protected hard cheese made in Gloucestershire. While complying to Single Gloucester production traditions, Greystones is a relatively new brand, resulting from a PES in the form of a farm tenancy contract between the cheese producer and the Gloucestershire Wildlife Trust, which owns the 27-hectare Greystones Nature Reserve, and includes the Salmonsbury Meadows Site of Special Scientific Interest (SSSI), designated principally for its wildflowers. The floral profile has resulted from mainly unchanged pastoral management for centuries. The Wildlife Trust, which acquired the reserve 20 years ago, specifies very sensitive and seasonal management of the land by the tenant farmer, whose cattle follow organic husbandry principles, thereby adding a premium to the price of the cheese. This management arrangement enables the Wildlife Trust to attract higher level agri-environmental subsidy, but also benefits from a cheese marketing arrangement through which the cheesemaker donates a proportion of the profits of Greystone cheese back to the Wildlife Trust.

(v) *Lysekil Nutrient Trading Scheme (Sweden)*—This scheme involved the establishment of a blue mussel (Mytilus edulis) farm in a coastal region of south west Sweden, on the Skagerrak (Smith et al., 2013). Eutrophication of sea water had resulted from 5–10% increases in nitrogen run-off into the Baltic sea, as well as from outflows of waste water from the local wastewater treatment plant, leading to excessive production of phytoplankton, which can overwhelm marine habitats. Blue mussels are filter feeders and consume phytoplankton, converting it into mussel flesh. A private mussel farmer operated the mussel farm, the establishment of which was supported through an INTERREG programme which established a co-ordinating network of public bodies and community organisations. Payments were received by the farmer through the scheme for the provision of nitrogen reduction, and mussels were marketed for human consumption. This commercial benefit was matched by environmental improvements in water quality, which were substantially cheaper to achieve than alternative technical and municipal interventions. The programme ran as a 6-year trial and PES were based on the level of nitrogen found in the mussels—effectively a recycling of nitrogen from the sea to the land. Future potential exists to bundle ESS through the mussels, which also remove phosphorus. The dispersed origin of the nitrogen pollution in the Baltic remains one challenge for this otherwise locally highly effective scheme.

(vi) *'Section 106' (S106) planning agreements and Community Infrastructure Levy (CIL) (UK)*—S106 Legal Agreements are agreements made between a planning authority (county and/or district council) and a developer/owner. These agreements contain obligations linked to a strategic development site which are required to mitigate the impact of the development. For example, if a development is likely to create more traffic, there may be obligations, either financial or non-financial, to carry out highway improvement works, or to ensure that a proportion of houses within the development are available as affordable housing. CILs differ from S106 agreements because they are not linked to a specific development, but income through CIL agreements may be invested strategically by the planning authority (usually a city, county or district council). Studies have indicated that potential exists for S106/CILs to become effective mechanisms for initiating rural water improvements, urban habitat management and peri-urban recreational ESS in relation to the Leeds and Liverpool canal in England (Defra, 2016), as a future contributory funding mechanism for previously public sector agencies, in this case the Canals and Rivers Trust.

(vii) *Landscape Auctions, Netherlands*—Around a decade ago, (sub-)regional Landscape Auctions emerged in the Netherlands with the ambition to mobilise private funding for the preservation, strengthening and payment of areas that maintain typical landscape attributes and features. Mostly initiated by regional nature and landscape organisations, often in collaboration with agri-environmental cooperatives, landscape auctions try to mobilise regional people, and most especially urban-dwellers, by organising social activities that

intend to induce participants to financially adopt landscape elements for a certain time period, and/or to volunteer in their maintenance. The resulting budgets mobilised through auctions are allocated to regional land users, which are usually farmers responsible for the maintenance of specified landscape elements and/or who are willing to work with volunteers. Sometimes accompanied by additional urban business sponsoring, regional landscape auctions succeed to different degrees in mobilising significant private funding for landscape management, to create continuity in land management activity and to strengthen wider regional rural-urban relations. The latter, for instance, may manifest itself through short-food supply chain initiatives, or meadow bird protection schemes targeted at regional urban dwellers (see www.landschapsveilingen.nl).

(viii) *Green Development Fund Brabant*—Partly financed by the national privatisation of public energy companies, the Green Development Fund of the Dutch Province Noord Brabant includes provincial administrations as sole shareholders. The Fund stimulates nature inclusive land use via various novel instruments. For example, it compensates and stimulates land users for ESS delivery, especially (but not exclusively) biodiversity and landscape features, ranging from experimenting with land tenure regulations that specify the quality of natural attributes, accompanied by a reduction of tenure prices for those with nature-inclusive business plans. Other methods include financing voluntary land consolidation schemes that facilitate similar purposes and a subsidy regulation for food forests (ie. agroforestry) in five different, province-owned locations. The overall set of instruments aims to improve land access ability for alternative rural business models. It is anticipated that these will develop complementary remuneration and compensation mechanisms for ESS delivery. This could be achieved by developing direct and close relations with regional food consumers, providing services for regional nature organisations, or more co-funding and risk-sharing oriented organisational structures and, more generally, through the uptake of economic activity that valorises ESS delivery indirectly. In addition to distinctive, farm-based initiatives linked to marketing regionally typical food qualities, this may comprise the provisioning of green care or leisure- and educational activity for multiple target groups. By providing in several direct and indirect opportunities for financial support to nature-inclusive land use, Green Development Fund Brabant aspires to strengthen wider regional rural-urban relations and interdependencies (see www.groenontwikkelfondsbrabant.nl)

(ix) *Serchio River, Tuscany*—The Serchio River has the second highest level of hydro-geological risk in Italy, as a territory very prone to floods and landslides. Recently, this situation has worsened because of climate change and of an unbalanced process of development. The river's basin presents features of hydrogeological instability, seismic risk and water pollution, and for these reasons it has been constituted as a "pilot basin" in Tuscany Region (cf. Upper Thames above). The Serchio river case (Rovai & Andreoli, 2016) concerns an ecosystem service directly supplied by farmers through activities carried out

beyond their own farms, initiated in 2007, with PES contracts starting in 2009/10. Land Reclamation and Irrigation Consortia in Italy coordinate public and private actions aimed at safeguarding the territory, its environmental protection, the hydraulic shelter, the development of agriculture, and the management of water. The Land Reclamation Consortium in the Serchio valley experienced difficulties in guaranteeing both direct activities aimed at territorial protection from hydraulic hazards, and a satisfactory level of monitoring and maintenance of the territory because of scarce endowment of human and financial resources. The process of abandonment of agricultural activities, also exacerbated this situation. Subsequently, the hydrological instability was addressed by awarding farmers with contracts for services of monitoring and light maintenance of the hydraulic network. This scheme proved more efficient and effective than contracting specialised firms, thus optimising farmers' local knowledge and peer-relationships. Farmers were required to present regular reports, which included digital photos and GPS coordinates of the hydraulic structures they were monitoring, to adequately map those structures and their level of criticality as well as prove their monitoring activity. Significantly, the use of a digital camera and of information technology tools were among the most critical aspects of the project and some farmers, especially if elderly, had problems using them. During the second year, only some of the previous agreements were renewed. Only 13 of the original 20 farmers were included in the continuing project; those with the best results for the initial period were chosen to stay on. Subsequently, the budget allocated to monitoring activities was reduced since an adequate knowledge of the territory had already been attained. In the operating year 2010/2011, agreements were made with 29 farmers, among which 25 were individual land managers, and four were cooperatives. They were awarded the monitoring and light maintenance of 40% of the territory, where ca. 33% of the hydraulic network is located, with a total cost of €44,000 to the authority.

(x) *PES within Italian Natura 2000 sites* - As part of European network of protected areas established through the European Habitats Directive (92/43/EEC) and the Birds Directive (79/409/EEC), (Marino & Pellegrino, 2018) and (Schirpke et al., 2018) describe PES schemes in 19 areas and evaluate their socio-economic condition at different spatial scales and for different beneficiaries. Various ecosystem services are addressed by these authors, including provisioning, regulating and cultural services. The latter were most frequently addressed by the "recreational value" service (e.g. small payments (€1) via SMS to visitors for signposts maintenance). Provisioning services involved, amongst others, the "forage and pasture" scheme for mountain farmers receiving a discount on their annual rent for sustainable cattle breeding) and "hunting and fishing" services for hunters spending part of their working hours on maintenaning work the protected area as a compensation for hunting rights. PES for regulation services concentrated mainly on "protection against hydrological instabilities" (e.g. municipalities allowing a Forest Consortium to freely benefit from raw material and recreation in the

forest for implementing reforestation operations to prevent flooding) and "carbon sequestration" services (for instance, an agreement between the forest management authority and NGOs to valorise forest management plan by selling carbon credits derived from wood saving).

Most initiatives concern "input-based" schemes where the payment is granted for a certain land-use practice or management activity securing ESS provision. In "output-based" schemes, which are harder to define and implement, payments were directly linked to the ESS provision to measurable units (i.e., metric tons of wild fruits, tons of carbon sequestered, water quality, etc.). Payments are both in kind (e.g. picking herbs, fruits, mushrooms) and in cash (e.g. discounts). Public authorities take the responsibility of managing protected areas as ESS "sellers", while private stakeholders, especially tourists or residents, are ESS 'buyers'. In addition, private enterprises or associations from rural and urban backgrounds may be involved in improving the effectiveness of agreements by assisting and supporting transactions between buyers and sellers. As further concluded, most of the PES analysed reveal local effects, although some might serve a wider area (the National Park, the wider forest, etc.) (Marino & Pellegrino, 2018:10).

Finally, socio-economic impact assessments have observed positive effects on the local economy and on the broader social well-being varying across the sites, depending on the type of ESS, the conditions of the PES agreement, and the general socio-economic context of the local communities (Schirpke et al., 2018:104).

Discussion—Knowledge Gaps

In this section some of the conceptual considerations associated with PES will be revisited in order to identify knowledge gaps. It is helpful to start by recalling Wunder's (Wunder, 2005) four general types of PES schemes, namely:

(i) Area-based schemes, where contracts agree management of particular land areas.
(ii) Product-based premiums, where consumers pay an environmental premium for goods or services with ESS enhancing management or governance methods (examples of which include fair trade or organic foods).
(iii) Use-restriction schemes, which reward providers for limiting resource extraction or land use development.
(iv) Asset-building schemes, which are linked to ecosystem restoration.

Within the context of ROBUST and its emphasis on rural-urban synergies, particular challenges or opportunities arise from Wunder's quartet. For example, area-based catchment management schemes may need to cross multiple administrative territories, demanding a territorially networked approach to environmental governance. Product premia, despite the extra cost to users, can serve to bind urban consumers to rural producers, species or landscapes. Making room for the countryside in cities, in the form of urban agriculture, offers psycho-social benefits for those involved (Howarth et al., 2020). In fact, the willingness of farmers to work in social and therapeutic programmes with lay people to secure medium-term land

management furthermore indicates the multi-functional nature of ESS, and the innovative financial models now available for PES compared to the earlier experiences described in Wunder's writing. Of particular interest in the context of ROBUST are three principles:

(i) The idea that PES is allocated as a compensation for potential lost earnings for a hitherto practised land intervention that undermines ESS delivery.
(ii) That PES is allocated in relation to a territorially defined area of intervention.
(iii) That PES is voluntary and alternative to policy/regulation and based on performance (i.e. conditionality).

These three themes are significant for the governance of rural-urban relations in both proximate and more extended scales and would benefit from innovation in spatial (regional) networked governance.

(i) *Compensation for lost earnings*

The Volvic/Vittel and Farmer-Beer-Water (FBW) schemes raise distinctions between types of market actors, namely on the one hand farmers as land managers whose practices directly affect the quality of natural assets exploited in the market by, on the other hand, commercial water bottling companies and brewers. The deleterious impacts of the agri-food industry result from a legacy of industrial subsidy and food retail structures and are well-documented (for example, Lang and Heasman, 2015). But in these cases, the co-dependence of commercial actors and the need to align and agree mutually beneficial practices is striking. The fact that Vittel was able to influence land management not just through agri-payment contracts but also through agricultural tenancy clauses following the purchase of farm land emphasises the importance of non-agricultural commercial actors as stakeholders in the governance of ESS. This link is also made in the Gloucestershire cheese example, much of which is sold in farmers' markets in towns across the county. In FBW, the PES has emerged as a systematic alignment of the interests of commercial brewer and barley farmers. The Swedish mussels example indicates that such commercial alignments and innovations not only cross public-private boundaries (i.e. they are multi-sectoral innovations), but relate to multiple ESS regulatory spheres governed by the municipal state—in this case waste, pollution and conservation measures. Together these types of experiences reflect ongoing attempts to establish true pricing systems (Michalke et al., 2022), which are a correction of prevailing market relations and dependencies with the purpose to remunerate positive externalities of land use practices.

(ii) *Intervention areas*

In relation to the second theme, the river catchment cases in particular indicate the importance of adopting an extended view of the area of ESS impact: interventions upstream affect water quality along the whole watercourse. WILD and the Serchio River cases both complicate the stakeholders needed in PES development and ESS delivery, and draw in extra-local actors, including agencies responsible for meeting the requirements of EU regulations such as the Water Framework Directive.

In this sense, the WFD, while not itself a payment scheme, has proved an effective regulatory goal when combined with national rules on water quality and governance arrangements for hydrological infrastructure. A common feature in these cases, which resonates in the literature, is that PES works well if the level of cost for adoption is demonstrably lower than the cost of alternatives—which in the Upper Thames and the French mineral water case would need to be chemical treatment of water pollution, and in Tuscany the requirement for specialist hydro-engineering had it not been incrementally integrated into agricultural routines. The shift from site-specific S106 agreement to the county-wide application of planning gain for environmental compensation interventions, indicates a more strategic view of the potentials of some forms of PES.

The case of Natura 2000 sites in Italy shows that the benefits from ESS provision are mainly enjoyed locally or at regional and wider levels, and PES schemes represent an opportunity to meet demand and supply of ESS in the same place raising stakeholders' awareness on the importance of biodiversity conservation and land management. As highlighted by Schirpke et al. (2018: pp. 102) direct economic impacts of PES are limited to the local level, whereas positive effects on human and social well-being could be observed at greater scales. Such effects may be evident, for instance, among people that benefit from the maintenance or improvement of specific ESS, especially cultural services provided by the sites, and among stakeholder groups that were involved, increasing their skills in sustainable management solutions.

Some cases, including Upper Thames, Serchio river, Landscape Auctions as well as Natura 2000 sites, reveal a reliance on farmers for local knowledge of their territories. Farmers' involvement in professional and social networks is an asset in the development of PES schemes. In this respect, the local knowledge-base of land managers, and their adaptability following the encouragement of civil society networks, implicates them in ESS governance networks which require a wide range of data types to complement ecological or policy expertise. As shown by the Natura 2000 case, PES provides a support for ESS providers such as farmers and forest-owners sustainable practices (Schirpke et al., 2018:104).

(iii) *Conditionality*

The blurring of public-private boundaries is evident in various cases, e.g. in those where commercial or civil society actors apply land use change through the instrument of tenancy contracts. Given the diffusion of land holdings in Europe, land managers will need to be involved in consultations to initiate PES schemes successfully induce specific practice changes. Cross-sectoral collaboration may need to be reviewed, enhanced and renewed to create links to public sector agendas (agri-environment schemes, water quality, urbanisation, carbon neutrality etc.), to deliver public benefits and /or offer useful springboards for private PES schemes that may combine cost savings with ESS gains. To do so, the role of the local/regional state will be significant, both as a contributor of tax-payers' money in some PES schemes, and as the democratic representative of citizens who rely on shared ESS, especially where these are generated (supplied) and enjoyed (demanded) locally. This is not to

suggest priority of state-led PES development, but rather, to emphasise that local administration can play important contributory roles in facilitating and enabling the alignment of ESS through co-designing PES innovations. Consequently, more profound understanding is needed of how to develop, maintain and evolve blended ESS finance and to systematically monitor the impacts and durability of PES interventions. For instance, the question remains of whether PES works in the case of weaker 'market demands' for ESS gains (witnessed in the pioneering days of fair trade).

Other knowledge gaps derived from our case-study inventory can be summarised as follows:

(i) While private companies may be happy to finance PES schemes with outcomes that deliver clear commercial benefits (such as clean water saving purification costs), they seek to isolate the costs of unintended or secondary ESS outcomes (e.g. biodiversity). How can the bundling of multiple ESS be embedded in PES schemes (as in the Natura 2000 case)?
(ii) If private PES schemes are linked to consumer markets, questions arise in relation to what period of time passes before schemes should be reviewed, if consumer markets change.
(iii) Certain PES configurations—such as multiple buyers and multiple sellers—are more complex to manage than if one side is a single party. The Dutch Landscape Auctions is one example of multiple-to-multiple supplier-user relationships, but these diffused models are under-researched. The Natura 2000 cases illustrate a network of actors that must be involved for the PES to function effectively.
(iv) How PES be arranged in places where complex, seasonal or traditional land tenure rights result in multiple stakeholders or within common land tenure settings needs further research. An example of this is the Portuguese Montado landscape (Cruz et al., 2016).
(v) Given the level of state subsidies spent on the environment in territorial subsidies, notably the CAP, it remains unclear if private sector PES schemes will ever be able to reach state-led ESS delivery approaches. Research is needed into strategic PES consolidation, including its integration with and dependency on state-led ESS delivery.
(vi) Provisioning and regulating ESS seem well-represented in our list of case studies. Supporting ESS seem to be under-developed with clear potential for rural-urban links, while the cultural ESS seem closely linked to rural life, as the NATURA sites case shows.

PES as Co-Shaper of Rural-Urban Synergies

Several cases imply the significance of rural-urban interdependencies, for instance by highlighting extended territorial spatialities (e.g. water courses) or by interlinking PES prospects with (complementary) product and service marketing opportunities (i.e. food, leisure, culture). The burgeoning scholarship on urban and peri-urban agriculture in recent years is roughly concomitant with PES literature timescales (for example Viljoen (2005), de Zeeuw and Drechsel (2015)). This literature associates ESS with topics including urban land use planning, the proliferation of short

food chains and rural-urban cultural connectivity. As such, it approaches ESS as a key condition for synergistic rural-urban relations in times of climate change and spatial unbalances between ESS demand (i.e. urban shortage) and supply (i.e. particular rural amenities). The ROBUST project experienced that PES attract a lot of interest among policy actors; PES were actively addressed and explored within a range of novel rural-urban governance arrangements, encompassing both upscaling (e.g. metropolitan areas) and downscaling initiatives (e.g. participatory spatial planning efforts) and several are discussed elsewhere in this volume. ROBUST experiences also show that PES interests may be driven by shared objectives to preserve and valorise rural distinctiveness as well as collaborative aspirations to enhance urban ESS delivery capacity for multiple purposes (e.g. heat stress reduction, health and life-style benefits, etc). In that way PES may enhance rural-urban synergy relations, including the (re-) introduction of 'typical' rural qualities into urban space. The growing amount of PES initiatives thus reflect a territorial or place-based capacity to explore, combine and align rural-urban synergy prospects. Such territorial capacity-building efforts should evolve alongside other comprehensive well-being concerns such as sustainable food systems, circular resource use, cultural connectivity and public infrastructure and public service provisioning.

References

Capodaglio, A. G., & Callegari, A. (2018). Can payment for ecosystem services schemes be an alternative solution to achieve sustainable environmental development? A critical comparison of implementation between Europe and China. *Resources, 7*(3), 40–59.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*(6630), 253–260. https://doi.org/10.1038/387253a0

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change, 26*, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

Cruz, D., Guiomar, N., Juste, R., & Pinto Correia, T. (2016). *Case Study: Montado, Portugal. Deliverable D4.1 Pegasus EC Horizon Project Grant Agreement No. 633814*.

de Zeeuw, H., & Drechsel, P. E. (2015). *Cities and agriculture - developing resilient urban food systems*. Abingdon, Routledge.

DEFRA, (2016). *Payments for ecosystem services pilots 2012–2015 - Review of Key Findings.* London, Department of Environment, Food and Rural Affairs.

Eckert, S., & Börzel, T. A. (2012). Experimentalist governance: An introduction. *Regulation & Governance, 6*(3), 371–377. https://doi.org/10.1111/j.1748-5991.2012.01163.x

Eldridge, S. M., Yin Chan, K., Donovan, N. J., Saleh, F., Orr, L., & Barchia, I. (2018). Agronomic and economic benefits of green-waste compost for peri-urban vegetable production: Implications for food security. *Nutrient Cycling in Agroecosystems, 111*(2), 155–173. https://doi.org/10.1007/s10705-018-9931-9

Ferrier, S., Ninan, K. N., Leadley, P., Alkemade, R., Acosta, L. A., Akçakaya, H. R., Brotons, L., Cheung, W. W. L., Christensen, V., Harhash, K. A., Kabubo-Mariara, J., Lundquist, C., Obersteiner, M., Pereira, H. M., Peterson, G., Pichs-Madruga, R., Ravindranath, N. C. R., &

Wintle, B. A. E. (2016). *The methodological assessment report on scenarios and models of biodiversity and ecosystem services.*

Gutman, P. (2007). Ecosystem services: Foundations for a new rural–urban compact. *Ecological Economics, 62*(3), 383–387. https://doi.org/10.1016/j.ecolecon.2007.02.027

Hein, L. (2011). Economic benefits generated by protected areas: The case of the Hoge Veluwe forest, The Netherlands. *Ecology and Society, 16*(2), 13–31.

Hodson, A. K., Sayre, J. M., Lyra, M. C. C. P., & Rodrigues, J. L. M. (2021). Influence of recycled waste compost on soil food webs, nutrient cycling and tree growth in a Young Almond Orchard. *Agronomy, 11*(9), 1745. https://www.mdpi.com/2073-4395/11/9/1745

Howarth, M., Brettle, A., Hardman, M., & Maden, M. (2020). What is the evidence for the impact of gardens and gardening on health and well-being: A scoping review and evidence-based logic model to guide healthcare strategy decision making on the use of gardening approaches as a social prescription. *BMJ Open, 10*, e036923. https://doi.org/10.1136/bmjopen-2020-036923

Lang, T., & Heasman, M. (2015). *Food wars: The global battle for mouths, minds and markets* (2nd ed.). Routledge.

Marino, D., & Pellegrino, D. (2018). Can payments for ecosystem services improve the Management of Natura 2000 sites? A contribution to explore their role in Italy. *Sustainability, 10*(3), 665. https://www.mdpi.com/2071-1050/10/3/665

Michalke, A., Stein, L., Fichtner, R., Gaugler, T., & Stoll-Kleemann, S. (2022). True cost accounting in agri-food networks: A German case study on informational campaigning and responsible implementation. *Sustainability Science, 17*, 2269–2285. https://doi.org/10.1007/s11625-022-01105-2

Morrison, A., & Aubrey, W. (2010). *Payments for ecosystem services literature review. A review of lessons learned and a framework for assessing PES feasibility*. WWF.

Muradian, R., Corbera, E., Pascual, U., Kosoy, N., & May, P. H. (2010). Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services. *Ecological Economics, 69*(6), 1202–1208. https://doi.org/10.1016/j.ecolecon.2009.11.006

Rovai, M., & Andreoli, M. (2016). Combining multifunctionality and ecosystem services into a win-win solution. The case study of the Serchio river basin (Tuscany—Italy). *Agriculture, 6*(4), 49–74.

Russi, D., Corbera, E., Puig-Ventosa, I., & Cazorla-Clariso, X. (2011). Payment for ecosystems Services in Catalonia, Spain. A review of experience and potential applications. *Spanish Journal of Rural Development, II*, 87–100.

Schaller, L., Targetti, S., Villanueva, A. J., Zasada, I., Kantelhardt, J., Arriaza, M., Bal, T., Fedrigotti, V. B., Giray, F. H., Häfner, K., Majewski, E., Malak-Rawlikowska, A., Nikolov, D., Paoli, J.-C., Piorr, A., Rodríguez-Entrena, M., Ungaro, F., Verburg, P. H., van Zanten, B., & Viaggi, D. (2018). Agricultural landscapes, ecosystem services and regional competitiveness—Assessing drivers and mechanisms in nine European case study areas. *Land Use Policy, 76*, 735–745. https://doi.org/10.1016/j.landusepol.2018.03.001

Schirpke, U., Marino, D., Marucci, A., & Palmieri, M. (2018). Positive effects of payments for ecosystem services on biodiversity and socio-economic development: Examples from Natura 2000 sites in Italy. *Ecosystem Services, 34*, 96–105. https://doi.org/10.1016/j.ecoser.2018.10.006

Schröter, M., Ring, I., Schröter-Schlaack, C., & Bonn, A. (2019). The ecosystem service concept: Linking ecosystems and human wellbeing. In M. Schröter, A. Bonn, S. Klotz, R. Seppelt, & C. Baessler (Eds.), *Atlas of ecosystem services: Drivers, risks, and societal responses* (pp. 7–11). Springer International Publishing. https://doi.org/10.1007/978-3-319-96229-0_2

Singh, N. (2015). Payments for ecosystem services and the gift paradigm: Sharing the burden and joy of environmental care. *Ecological Economics, 117*, 53–61. https://doi.org/10.1016/j.ecolecon.2015.06.011

Smith, S., Rowcroft, P., Everard, M., Couldrick, L., Reed, M., Rogers, H., Quick, T., Eves, C., & White, C. (2013). *Payments for ecosystem services: A best practice guide*. Department for the Environment, Food and Rural Affairs.

Spash, C., & Aslaksen, I. (2012). Re-establishing an ecological discourse in the debate over the value of ecosystems and biodiversity. *Journal of Environmental Management, 159*, 245–253. https://doi.org/10.1016/j.jenvman.2015.04.049

Ten Brink, P., Kettunen, M., Vakrou, A., & Wittmer, H. (2009). *TEEB - The Economics of ecosystems and biodiversity for national and international policy makers.* www.teebweb.org

Viljoen, A. E. (2005). *Continuous productive urban landscapes: Designing urban agriculture for sustainable cities*. Architectural Press.

Voytenko Palgan, Y., McCormick, K., Evans, J., & Schliwa, G. (2015). Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda. *Journal of Cleaner Production, 123*. https://doi.org/10.1016/j.jclepro.2015.08.053

Wunder, S. (2005). *Payment for Ecological Services: Some nuts and bolts.* Occasional Paper, Issue. C. f. I. F. Research.