Università degli Studi di Padova

Università degli Studi di Padova

Dipartimento Territorio e Sistemi Agro-Forestali (TESAF)

SCUOLA DI DOTTORATO: TERRITORIO, AMBIENTE, RISORSE E SALUTE

CICLO XXVII

CHARACTERIZING GOVERNANCE AND BENEFITS OF PAYMENTS FOR WATERSHED SERVICES IN EUROPE

Direttore della Scuola: Ch.mo Prof. Mario Aristide Lenzi

Supervisore: Prof. Davide Pettenella

Dottorando: Alessandro Leonardi

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

PES	Payments for Ecosystem Services
PWS	Payments for Watershed Services
EC	European Commission
AEP	Agri-Environmental Programs
PHS	Payments for Hydrological Services
IWS	Investments for Watershed Services
EU	European Commission
NWRM	Natural Water Retention Measures
RSPB	Royal Society for Protection of Birds
WWF	World Wide Fund for Nature
UU	United Utilities
SWW	South West Water
WRT	Westcountry River Trust

ACKNOWLEDGEMENT

First, I would like to express my sincere gratitude to my supervisor Professor Davide Pettenella - Department of Land and Agro-Forestry Systems (TESAF) - University of Padova, for his unstinting support, and charismatic guidance throughout the PhD.

I am grateful to Professor Laurence Smith, SOAS - University of London, to support me during my field work and make possible to investigate on very interesting case studies in England. I thank Kieran Conlan (CASCADE), Laurence Couldrick (WRT), Phil Austin (United Utilities), Dylan Bright (SWW), Pamela Giani (Unione dei Comuni Media Valle del Serchio) for their support during case studies interviews.

I am indebted to Nicolas Robert, Mediterranean Regional Office of the European Forest Institute, for enlightening me, on finer aspects of research work and valuable guidance during the Short Scientific Visits in Barcelona.

My thanks are also due to Genevieve Bennett, Forest Trends' Ecosystem Marketplace, who allowed me to be part of the global market research on watershed investments, which resulted into the publication attached to this thesis. I also thank all project managers of Payments for Watershed Services in Europe who answered to the survey.

I also have to recognize the chance I was given by University of Padova, Fondazione Aldo Gini, EFIMED Short Scientific Visit, SOAS University of London, and the European Commission that have sponsored my research and fieldwork.

I would like to thank all friends, my family and my special colleagues, who helped me to go through the whole PhD.

Last, but by no means least, I thank my partner J. Kang that supports me with incredible patience.

Without all these people and institutions, I could never have completed my thesis work.

SUMMARY

Globally, Payments for Watershed Services (PWS) make-up the largest ecosystem service market (Bennett *et al.*, 2014b). Driven by the negative impacts of climate change and economic development for water quantity and quality provision, hydrological services are assuming a leading priority among forest and agriculture-based ecosystems. Indeed, afforestation and sustainable agriculture tend to be among the most rewarded management practices under contracts aiming to achieve additionality in upstream water storage, water quality protection and flood risk mitigation. Although conventionally PES is seen as a market-based tool, most existing PWS in Europe fundamentally depend on public bodies that act as intermediaries. European PWS are thus best described as “PES-like” schemes implemented by public entities, often acting in a rather complex institutional framework (Vatn, 2010). Accordingly, the research to date has tended to focus mainly on analyzing case studies from developing countries and US rather than Europe (Schomers and Matzdorf, 2013).

Through a snowball approach and networking, the study provided the first most comprehensive inventory of PWS case studies in Europe. We then used the 76 case studies for a comparative analysis aimed to characterize institutional, economic and governance mechanisms associated with PWS in Europe. Besides, we conducted a more detailed institutional analysis of four selected case studies in Italy and England.

The results show how co-investment approaches, public procurement and collaborative partnerships are substituting the theoretical idea of market transactions and commoditization of ecosystem services.

Long-term durability of private driven PWS depends on the ability of integrating different sources of funding, starting from existing subsides, private investments and service beneficiaries funds. We found evidence that innovative governance models based on partnership may increase PWS success by developing schemes with a clear benefits related to social, carbon and biodiversity. Ensuring PWS related co-benefits is important in order to engage and have a positive actors’ interaction, thus increase capacity and scale through partnerships and cross-cutting

institutions. Collaborative approaches provide better territorial coverage, technical and financial capacity that has showed to be a key factor for PWS success.

Regarding public schemes, PWS based on public budget allocation are often undermined by political instability that could affect the allocation of resources depending on availability and political decisions. To avoid instability public PWS should be coupled with regulations that set financial instruments such as water charges or funds that systematically raise financial sources to run the scheme. Considered schemes based on water charges are run on long-term and seemed to have bigger scale and impacts.

RIASSUNTO

I Pagamenti per i Servizi Ecosistemici nel settore idrico (PWS, dall'inglese *Payments for Watershed Services*) costituiscono il mercato dei servizi ecosistemici più grande al mondo (Bennett *et al.*, 2014b). I servizi idrologici stanno via via assumendo un ruolo di primo piano nella gestione degli ecosistemi agricoli e forestali, in modo particolare per contrastare gli effetti del cambiamento climatico e dello sviluppo economico sulla qualità e quantità della risorsa idrica.

Infatti, il rimboschimento e le pratiche di agricoltura sostenibile tendono ad essere tra le pratiche di gestione più premiate nell'ambito di contratti di pagamento volti a tutelare la qualità della risorsa idrica e mitigare i rischio idrogeologico.

Anche se convenzionalmente i PES sono definiti come strumenti di mercato, la maggior parte dei PWS esistenti in Europa dipendono fondamentalmente da enti pubblici che agiscono come intermediari per conto dei cittadini contribuenti. I PWS europei dunque vengono così meglio descritti come sistemi "quasi-PES" attuati da soggetti pubblici, spesso agendo in un quadro istituzionale piuttosto complesso (Vatn, 2010). Di conseguenza, fino ad oggi gli studi si sono concentrati principalmente su esempi provenienti dai Paesi in via di sviluppo e dagli Stati Uniti piuttosto che in Europa (Schomers and Matzdorf, 2013).

Attraverso un approccio *snowball* e *networking* europeo, lo studio ha fornito l'inventario più completo di PWS in Europa. Successivamente, attraverso un'analisi comparativa di 76 casi di studio, sono stati caratterizzati i meccanismi istituzionali, economici e di governance associati ai PWS in Europa. Inoltre, per raffinare la comparazione tra casi europei, è stata condotta un'analisi istituzionale più dettagliata di quattro casi di studio in Italia e in Inghilterra.

I risultati mostrano come gli approcci di co-investimento, gli acquisti pubblici e le *partnership* stanno sostituendo l'idea teorica di transazioni di mercato e *commoditization* dei servizi ecosistemici.

Il successo dei PWS privati è spesso determinato dalla capacità di integrare diverse fonti di finanziamento, a partire dai sussidi esistenti, investimenti privati e fondi beneficiari dei servizi. I modelli di governance innovativi basati sul partenariato orizzontale (locale-territoriale) e verticale (rispetto alle istituzioni nazionali e internazionali) possono aumentare il loro successo legando gli

schemi di pagamento alla valorizzazione dei *co-benefits* legati alla biodiversità, allo stoccaggio di carbonio e agli obbiettivi di sviluppo socio-economico. Garantire i *co-benefits* è importante al fine di coinvolgere gli stakeholders e creare interazioni positive, aumentando la scala territoriale d'azione e la capacità tecnica e finanziaria, attraverso il partenariato e il *networking*. Gli approcci collaborativi forniscono dunque una migliore copertura del territorio, capacità tecnica e finanziaria, che hanno dimostrato essere fattori chiave per il successo PWS.

Per quanto riguarda gli schemi pubblici, quelli che basono il sistema di finanziamento dei PWS sulla semplice allocazione di bilancio annuale, sono spesso messi in difficoltà dall'instabilità politica che influenza la disponibilità delle risorse in base alle decisioni e preferenze politiche. Per evitare l'instabilità e l'incertezza, gli schemi pubblici dovrebbero essere accompagnati da regolamenti che stabiliscono strumenti finanziari, quali tasse di scopo o fondi speciali di accantonamento, che aumentano sistematicamente le risorse finanziarie per alimentare lo schema di pagamento. I PWS che implementano la "tassa di scopo" sulla bolletta idrica e altri che creano fondi di accantonamento appositi dimostrano maggiore longevità, dimensioni e capacità di raggiungere gli obbiettivi prefissati in termini idrogeologici.

1. INTRODUCTION

1.1. Background

A large proportion of the world's population is currently experiencing water stress. Population growth and economic development over the next years will dictate the future relation between water supply and demand to a much greater degree than climate change will do (Vörösmarty, 2000). The "nexus" among water, food and energy has been recognized as one of the most fundamental relationships and issues for society (Hussey and Pittock, 2012). Much of the world indeed will face substantial challenges associated with the implementation of response strategies to balance ecological and human needs. Water, inland water bodies and wetlands are among the most valuable ecosystems, in term of services provided to human society. The recognition of the value of water and wetlands and their integration into decision making process to ensure their wise use are, therefore, essential to meet future social, economic and environmental needs (Russi *et al*., 2013)

One of the main challenges in water management is the adequate accounting and evaluation of positive and negative externalities of different uses to provide a better allocation of water resources among competing users. Payments for Environmental Services (PES) offer a promising mechanism in relation to this challenge, especially in the absence of a legislative framework or functioning local governance (Schomers and Matzdorf, 2013). According to the last EU blue print on water, in many European member states there seems to be a lack of integration and implementation of policies on water mainly due to the insufficient use of economic instruments and poor governance (EC, 2012). PES are therefore, in the same document, encouraged and are likely to become one of the most important tools that the European Commission will try to promote among member states in order to ensure the implementation of the Water Framework Directive (WFD).

In the literature, PES schemes are described as "*(a) a voluntary transaction where (b) a well-defined environmental service (ES) or a land use likely to secure that service (c) is being 'bought' by a (minimum one) service buyer (d) from a (minimum one) service provider (e) if and only if the service provider secures service provision (conditionality)"* (Wunder *et al.*, 2008). However, the development and the understanding of PES schemes in the real world are not without problems. These difficulties become more challenging when we apply the PES concept to the provision of water-related services. Payments for Watershed Services (PWS) are those PES schemes that reward farmers or forest managers for improving their management practices or restore valuable water-related ecosystems in order to increase the provision of hydrological services.

1.2. Problem statement

This paragraph describes the problem statements that provide fundamental basis for the present research project. The first problem is more connected with the ethics of the research, providing evidences of needs and applications of the possible outcomes.

Problem 1: water-related societal issues and challenges

First, the research focuses on PWS at EU level as an attempt to respond to water related societal challenges that the continent is facing in the last decades. Groundwater consumption is estimated 3.5 times the recharging capacity, leading to depletion of the most aquifers in Europe (Gleeson *et al.*, 2012). According to the blue print on water, 38% of water bodies in EU are in a not favourable condition and are considered according to the WFD indicators as "polluted" water bodies (European Commission, 2012). Moreover at European level it is estimated that climate change will double river flood probability (Ciscar *et al.*, 2011; Dankers and Feyen, 2008). Accordingly, large economic costs are likely to occur for re-establishing or improving green water infrastructure and related water services (Alcamo *et al.*, 2003; Parish *et al.*, 2012), however adaptation could be highly cost-effective, compared to a "no action" scenario (Rojas *et al.*, 2013).

Worldwide, and so far marginally in Europe, PWS have demonstrated to provide a mixed public-community-market based tool for improving the provision of several hydrological services undermined by competing uses (agriculture, potable water hydroelectric power generation), such as in the case tap water provision in the city of New York and Munich (Grolleau and McCann, 2012), water bottle industry (Perrot-Maître, 2006), and in the Murray–Darling agricultural Basin to increase environmental river flows (Wittwer and Dixon, 2013). Therefore, there is the need of better understating PWS in order to extend their use and provided greater positive impacts on water resource management.

Problem 2: Lack of data on PWS within the European context

Although, there is an increasing interest on PES from both policy makers and researchers, a recent PES scientific review provided by Schomer and Matzdorf (2013) shows that almost 75% of literature focuses on PES in developing countries. Approximately 15% of all published articles within the PES literature refer explicitly to the EU, US or Australia, with only 10 papers investigating on EU based case studies, of which most of them report on Agri-Environmental Programs (AEP) (Schomers and Matzdorf, 2013).

Regarding water-related PES, in the last 2012 State of Watershed Investments identified only 15 active programmes in EU (Bennett *et al.*, 2012), with a likely underestimation of the real number of initiatives. Within the literature review of the present research, a systematic search lead to a collection of only 16 papers on PWS in EU, of which around a quarter on peer-reviewed journals. Accordingly, there is the need to better understand the phenomena of PWS in Europe, providing a better estimation of number of programmes and create an inventory as a base for future studies and comparisons.

Problem 3: Lack of recognition the institutional nature of PWS

Finally, the lack of studies and inventories of PWS in Europe, highlighted in the previous sub-section, is mainly due to the lack of understanding about their aims and governance structures. Ideally, a PES should aims to “provide a well defined environmental service”, however within the reported programmes, many payments are directed to avoid human impacts (use of fertilizers and other chemical inputs), enforce environmental water regulations, compensate farmers for forgone income or for legal restrictions, etc.. Therefore, understanding the nature of the payment and the real “hydrological service” targeted by programmes is of paramount importance for their classification and understanding. Moreover, the existence of a very articulated water institutional and legal framework that changes among Members States provides a very intricate context for the governance and forms of PWS. Therefore, current existing programmes are hardly classifiable and often not included in the literature of PES as for their PES-Like mixed nature (Wunder, 2005a). The present research can then respond to the need of a more comprehensive and detail understanding of PWS aims and governance structures in order to characterize numbers, scales, impacts and success of these programmes.

Problem 4: Lack of understanding impacts and outcomes of PWS

Some studies have tried to evaluate outcomes of PES schemes, however their diversified aims, mixed governance nature, different spatial and institutional scale, and long term relations between proxy management practices and service provision provide difficult base for outcomes and impacts evaluation. In some studies there was the attempt to provide a link between several characteristics of PES (type of payments, design, actors, scale, etc.) and their performances (Sattler *et al.*, 2013). In others, the assessment of the link between stated goals and final monitored impacts (Brouwer *et al.*, 2011) and finally the institutional analysis of PES has brought a more contextualized and flexible way to assess multiple outcomes and co-benefits and governance of PES (Corbera *et al*., 2009; Muñoz Escobar *et al*., 2013; Prokofieva and Gorriz, 2013). Once identified the governance models and programmes goals, there is then the need to better understand evidences and assess outcomes in relation to the different PWS models. The link between governance models and outcomes will help to provide better theoretical and managerial insights to respond to water societal challenges for improving the provision of hydrological services and provide better trade off among competing uses.

In the next paragraphs, the research goals will try to set the basis of the research in order to respond to the four problems highlighted in this section.

1.3. Research goals

The present research has identified two main goals in relations to the four problem statements illustrated in the last paragraph.

GOAL 1: Characterizing and critically evaluating PWS in EU with special regards to:

2.1. Service provision (supply);

2.2. Policy drivers and payments/markets (demand); and,

2.3. Typologies of governance models (organizational arrangements).

GOAL 2: Identifying organizational arrangements that may contribute to increase effectiveness of PWS toward their improved good governance

Within the first goals, as we previously stated, there is a general lack of understanding and evaluation of existing programmes in EU. The first step consists in identifying programmes in EU and then characterizing and evaluating their characteristics. The research focuses on three main dimensions. The first is related with the service provision, therefore analysis the natural and human capital that are invested in order to provide the desired hydrological services, analyzing the type of service provided and therefore understanding the main aim of the PWS.

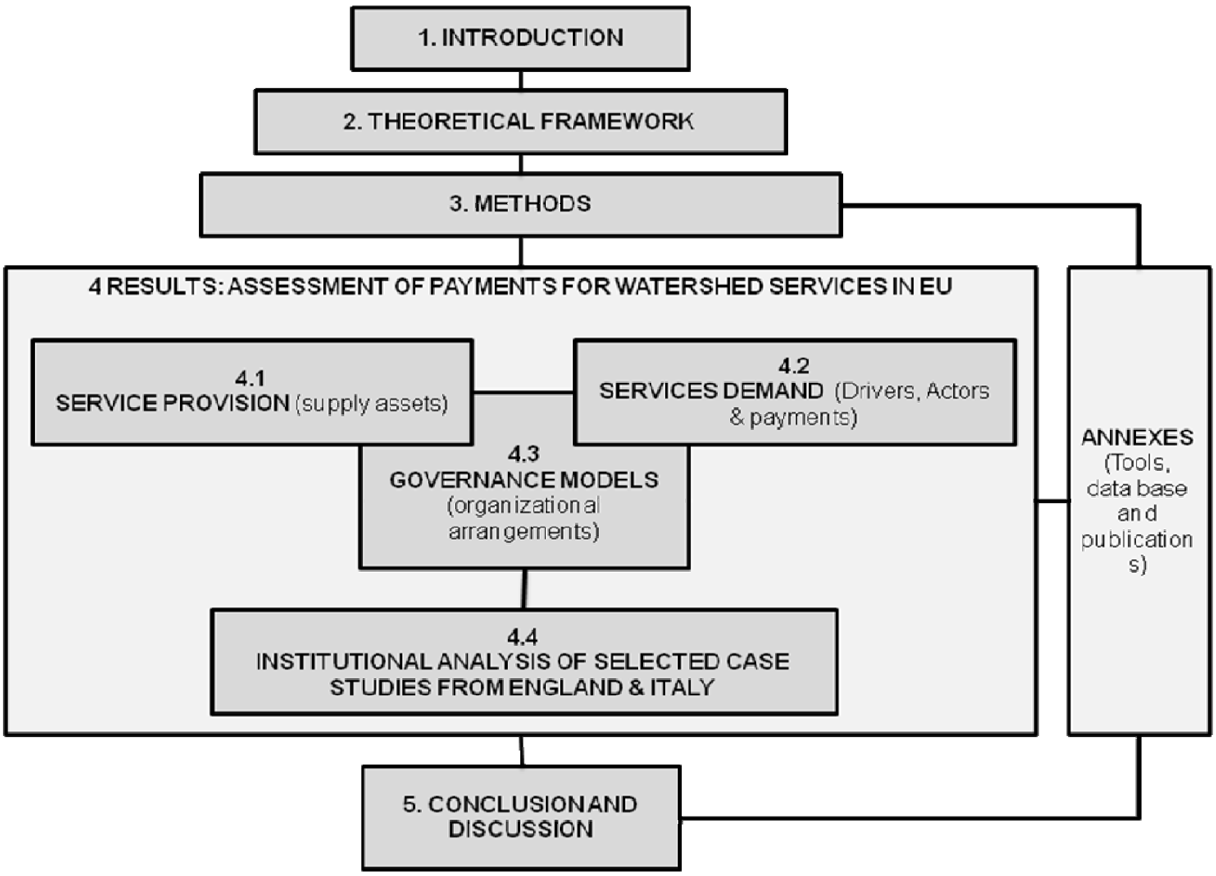
Secondly, it’s important to characterize several features such as policy and market drivers, market dimension, type of payments, actors involved, scales and outcomes of programmes.

These last elements, as more descriptive data, will eventually help the research to understand the different typologies of governance models, describe them and provide categorization of programmes, helpful for future researchers, practitioners and policy makers, in order to link context, type of PWS and outcomes.

1.4. Structure of the thesis

The thesis is structured in 5 chapters. After introducing background, problem statements and research goals, Chapter 2 on the theoretical framework presents the theories and definitions behind the methods used to assess and evaluate PWS. Chapter 3 explains all methods and tools used to obtain results useful to achieve research goals. Chapter 4 presents 4 blocks of results, related with research goals and methods (for a better representations of links between research goals, methods and results, see Figure 8: Research design flow chart). Finally, Chapter 5 presents conclusions drawn from results. Annexes report programme database and tools used to assess PWS, which are explained in Chapter 3.

Figure 1: Graphical representation of the thesis structure



2. THEORETICAL BACKGROUND

This Chapter first introduces the main elements related with ecosystem services and their relations with PES. Secondly, it describes the PES theory, such as the main principles and design components. Thirdly, it focuses on general information regarding PWS presenting some examples from the international and European context. Finally, the Chapter concludes with a comprehensive view on institutional analysis of PES, providing the main theoretical background to the research methodology.

2.1. Ecosystem services, functions and natural capital

The Millennium Ecosystem Assessment defines ecosystem services as "*benefits humans obtains from ecosystems*" and emphasizes on society's dependence on ecosystem process and functions (MEA, 2005). Ecosystems provide valuable services and resources that are often underestimated and are not internalized within the market (Coase, 1960; Hardin, 1968; Knight, 1924). In recent years, there has been an increasing interest by land owners and decision makers on Payments for Ecosystem Services (PES) as public-private tools to compensate voluntary and additional positive environmental externalities (i.e. ecosystem services) provided by land managers (Kemkes *et al.*, 2010; Sattler and Matzdorf, 2013; Van Hecken and Bastiaensen, 2010). Consequently these mechanisms have attracted a lot of attention within the scientific and academic community (Martin-Ortega *et al.*, 2013).

A large body of literature describes PES as "*(a) a voluntary transaction where (b) a well-defined environmental service (ES) or a land use likely to secure that service (c) is being 'bought' by a (minimum one) service buyer (d) from a (minimum one) service provider (e) if and only if the service provider secures service provision (conditionality)"* (Wunder, 2005a). Despite these well known definitions of PES, PES as an acronym, is still used in the literature without a clear and standardized definition, leading to many interpretations and conceptualizations (Schomers and

Matzdorf, 2013). Moreover, additional conceptualization issues arise from the complexity of classifying and evaluating “well-defined ecosystem services” (Boyd and Banzhaf, 2007).

We thus purpose a new PES framework starting from clarifying two main areas of confusion in relation to the wording and theoretical definition of PES (paragraph 3.6.2 Assessment of the service provision within PWS schemes):

- the use of adjective “ecosystem” versus “environmental” services (Derissen and Latacz-Lohmann, 2013); and,
- the distinction between “structure”, “function”, “services” and final “benefits” (de Groot *et al.*, 2002; Haines-Young and Potschin, 2011).

Regarding the first area of confusion, within the PES acronym many authors use the term “environmental” or “ecosystem” interchangeably. Some of them distinguish “environmental” payments when the provided services are generated by the built environment (Muradian *et al.*, 2010; Wunder, 2005a), while “ecosystem” payments are commonly referred to the services provided by natural, not actively managed, ecosystems (Corbera *et al.*, 2009; Kosoy and Corbera, 2010). There have been some efforts to distinguishing the “environmental” from the “ecosystem” adjective used within PES acronym (Derissen and Latacz-Lohmann, 2013). However, owing that the limits between “natural ecosystems” and “build environment” are not always well defined, attempts of categorization fail to meet the complexity of the relations between ecosystem and human dimension. Different author’s views provide contradictory definitions. For instance, according to Derissen (2013), PES can be referred only to “environmental” services because the payments are direct to land managers (which are actively managing the “built environment”) and not to the ecosystem itself. On the other hand, Boyd and Banzahalf (2007) conclude that, once ecosystem services are combined with other types of inputs (such as labour, social capital and capital works), their environmental benefits stop to be considered “ecosystem based”. We thus can draw a lesson from the comparison of the different definitions in the literature; all the proposed categories refer to a main common variable to discriminate between “ecosystem” and “environmental” services: the extent to which humans interact with ecosystems. Hereafter, we then refer to “ecosystem” services as those services mainly directly and spontaneously provided by ecosystems, while we refer to “environmental” services for those services that are provided by the direct interaction of humans with ecosystems.

The second area of confusion regarding PES conceptualization is linked with the unclear distinction among ecosystem “structures”, “functions”, “services” and the final “benefits” people gain. If these components are not clearly separated it is rather difficult to identify a “well defined ecosystem services” to pay for, as stated in the Wunder definition. In fact, according to some authors (Boyd and Banzhaf, 2007; Fu *et al.*, 2010; Groot *et al.*, 2010), the distinction between eco-hydrological systems (structures, process and functions), their contribution to human well-being (services), and the welfare gains they generate (benefits), is necessary to avoid confusion and double counting. Many initiatives such as The Common International Classification of Ecosystem Services (CICES), The Economics of Ecosystems and Biodiversity (TEEB) and The Millennium Ecosystem Assessment (MEA) have attempted to distinguish the different ecosystem services components and consequently provide ecosystem services classification systems (Haines-Young and Potschin, 2011; MEA, 2005). However, it is often difficult to make a coherent and consistent classification which is able to represent the complexity of ecosystem functions (Groot *et al.*, 2010). The difficulty depends on the “multi-step process nature” of ecosystem service provision, which is made up by several intermediate steps (supporting services are for example input services to other final regulative, provisioning and cultural services). Therefore, in order to avoid confusion, we adopt the following definitions, based on the TEEB report: the “structure and process” are the physical ecosystems with their complex interactions of biotic and abiotic components, while “functions” represent the potential that ecosystems have to deliver a service. Thus, “services” are those intangible ecosystem functions and processes which are perceived by humans as economic goods and that ultimately generate welfare benefits (TEEB, 2010). As an example, riparian forests (structure), through their photosynthesis activity (process), absorb nitrogen and phosphorous (functions) thus decreasing nutrients concentrations (service) and lowering the cost for drinking water treatment (benefit). The distinction highlighted here is important to understand what in the following is considered an “input” or an “output” within the provision process of environmental services.

Starting from this first theoretical background and elaborating on production theory, the input-output analysis and the supply chain approach of environmental benefits (the pathway from ecosystem structure to human well-being), we develop a framework that helps to clarify the mixed human and ecosystem-based origin of the final environmental benefits rewarded within PES schemes (see paragraph 3.6.2 Assessment of the service provision within PWS schemes).

The framework that we introduce here and we further develop within paragraph 3.6.2 is then used to assess inventoried PWS case studies in EU (see Annex 1: List of inventoried case studies). We finally discuss the outcome of the analysis within Chapter 5 (see paragraph 4.1 - What are PWS paying for? A critical analysis of PWS service provision).

2.2. Payments for Ecosystem Services: definitions and overview

As mentioned in the first paragraphs, although in the literature we find clear theoretical definition of PES, in the real world is quite difficult to find examples that strictly correspond to the theory. Recently, there has been an increasing use of Muradian *et al.* definition: “PES are… a transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources” (Muradian *et al.*, 2010). While Wunder stresses the point on the transaction mechanisms, Muradian *et al.* focus on type of actors and outcomes of PES.

Several authors have therefore highlighted the discrepancies between the theory and the practice (Muradian *et al.*, 2010; Sattler and Matzdorf, 2013; Vatn, 2010). The main gaps are related with the “market based” vs. “government based” nature of the system and with the “voluntariness” of the transaction. Many critical discussions also emerged regarding the “additionally” of many PES schemes worldwide. In fact, very few programmes are able to demonstrate their effectiveness in term of additional increase of service provision. As these general principles of PES theory are important and used within the methodology of Chapter 3 for the assessment of governance of PWS, we provide and discuss their definitions and implication.

Voluntariness of the transaction

The voluntariness is the degree to which the contracting parties, the service provider(s) and the beneficiary(ies), enters in agreement and participate through a free and informed process of negotiation (Wunder, 2005a). The voluntariness principle is therefore a characteristic that differentiate PES from the more "government based" command and control measure. However, voluntariness is not a "black or white" principle as it might appear (i.e. voluntary vs. not voluntary). In fact, PES are negotiation processes where two or more involved parties are participating with different degree of power and participation (de Groot and Hermans, 2009). Therefore, we can distinguish different degree of voluntariness as for the actual degree of participation and level of information between the contracting parties (Fung, 2006). Moreover, the role of governments and regulations may influence the voluntariness only from the supply side (for example, through fertilizer restrictions imposed to farmers), or the demand side (for example, through higher water quality standards imposed to bottle water brands), or both supply and demand side.

Actors involved

Although PES theory mainly refers at two actors (a service provider and a service beneficiary), other actors can influence the design and implementation of the contractual agreement. We can therefore summarize the main groups that are typically involved in a PES scheme:

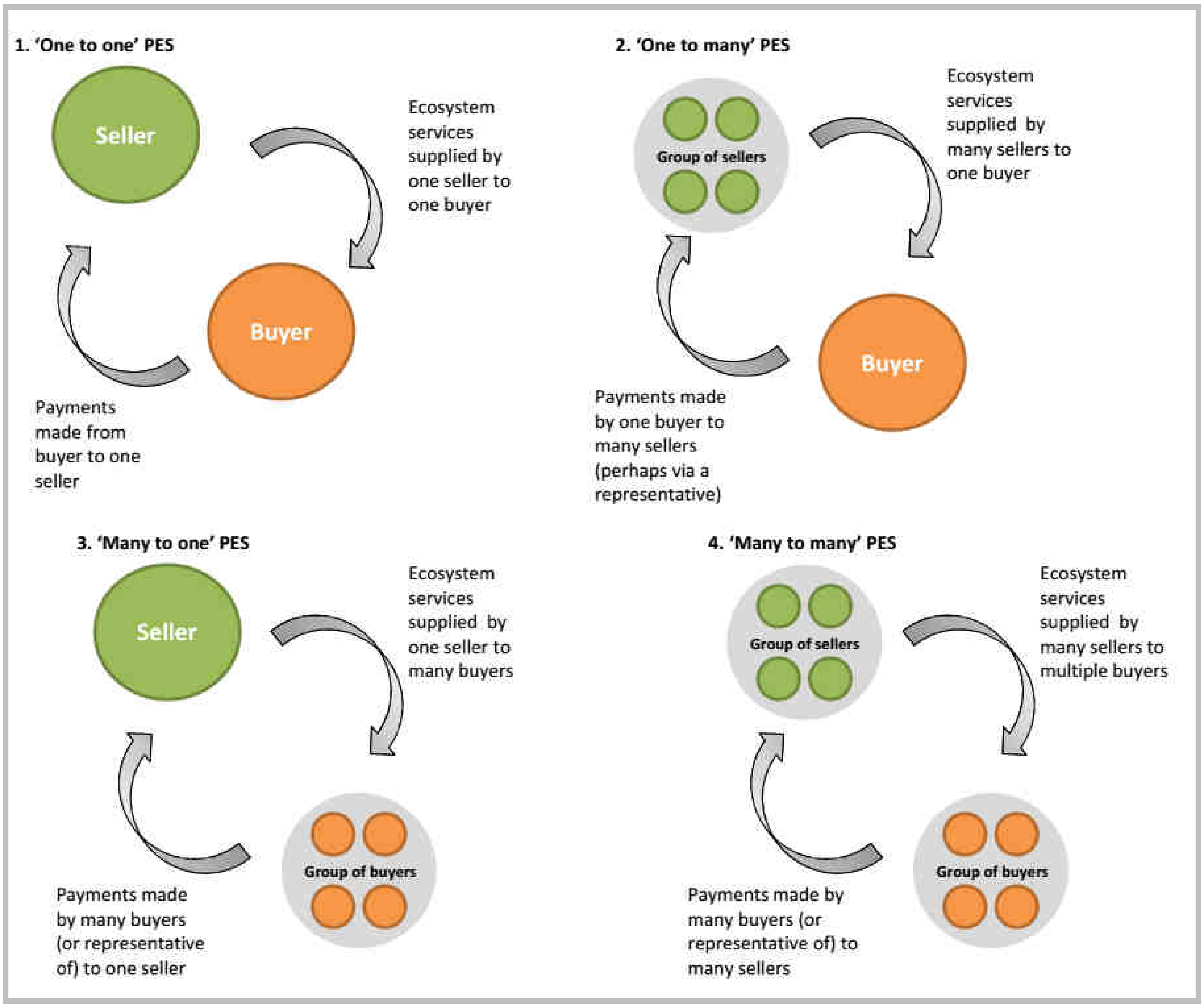
- 'Buyers or beneficiaries": those who are willing to pay for an improved or safeguarded or restored ecosystem service. These include citizens, water utilities, municipalities, beverage companies, etc.;
- 'Sellers or service providers': land and resource managers whose change of management practice can potentially secure or improve supply of the ecosystem service;
- 'Intermediaries': who can serve as agents linking buyers and sellers and can help with scheme design and implementation. They often are NGOs, parks authorities, river trusts, farmers associations, etc.;

- ‘Knowledge providers’: these include resource management experts, valuation specialists, land use planners, universities, participation expert, business and legal advisors who can provide knowledge essential to scheme development;
- “Regulators”: who can impose command and control measure that influence PES or can regulate and/or facilitate the start up and the effectiveness of PES mechanisms.

Figure 2 represents the different supplier(s)/supplier(s) combinations. We distinguish four types of market situation (Lockie, 2013):

- One to one, represents a bilateral monopoly or oligopoly with only one/few ES sellers and one/few ES buyers;
- One to many, represents a monopsony or oligopsony with many ES sellers but only one or few ES buyers;
- Many to one, represents a monopoly or oligopoly situation with only one/few ES sellers but many ES buyers;
- Represents a PES situation with many ES sellers and many ES buyers (polypoly).

Figure 2: Possible configurations of provider(s)/supplier(s) in PES schemes



Source: (DEFRA, 2013a).

Well defined ecosystem services

The transaction and thus the whole PES design should be based on a "well defined" ecosystem service, which would be the subject of the contract. Specific metrics and monitoring process and output indicators shall be identified in order to verify the type of land use likely to secure the service and to measure the final service provided to beneficiaries.

Special attention has to be given to identify the actual "environmental benefit" for the service user and to the management practice that is more likely to deliver that specific benefit (Keeler *et al.*, 2012). PES worldwide are often considered not very effective as for the lack of targeting the payment to the best land management practices and to the land mangers that are more likely to provide the defined service (Porras *et al.*, 2013; Reed *et al.*, 2014). Paragraph 2.1 describes this aspect in more detail.

Increasingly, there is a special attention to co-benefits of PES schemes, these last may assume different forms within the PES schemes, depending on how they are included within the payments and design of the scheme. We have therefore different situations that can be summarized as following (DEFRA, 2013a):

- Bundling: a single buyer, or consortium of buyers, pays for the full package of ecosystem services that are provided from the same land manager and/or ecosystem (Kemkes *et al.*, 2010; Kosoy and Corbera, 2010);
- Layering/stacking: multiple buyers pay separately for the ecosystem services that are provided from the same land manager and/or ecosystem (Porras *et al.*, 2013);
- Piggy-backing: in this case, not all of the ecosystem services generated from a single land manager and/or ecosystem are sold; instead, a single service (or possibly several services), is sold as an umbrella service, whilst the benefits provided by other services accrue to users free of charge (i.e. the beneficiaries ‘free ride’).

Conditionality of the payment[1]

Conditionality is the degree to which the service provision is conditional to the payment. This principle is often very hard to meet because of several factors. First, in many cases there is a lack of knowledge about the “baseline” scenario, so as to understand and measure how the payment have influenced the service provision, compared to a “no intervention” scenario (Kroeger, 2013). Secondly, payments are often targeted to management practices that are already undertaken by farmers and forest owners, so these can be characterized as payments for “spill over” effects. Sometimes payments are used to enforce regulations that should anyway respected by law (Pirard, 2012). Therefore, there is a lack of real additionality of the payment respect to the business as usual scenario. Finally, lack of monitoring and real evaluation instruments lead to a

[1] Conditionality means that with the help of PES the targeted ES are actually provided, while additionality means that the ES would not be provided in the absence of PES.

very poor understanding of the actual link between rewarded management practices and their effects on the service provision (Kroeger, 2013; Porras *et al.*, 2013; Reed *et al.*, 2014).

Private vs. public PES

In the literature, PES that strictly meet all above mentioned criteria are categorized as "Coasean PES". The underlined theory says that, given certain conditions, and regardless the initial allocation of property rights, the problem of environmental externalities can be overcome by private negotiation between economic actors (Coase, 1960). These assumptions led to the definition of PES as a pure "market based" instruments. However, PES in practices do not meet all the "market based" criteria, following more a policy and regulation perspective, where governments have a strong influence in the system. These last schemes are categorized as Pigovian PES where environmental taxation and subsidization are seen as tools for the correction of negative externalities (Sattler and Matzdorf, 2013). This last category is also called "quasi-PES" or "PES-like" and is defined by Muradian as: *"PES are transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources"* (Muradian and Rival, 2012; Muradian *et al*., 2010).

Thus the main distinguishing factor is the presence or absence of government intervention. The public sector can intervene both as buyer and/or as legal actor, providing a legal framework and/or obligations for the creation of PES. Figure 3 classifies four main types of PES governance models depending on the role of state: user-and non-government financed payments, government-financed payments, compliant payments and compensation payments (Matzdorf *et al.*, 2013). The user financed PES, represent the classical Coasean type, market based instruments, where the contract are negotiated by two private parties, without any intervention from the government, either as a buyer nor as legal actor (Engel *et al.*, 2008).

Figure 3: PES governance models depending on the role of state

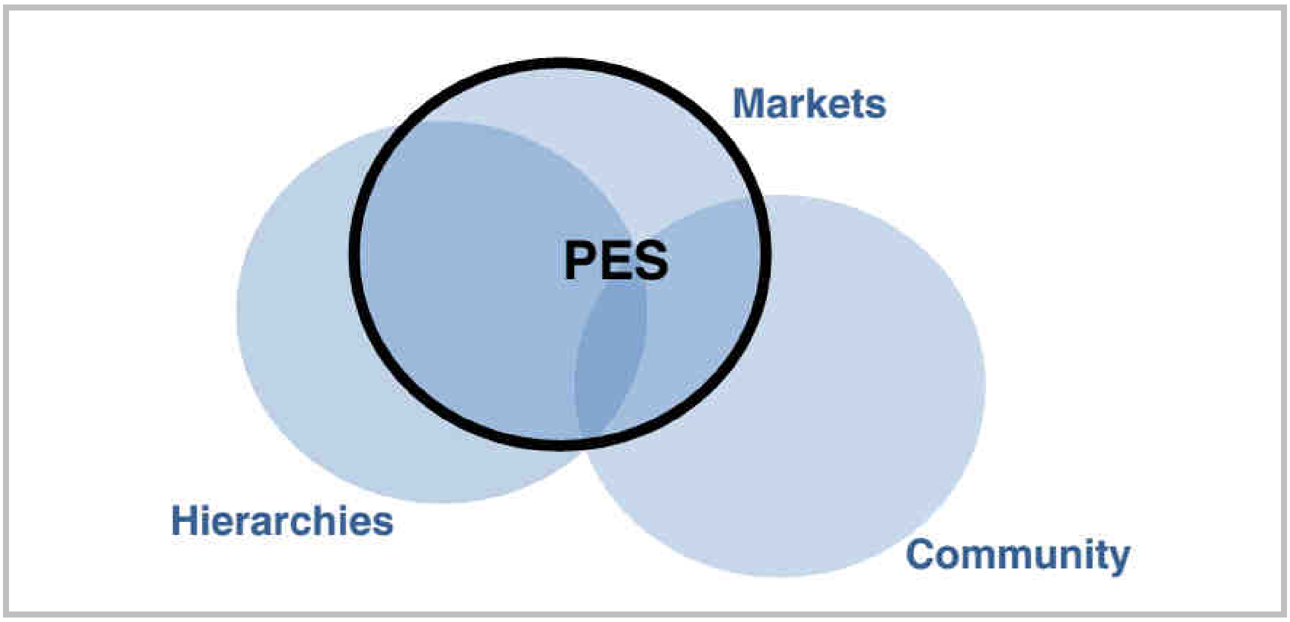
State involved as a buyer \ State involved as a legal actor	No	Yes
No	User-financed (Coasean approach) and non-governament financed payments e.g. Vittel case study	Compliant payments e.g. US mitigation and wetland banking
Yes	Governament-financed payments (Pigouvian approach) e.g. Agri-environmental schemes in the EU	Compensation payments for legal restrictions e.g. Groundwater protection areas payments

The categories where the government intervene in the scheme as a buyer correspond to the "Pigouvean approach". The state can be seen as a "third party acting on behalf of service buyers" (Engel *et al.*, 2008). This is the case of agri-environmental schemes or in those schemes where municipalities are paying farmers and forest owners on behalf of citizens to increase water-quality within the water abstraction areas. These programmes are often associated to a lack of additionality and conditionality as the self-interest of the citizens is often not well reflected in the public body acting on their behalf. An interesting example of mixed model user-government financed payments can be found in those government led schemes where final users are charged with a water levy, such as in the case of Lower Saxony (Bluemling and Horstkoetter, 2007).

In this case, the state act as legal driver, influencing the demand side by creating a "duty to pay" for environmental externalities (positive or negative) and providing a financial source for PES development. This is the case of wetland banking in the US (J.B.Ruhl and Juge Gregg, 2001).

The last category, compensation payments for legal restrictions, is related to those cases where the government regulates the supply side of ecosystem services. For example by imposing legal restrictions on land management practices. This is the case of groundwater protection compensations payments, where groundwater source areas are covered by legal restrictions on the use of chemical inputs and farmers are compensated for the income forgone. However, these last four categories are often providing mixed models between market and public intervention and a third institutional dimension, the community intervention (Muradian *et al.*, 2010; Vatn, 2010). Figure 4 represents PES relations with the main governance types, the black circle is to indicate that real schemes are more hierarchy based then community and market driven (Vatn, 2010).

Figure 4: PES and their relations to the main governance types



Institutions of community are particularly relevant where PES target ecosystems where the social interest is very high and associated with many civil society organization institutional goals. Cooperation among different stakeholders, regulations from the state side, lobby and fundraising from the civil society side, and self private interest from the business sector, as well as intrinsic motivations and trust are important to deal with uncertainty in complex social–ecological systems (Ostrom, 2000).

2.3. PWS: global experiences and European perspective

Definitions of Payment for Watershed Services

While a variety of acronyms and definitions are in use to define those payments that reward ecosystem services managers for the provision of water-related services (see Table 1), this research recognize that the more correct definition is the one first suggested by Brauman *et al.* (2007), which directly refers to Payment for Hydrologic Services (PHS). Where Hydrological services are defined as "*the benefits to people produced by terrestrial ecosystem effects on freshwater*". These services are organized into five broad categories: i) Improvement of extractive water supply; ii) Improvement of in-stream water supply; iii) Water damage mitigation; iv) Provision of water related cultural services; v) Water-associated supporting services.

The PHS concept stresses the importance on the type of service someone is paying for (as such, final delivered services), regardless the specific ecosystem and the geographical boundaries that are responsible for its provision. The definition choice is made also on the fact that by considering the final services provided, or the benefit people receive from the ecosystem, we avoid confusion and overlapping. In some cases they are defined as Hydrological Ecosystem Services because there is a stress on their biophysical process that generates the final service (Brauman *et al.*, 2007). In other cases, the geographical dimension is more important and the attention goes to water ecosystem that generate that service limited to a specific area, in this case they refers to "Catchment ES", or "Wetlands ES" (He *et al.*, 2011; Taylor *et al.*, 2011; ten Brink P., Badura T. and Note, 2012), or "Costal ES", or "Watershed ES" (Tracy Stanton, Marta Echavarria, Katherine Hamilton, 2010). Sometimes wording is changing according to the considered country, in US "Watershed" is the most common used term, while in the UK, "catchment" is commonly used to refer to "watershed". The literature review founds many ways of naming water related PES, and they are listed in the following table.

Table 1: Overview of main definition for Payment for Watershed Services

Acronym	Name	Description
WPES	Water Payment for Ecosystem Services	Or water related PES, this concept stress the importance on payments that are related to all ecosystem services which are responsible to deliver water related benefits or final hydrological services.
IWS	Investments in Watershed Service	Ecosystem Marketplace defines the term as to cover the broad diversity of incentive- or market-based mechanisms being used to protect the natural infrastructure of watersheds – including payments for ecosystem services (PES), payments for watershed services (PWS), water quality trading markets, and reciprocal or in-kind agreements (Bennett *et al.*, 2012)
PWS	Payment for Watershed Services	This concept stress the importance on the geographical boundaries of the service production area which is identified as the "reference watershed" (Muñoz Escobar *et al.*, 2013; Tognetti *et al.*, 1999)
NA	Payment for Catchment Services	This term is more often used in the United Kingdom and refers to those payments that are organized at catchment (watershed level) (Smith *et al.*, 2011)
NA	Payment for Wetlands ES	This term refers to those incentive schemes that are targeted to wetland conservations. Wetlands mitigation banking schemes in the US are an example.
NA	Costal ES	This term refers to those incentive schemes that are targeted to farmlands or forest areas which are directly connected with a valuable costal ecosystem (Essam Yassin, 2013)
NA	Payments for Groundwater recharge/quality	Those payments that are targeted to a specific aquifer with the aim of enhancing the quality or quantity of groundwater (Bluemling and Horstkoetter, 2007; Brunner, 2008; Greiber *et al.*, 2009)
PHS	Payments for Hydrological Services	This concept stress the importance on the type of the service someone is paying for (as such, final delivered services), regardless the specific ecosystem that is responsible for its provision. Brauman *et al.* (2007) defines hydrologic services as "the benefits to people produced by terrestrial ecosystem effects on freshwater (Hack, 2011; Muñoz-Piña *et al.*, 2008; Turpie *et al.*, 2008).

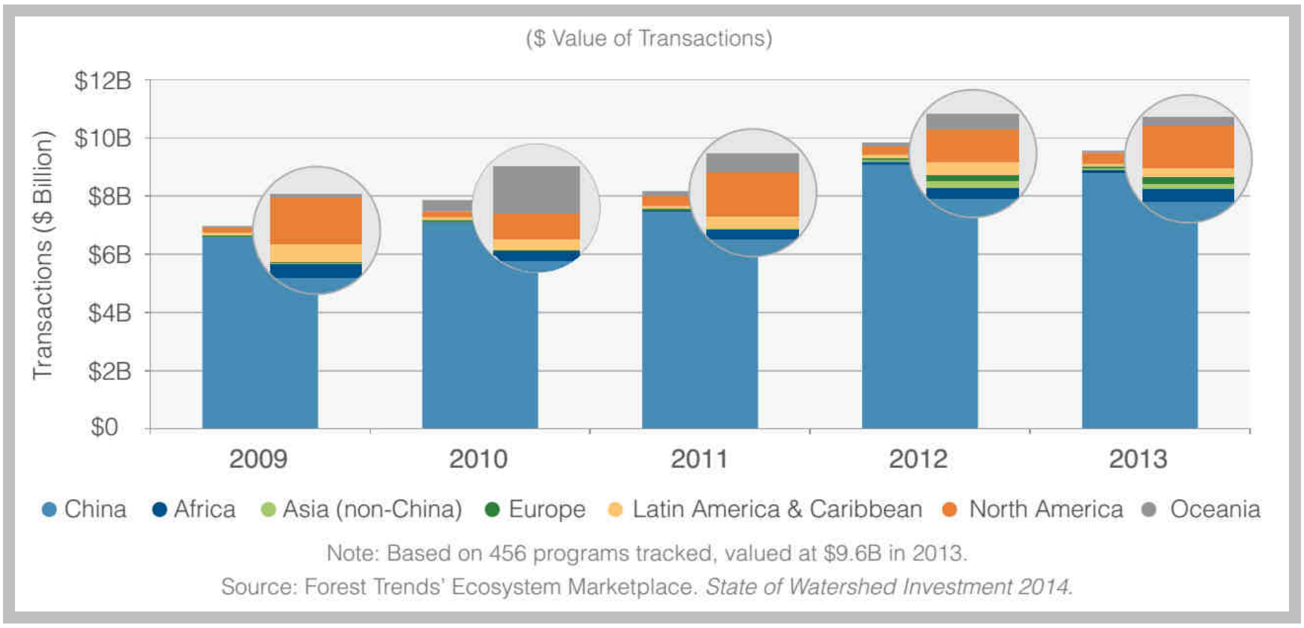
Nevertheless, if from a scientific point of view the term "Payment for Hydrological Services" is more correct and defines the scope of the present research**,** in order to improve the effectiveness of scientific communication of this research we deliberately refer both in the title and within the text to the most commonly used term "Payments for Watershed Services".

Finally, depending on the type of actors and the type of payment we can distinguish, who makes payments to operational programs for watershed services – and program investors, who contribute initial capital to develop programs. When referring to capital investments and start up contribution we will refer within the document to Investments for Watershed Services (IWS).

Markets and typologies of Payments for Watershed Services

In 2014, Ecosystem Marketplace identified approximately 405 active PWS and Water Quality Trading (WQT) programs at global level. In 2008, the baseline year (first worldwide study) about 127 programs were actively receiving payments or transacting credits. In 2008, the transaction value from all active programs was estimated at € 8 billion and they seem to remain stable at € 8.2 billion for 2014. At EU level, the first report found only 1 active programme in 2008, 15 active programmes in 2012 and 41 in 2014. It's clear that the general trend is growing but at EU level there has been an historical underestimation and lack of data regarding existing and emerging programmes in different countries (Bennett *et al.*, 2014b, 2012; Tracy Stanton, Marta Echavarria, Katherine Hamilton, 2010). By value, the field is still dominated by national public subsidy programs, which account for more than 90% of funding – and which came primarily from Chinese government agencies. Direct investment by water users was still relatively low. Water utilities' engagement with PWS grew considerably in recent years (to $8.9M in 2013) but remained small relative to the sector's risk exposure. Figure 5 shows the historical data of transaction value (2009-2013). Data for Europe did almost not exist before 2012. This research has contributed to provide data for 2012-2013, for more information see Annex 2: Publication 1.

Figure 5: Value of Global PWS by Region, 2009-2013



Worldwide we can find many typologies of PWS, especially in the US, the government acting as regulator, has promoted the creation of several systems to offset and compensate water footprint, such as Water Quality Trading, Wetland Banking, and Hydropower Mitigation Initiatives (Bennett *et al.*, 2014a). These initiatives have also contributed to the development of private initiative of Water Footprint Offsetting. Table 2 presents the main broad existing forms of market mechanisms at global level. At EU level, the first two are the most commons; however, we can see a more in deep study of governance models within the Chapter presenting our survey results.

Table 2: Types of Water Related Market mechanisms

PWS type	Description	Payment mechanism	Example
Government PWS	Publicly administered programs that use public funds to make direct payments to a private landowner, for stewardship of ES on their property or under their stewardship.	Payments take the form of economic incentives and subsidy payments, cost - share arrangements, land purchase deals, direct transfer payments, and subsidized public/private funds.	• US government water quality improvement programs via the Farm Bill • China's Sloping Lands Forest Conservation Program • NY City's Watershed Protection Program
Private PWS	Private entity develops its own payment mechanism in protection of a vital watershed service for either business or philanthropic interests.	Privately funded transfers that take the form of direct payments from one private entity to another and the purchase of land or development rights to land.	• Vittel in France • Uganda Brewery Wetland - Watershed program in Uganda
Water Quality Trading	Government sets a water quality standard on the total amount of pollution flowing into a body of water or watershed.	Polluters collaborate to meet the standard by trading (buying and selling) pollution credits to maximum economic benefit.	• Long Island Sound Nitrogen Credit • Salinity trading programs in NSW, Australia
Wetlands banking	A mitigation bank is a wetland, stream, or other aquatic resource area that has been restored, established, enhanced, or preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources permitted under state or local wetland regulation	The value of a bank is defined in "compensatory mitigation credits." A bank's instrument identifies the number of credits available for sale and requires the use of ecological assessment techniques to certify that those credits provide the required ecological functions.	• US Clean Water Act and private wetlands banking
Water offsetting schemes	Certification schemes which allow to offset the water footprint trough the purchasing of "water credits" generated from water projects that enhance the quality or quantity of water flow or the provision of Water Ecosystem Services	Certified projects generate "water credits" which are sold to private and public entities that wish to compensate their footprint. The value of the credit goes to finance specific water related projects.	• Water Restoration Certificates (USA) • Water Neutral (South Africa) • GreenAdsBlue

PWS in Europe

The EU has been historically less receptive than North America and Oceania to incentive-based approaches in watershed protection, however the need for locally based solution for the implementation of the WFD, may be a policy drivers toward the adoption of PWS (European Commission, 2012). Water sector in Europe is politically dominated by public command-and-control management. In some countries, notably France, the UK and the Czech Republic, the water industry is publicly regulated but services are largely operated by private companies with exclusive rights for a limited period and a well-defined geographical space.

Nevertheless, although historically the literature has focused more on developing countries (Schomers and Matzdorf, 2013), EU also provides interesting examples of both public and private PWS. In the following pages we provide three examples cited in the scientific literature that are illustrative of the three main typologies, namely: private driven PWS of a bottle water company, the public driven water charge based PWS, and mixed public-private water utility budget allocation.

In France since 1989, Vittel (Nestlé Waters), in order to address the risk of nitrate contamination caused by agricultural intensification in the aquifer, invested on financing farmers in the catchment to change their farming practices and technology. To manage the relations with farmers Vittel created a farmers-advisor association called AGRIVAIR, which managed the payments and the institutional relations on behalf of the bottle water company. The case has been named as “a perfect PES” as it involves a private actor as a main buyer. However, the drivers for Vittel originated from a very strict regulation on bottle water quality standards which expose the company to a high business risk (Perrot-Maître, 2006).

In 1992, the Lower Saxony government promoted the so-called “Co-operation Decree” as a basis for the so-called “Lower Saxon Co-operation Model”. Its objective was to create a system to finance farmer’s groundwater protection payments through a specific water charge paid by tab water user. The government regulates and decides the type of interventions water utilities can invest in through the money collected with the water bill. The system is still working and collects around 30 million euro/year that increase the area under organic farming, decrease fertilizer application and improve conditions of water protection areas (Bluemling and Horstkoetter, 2007)[2]. This system has then been implemented in other regions in Germany, such in the Munich area where, in order to overcome high cost of monitoring and to increase farmers' acceptability, organic farming has been adopted as proxy management practice to reduce chemical inputs within groundwater protection areas. To increase the appealing of the system, the PWS has been coupled and developed in collaboration with organic farming associations, which help farmers to market their organic products and increase their benefit as part of the program (Barataud *et al.*, 2014; Grolleau and McCann, 2012).

In Italy there are some quasi-PES described in the literature, however very few are close to the idea of a market-based mechanisms (Pettenella *et al.*, 2012). An interesting example which will be better explained as a case study in Chapter 4, is the one of Romagna Acque "Mountain Fund", where a water utility invest 4% of its revenues for watershed protections activities within the mountain area surrounding the water damn. The utility has signed an agreement with the municipalities that are the direct beneficiary of the funds and carry out the environmental improvements of slopes and forest management. The PWS is directed to decrease the level of sedimentation of the damn, through the adoption of several interventions that are able to decrease run off and soil erosion.

Europe offers much more examples and governance typologies that are better achieved and explained within Chapter 3[3]. The next paragraph provides the basics of the institutional analysis of PES, describing the main dimensions and factors that will be further analysed within the methodology and the results.

[2] Updated information about this case study can be found on the regional government website
[3] For more information regarding EU PWS please refers also to Annex 2.

2.4. Institutional analysis of PES governance

This study adopts an institutional analysis approach to PES assessment, drawing from the Institutional Analysis and Development (IAD) framework (Ostrom, 2011), and the conceptual framework developed for the study of the role of institutions in global environmental change (Mitchell, 2003), further refined for PES analysis from other authors (Corbera et al., 2009; Muñoz Escobar et al., 2013; Prokofieva and Gorriz, 2013).

We define institutions as the "rules of the game" as all those informal and traditional norms, formal rules, contract as part of the "play of the game" and resource allocation rules (Williamson, 2007) that shape humans and organizations by giving rise to social practices, assigning roles to different actors and structuring their relations and interactions (Mitchell, 2003; Prokofieva and Gorriz, 2013). Therefore, institutions differ from actors that are the "players" of the game, with a capacity to act upon their self-interests.

PES are policy tools that build on the theoretical assumption that conventional markets are failing toward environmental conservation. Although mainstream economic models have proved to be efficient to manage private goods, they are less capable to cope with specific difficulty of exclusion and rivalness characteristics of public goods, such as hydrological services (Fisher *et al.*, 2009; Kemkes *et al.*, 2010). Rivalness means that one person's use of a ecosystem service affects the availability of the service for another person, while the difficulty of exclusion arises because it is costly to exclude or limit potential beneficiaries of a service flow once it is provided by nature (Ostrom, 1999). Therefore PES are institutions that can internalise environmental externalities that are often not internalized within the traditional market mechanisms (Van Hecken and Bastiaensen, 2010). Watersheds can be considered as a complex Common Pool Resource (CPR) where many different groups (land users and water users) are competing for alternative uses of water resources (Agrawal, 2001). PWS are then defined as an institution established to resolve the environmental conflicts derived from competing users and uses of water resources (Muñoz Escobar *et al.*, 2013).

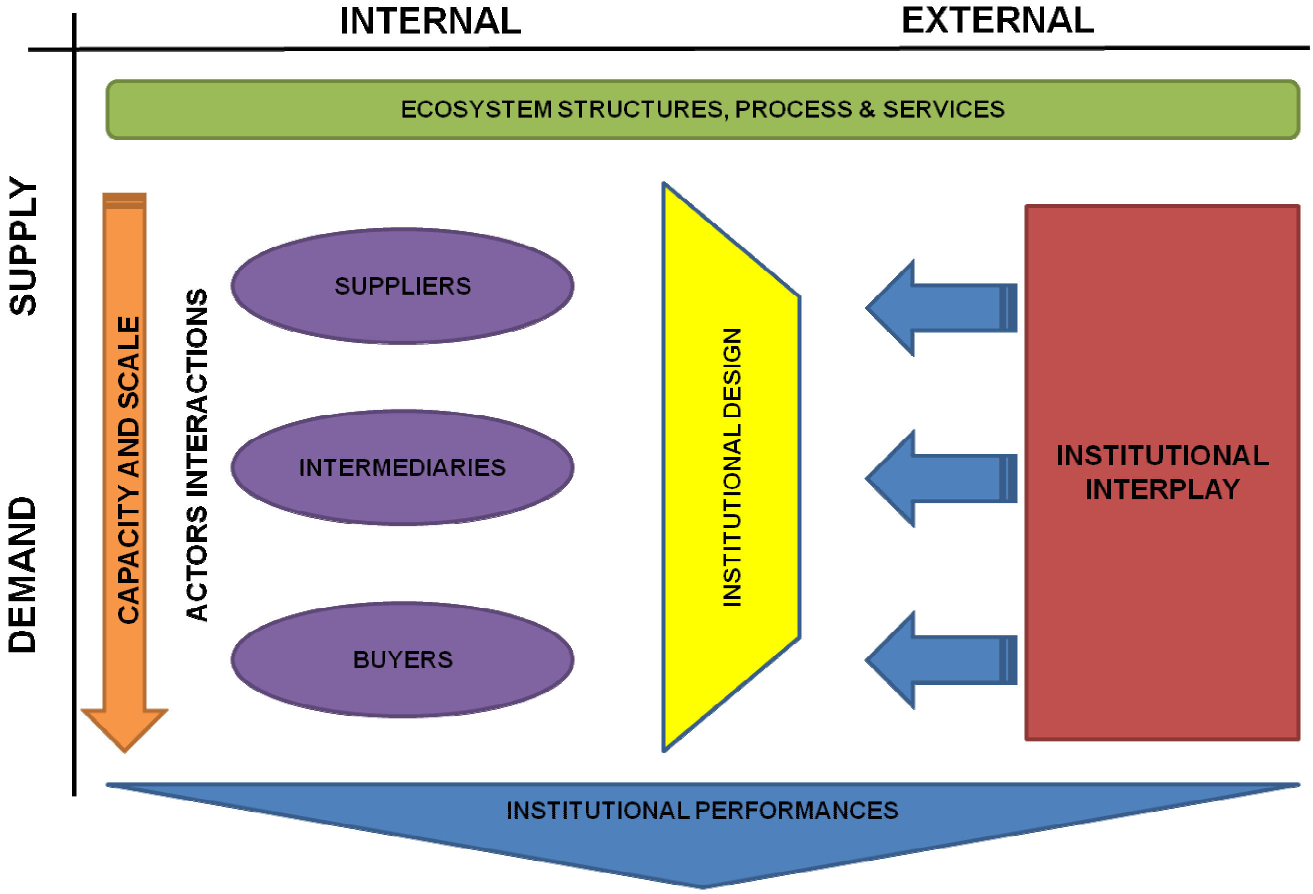
Institutional analysis can help to understand the organizational arrangements, design rules, motivational and cognitive structure of an actor interest and expectations within a PWS. It is also a useful playground in order to understand the different interactions between external regulations at different level and the PWS design and adaptation response (likely future behaviour). Enhancing understanding of synergies between PWS and other policies and institutional goals can provide insights for a better integration of PWS with traditional land management practices and tools that are quite rooted within the EU policy context. Moreover, institutional analysis can provide insights for the link between PWS design and their durability and sustainability. It can also provide a view to explain and balance the high transaction costs for implementing PWS and their several co-benefits in term of social capital (Miranda *et al.*, 2003; Tognetti *et al.*, 2005).

A second step of institutional analysis explores how an "action situation" changes over time depending on how outcomes affect the evolution of perceptions and strategies over time. The term "action situation" refers to the process of isolating the structure affecting a process (in our case the governance structure of PWS) in order to explain regularities in human actions and results, and potentially to reform them. A common set of variables used to describe the structure of an action situation includes *"(i) the set of actors, (ii) the specific positions to be filled by participants, (iii) the set of allowable actions and their linkage to outcomes, (iv) the potential outcomes that are linked to individual sequences of actions, (v) the level of control each participant has over choice, (vi) the information available to participants about the structure of the action situation, and (vii) the costs and benefits—which serve as incentives and deterrents—assigned to actions and outcomes" (Ostrom, 2011).*

The analytical framework used in this study is represented in Figure 6. In the following paragraphs, the different dimensions that affect institutions of PWS are explained. The study is structured into two main dimensions, internal and external to the program design/network, demand and supply (supply chain perspective). Six interdependent analytical components that derive from the institutional literature review on PES are identified and elaborated (Corbera *et al.*, 2009; Kemkes *et al.*, 2010; Muradian *et al.*, 2010; Ostrom, 2011; Prokofieva and Gorriz, 2013; Vatn, 2010): i) ecosystem structure, processes and service; ii) institutional interplay; iii) actors interactions; iv) institutional design; v) capacity and scale; vi) institutional performance.

We assume that PWS services are highly influenced by the characteristics of targeted ecosystem structures, processes and hydrological services (especially in regards to their rivalry and excludability) (Kemkes *et al.*, 2010). Depending on the hydrological services, we have different internal actors' interactions and a specific institutional interplay (e.g., hydropower related PWS would have a normative and regulation background that is different from the one of tap water provision). PWS schemes design is shaped by the type of actors and their power and expressed interests. The design is also highly influenced by the institutional interplay, that define the boundaries and the "rules" within which the actors can play "the game". Finally, institutional performances are influenced by all these factors, however capacity and optimal scale are main factors that determine the success and the impacts of PWS.

Figure 6: Conceptual framework for institutional analysis of PWS



2.4.1. Ecosystem structure, processes and services

The institutional dimension of PWS is highly influenced by the type of ecosystem structure, processes and services (de Groot *et al.*, 2002; Groot *et al.*, 2010). They are the basis for the so called "functional interplay" (Young, 2000). Different ecosystems are covered by different types of institutions: therefore PWS that develop within agricultural catchments deal with different issues and interactions than those that develop within wetlands or rivers. The type of ecosystem eco-hydrological processes that provide the final services are also very important as they influence the type of management practices that are rewarded within PWS schemes. The selection of the type of management practices adopted by the schemes influences the interaction of institutions and organizations. For example, reforestation and forest management would require the interaction with regional forest department, while conversion to organic agriculture would require working with organic farming associations and farmers unions. Finally, the type of ecosystem services (and their final benefits to the society) conditions the type of final suppliers and beneficiary and the set of property rights, institutions that regulate the specific ecosystem service (Haines-Young and Potschin, 2011; Keeler *et al.*, 2012; Maille and Collins, 2012; MEA, 2005). For example water quality, hydropower generation, ecological river flow, and fishing, are all regulated from different organizations and institutions, both at horizontal and vertical level.

The specific characteristics of the service, such as rivality and excludability, strongly influence the effectiveness of the scheme (Kemkes *et al.*, 2010). Besides, the service attributes such as, quantity, quality, timing and the spatial characteristics of the flow between service provision and consumption also shape the scheme and influence type and location of interacting organizations (Brauman *et al.*, 2007). Hydrological services are often mismatching on timing (for example in the case of groundwater recharge that happens during winter time to provide better availability during the dry summer seasons) and on spatial scale, where the service providers are often located upstream and service users are placed downstream (Serna-Chavez *et al.*, 2014). This spatial mismatching increase the local horizontal interplay and is at the basis of PWS scheme governance systems.

For all these reasons it's important to specify all these ecosystem structures, processes and services, their benefits and attributes, in order to better address all the other components of institutional analysis.

2.4.2. Actors interactions

After the understating of which are the ecosystem structures, processes and services the second analytical dimension is related to the identification of actors and their interactions. We can define the "actor" as a single individual or as a group functioning as a "corporate actor", or a social group acting as one single organization. The type of actors and ecosystems both influence institutional interplay and design, and implementation of PWS schemes.

We can identify relevant actors by analysing the type environmental problem or resource management and the type of hydrological services that are required by a certain group of beneficiary. Given the spatial mismatching of hydrological issues and services the spatial analysis is important during the identification phase (Borowski *et al.*, 2008; Hauck *et al.*, 2013; Serna-Chavez *et al.*, 2014).

Actors can be identified through spatial stakeholder analysis, identifying external and internal actors, and those direct and indirect ones (Bryson, 2004; Hein *et al.*, 2006). Following the IAD approach (Ostrom, 2011), the analysis have to take into account different aspects such as: i) preferences and resources roles, rights and responsibilities; ii) preferences, interests, expectations and values; iii) actions and interactions, use and management of resources; iv) information sharing; v) lobbying; vi) deliberation. These aspects are all useful to understand better the decision-making processes upon resource strategy and management.

Institutions are essentially deriving from actors' interactions and their historical relationships. Institutions are rules that define what actors can do and cannot do while interacting among each other's. Therefore, actors' interactions originate the evolution and the patterns of institutions, and can determinate their positive or negative outcomes. Actors' interactions create networks and rules on resource management and conservation. PWS are essentially networks of organizations and actors that set specific economic rules for the sake of a specific ecosystem service provision, leading to social and natural capital improvement (England, 2000; Hejnowicz *et al.*, 2014). Understanding actors' interactions, their mutual preferences and expectations, helps to provide a better picture to forecast possible evolutions and actors' reactions to a likely external institutional change or an internal reorganization of the system.

2.4.3. Institutional interplay

A third analytical dimension that externally influences the whole PWS supply chain, both supply and demand side, is that of institutional interplay (Mitchell, 2003; Young, 2000). The institutional interplay concern about how the scheme interacts with other institutions at different levels. The main assumption is that interactions between institutions can influence each other final outcomes. The results of the interaction can be positive (such as in the case where local institutional regimes are strengthened from international ones) or negative (such as in the case where national regulations undermine local traditional systems of land tenure or use rights). In the literature review there are three types of characteristics to describe institutional interplay: the level of interaction that can be horizontal or vertical; the nature of the interaction that can be political or functional; the asymmetry of relations that can be symmetric versus unidirectional.

Institutions can interact both horizontally and vertically depending on the level of social organization they interact (Young, 2000). An example of vertical interplay can be related to the synergies between WFD (top-down policy instrument from the EC) and its implementation at national level and its impact on the acceptability and adoption of PWS schemes at local level. An example of horizontal interplay can be found within the integration of different local property and use rights regimes and the design of the PWS scheme. Commons are often interacting and influencing the ways of PWS schemes (Ostrom, 1999).

The interaction can have also a dual nature: functional or political interaction. The first is more connected with the biophysical and the socio-economic context (given conditions, for example the type of ecosystems and their services) while the former is related to more intentionally and deliberately institutional links for achieving a collective goal and improving institutional effectiveness.

Institutional interplay can be more or less symmetrical, being unidirectional or reciprocal. For example, when national regulations strongly affect local institutions (such as property and use rights) and the local institutions have no chance to respond to very top-down approaches.

PWS schemes at EU level operate in a very complex vertical and horizontal institutional context. Water uses such as tap water, hydroelectric power, irrigation, flood control, are highly regulated and generally, there is a stratification of institutions at all levels. Hydrological services are highly conditioned by other sectors' institutions, such as agriculture and forestry, urban development, climate and health regulations (Tzoulas *et al.*, 2007).

PWS schemes can interact as a catalyst of these stratified institutions, creating synergies and harmonization of collective goals. However, if design doesn't take into account all different aspects of institutional interplay, PWS scheme might overlap with existing regulations and creating conflict, especially regarding local existing property and user rights (Turner *et al.*, 2003).

Understanding the nature of interplay and its positive or negative attitude at different level, identifying synergies or conflict is a first step for PWS start-up, for decreasing transaction costs and therefore increasing their durability and sustainability.

2.4.4. Scheme design

The institutional design entails the analysis of drivers, scope of the PES scheme, the main actors (seller, buyers, and intermediaries), decision-making mechanisms, rules of the game and how these rules change through time (Corbera *et al.*, 2009; Engel *et al.*, 2008). The study has identified four analytical dimensions of institutional design: start-up, contract and procedures, payments and monitoring and evaluation.

PWS design may be at different development stages such as exploration, piloting/development, implementation, and evaluation (Sattler and Matzdorf, 2013). First of all, it is important to understand why a PES has been proposed as a policy tool among other options (Kemkes *et al.*, 2010). Secondly, an analysis of drivers and the affected actors of a scheme helps to understand how their interests are reflected within the design. The existence of feasibility studies, scientific mapping and design, before PES implementation also help to draw conclusion on the type of approach and the durability of a scheme. Finally, it's important to capture how the PES idea is communicated to internal and external actors, as it is a main factor of a scheme success (Sattler and Matzdorf, 2013).

PES are basically contracts among resource users, therefore the analysis of the agreements and their procedural work can offer a better understanding about their sustainability and performances. Successful design characteristics have been summarized by (Wilson *et al.*, 2012) in these following points: "*1) Clearly defined boundaries; 2) Proportional equivalence between benefits and costs; 3) Collective-choice arrangements; 4) Monitoring; 5) Graduated sanctions; 6) Conflict resolution mechanisms; 7) Minimal recognition of rights to organize; 8) coordination among relevant groups".*

The assessment of the institutional design of contracts and procedures can be based on the analysis of the correspondence of the system toward these good governance principles.

Payments are at the core of the institutional design of PES, tracing the source and the financial flows of money can help to map the design of the system and understand its functioning in detail. Several source, timing and modalities of payments have been identified in order to describe transactions within PES (see for detail Annex 5: Analytical framework for qualitative case study interviews).

Finally monitoring and evaluation have been identified as one of the main factor in PES design and these dimensions are very crucial when targeting hydrological services. The definition of a monitoring system coupled with a clear identification of proxy indicator and ecosystem service metrics are essential for the whole system performance and durability (Keeler *et al.*, 2012; Lu and He, 2014; Sandin and Solimini, 2009; SCBD, 2011). Clear proxy management practices, indicators and monitoring techniques avoid dispute within contract application and improve the performance of the system (Kroeger, 2013; Porras *et al.*, 2013; Reed *et al.*, 2014).

2.4.5. Capacity and scale

Capacity and scale are two crosscutting dimensions that influence all those explained above and thus determine the final performances and outcomes of a scheme.

Corbera *et al.* (2009) defines the term "capacity" as the "*availability of social, institutional and material capital to design and implement PES programmes to achieve their stated objectives*". Usually PWS are the result of an interaction of several organizations or groups with different capacity level. Therefore, it is important to assess each actor within the scheme, in term of technical, financial, legal and political capacity. PWS are quite complex systems that have to respond and adapt to different geographical, administrative, and institutional scales. A special attention goes to the existence of cross-scale institutions that are able to cope with this multiple scale of intervention (Heikkila *et al.*, 2011).

The concept of scale is of paramount importance to understand general phenomena. The concept of scale entails the spatial, temporal, quantitative dimensions to measure a certain object or process. A proper geographical scale for the implementation of PWS is of a high importance to improve outcomes within hydrological process (Wendland *et al.*, 2010). Finally, we should distinguish the administrative scale from the implementation scale, as a scheme can be managed from a national administration but implemented locally, at catchment level.

In the analysis of capacity and scale, scholars have to pay attention to how the design of the scheme responds to the need of targeting different governance and ecosystem scales, and therefore conditioning the final performances and outcomes of the scheme.

2.4.6. Institutional performances and outcomes

The institutional performance is an assessment of how and at what extent the PES scheme achieves its conservation goals. There are several dimensions of performances that have to be considered for its evaluation, they can be summarized as follows: scale, reference point, standard, and score. Figure 7 explain all different types of performance dimension (Mitchell, 2008).

Figure 7: Performance-related terms

Performance dimension	A specific aspect of an institution under evaluation
Performance scale	System of measurement for a given performance dimension
Performance reference point	Counterfactual point to which observed outcomes can be compared to identify institutional influence
Performance standard	Normative point to which observed outcomes can be compared to assess the magnitude of institutional influence
Performance score	The numeric or nonnumeric value assigned to an institutional outcome on a given scale

However, the efficiency and thus its performances are also determinate by the costs at which the goals are achieved compared to other alternative institutional options (Falconer, 2000; Marneffe and Vereeck, 2010; Pannell *et al.*, 2012; Williamson, 1981, 1979). These costs include the opportunity cost of alternative land uses, the implementation and operational costs of land use changes, and the transaction costs of programme management and monitoring (Wunder, 2007).

Therefore, institutional performances assessment should evaluate results of the scheme monitoring system in terms of ecosystem services flows and impacts compared to a certain baseline. The additionality, conditionality, permanence, leakage, and negative side effects principles help to conduct this type of analysis (García-Amado *et al.*, 2011; Pattanayak *et al.*, 2010). Sustainability and durability of the institutional governance should also assess performances against a set of principles, criteria and indictor for each of the dimensions considered (Secco *et al.*, 2013). However, scheme performance should also account for co-benefits that result from the scheme, such as biodiversity assets improvements and social capital (Hejnowicz *et al.*, 2014). Taking into account also the existence of possible social negative side effects such as the change of ecosystem service gratuity provision and social disaggregation (Vatn, 2010). Some authors has also followed a capital asset framework to assess the outcomes of PES programmes, in term of financial, institutional, natural and social capital (Hejnowicz *et al.*, 2014). Moreover, acceptability and perceptions of service suppliers and beneficiaries are also useful to test PES institutional performance (Ma *et al.*, 2012).

Finally, Vatn (2010) identifies two types of performance criteria: outcome evaluation criteria (environmental effectiveness, efficiency and equity) and process evaluation criteria (flexibility, implementation complexity, acceptability). These criteria will be taken into account for the assessment of case study performance following the framework provided in Annex 5: Analytical framework for qualitative case study interviews (Prokofieva and Gorriz, 2013).

3. METHODS AND TOOLS

This section introduces the overall research design, network, methods and tools that have been adopted in order to achieve the research goals. The study was drawn from three parallel and complementary processes: i) EU inventory and data collection of PWS; ii) development of PWS analytical frameworks and tools; iii) assessment of inventoried case studies.

The research used an inductive approach rather than relying on a pre-existing conceptual model or typology of PWS programs. Therefore tools and conceptual frameworks have been improved after a preliminary assessment of identified PWS, using the first findings to enrich and adapt the previously developed tools, in a cycle based improvement process.

3.1. Research design

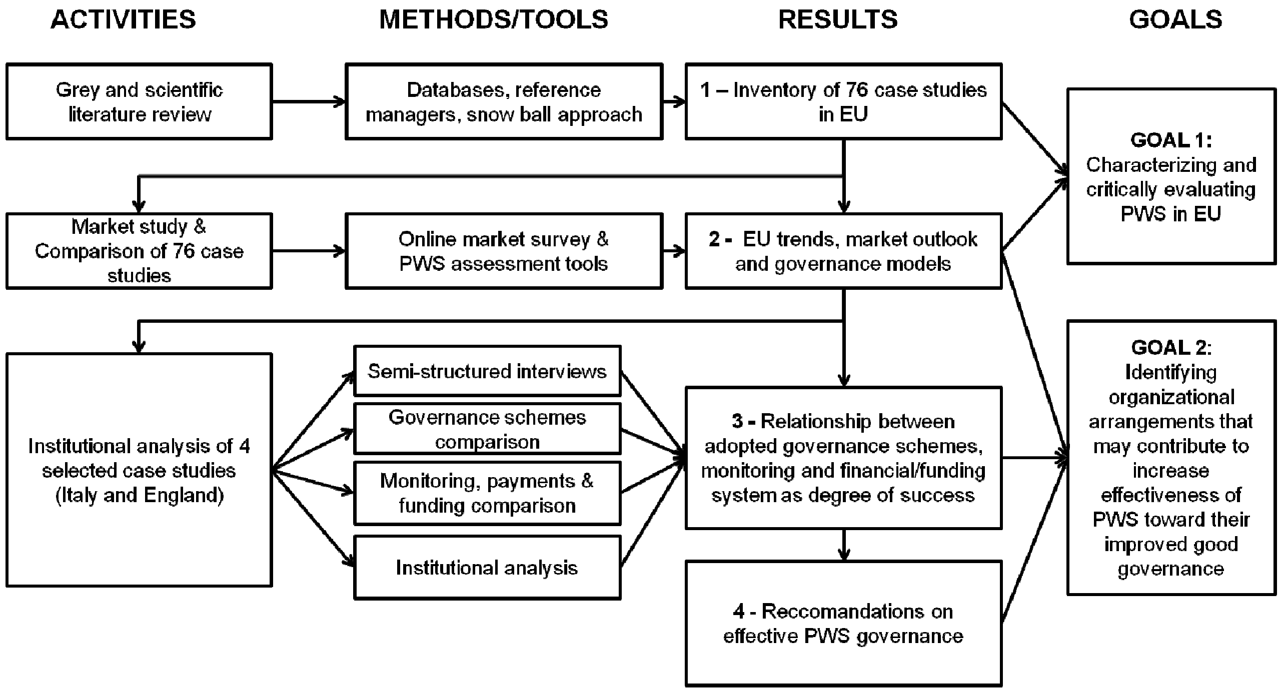
The research project has followed a consequential and systematic logical framework. The research design is divided in three main steps, each one has specific methods, conceptual frameworks and tools which are expected to deliver intermediate results. Each step builds upon the previous step results. Finally, results are linked to the main two research goals.

Firstly, scientific and grey literature review has been conducted with the support of existing databases, reference managers, and snowball approach in order to identify existing case studies at EU level. The final intermediate output is the most comprehensive inventory of PWS at EU level existing in the literature.

Secondly, starting from the PWS collection, we provide an assessment of inventoried case studies and a market outlook, using both a set of assessment tools (see next paragraphs) and an online market survey. These two last activities delivered several outputs, such as a critical evaluation of service provision, drivers and market outlook, and a set of typologies governance models.

Finally, an institutional analysis approach has been adopted to assess four selected case studies from England and Italy. Both the qualitative focus on specific selected case studies and the assessment at EU level provide the basis for drawing conclusions about the relationship between governance models and degree of success. The below Figure 1 provide a flow chart which summarize the research design process. Each single step is then further elaborated within the next paragraphs.

Figure 8: Research design flow chart



3.2. The project network

In order to achieve the research goals a network of key organizations was established. First, it was considered of paramount importance to involve a research institution in England, in order to have a strong basis for contacts with case studies and provide advice on the institutional background of the country. Therefore a cooperation agreement was signed between the University of Padova (TESAF, as home institution) and the Centre for Development Environment and Policies, SOAS, University of London (hosting institution). Within the agreement, the research institution co-supervised the research and became a hosting institution for the field work in UK, providing useful contacts and background information.

Secondly, the Mediterranean Regional Office of the European Forest Institute was involved within the EFIMED Short Scientific Visit program. The institute provided insights and feedbacks on adopted methods and tools.

Thirdly, and agreement was signed with Forest Trends' Ecosystem Marketplace, the main reference organizations on Ecosystem Markets (carbon, water and biodiversity) at global level. The collaboration aimed at sharing useful contacts at EU level, increasing the effectiveness of the snow ball approach and launching the online market outlook survey. The collaboration then lead to the co-authored publications which is attached in Annex 2: Publication 1.

Finally, collaboration and confidential agreements were held with the reference organizations for the selected cases studies. Last but not least, some research and mobility funding proposal were successfully submitted to both Aldo Gini Foundation and European Commission in order to cover expenses of mobility and field work. Figure 9 summarize the institutions involved, reference contacts and their roles within the research project.

Figure 9: The project network: partner organizations and their roles

Institution	Reference Contact	Role within the project
Università degli Studi di Padova | TESAF	Davide Pettenella	Home institution, sponsor and supervision.
SOAS University of London – Centre for Development, Environment and Policy	Laurence Smith	Hosting institution, supervision and contact with case studies in UK
European Forest Institute – Mediterranean Regional Office – EFIMED	Nicolas Robert	Feedbacks on methods used and case studies in EU. Sponsor.
Ecosystem Marketplace – A Forest Trends Initiative	Genevieve Bennett	Online market survey and snow ball approach
Aldo Gini Fundation & European Commission	NA	Main sponsors

3.3.

3.4. Secondary data collection: scientific and grey literature review

The literature review was conducted using key words in four main EU languages (English, Italian, Spanish, and French) in Google Scholar and ScienceDirect. Among the key-worlds there are "payments for hydrological services", "payments for water-related ecosystem services", "payments for watershed services", "payments for catchment management", "payments for wetlands", "agri-environmental schemes", and "cooperative agreements". Only those publications related to the EU context and to specific "water related" case studies were selected. Very few peer-reviewed scientific publications exist regarding examples of PWS in EU (Barataud *et al.*, 2014; de Groot and Hermans, 2009; Garin, 2012; Grolleau and McCann, 2012; Pettenella *et al.*, 2012).

The same process, using the same key words, has been carried out for the grey literature review, using mostly Google search, in different languages. We found hundreds of reports, documents, websites, through a more focused grey literature review and web search. Materials were organized by country and by case study.

From the grey literature review, we could assess the main international reports that provide worldwide or country case study collections. Few of them highlight cases of PWS at EU level (Bennett *et al.*, 2012; CTFC, 2012; DEFRA, 2013b; Ham *et al.*, 2009; OECD, 2013; United Nation, 2013). These reports helped to add to the scientific literature review other lesser-known examples.

The literature review allow to set the basis to create a first database of EU PWS and related contacts to start the snow ball approach and launch the online market survey.

3.5. Primary data collection: inventorying, online survey and qualitative interviews

The primary data collection was organized through three and complementary processes: i) Snow ball approach and inventorying of PWS in EU; ii) EU online market survey; iii) qualitative interview to selected case studies.

To analyze PWS in EU, we developed a database of projects and schemes by conducting an extensive inventory and data collection of these initiatives. The inventory drawn case studies identified through the scientific and grey literature review and the snowball sampling approach. We then established contacts with at least one university expert team per country and/or at least one environmental NGO/consulting firm working on PWS per country (EU15).

For all EU fifteen countries and especially for those where no major findings had emerged from the literature, we investigated the water sector and explore several websites of Water Utilities Associations and Water Works Associations. In some cases such as England, Netherland, Belgium, Denmark, the assessment was done for all water utilities, as the number is very limited. In countries like Italy, where the water sector is very fragmented with hundreds of utilities, the search was just partially covered and more focused on associations of utilities and river basin authorities. The investigation had the aim to find water protection projects that provided evidences of a compensation or payment system. Eventually we collected a list of around 100 informed contacts of scheme/project managers, university experts and informed consultants as a basis for finding new schemes and collecting data[4].

Thanks to the collaboration with Forest Trends Ecosystem Marketplace, from April and June 2014, we could merge existing contact and project databases and lunch the Water Survey to collect data on identified schemes at European level. The online survey was launched by Ecosystem Market Place at global level, through their targeted information and promotional channels. The data collection at EU level was managed directly through the author of the present research project. For more information refers to Annex 4: Online Water Survey. Several recalls were carried out and where there was missing information, we improved the data collection through phone calls. Drawing from multiple sources (literature review, website analysis, online survey, phone and conference calls) we systematically organized all collected information by country and by case study. The case studies were selected according to the following criteria: i) meet the broader definition of PES according to both Wunder and Muradian (see first Chapter); ii)

[4] For privacy policies, the contact database with sensitive data is not attached as Annex. However, we report a list of considered case studies.

defined by the manager or by literature as “PES”; iii) with a primary aim of provision of hydrological services (bundled ES-based initiatives were excluded); iv) be implemented at EU level. Although all cases were inventoried only those established beyond a pilot phase were assessed as those in design phase diDK’t have enough data to be analyzed. Annex 1: List of inventoried case studies reports the selected case studies.

Finally, four cases studies from Italy and England were selected for qualitative direct interview. The qualitative analysis helped to improve the information collected at EU level and provide more in detail interpretation of trends, drivers and institutional perspective of PWS.

Drawing from collected secondary and primary data, each inventoried PWS was assessed against the conceptual frameworks and analytical tools. The next paragraphs provide a detailed description of adopted conceptual frameworks and tools.

3.6. PWS assessment tools

This paragraph present in details the different frameworks and tools used to asses inventoried case studies. Firstly, we introduce the general assessment tool, including all considered dimensions. Secondly, we focus on the framework used for the critical evaluation of the service provision, which build on the theoretical background of paragraph 2.1. Thirdly, we explain in detail the governance assessment framework that builds upon the theoretical background provided within paragraphs 2.2 and 2.3. Finally we present general details of the four selected case studies and the framework used for qualitative analysis, which build on the theoretical background illustrated within paragraph 2.4.

3.6.1. Multi-classification assessment for PWS

From the literature review we identify the main gaps, definitions, principles and existing PES analytical frameworks, e.g. discussed by (Derissen and Latacz-Lohmann, 2013; Muradian and Rival, 2012; Muradian *et al.*, 2010; Sattler and Matzdorf, 2013; Sattler *et al.*, 2013; Vatn, 2010; Wunder, 2005a). From this first process seven blocks of characteristics were identified (PES general details, ecosystem services, type, payments, actors involved, scale, impacts and success) and for each of them a more specific literature review was conducted in order to further detail the number of considered aspects and specification per block. We then used an inductive approach to refine our framework rather than relying only on existing conceptual models of PWS programs. The analysis of the inventoried case studies contributed to draw examples of proxy management practices, actors involved and institutional arrangements from the multifaceted nature of the PES in the water sector at EU level. Therefore, case studies helped to provide a series of specifications targeted for the PWS and make our framework more robust. Table 3 represent the framework, which specify the general aspect, the characteristics (with a specific code) and relative specifications and references.

Table 3: General multi-criteria assessment framework

Aspects	Code	Characteristics	Specifications
PES ID	ID1	Country	[Descriptive]
	ID2	Scheme name	[Descriptive]
	ID3	Programme administrator	[Descriptive]
	ID4	Region	[Descriptive]
	ID5	Location	[Descriptive]
	ID6	Source of information	[Scientific, grey, website, primary data]
Ecosystem services	ES1	Type of Ecosystems	[Forests, wetlands, Fresh waters, agricultural catchments, others]
	ES2	Water related issues	[Nitrates, phosphorus, chemicals, biological, water colour, heavy metals, groundwater depletion, hazard control, missed cultural services]
	ES3	Rewarded management practices	[Improved farming practices, chemical inputs restrictions, reforestation, improved forest management, farm capital works, livestock limits, wetlands restoration/maintenance, forest hydrology management practices, water ways monitoring and cleaning, organic certification water protection areas]
	ES4	ES - Provided Hydrological services as referred on site	Descriptive
	ES5	ES - Type of Hydrological benefits	[IEWS; IISWS; WDM; WCS] [Quantity/Quality based]
	ES6	ES Bundling	[Yes/No] [Carbon, Biodiversity, Social]
Type	TY1	PES Market situation	[polypoly, monopsony/oligopsony, monopoly/oligopoly, bilateral monopoly/oligopoly]
		Regulative background	[Yes/No] [Descriptive]
	TY2	Voluntariness	[Completely voluntary, partly involuntary (demand side), partly involuntary (supply side), involuntary]
	TY3	Degree of voluntariness (supply and demand)	[Regulated mandatory with penalties, regulated markets/agreements, voluntary with a regulation framework, voluntary without negotiation, voluntary through free and informed negotiation]

	TY4	Degree of directness	[Public procurement, scope tax (Water charge), tradable rights, beneficiary pay funds, bilateral voluntary agreements]
	TY5	Degree of commoditization	[In-kind benefits, rewards, subsides/Incentives, payments, markets]
	TY6	Degree of conditionality	[Payment by law, payment to enforce, payments for spill over effects, payment by conditional management, payment by service provision]
	TY7	Typology of PWS	[Compensation for legal restrictions, Agro-environmental schemes, Water charge - public bilateral agreements, Regulated trading initiatives, Trading initiatives, CSR offsetting, Avoided impacts bilateral agreements, Multiple benefits partnerships, User funded schemes, Environmental benefits – bilateral agreements]
Payments	**PAY1**	Funding mechanism	[Single source funding, multiple source funding, utility/public budget allocation, consumer water levy/fees, CAP payments, national/EU funding, private budget allocation, water rights]
	PAY2	Pay source	[Public, private, mixed, citizens]
	PAY3	Pay mode	[Input - based, output - based]
	PAY4	Pay type	[Cash, in-kind, both]
	PAY5	Pay frequency	[One off, periodical, both]
	PAY6	Pay time	[Upfront, after adoption of management practices, after ES delivery]
	PAY7	Pay eligibility	[Horizontal, targeted]
	PAY8	Pay amount in relation to costs of ES provision	[Spill over, partial cover of costs, full cover of costs, above the costs]
	PAY9	Pay aim	[Avoided negative externalities, compensate negative impacts, compensate opportunity costs, provide positive externalities]
	PAY10	Payment amount	[€/Ha min, €/Ha max, total transaction last year available, historical transactions]
Actors involved	**AC1**	Service link providers and beneficiary	[Yes/No]
	AC2	ES Provider	[Private, public, CSO, cross-sectoral, partnership]
	AC3	Type of ES provider	[Forest managers, farmers, both, other]
	AC4	ES Buyer	[Private, public, CSO, cross-sectoral, partnership] [Descriptive main buyer]
	AC5	Type of main intermediary	[Private, public, CSO, cross-sectoral, partnership] [Descriptive main buyer]
Scale	**SC1**	Institutional scale	[Large organization, public body, cross scale partnership, medium size organization, small size organization]
	SC2	Spatial administrative	[International, national, regional, local]
	SC3	Spatial implementation	[International, national, regional, local] [Hectares of area covered by the scheme]
	SC4	Time	[Long term, medium term, short term] [Year of establishment]
Impacts and success	**IS1**	Status	[Active, pilot, design phase, abandoned, unknown]
	IS2	Repeatability	[Multiple phase, phase one, applied to other areas, ongoing study or pilots, failed, unknown]
	IS3	Goal achievement	[1-5 scoring based on the following criteria: Existing relevant literature, updated literature review and or multiple sources, positive evaluation of the existing literature, existing monitoring show goals achievement, repeatability (applied to other areas or second phase)].

The aspect related to ecosystem services provides useful data for the critical assessment of service provision. Assessed characteristics and specification are better elaborated in the next paragraph. The characteristics and their specification related to “type” dimension are better explained within the next paragraphs on governance assessment.

3.6.2. Assessment of the service provision within PWS schemes

Building on the theoretical background proposed within paragraph 2.1 we provide an original framework based on production theory and supply chain analysis of ecosystem services. We then create a system to assess the inventoried case studies.

Production theory analysis of environmental services provision

In economics, “production” means converting of inputs into outputs such as goods or services. This economic concept (i.e. production theory) can easily be extended to the ecosystem service provision process, with the main difference that human related service production is mainly voluntary, while ecosystem services are involuntary provided by nature (Witt, 2005). When PES schemes are activated for the specific provision of a certain desired environmental service, they influence nature (i.e. the built environment) through direct human-based inputs and the modified “natural” ecosystem processes.

In order to simplify our model we can thus say that the main input for the provision of ecosystem services can be summarized with the concept of “natural capital” which consist of the stock of ecosystem structures, processes, functions and supporting services (Costanza *et al.*, 1997). Within the production theory, natural capital is therefore the production input that involuntarily provides ecosystem services to human being.

As shown before, if the ecosystem services are the outputs of natural capital, environmental services rather result from a combination of two main input factors: i) human-based capital; and, ii) natural capital. According to Bourdieu (1986), the capital can present itself in three fundamental forms: economic, cultural and social capital. “Human-built capital” (hereafter human capital) is defined in this paper as the combination of economic capital (financial capital, capital works, infrastructures, property rights), cultural capital (knowledge, expertise and technological inputs), social & institutional capital (legal frameworks, institutions, social perceptions, values, institutions, governance arrangements and networks). Within PES schemes the three dimensions of capital are often fundamental inputs (and indicator of final performance) to actively organize the ecosystem in order to deliver the desired environmental service (Corbera *et al.*, 2009; Gong *et al.*, 2010; Muradian *et al.*, 2010; Vatn, 2010). In Figure 10, we use the input-output analysis to show how final environmental benefits targeted in PES schemes are eventually "final outcomes" that result from the combination of different inputs. Depending on the type of links and relations between the inputs, different outputs, in term of services, and outcomes, in term of benefits are obtained. Yet, Figure 1 shows how the two main input factors (natural and human capital), by standing alone or by interacting, contribute to the provision of different types of services, namely ecosystem (a), environmental (b) and human services (c)[5]. These services have different nature but they all result in perceived "environmental benefits" (outcomes). While some ecosystem services originate directly from ecosystems without being combined with other inputs (a), "environmental services" (b) results from the interaction between ecosystem process, functions and human activities. However, sometimes, human capital, without actively interacting with the ecosystem structures and functions, generates "human services" that have "nature based" or "environmental benefits" as an outcome.

Table 4 provides three examples with the aim of clarifying the above-mentioned concepts.

[5] The three categories of services do not pretend to substitute the MEA ecosystem service classification (provisioning, regulating, cultural and supporting) rather, they represent a larger set of "services" that humans benefit from and that are willing to pay for, within the framework of PES.

Figure 10: "Input – Output – Outcome" simplified representation of environmental benefits provision model

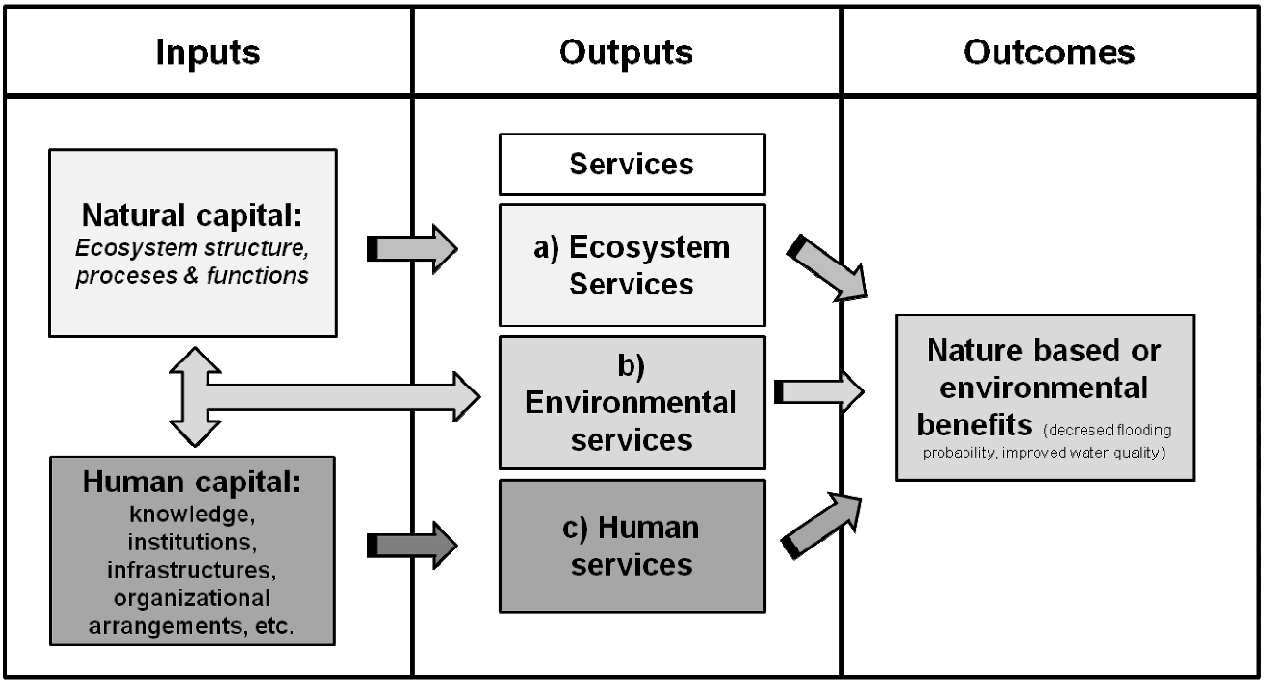


Table 4: "Input – Output – Outcome" of different environmental benefits associated to ES supply chains

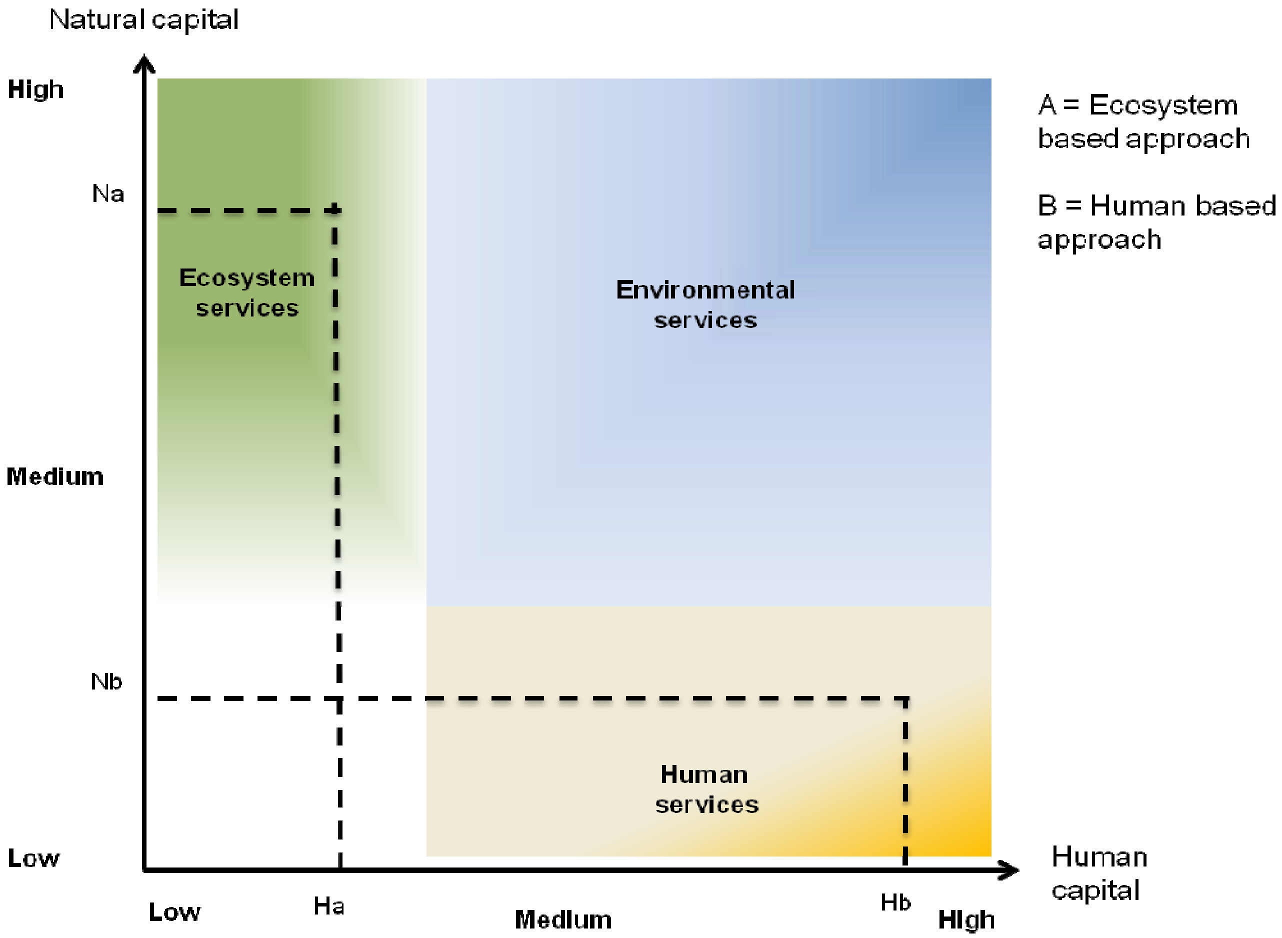
Inputs			**Outputs (services)**	**Outcomes (benefits)**
Ecosystem structure & processes	**Ecosystem functions**	**Human based inputs / activities**		
Forests ecosystem	Maintenance of soil structure, water retention and bioremediation	Improved forest management, fire protection, conversion to broadleaf	Decreasing nutrients concentrations / Improving drinking water quality and quantity	Availability (within time) of water at a certain quality and quantity Avoided water treatment costs Avoided alternative sources related costs
Pasture lands ecosystem	Maintenance of soil structure, water retention and bioremediation	Grazing control, conversion of arable lands to grasslands, avoided use of fertilizers and chemicals		Availability (within time) of water at a certain quality and quantity Avoided water treatment costs Avoided alternative sources related costs
Wetlands ecosystem	Bioremediation, water cooling and storage	Wetlands restorations or Integrated Constructed Wetlands		Availability (within time) of water at a certain quality and quantity Avoided water treatment costs Avoided alternative sources related costs Lower flood risk and associated costs

Substitution between inputs: the physical interaction between natural and social capital

Within the neoclassic approach to production, the principle of substitution states that a certain quantity of output can be produced with more than one combination of inputs. This has been largely applied with regard to choice of technique in agriculture production, with combination of inputs such as land and labour or land and fertilizers (Ellis, 1993). Therefore, if we assume that PES schemes adopt ES provision technology that use both human and natural capital (input factors) to produce a certain service (output), we can thus apply the principle of substitution to environmental service provision systems.

Figure 11 represents the production theory model, where the two input factors are respectively natural capital (Y) and human capital (X). The iso-product curve describes the entire range of possible combinations between the two input factors to achieve the same quantity of desired ecosystem-environmental-human service (output).

Figure 11: Production theory model - substitution between two input factors: natural capital and human capital

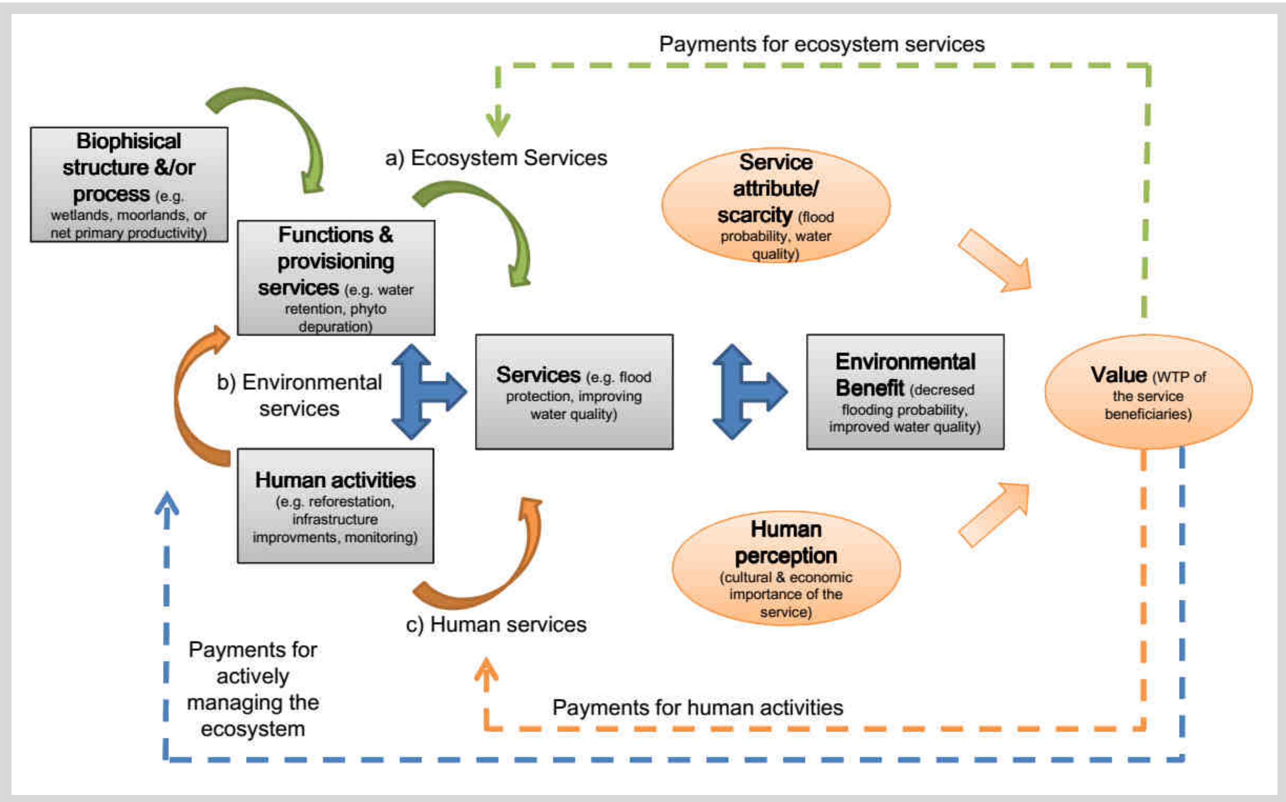


For instance, a water utility that wants to meet the legally binding standards of water-regulators has a range of different options to lower the level of nitrates or chemicals and eventually to provide drinking water at a reasonable price for its customers. On one hand, the utility can invest in protecting the land surrounding the catchment areas to be able to source water from an uncontaminated spring, adopting a strict ecosystem approach and taking advantage of the services provided by the natural capital (A). On the other hand, the utility could directly build a water treatment plant, investing in grey infrastructures, technology, and labour for plant maintenance, investing substantially on human capital (B). In some cases, water utilities achieve the quality goals through a combination of the approaches A and B, taking advantage of natural ecosystems (existing wetlands, aquifers, etc.), providing wetland restoration and afforestation, organizing training for farmers for win-win use of agricultural inputs, investing in capital works, etc. The optimal combination of inputs (units of natural and human capital) is in theory determined by the ratio of their prices. However, given the fact that natural capital has not been given a price yet (de Groot and Hermans, 2009) and the relative new introduction of the ecosystem approach, the real combination of inputs is rather driven by lexicographic preferences, political and negotiation process. Thus in some cases, one choice (i.e. water treatment plant) might exclude the other (ecosystem catchment approach). Yet, Figure 12 shows how different ranges of combination between inputs result in three main service areas: ecosystem service are those produced with intensive use of natural capital and little contribution of human capital, while human services are those produced predominantly by the use of human capital. Environmental services can thus be defined as those services produced using both medium-high quantity of natural and human capital. Section 2.3 thus characterizes PES by the type of inputs for service provision.

PES analytical framework: characterizing PES by type of inputs for service provision

Building on the theoretical assumptions presented within the previous sections, in our view PES schemes are production systems and/or networks/clusters that use - and thus pay, or are compensated for - different combinations of natural and human capital, to produce the desired services in order to satisfy a certain human need and increase society wellbeing (environmental benefit). Figure 3 shows how the two input factors interact all along the cascade framework proposed by Young (2007), where eventually, services are gained as “benefits”, i.e. real improvements of the quality of life, which are perceived through the interaction of the “services attribute” and the “human perception” (Brauman *et al.*, 2007; Haines-Young and Potschin, 2007; Keeler *et al.*, 2012). As we show from the different case studies in Table 5, PES may have different subjects of the payment (although the final aim remains the same, i.e. securing environmental benefits): a) Paying for ecosystem services that are naturally provided by the ecosystem process and functions to avoid reduction in the service that could result from potential human impacts (avoided deforestation in REDD+ projects and/or wetland conservation); b) Paying for land management practices that influence ecosystem functions and process in order to secure or increase the service provision; c) Paying for human based actions that, without actively interacting with the ecosystem structure, functions and processes, provide or secure an environmental benefit.

Figure 12: Interaction between ecosystem and human dimension and type of payments for securing environmental benefits



Source: Adapted from Haines-Young and Potschin (2007) and Brauman (2007)

Under point “a”, we refer to those PES schemes where service providers are paid for “not doing” or just for the fact of owning a particular ecosystem, such as tropical forests (Fletcher and Breitling, 2012; Wunder, 2005a) and/or wetlands based PES. Therefore, the final service dependence on human activities, infrastructures or governance arrangements (i.e. human capital) is very low. In this case, beneficiaries pay for an “ecosystem function or process” which does not result from an interaction with human activities or inputs in order to deliver the expected ecosystem services. These types of payments are often result-based rather than input-based (Gibbons *et al.*, 2011). They usually work better when the monitoring of the service provision is relatively easy (For example, the persistence of forest), but at the same time they are argued to lack additionality (Pagiola, 2008). In reality, this type is barely put in practice while preference goes to those incentives that lead to the implementation of proxy management practices.

Regarding the second point “b”, some other PES schemes show that services providers are paid for “actively managing and shaping the ecosystem”, interacting with ecosystem functions in order to deliver a specific well desired environmental benefit. This is the case of the implementation of land management practices that reduce runoff in the “Slowing the Flow at Pickering” (DEFRA, 2013b), or the case of systemic recreation of Forest Infiltration Areas in Veneto Region in Italy (Leonardi and Pettenella, 2012). These payments schemes require both high level of natural and human capital. Eventually, in other cases, under category “c”, more frequent in the water sector, PES schemes refer within the contract to “human based activities”, such as the number of hours of labour, avoided use of agricultural inputs (Bluemling and Horstkoetter, 2007), organizational arrangements (Giani, 2012), grey infrastructure improvements (Day and Couldrick, 2013), which ultimately, without actively interacting with the ecosystem process, terminate in a perceived “environmental benefits”. These last PES schemes are characterized by very high level of human capital, while the contribution of the natural capital to the final environmental benefit is very little.

Table 5 shows the definitions of the three categories of identified type of service areas, associated with case study examples of rewarded management practices, and final environmental benefits.

Table 5: Explanatory table comparing differences between the concepts of ecosystem, environmental and human services

Type of Services	Definitions	Example of the rewarded services/management practice	Example of environmental benefit	Case study (See Annex A)	Main references
a) Ecosystem Services	Ecosystem services are all the benefits people obtain from natural capital. Produced naturally by the ecosystem, without any active human based management.	Water quality improvements by natural wetlands	Increased water quality	Dune sustainable catchment management (NL2)	(Derissen and Latacz-Lohmann, 2013; MEA, 2005; Muradian *et al.*, 2010)
b)Environmental Services	Environmental services are those produced by actively managed ecosystems, through the combination of natural and human capital.	Water quality improvement by reforestation projects	Increased water quality	SCAMP (UK4)	(Derissen and Latacz-Lohmann, 2013; MEA, 2005; Muradian *et al.*, 2010)
		Water quantity provision	Increased water table level	Forest Infiltration Areas (IT1)	
c) Human Services	The human services that land or PES scheme managers can produce through their labour, presence, technology and social capital (human capital), without interacting and actively managing the ecosystem. Eventually, these human services result in a perceived environmental benefit.	Improving farm grey infrastructure to avoid nutrients run off	Increased water quality	Upstream thinking (UK3)	Own elaboration
		Forest fire control	Avoided risk of water quality loss	Gulf de Saint Tropez fire protection scheme (FR7)	
		Monitoring flood control	Reduced flooding risk	Land stewards, Tuscany (IT6)	

Based on this classification, we develop a framework to assess PES schemes against their physical interaction between ecosystem functions/process and humans activities/inputs, i.e. natural and human capital. In order to rank the degree of service dependence on two main production factors, two tables with values, definitions and examples are provided. Table 4 explains the service dependence on natural capital on the basis of the extent to which the final benefits depend on ecosystem structures, processes, functions and provisioning services. The lowest level is allocated to those final environmental benefits that are delivered regardless ecosystem components (improving drinking water through reducing agro-chemicals). While the highest level is allocated to final environmental benefits that depend upon a specific natural ecosystem process, function, etc. (For example, wetland water purification).

Table 6: Service dependence on natural capital

Level of dependence	Definition	Examples
1 – Low	The final environmental benefits are delivered regardless ecosystem structures and functions	Flood & fire control and monitoring activities. All PES based on avoided use of agro-chemicals. PES based on capital works and grey infrastructures improvements
2 - Medium	The final environmental benefits depend partially from specific ecosystem structures and functions. They rely on built environment such as agriculture land or restored ecosystem	Typically those agro-environmental benefits that depend upon specific land management practices, such as wetland restoration, reforestation, environmental friendly farming techniques
3 – High	The final environmental benefits depend from a specific natural ecosystem (wetlands, forests, and peatlands) with a particular combination of structure and functions	Wetland water purification. Natural peatlands ecosystem services. Natural forest drinking water provision. Services derived from improved forest management. Generally, ecosystem services provided by natural protected areas.

Table 7 explains the service dependence on human capital based on the extent to which the final environmental benefits depend on human inputs and activities (economic, cultural and social capital). The lowest level is allocated to the final environmental benefits that are delivered regardless human actions that help the production and delivery of the final benefit. For instance, in the case of wetland bioremediation, or tropical forests ecosystem services, where the human action is limited to “no intervention” on natural capital. Level two is allocated to those final environmental benefits which are delivered by avoided human impacts, which is traduced into a reorganizational arrangements (thanks to awareness raising and training) at farm level with low level of inputs (changing type of pesticides, conversion to organic agriculture, or avoided use of fertilizers). While the highest level is allocated to final environmental benefits that depend on service providers actions, behaviours or inputs (labour governance arrangements, infrastructures and social capital).

Table 7: Service dependence on human capital

Level of dependence	Definition	Examples
1 – Low	The final environmental benefits are delivered regardless the human actions or inputs (human capital). Therefore land managers have no influence on the actual service provision	Wetland water purification. Natural peatlands ecosystem services. Water provide by deep aquifers.
2 - Medium	The final environmental benefits are delivered thanks to "no actions" or avoided impacts of land managers through reorganizational arrangements of farm production	All PES based on avoided use of agro-chemicals
3 - High	The final environmental benefits highly depend on human capital. Service providers actions, behaviours or technical inputs, are the production factor for service provision (labour, governance arrangements, infrastructures, social capital)	Flood and fire control and monitoring activities. PES based on capital works and grey infrastructures improvements. Typically those agro-environmental benefits that depend upon specific land management practices, landscape conservation, such as restoration, reforestation, other environmental friendly techniques.

3.6.3. Governance assessment for PWS schemes

Building on the theoretical framework presented within paragraphs 2.2 and 2.3 we introduce the assessment tool developed to analyse the inventoried case studies according to the main PES theoretical principles.

Important principles of PES theory (Wunder, 2005b) have been used to derive four graduated axes of scheme design and governance. The aim is to better describe the variation in “PES-like” schemes found to exist in the EU context. Therefore, for each of the main principles (voluntariness, directness, commoditization, and conditionality) a set of type of corresponding governance arrangements has been identified in literature and within the selected case studies. Each governance arrangement has then been further described in detail, providing examples from the literature and associated case studies. The degree of correspondence to the theoretical principle is then rated from “very low” to “very high”.

Degree of voluntariness

The term voluntariness is defined as “Free and informed choice of both ES providers and beneficiaries to enter in a payment scheme”. This criterion is influenced mainly by the existence of mandatory or non mandatory regulations and the dynamics of negotiations between the contract parties. The level of information is playing an important role within the theory of contracts but is difficult to estimate at program level (Salanié, 1997). Table 8 provides the five degree of voluntariness which is related to the existence of mandatory or regulating legal frameworks, and with the degree of free and informed negotiation between the parties.

Table 8: Degree of voluntariness

Type of governance arrangement	Definition	Degree of voluntariness	Examples
Regulated mandatory with penalties	PWS that are enforced (from the supply or demand) through the use of mandatory regulations which are followed up by penalties. Usually these payments refer to environmental impact compensations.	1 - Very low	Hydroelectric payment scheme in Italy (Pettenella, Vidale, Gatto, & Secco, 2012)
Regulated markets/agreements	PWS that are enforced through the use of regulated markets. Usually these schemes are highly regulated and are related with environmental impact compensations or banking initiatives. Regulation often act both on demand and supply side.	2 - Low	Public-private river payback or wetland banking initiatives (Wittwer & Dixon, 2013)
Voluntary with a regulation framework	PWS that are implemented voluntarily but following a detailed regulation that defines terms and conditions of the agreements. The regulation might apply to both supply and/or demand.	3 - Medium	Most of EU PHP, such those in UK where water company are regulated by OWFTA and DWI
Voluntary without negotiation	PWS that are implemented voluntarily by the two parties, but where one of the two is not able to negotiate the terms and conditions of the agreements.	4 - High	Most of PWS managed by municipalities
Voluntary through free and informed negotiation	PWS that are implemented voluntarily by the two parties, where the two are fully informed and able to negotiate the terms and conditions of the agreements.	5 - Very high	Vittel in France, Land stewards in Italy.

Degree of directness

By directness of the transfer, we refer to the extent to which individual providers receive direct payments from the ultimate beneficiaries of the environmental service (Muradian *et al.*, 2010). The less direct case is when governments play as an intermediary of the transaction between the final user and the service providers. This is the case, for example, of the agri-environmental payments schemes such as Environmentally Sensitive Areas (ESA) and Countryside Stewardship Scheme (CSS) in UK where the government pays landowners in order to protect valuable landscape environment and biodiversity conservation (Dobbs and Pretty, 2008).

Table 9 provides the five degree of directness, each of them correspond to a different scheme governance arrangement.

Table 9: Degree of directness

Type of governance arrangement	Definition	Degree of directness	Examples
Public procurement	PWS where the public entities are buying the environmental services on behalf of the general public/beneficiaries.	1 – Very low	The English Woodland Grant Scheme, Catchment Sensitive Farming, etc.
Scope tax (Water charge)	PWS where the public entities are buying the environmental services on behalf of the general public/beneficiaries through a specific scope tax.	2 - Low	Lower Saxony, Germany, Water companies levy water abstraction charge on consumers and money passed to state government who give it to the state forestry agency for afforestation
Tradable rights	PWS where through a banking system service providers and beneficiaries are connected through a brokering/credit developer.	3 - Medium	Wetland mitigation banks in USA and Australia
Beneficiary pay funds	PWS that are organized under third party funds or trusts that collect the beneficiaries payments and redistribute them to the service providers.	4 - High	Angling passport Scheme, where fishermen pays a River Trust (NGO) who directly pays the farmers.
Bilateral agreements	PWS where contracts are signed directly between beneficiaries and service providers.	5 - Very high	Vittel in France

Degree of commoditization

By degree of commoditization we refer to the extent and clarity with which compensation received by the environmental service providers has been defined as a tradable commodity (Muradian *et al.*, 2010). Table 10 provides the five degree of commoditization, each of them correspond to a different scheme governance arrangement.

Degree of additionality and conditionality

We have additionality where the provision of ecosystem services is additional to the business as usual scenario and is conditional to the payment (Kroeger, 2013). The assessment of additionality and conditionality therefore depends on what is required by law, what is the additional effect of the payment, and at what conditions the payment is actually provided. Table 11 provides the different degrees of additionality and conditionality, providing definitions of related governance arrangements/situations and examples.

Table 10: Degree of commoditization

Type of governance arrangement	Definition	Degree of commoditization	Examples
No monetary benefits	Other types of benefits such as trainings, technical advice, etc. These benefits might indirectly improve management practices and influence the provision of the desired services.	1 - Very low	Most of PHP are also providing on the “payment package” non monetary benefits.
Rewards	Rewards are meant to provide social acknowledgement for resource managers who have historically played an important role in the provision of ecosystem services. Rewards are often direct to management practices that are already occurring regardless the payment (Muradian & Rival, 2012).	2 - Low	Most of PHS in developing countries fall under this category. Costa Rica case is a well know one (Fletcher & Breitling, 2012; Pagiola, 2008)
Subsides/Incentives	Incentives can also take the form of additional investments (the operational costs of reforestation, fencing, the cost of adopting new technologies, infrastructure, etc.) that users of the resource base are unable to undertake by themselves due to budgetary constraints. The external provision of such investments may become the ‘‘tipping point’’ in changing practices and behaviour. The difference between incentives and markets is that incentives do not cover fully the opportunity costs of more environmentally-friendly practices.	3 - Medium	All agro-environmental schemes such as The English Woodland Grant Scheme, Catchment Sensitive Farming, etc.
Payments	Payments have a high level of commoditization (the service is clearly defined) and a high level of conditionality. Payments are expected to cover fully the opportunity cost of more environmentally friendly practices.	4 - High	Vittel in France, Land stewards in Italy and SCAMP in UK.
Markets	Markets are consolidated payments flows among services beneficiaries and providers. These are the cases where we observe a fairly high degree of commoditization, often paired with some kind of marketplace exchange arrangement.	5 - Very high	Water quality trading programs in North America and Oceania fall into this group as do some quantity-driven mechanisms like groundwater mitigation banking programs and instream flow restoration certificates in the United States.

Table 11: Degree of additionality

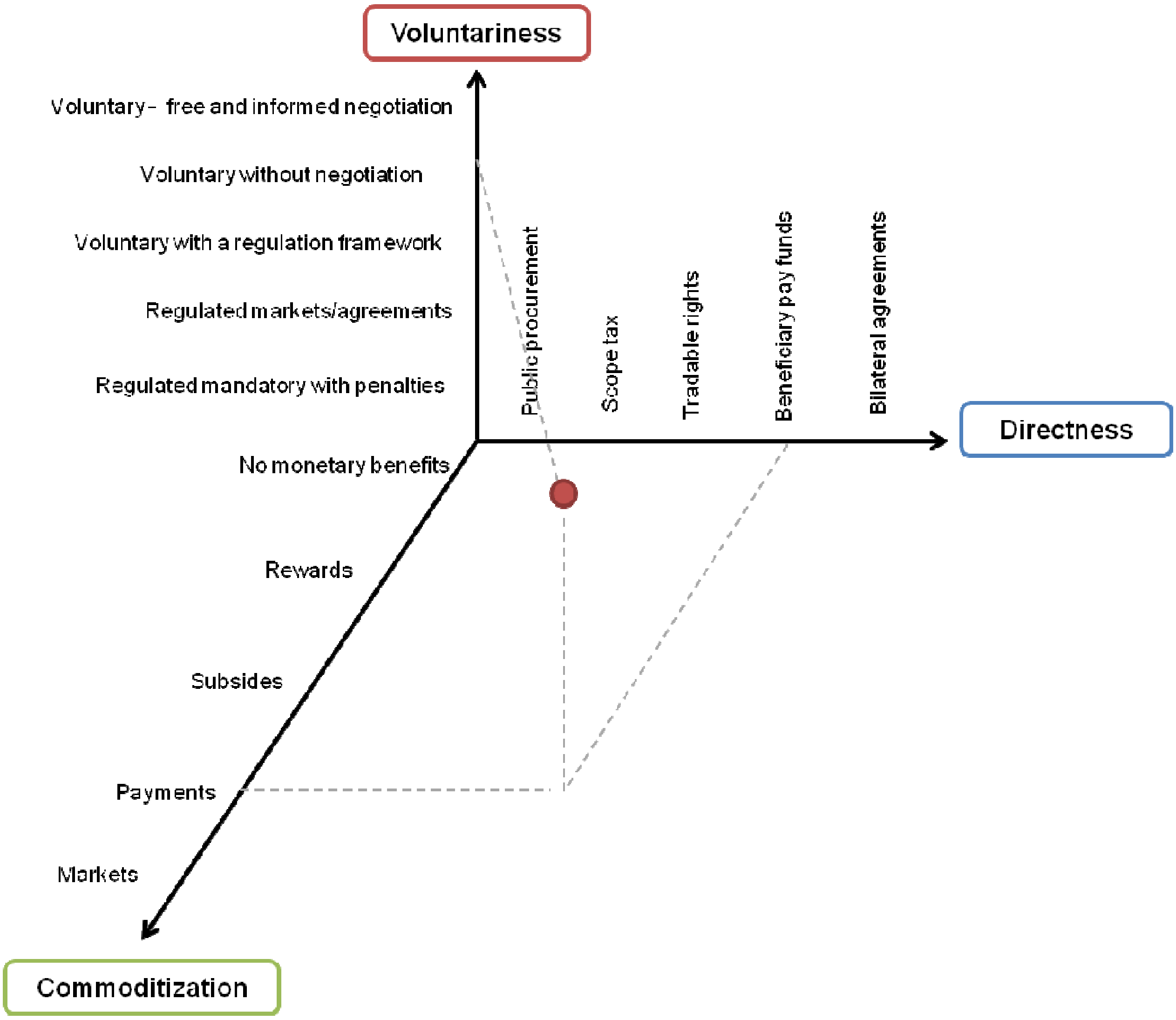
Type of governance arrangement	Definition	Degree of additionality	Examples
Payment by law	Payments are given for practices that are required by law (monitoring might exist or not depending on the regulation framework)	1 - Very low	Hydroelectric payment scheme in Italy (Pettenella, Vidale, Gatto & Secco, 2012)
Payment to enforce	Payments are given for practices that are required by law, but the PES ensure the enforcement of the law through incentives and monitoring	2 - Low	
Payments for spill-over effects	Payments are made in relation to the cost of maintaining the business as usual scenario, monitoring check the land use management maintenance but not the service provision (the cost of provisioning the ES doesn't increase the Business as Usual costs)	3 - Medium	Some agro-environmental schemes in Europe
Payment by conditional management	Payments are made in relation to the cost of implementing the management practices, monitoring check the land use management change but not the service provision	4 - High	Land stewards in Tuscany
Payment by service provision	Payments are made in relation to the cost of provision of the ES and monitoring ensure the implementation of the management practices and the actual service provision	5 - Very high	United Utilities, UK.

The assessment cube

After a first assessment of all schemes we selected three dimensions (voluntariness, directness and commoditization) as we saw that most of the schemes has not such a diversification in term of additionality and conditionality, most of them are either payments to enforce or payment by conditional management. So the variable about additionality and conditionality was excluded although it has been taken into account for further elaboration and conclusions.

By assessing the governance scheme of each PWS using the three tables outlined above (voluntariness, directness and commoditization), an institutional design space results that maps arenas of governance arrangements along these three dimensions. This can then be used to fully characterize the constellation of mechanisms and categories of PWS and make assessments of and assessments for concepts such as directness, voluntariness and commoditization, particularly when used in conjunction with other information on the scheme. It must be recognized however, that PWS schemes are often composed of multiple tools and different mechanisms, so it is likely that there will be more than one mechanism to illustrate in the final “cube”. The three axes provide a ‘cube’ of ‘institutional design space’ and map governance arrangements. Our aim is to fully characterize the variation in mechanisms and categories of PWS examples that is observed to exist.

Figure 13: Case studies assessment framework



3.6.4. Institutional qualitative analysis of PWS schemes

This paragraph present how four selected cases studies have been assessed, following the institutional theoretical background presented in Figure 6 (paragraph 2.4), and an *ad hoc* institutional framework for qualitative analysis of PWS (see

Table 15: Conceptual framework for institutional analysis of PWS).

Case studies for qualitative institutional analysis were chosen according to the criteria presented in Table 12. Following these criteria we thus selected the case studies that are further detailed in the following Table 13.

Table 12: Criteria for case study selection for qualitative institutional analysis

PWS selection criteria	Reason for
Be selected among the EU inventory following the criteria explained within paragraph 3.4*	This criterion allows us to compare the case study with the broad situation at EU level. Drawing more specific conclusions and better understand trends at EU level. *The case studies were selected according to the following criteria: i) meet the broader definition of PES according to both Wunder and Muradian (see first Chapter); ii) defined by the manager or by literature as "PES"; iii) with a primary aim of provision of hydrological services (bundled ES-based initiatives were excluded); iv) be implemented at EU level. Although all cases were inventoried only those established beyond a pilot phase were assessed as those in design phase diDK't have enough data to be analyzed.
Be representative of two opposite national institutional background, namely Italy and England	This criterion allows us to compare and how different institution influence the development and implementation of PWS. Italy has a public managed water sector while England has a private system, although public regulated. The former has a national policy and strategy for the adoption of PES schemes while Italy doesn't consider PES from a national policy perspective.
Be considered successful PWS according to criteria set under Table 3**	This criterion allows us to learn lessons about what systems are working and which the factors that influence their success are. ** "Existing relevant literature, updated literature review and or multiple sources, positive evaluation of the existing literature, existing monitoring show goals achievement, repeatability (applied to other areas or second phase)".
Long term scale of implementation	Selecting case studies with more than few years of existence allow us to have enough information and available data to see how PWS design and governance have evolved responding to institutional interplay and actors interactions
Be relative new within the scientific literature review	We tried to avoid the selection of well know case studies for which there are already several scientific articles in the literature. Especially for the case of Munich, Lower Saxony, Vittel, etc. This allows us to publish on quite original case studies and provide new insights on not well investigated PWS.

Table 13: Selected case studies for qualitative institutional analysis

Selected PWS	Country	Region	Program administrator	Type of main buyer	Year establishment	Type of service
SCaMP	England	North west England	United Utilities	Private water utility	2005	Water quality
Upstream Thinking	England	South West England	South West Water	Private water utility	2007	Water quality
Land Stewards	Italy	Serchio Valley, Tuscany	Unione Comuni Media Valle del Serchio	Public watershed authority	2007	Flood control
Romagna Water Fund	Italy	Ridracoli, Emilia Romagna	Romagna Acque - Società Delle Fonti Spa	Private water utility (public owned)	1996	Water quality and avoided dam sedimentation

Due to the scarcity of published information on the schemes, information for the analysis was gathered using two main sources. Initially, we carried out a review of all publicly available information on the programmes, including normative background, implementation data, monitoring and evaluation reports, presentations, websites, etc. With then used the collected information to answer as many questions as possible, in order to reduce the number of questions and data to request to selected PWS stakeholders.

The second phase, which was aimed at collecting the non-public available information, was complemented by face-to-face, semi-structured interviews with project managers, intermediaries, knowledge providers, and researchers involved in the design, implementation or evaluation of the schemes (at least two per instrument, see Table 14).

Selected experts were asked several questions and data following the framework summarized in the following

Table 15 and further detailed within Annex 5: Analytical framework for qualitative case study interviews. The 6 dimensions identified within the theoretical background (paragraph 2.4), were further detailed into sub-dimensions, research questions and indicators. The framework has been taken and adapted from two main publications that has developed an institutional analysis of PES (Corbera *et al.*, 2009; Prokofieva and Gorriz, 2013). The first about ecosystem services has been developed as a new block compared to the reference studies. Actors' interactions, institutional interplay, capacity and scale, and institutional performances were taken mostly from the two reference studies, trying to complement aspects that were not covered by one or the other.

Table 14: Profile of interviewed experts

Organization	Role within the organization	Role within the PWS	Case study
United Utilities	SCaMP Programme Manager	Project manager/Buyer	SCaMP
RSPB	Senior Water Policy Officer at RSPB	Tenant - Intermediary - Knowledge providers	SCaMP
South West Water	Head of Sustainability at South West Water	Project manager/Buyer	Upstream Thinking
Westcountry Rivers Trust	Development & Policy Director	Intermediary - Knowledge providers	Upstream Thinking
SOAS, University of London	Head of the Centre for Development, Environment and Policy	University – scientific advisor	Upstream Thinking
CASCADE Consulting	Managing Director	Knowledge providers	SCaMP
UK Ecosystems Knowledge Network	Project Office	Cross Cutting National institution	SCAMP, Upstream Thinking
Ofwat	Interim Environment Director	Regulator	SCAMP, Upstream Thinking
Westcountry Rivers Trust	Senior Farm Advisor	Farm Advisor / Intermediary	Upstream Thinking
Unione Comuni Media Valle del Serchio	Agronomist of the public body	Project manager	Land Stewards
INEA	Researcher	Knowledge provider/researcher	Land Stewards
Romagna Acque - Società Delle Fonti Spa	Sustainability manager	Project manager	Romagna Water Fund
University of Padova	Researcher	Knowledge provider/researcher	Romagna Water Fund

The design block was further enriched drawing from Corbera and adding other sub-dimensions related to technical aspects of scheme design.The general framework provided in annex 5 was used as guide for semi-structured interviews, however for each case study a previous adaptation of the framework was carried out before the interview. The adaptation was made based on the case study characteristics, on the type of role covered by the interviewed expert and the information already available. Interviews were recorded with the use of a smart-phone. After a first phase of self-introduction, confidentiality statement, and background on the study, experts were asked to provide a general introduction on their role and on the scheme history. Secondly, experts were asked to respond to highlighted questions and missing data following the framework. Several paper documents and files such as maps, contracts, list of suppliers and their characteristics, transactions databases, and other relevant documentation were copied and or saved on hard-disk.

Finally, experts were asked to add everything they thought to be relevant and that was not covered by the interview. Usually interviews last on average from 2 up to 5 hours, depending on the availability of expert's time.

Table 15: Conceptual framework for institutional analysis of PWS

Dimension of the analytical framework	Sub-dimensions
Ecosystem structure process and services	Ecosystem structure, process, functions and services
	Environmental benefits
	Spatial temporal characteristics of flow between service provision and consumption
Actor interactions	Actors identification
	Actor roles, preferences and resources Roles, rights and responsibilities
	Preferences, interests, expectations and values
	Actions and interactions Use and management of resources
	Information sharing
	Lobbying
	Deliberation
Institutional interplay	Institutional interplay
	Policy interplay
	Instruments interplay
	Nature of the interplay
Institutional design	Start up
	Contract and procedures
	Payments
	Monitoring and evaluation
Capacity and scale	Capacity
	Scale
Institutional performances	Environmental effectiveness
	Economic efficiency
	Equity
	Flexibility
	Implementation complexity
	Acceptability

4. RESULTS

As of 2012, according to the last Global State of Watershed Investments, only 15 active programmes in EU were identified (Bennett *et al.*, 2012)**.** Thanks to the systematic scientific and grey literature review, snowball approach, database collection and online survey we identified 76 Payment for Watershed Services around the continent. The results of this section take into account all the information available for the 76 PWS. The list of inventoried case PWS is reported in Annex 1: List of inventoried case studies[6].

Multiple sources of information have made possible to collect information for all 76 inventoried PWS. Figure 14 summarize the percentage of information availability by type of source.

Firstly, grey literature was available for 88% of inventoried PWS, mostly project reports, NGOs reports, monitoring and evaluation reports, and European or international PES inventories such as Watershed Connect[7] and other global studies (Bennett *et al*., 2012; CTFC, 2012; Greiber *et al*., 2009; OECD, 2013).

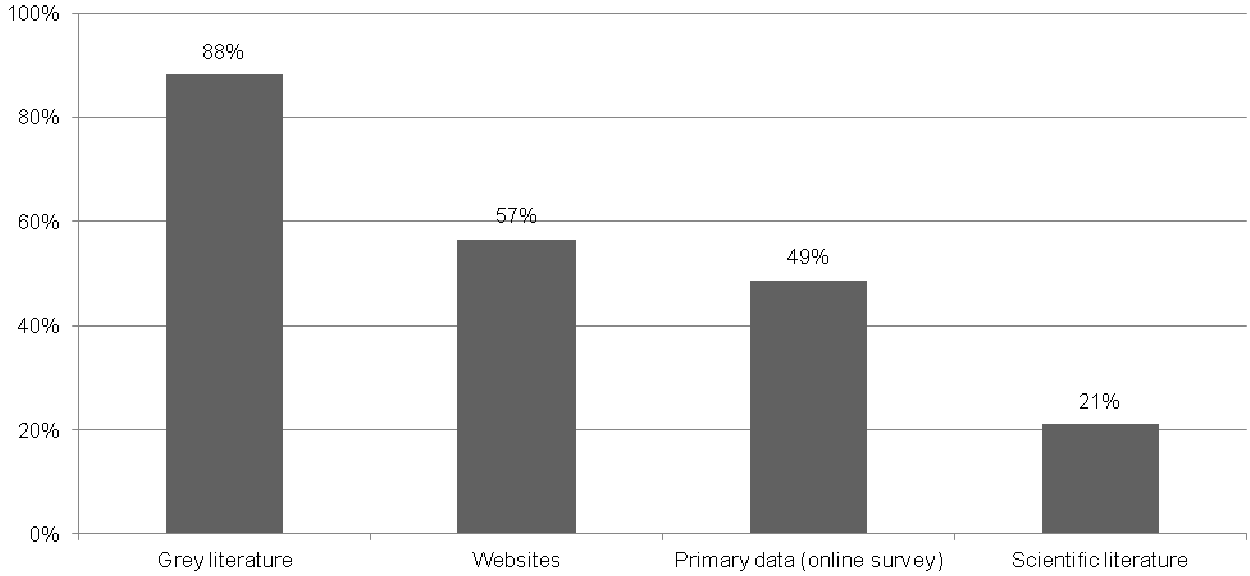
Secondly, project websites were the second most frequent source of information, with 57% of identified programmes that had their own website or a dedicated section to communicate the programme actors, design and monitoring, sometimes providing updated and very good quality information that complemented other sources.

Thirdly, the online survey obtained a response from 49% of identified PWS (37 programmes on 76). We then complemented the data collected through the online survey through emails, phone calls and direct interviews to selected case studies. Finally, only 21% of identified programmes were covered by scientific literature, with only very few peer-reviewed publications.

---

[6] The attached publication “Gaining Depth State of Watershed Investment 2014” reports less case studies at European level than this thesis does. This is because the research at Ecosystem Marketplace was carried out till May 2014, while this thesis collected data till November 2014, increasing the number of identified case studies. For more information, visit: www.watershedconnect.org

Figure 14: Percentage of information availability by type of source (no. = 76)

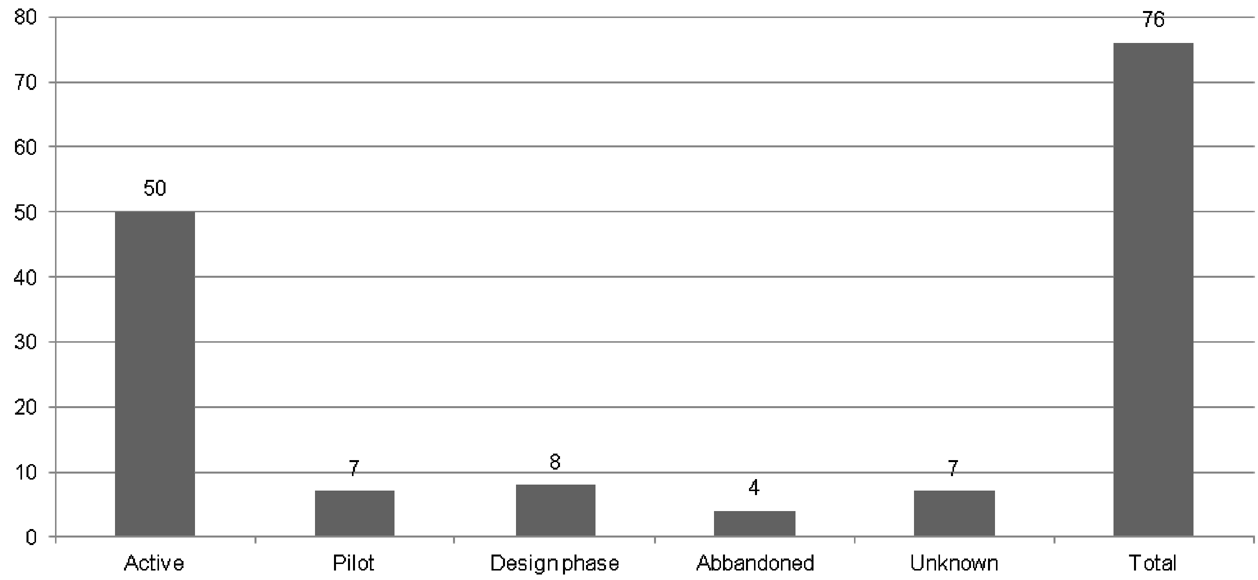


Pettenella (2012) described some Italian case studies on water related PES-like, regarding tap water provision and hydroelectric power generation (Pettenella *et al.*, 2012). The negotiation process of some pilots PWS in Netherland were covered by De Groot (de Groot and Hermans, 2009) and groundwater cooperative agreements (Brouwer *et al.*, 2003).

Some schemes in Germany were investigated by Grolleau for the case of Munich (Grolleau and McCann, 2012) and by Bluemling for the Lower Saxony regional groundwater protection scheme (Bluemling and Horstkoetter, 2007). Although the French case study on Vittel is the most known, there are no peer-reviewed publication specifically dealing with it, and we only found the report by IIED (Perrot-Maître, 2006). Other example from France on groundwater cooperation agreements (Eau de Paris, Saulce Plain, Lons le Saunier) have been recently investigated by Barataud who also compared French case studies with German ones such as Augsburg, Munich and SchALVO (Barataud *et al.*, 2014).

However, only 50 out of 76 are still active programmes, 15 are in pilot and/or design phase, four officially abandoned, and seven for which information of their status is not available. Figure 15 shows the number of programmes by their activity status.

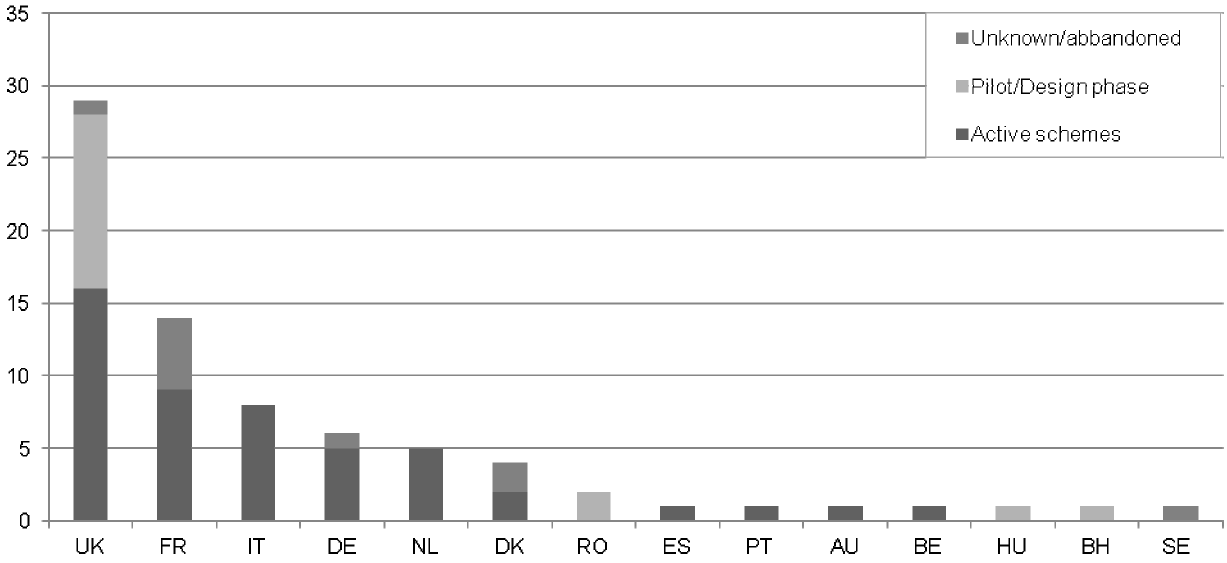
Figure 15: Number of programmes by activity status



With the exception of Switzerland, programs are mostly concentrated in the EU-15 region, collected case studies are representative of 14 countries in the European continent (see more in detail Figure 16). The number of discovered case studies also depends on the difficulties to conduct a detailed literature review at country level without using the local language (for data collection we used only Spanish, Italian, English and French). Nevertheless, the collection is the most comprehensive one existing in the literature at EU level. Many local PWS, especially in non-English or Spanish countries do not refer to the concept of PES when refereeing to payments or investments for increasing the provision of hydrological services. Many programs use other wording such as “Sustainable Catchment/River/Basin/Aquifer Management Plan”. The good representation for UK, IT, DE, FR, DKDK is due both for the existing literature review on the topic and by the fieldwork research. Nevertheless, the number of PWS by country is also explained by a existing regulatory frameworks or government investment programs (i.e. France, Germany & Denmark) and/or by specific hydrological conditions (Italy).

The number of existing mechanisms does not tell us about the type of pure or quasi PES, while in UK they are almost all private-driven and pure PES; in the rest of EU they are almost all quasi-PES, public driven.

Figure 16: Identified schemes by country and program status in 2013/2014



Most of the active schemes are concentrated in countries where there are high problems of water pollution from agriculture and/or high level of flood probability. Indeed the schemes are often dealing with these hydrological issues, as we will see in the next paragraphs.

UK and France with a private or semi-private water sector have the highest number of PWS. However while England has a government programme that promotes adoption of PES schemes to solve water quality issues (see the high number of PWS in development), water utilities in France moves from cooperative agreements toward the acquisition of land and/or the set up of water quality legal restrictions (this trend is the same for Denmark and Germany).

Given this general background on the most comprehensive inventory of PWS in Europe the next paragraphs, critically analyses and evaluate the following aspects:

- service provision (supply);
- policy drivers and payments/markets (demand);
- typologies of governance models at EU level;
- institutional aspects of selected case studies in Italy and England.

4.1. What are PWS paying for? A critical analysis of PWS service provision

In this paragraph we first analyse the general characteristics of PWS in regards the targeted water issues and types of ecosystems, type of rewarded management practices and type of hydrological services provided by PWS. We then use the framework developed in Chapter 3 to assess all inventoried case studies[8] (see paragraph 3.6.2 - Assessment of the service provision within PWS schemes).

Programmes in EU generally focus on solving human induced water related issues generated by agricultural activities or high urbanization. The majority of PWS aims to improve groundwater and surface water quality related issues such as nitrates concentration (72%), chemicals residuals (56%), and biological contamination (35%). Amongst water quality issues, the watercolour (Coloured Dissolved Organic Matter - CDOM) has reported interesting issues, as the colour does not cause any health issue thus it is not regulated by law but just with customer satisfaction. Some catchment schemes in the UK are targeting Metaldehyde (a pesticide used against slugs and snails) which is difficult to remove using conventional water treatment plants. Schemes are also increasingly targeting "hazards and flooding" (31%) and groundwater depletion (13%). Public authorities and utilities often use PWS as a good strategy for climate change adaptation, including forest fires control, and groundwater recharge. Figure 17 summarises the frequency of water issues targeted by PWS. Therefore, generally speaking, PWS do not pay farmers and forest owners for providing hydrological services; instead, they are often paying farmers and forest owner to decrease their impacts on ecosystems and their hydrological functions.

Schemes target for the 82% mainly the "built environment" such as agricultural catchments and reforested agricultural lands. While only 50% of them targets also forests, 22% freshwater bodies and 19% wetlands.

---

[8] As for inventoried case studies in the design phase information was not always available we excluded them by the assessment. Therefore, we assessed only 68 PWS.

Figure 17: Frequency of water issues targeted by PWS[9]

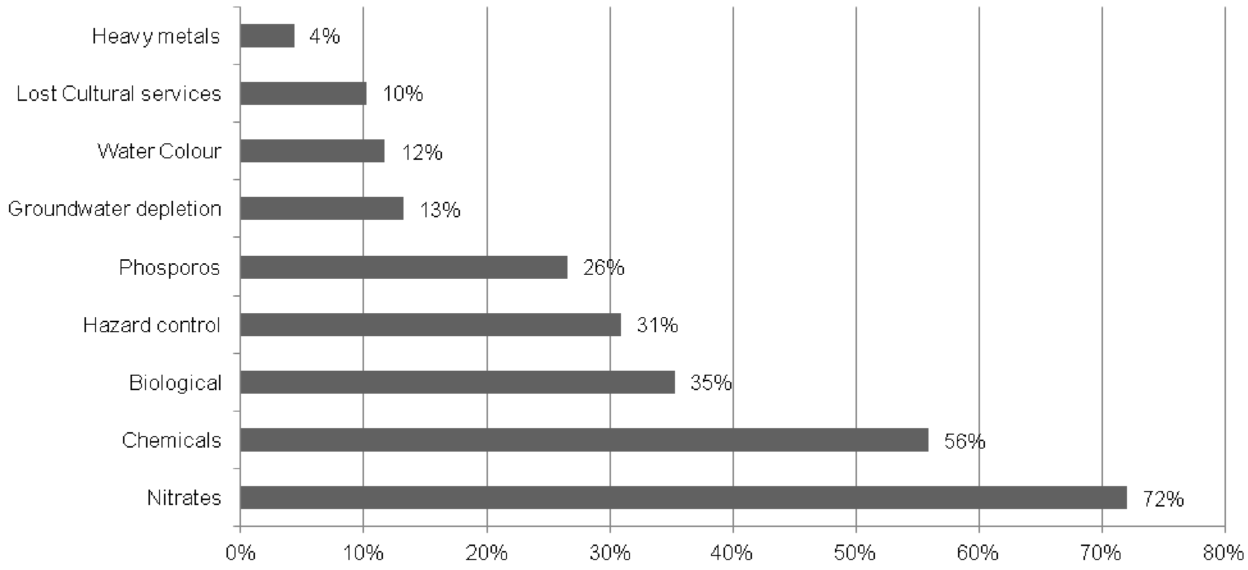
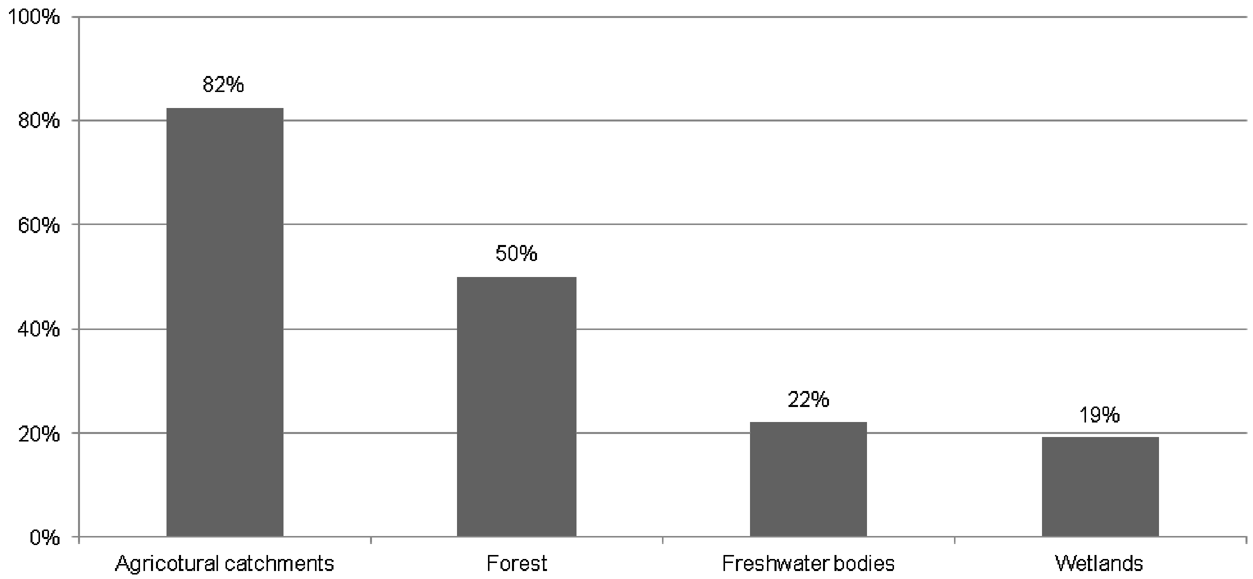


Figure 18 summarise the frequency of type of ecosystem targeted by PWS. Again, we reaffirm the idea that PWS are not paying natural ecosystems for their hydrological functions, instead they mostly pay farmers and forest owners to reduce their water footprint.

Figure 18: Frequency of type of ecosystem targeted by PWS[10]



---

[9] Categories are non-exclusive and a single transaction can include more than one type of water issue. Therefore, percentages do not necessarily add up to 100.

[10] Categories are non-exclusive and a single scheme can targets more than one type of ecosystem. Therefore, percentages do not necessarily add up to 100.

In order to mitigate agricultural water footprint and to improve hydrological services, PWS adopt a portfolio of proxy management practices. Most of them aim to improve farming practices through better fertilizers management or sustainable agriculture techniques, fertilizers restrictions, livestock limits.

Figure 19 summarizes rewarded management practices that PWS schemes use at EU level. Every scheme uses a portfolio of different measures, for example, the establishment of water and groundwater protection areas is often coupled with agriculture chemical restrictions and/or afforestation, fencing and grazing control. Forest related practices such as improved forest management (31%, for example fire control, conversion from pine to broadleaf forests, use water friendly forest technologies and management) and reforestation (40%) are also quite used to provide hydrological services. The importance of forests and trees within PWS is even bigger if we include other type of forest management such as the forest-hydrology management practices (19%). Improved agriculture practices (51%) and organic farming (18%) are also ones of the most used rewarded management practices which are likely to secure the service provision. Organic farming is often used as a way to delegate monitoring activities to a third party (certification body) and to provide market incentive to farmer (through marketing advantage of their products), such as in the case of Munich (Grolleau and McCann, 2012). PWS inventoried schemes reward a number of other management practices, such as rivers and water channels monitoring and cleaning, improving the access to angler's sites, incentivizing blue mussels farming for nitrates purification and wetlands restorations. These latter, are all site-specific and water service-specific and they do not constitute a trend in the PWS in EU.

The 76 case studies were classified against the Brauman output based hydrological service classification (Brauman *et al.*, 2007). Most of PWS are dealing with improvement of extractive water supply (79%) and water damage mitigation (29%); these seem to be the first two priorities. We might expect an increase of both these categories, considering the fact that groundwater consumption is 3.5 times the recharging capacity (Gleeson *et al.*, 2012), 38% of water bodies in EU are considered as "polluted", and that climate change will double river flood probability (Ciscar *et al.*, 2011; Dankers and Feyen, 2008) within the next two decades. Only 21% aim at in-stream water supply and only 10% to water related cultural services.

Figure 19: Frequency of proxy management practices rewarded by PWS[11]

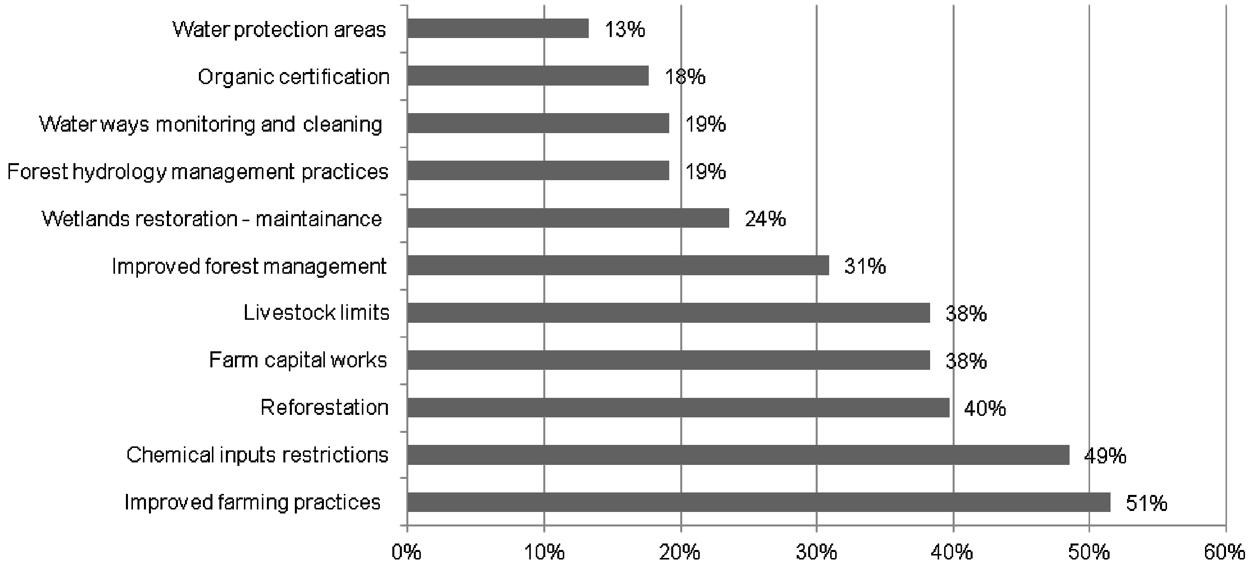
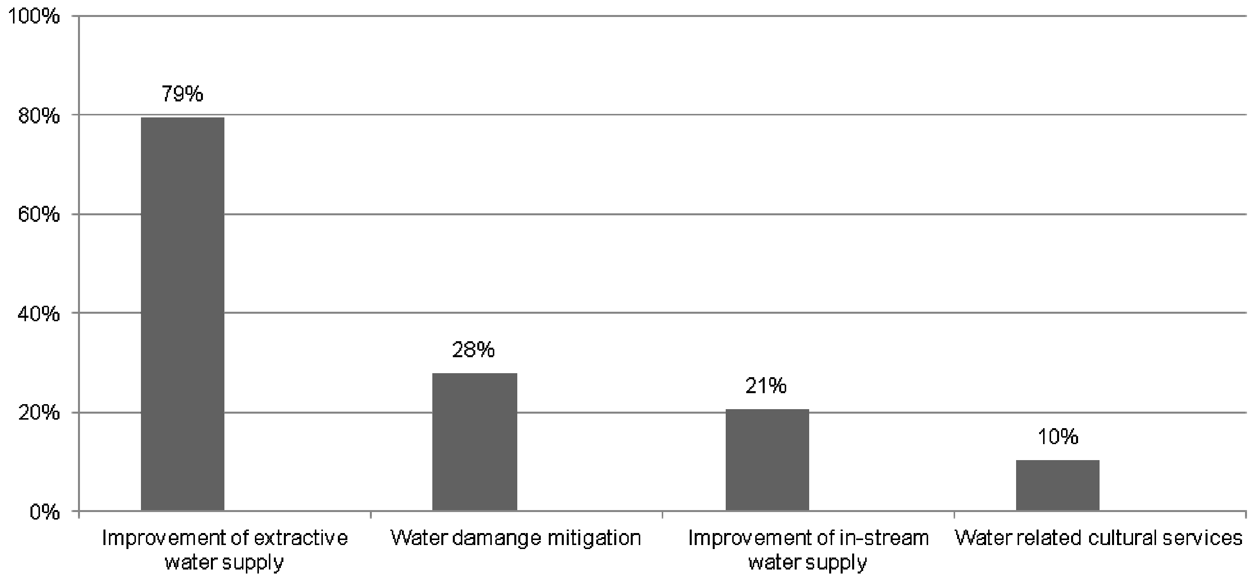


Figure 20: Frequency of hydrological services targeted by PWS[12]



According to the WFD (2000/60/EC) implementation report, the main problem of EU rivers is the over abstraction with the consequence of reducing the minimum ecological flow (European Commission, 2012). This has serious consequence both on quality of water resources and on the provision of ecosystem services. Therefore, in-steam water supply might be a future area of

[11] Categories are non-exclusive and a single scheme can reward more than one type of management practice. Therefore, percentages do not necessarily add up to 100.

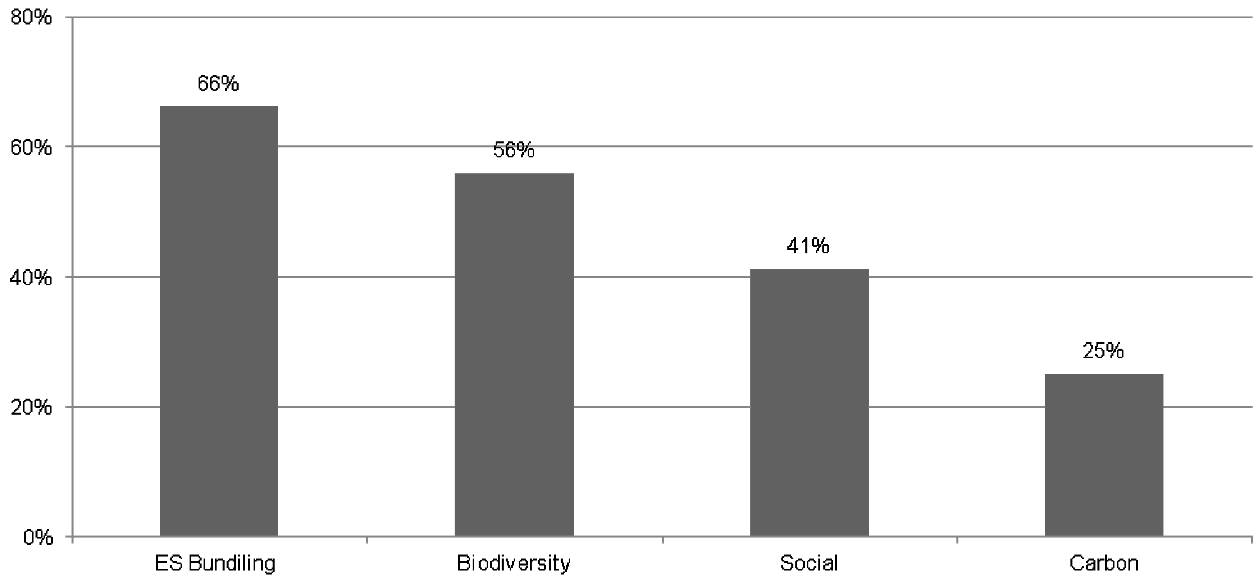
[12] Categories are non-exclusive and a single scheme can target more than one type of hydrological service. Therefore, percentages do not necessarily add up to 100.

expansion for PWS in Europe, together with recreational services such as fishing, etc. Regarding the service attribute, 57% of schemes deal specifically with water quality issues, while 22% with both quality and quantity, and only 8% are only dealing with quantity.

The hydrological services as referred on site are important to understand which is the targeted policy and environmental priority and to avoid confusion during evaluation studies (Ojea *et al.*, 2012). Generally, there is confusion when referring to the scope of the scheme, sometimes they refers to the hydrological services, sometimes to the causes of disservices, other to the final perceived benefits. That’s why it’s useful to classify schemes according to an output based classification (Brauman *et al.*, 2007; Ojea *et al.*, 2012).

Regarding the situation of other ecosystem services coupled with the hydrological ones, the 66% of schemes consider multiple benefits (i.e. they pay for projects that provide bundled services), and 34% do not. In most of the case PWS directly target biodiversity co-benefits (56%), social (41%), while carbon only is seen as a targeted co-benefits in 25% of projects. Generally, service suppliers receive monetary compensation for hydrological services, and then the programme additionally targets side benefits that complement the quality of the scheme. Therefore, the co-benefits often follow under the definition of piggy-backed, services that are provided by suppliers and enjoyed for free by service beneficiaries. However, as we see in the next paragraphs, the same PWS programme might be funded by several organizations with different aims. For example, while the water utility is often only looking to achieve water quality goals, environmental charities are looking at water-biodiversity related co-benefits. Therefore, although all funding agencies directly fund the water related scheme, they might ultimately target different co-benefits.

Figure 21: Frequency of ecosystem co-benefits targeted by PWS



In order to analyse each case study against the proposed framework (see paragraph 3.6.2 - Assessment of the service provision within PWS schemes), we assess the main water related issue, the type of ecosystems, and the processes and functions involved in the service provision[13]. These last three dimensions are useful to understand the extent to which the final service depends on natural and/or from human-built capital. On the other hand, we analyse service dependence on human capital taking into account the "conditionality of the payment" which means the type of inputs or rewarded management practices (i.e. human-built capital dependence). Then we classify all schemes according to the classifications systems presented within the Chapter on methodology (

Table 6 and Table 7).

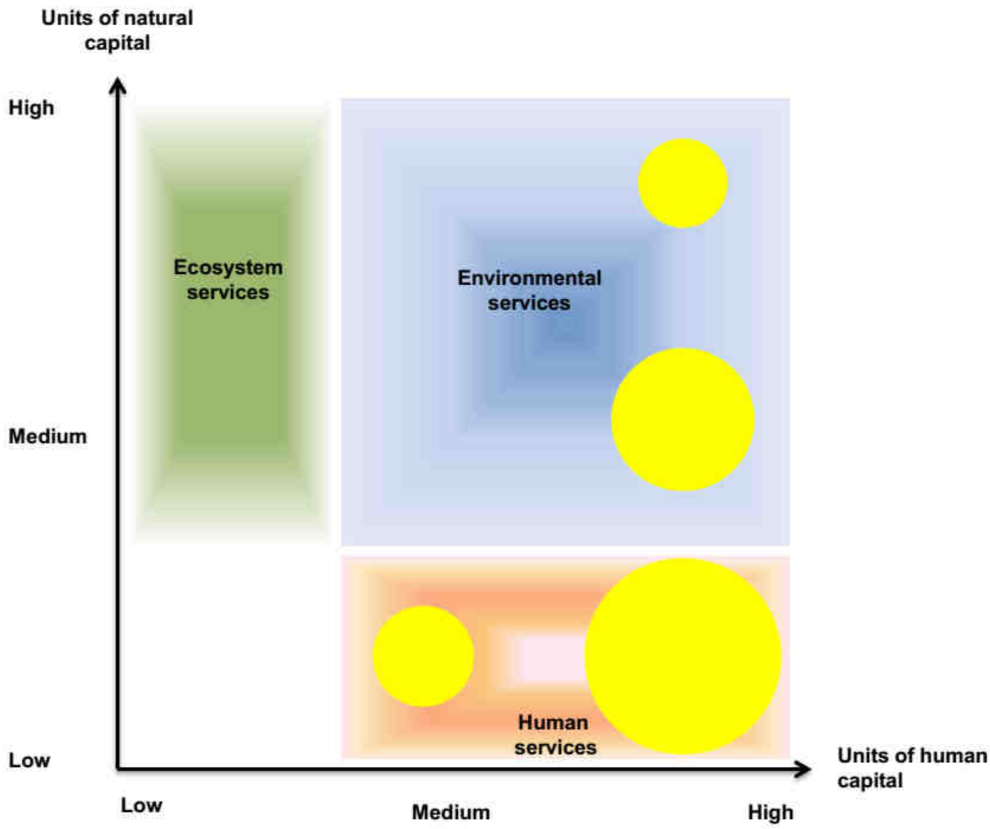
The study and the interpretation of the natural and human inputs involved in the service provision results into a categorization of all PWS schemes that we summarise in Table 16 and graphically represents in Figure 22. The bubbles dimension within the graph represents the number of programmes falling under that specific category.

[13] As for inventoried case studies in the design phase information was not always available we excluded them by the assessment. Therefore, the assessment results are based on 68 PWS.

Table 16: Results of service provision assessment of PWS

Dependence on human capital	Dependence on natural capital	No. of case studies	Case studies *(codes refer to Annex 1: List of inventoried case studies)*	Service category
Low	High	0	NA	Ecosystem services
Low	Medium	0	NA	Ecosystem services
Low	Low	0	NA	Spill over effects or by law due services
Medium	Low	9	UK3, UK4, UK24, FR1, FR2, FR3, FR4, FR5, SH1	Human services
Medium	Medium	0	NA	Environmental services
Medium	High	0	NA	Environmental services
High	Low	34	AU1, BH1, RO1, RO2, DK4, UK2, UK7, UK8, UK18, UK21, UK23, UK25, UK27, UK28, UK29, FR6, FR8, FR9, FR10, FR12, FR13, FR14, DE1, DE5, DE6, IT2, IT4, IT5, IT6, NL1, NL2, NL3, NL4, NL5	Human services
High	Medium	18	BE1, HU1, DK1, DK2, UK1, UK5, UK6, UK14, UK20, UK26, FR11, DE4, IT1, IT3, IT7, IT8, ES1, SE1	Environmental services
High	High	7	DK3, UK13, UK15, FR7, DE2, DE3, PT1	Environmental services

Figure 22: Graphic representation of results of the assessment of service provision of PWS



According to the assessment, none PWS is actually paying for services mainly directly provided by ecosystems. We can easily explain the no-representation of payments for “pure” ecosystem services in PWS by considering the fact that when nature already provides water related services, and if these services are not threatened by human activities, hardly someone will pay for them. This is the well-known “free-rider” problem, where for example water companies that source from protected areas benefit from pure and uncontaminated water without contributing to the protected areas associated costs. In this case, beneficiaries take for granted those ecosystem services generated by the natural capital. From the perspective of the production theory, this PWS category considers payment schemes that use little human capital in the “final environmental benefit” provision. In the case of drinking water industry, if the ecosystem delivers high quality water, the human capital employed to deliver drinking water is often limited to transport and logistics. When the human impacts harm the ecosystem’s capacity to deliver water related services we thus fall under other categories where human capital (through technology, organization arrangements and other inputs) is essential to deliver the final benefit to the society.

On the contrary, the inventoried PWS bring a strong representation of payments for environmental services, i.e. payments for services that are generated by the built environment (Muradian *et al.*, 2010; Wunder, 2005a) with a intensive use of human and natural capital. Within this category, we identified to main sub-categories.

The first includes schemes that pay for environmental services generated by the built environment (18 out of 68, such as Forest Infiltration Areas, reforested agricultural lands, improved agricultural management practices in agricultural catchments) with a high level of human capital and medium level of natural capital. For instance in the case of Forest Infiltration Areas (Code IT1), high human capital is required to engine the combination of reforested agricultural land with the systematic water infiltration channels in order to increase water storage in the aquifer. Besides technical capacity, high level of social capital and collaboration among different institutions are required (river basin authorities, regional and provincial public bodies, municipalities, and farmers) (Leonardi and Pettenella, 2012; LIFE+ TRUST, 2012). Medium level of natural capital is required since these environmental services arise within agricultural lands and not in natural ecosystems.

Although Forest Infiltration Areas make systematic use of ecosystem processes and functions (water retention, infiltration and storage) in order to deliver the final service provision.

The second sub-category (7 out of 68) includes those schemes that pay for services generated by natural ecosystems or “not-intensively managed ecosystems” (such as forest, wetlands or rivers) through improved forest management practices and wetlands restoration. This sub-category is characterized by a high use of natural capital because close-to-nature ecosystems are meant to be more valuable (in term of natural capital) than arable lands (Butler, 2009; De Groot *et al.*, 2012). However, we chose to allocate a high level of human capital because both improved forest management and wetlands restoration require a high level of technical knowledge, organizational arrangements, technological investments and social capital.

Finally, the last and newly introduced category named “human services” is represented by 43 out of 68 case studies. These payment schemes pay for labour, organizational arrangements, grey infrastructures and social capital that, with little interaction and active ecosystem management, result in a perceived environmental benefit. This service type is thus characterized by a low level of use of natural capital and high level of human capital. This category encompasses all payments schemes that pay for services that are generated regardless ecosystem structure and functions. Within the category, we identified two main sub-categories.

The first, with a value of human capital equal to “medium” that is represented by those schemes that pay for agriculture chemical inputs restrictions or substitution (9 out of 68). Therefore, the payment assures the service by the use of training, technology and incentives for farmers to lower their impact related to chemicals, and thus ensuring the environmental service provision. For instance, in the well known Vittel PWS (Code FR1), farmers are paid to decrease the use of agrochemicals and nitrates (human activity) within water source catchments, thus lowering the Vittel business risk (environmental benefit) of no compliance bottled water regulations (Perrot-Maître, 2006). To implement the scheme and set the water quality parameters under regulators’ thresholds, Vittel had to create an institution, AGRIVAR, which works closely with farmers, providing win-win chemicals application solutions, training on farm nutrient plans, etc. Therefore, the inputs used in the Vittel scheme and the final environmental benefits are all human-related (knowledge, institutional and social capital). Another interesting example for this sub-category is represented by Wessex Waters in the South of England (Code UK24), where the water utility pays farmers for substituting metaldehyde (a widely used molluscicide), with a more water-friendly pesticide (Wessex Water, 2013). In this way, farmers can still protect their crops from snails, while Wessex Waters avoids the risk of no-compliance with UK water regulators and decrease high costs related to metaldehyde water treatment.

The second sub-category of human services (34 out of 68), with a value of human capital equal to "high", includes schemes paying for services generated by capital works improvements (to avoid nutrients leakage), water channel fencing, monitoring activities for reducing forest fire (and thus reducing the risk on water quality provision), flood risk management activities, and forest hydrology engineer works. These schemes have the peculiarity of dealing mostly with ecosystem "disservice" (Lyytimäki and Sipilä, 2009; Zhang *et al.*, 2007) such as flooding and fires and/or often require high level of infrastructural investments. For instance, since 2007, Natural England established The Catchment Sensitive Farming Capital Grant Scheme (Code UK23). This agro-environmental scheme provides incentives to land managers in priority catchments to support the improvement or the installation of facilities that would benefit water quality by reducing diffuse pollution from agriculture (like water ways fencing, manure storage, etc.). In the same way but at regional level, Upstream Thinking (Code UK3), the most known PWS in the UK, operated by South West Waters (a water utility) in partnership with Westcountry Rivers Trust (charity organization), sets agreements with farmers providing incentives for capital work improvements that are directly linked with river and reservoir water quality. According to the UK Department for Environment, Food & Rural Affairs, Upstream Thinking is considered a proper PES scheme, because the capital works improvements go beyond the minimum legal requirements (the baseline). Farmers undertaking these grey infrastructure improvements directly contribute to improve drinking water quality and decreasing the cost of water treatment (otherwise beard by water utilities) (DEFRA, 2013b). A third interesting example within this sub-category is the Land Stewards scheme in Tuscany, Italy (Code IT5). The public authority in charge of managing the mountain river basin Media Valle del Serchio, has established agreements with about 40 farmers and forest owners in order to improve flood risk monitoring and control over 500 km of water ways within the mountain basin. Farmers are paid for monitoring and evaluating the degree of risk and for providing an alert-report service to the public authority on any situation regarding slope instability or waterways obstruction. Land Stewards scheme has contributed to efficiently decrease the flood risk and the occurrence of water damage related costs, providing the society with an environmental benefit resulting from farmer training, organizational arrangements and networks (Giani, 2012; OECD, 2013). The alert and control system works through an interactive Information and Communication Technologies (ICT) system (IDRAMAP) which helps land owners report and alert the public authorities and eventually deliver hydro-geological risk control of the district (Rovai *et al.*, 2013).

All three schemes are examples of payments for the provision of water related services that deliver environmental benefits and human well-being without any active management of natural ecosystems structure and functions.

4.2. EU PWS policy drivers and market outlook

In this paragraph we present the policy context and drivers, market actors and their characteristics, payments and investments scales at EU level. We also highlight some new trends at EU level giving the background to the following paragraph that better deals with typologies of governance models. All data presented are drawn from the online survey and a more detail institutional policy context analysis of several countries in EU.

Water Framework Directive & greening of European policies give light to future PWS

At European level, the policy context is increasingly providing a playground for the start-up of new PWS and the up-scale of existing ones. In fact, the EU water, biodiversity and Common Agriculture Policy (CAP) agendas are promoting several new initiatives and innovating existing financial instruments that will be likely to boost PWS as tools to meet water related goals and environmental conservation.

WFD looking for an ecosystem approach

In the late 2012 the EU has published the EU blueprint on water (European Commission, 2012). Despite significant improvements on water quality, just 53% of EU waters will achieve a good status by 2015. At national level, the lack of implementation of policies on water is often due to the limited use of economic instruments and poor local governance. Therefore, the EU Blueprint on water has stressed the need for a better horizontal integration with other policy areas such as CAP, Cohesion and structural Fund and renewable energy. With regard to the implementation of PWS the Blueprint set the agenda and a time schedule for implementing guidance documents on many relevant topics such as water trading schemes, water catchment accounts, Natural Water Retention Measures (NWRM), PES, among others[14]. Although not explicitly mentioned in the Water Framework Directive, the Ecosystem Approach appears to be a promising concept for the EC to help WFD implementation and the provision of ecosystem services at catchment level (Vlachopoulou *et al.*, 2014). In particular, two relevant initiatives from the DG Environment are promising for the development and promotion of payments for watershed services, the Pilot Project – "Atmospheric Precipitation - Protection and efficient use of Fresh Water, Integration of NWRM in River basin management" for collaboratively building knowledge and promoting best practice on NWRM in Europe[15]. A parallel study on "Integrating Ecosystem Services with Water Framework Directive and Floods Directive Implementation" has a specific focus on how to implement payments schemes at river basin level[16].

Linking water and biodiversity policy agenda

A favourable link between biodiversity policies and PWS is represented by the Habitats and Bird Directives that all together cover almost 18 % of the EU's terrestrial territory and 21% of EU's marine areas. These sites are facing both biodiversity and water related issues and, as our inventory shows, are often a good ground for the development of PWS. For example, this is the

[14] http://ec.europa.eu/environment/water/blueprint/index_en.htm
[15] For more information go to Natural Water Retention Measures website: http://nwrm.eu/
[16] For more information: http://www.watereco.info/

case of the SCaMP project of United Utilities in the North West UK, the Upstream Thinking project of South West Waters, where in both cases the relation with the habitat directive was crucial for their design and implementation (see next paragraph 4.4 on case study analysis). In order to meet with the directive requirements, management authorities have to identify the source of funding to manage their protected areas (through the elaboration of the so-called Prioritized Action Framework - PAF). Therefore the Commission, in order to raise private-public match funding has created a dedicated website, guidance and financing tools, encouraging members states and regional authorities to undertake innovative financing tools such as PES, visitor payback schemes and trust funds[17]. The elaboration of the PAF is now a prerequisite to accede to the Programme for the Environment and Climate Action (LIFE), the biggest environmental fund of the European Commission. In between 2014 and 2020 the fund is expected to provide € 3.4 billion which will mostly directed to Natura 2000 areas, with specific preference for project that will attract innovative governance/financing systems for environmental conservation and climate adaptation. A new type of regional project funded under LIFE, Integrated Project, will fund large scale interventions (€10-20 M per project) for targeting the Habitat, Bird and WFD directives and projects able to show a link between biodiversity conservation and the implementation of River Basin Management Plans. The fund guidelines require a special regard for evaluation, assessment and restoration of ecosystems and their services and increase of the contribution of agriculture and forestry to biodiversity.

The new Green Infrastructure Strategy (Green Infrastructure - Enhancing Europe's Natural Capital Strategy) approved by the EC in 2013 will seek to integrate green infrastructure within the existing funding mechanisms such as CAP, the Cohesion Fund, the European Regional Development Fund, Horizon 2020, the Connecting Europe Facility, the European Maritime and Fisheries Fund and the Financial Instrument for the Environment (LIFE). According to the strategy, the EC together with the European Investment Bank will set up an ad hoc EU financing facility by 2014 to support public and private organizations seeking to develop GI projects. Again, all these

---

[17] For more information visit Financing Natura 2000 website: http://www.financing-natura2000.eu/

public funds will look for possible match funding mechanisms, providing an opportunity for emerging PWS.

Considering that most of Natura 2000 areas are water related ecosystems, such as rivers, lakes, wetlands, peatlands, etc., many of the identified EU PWS have joined the support of the EU funds dedicated to Natura 2000 areas to cover start up, piloting and monitoring activities. The new trends highlighted above build a solid basis for future development of new PWS at EU level.

Matching CAP payments with Private Watershed Investments

In the new CAP reform, the expenditure for agriculture and rural development is financed by two funds. The first pillar, The European Agricultural Guarantee Fund (EAGF), is targeted to the provision of environmental public goods. From 2015 onwards, the CAP will introduce a new policy instrument in Pillar 1, the Green Direct Payment. Accounting for 30% of the budget, it will support permanent grassland, ecological focus areas and crop diversification, for a total budget of € 312,74 billion 2014 and 2020. The second pillar, European Agricultural Fund for Rural Development (EAFRD), focuses on 6 priorities of which one is dedicated to “Restoring, preserving and enhancing ecosystems dependent on agriculture and forestry”, with 3 focus areas i) Restoring and preserving biodiversity (including in NATURA 2000 areas and areas of High Nature Value farming) and the state of European landscapes; ii) Improving water management; iii) Improving soil management. Sustainable measures account for 30% of the total budget, which account for 95,58 billion euro between 2014 and 2020[18]. Several cases studies from our inventory have declared to use CAP agro-environmental schemes as match funding for sustaining the payments for watershed services.

For instance in the UK, almost all PWS are using the Catchment Sensitive Farming Capital Grant Scheme funds to help farm investing on capital works improvements and complement the payments of water utilities for improving water quality. Technical and advisory programmes, often financed by the Rural Development Plans, are providing capacity building and training to farmers

[18] For more information visit the CAP website: http://ec.europa.eu/agriculture/cap-funding/index_en.htm

participating in watershed payments. An interesting new measure of the CAP reform is related to cooperation among different actors for multiple purposes (Regulation (UE) N. 1305/2013 art.35, art.56, art.57). This measure specifically funds cooperation among farmers, forest owners and other actors, and among others actions, specify the use of cooperation projects for the improvements of water management.

Policy drivers: a snapshot at national level

Many EU PWS are often based on regulations that establish the right to economic compensation for legal restrictions toward drinking water source protected areas. This is the case of Germany (Article 14 Para.2 of the German Basic Law), Lower Saxony (Federal and Provincial States' Water Acts) and in Bavaria (Art. 36 a Para 2 of the Bavarian Nature Protection Act), Italy (Galli's Act indications - art.18 and 24, Law 36/1994), Netherlands (Groundwater Act 1981), Austria (Austrian Water Rights Act. article 34) and Switzerland (article 62 of the Federal Law on the Protection of Waters). In these cases the payments is targeted to cover the opportunity cost of farmers that face loss of income for legal restrictions on the use of agricultural inputs. Many of these regulations also introduce Water Levies (Netherland, Denmark, Lower Saxony, etc.) which helps to collect funds to reinvest in farmers compensations and other watershed management and monitoring.

An interesting PWS in Italy, Land Stewards, in the absence of a national law that regulate payments for ecosystem services, has made use of a national law[19] that establish the possibility for public bodies to contract private and public entities (thus including also farmers) to deliver landscape management works. This law was conceived in order to promote multifunctional agriculture but the concept of "provision of ecosystem services" is not properly achieved. Therefore, the contracts between public bodies and farmers refer to the number of hours of labour to carry out planned conservation works, instead of targeting the final ecosystem service provision.

[19] Decree 18 maggio 2001, no. 228 "*Orientamento e modernizzazione del settore agricolo, a norma dell'articolo 7 della legge 5 marzo 2001, n. 57*" and Law 97/1994 - Art. 17. *Incentivi alle pluriattività*.

In Spain, the new law for environmental compensation approved in 2013 has established the rules for creating a habitat banking system for the country[20]. New infrastructure projects will have to go through an environmental assessment and compensate the impacts on specific habitats (including water bodies, wetlands and coastal areas) therefore in the near future we expect the emergence of wetlands or habitat banks in the Iberian Peninsula.

As the Figure 16 shows, England is leading on PWS implementation and emerging mechanisms and we dedicate a special section to explain what the drivers look like in the UK.

PWS momentum in England

We have identified 16 consolidated and 12 pilot schemes in England counting more than one third of the total PWS in Europe. In 2011, the UK Department for Environment, Food and Rural Affairs (DEFRA) had committed to set up a business-led Ecosystem Markets Task Force, to publish an action plan, to expand PES schemes around the country, to create a new research fund targeted at these schemes and publish a best practice guide to design them (DEFRA, 2013a, 2013c, 2011). DEFRA has met all these tasks and has established a research fund that helps to set up new schemes around the country and to share the existing best practices. Moreover, in 2011 the Government's Water Strategy for England has set out Defra's proposals for expanding catchment management schemes to address diffuse pollution to achieve compliance with the requirements of Article 7 of the WFD. Despite these efforts, DEFRA lacked of a participatory approach during the development of River Basin Management Plans (RBMPs) and WWF UK and RSPB have suited the UK government for non-compliance with Article 14 of the WFD on Public information and consultation[21]. In 2013, in order to achieve an integrated catchment based approach according the WFD, DEFRA published the Catchment Based Approach policy framework and set € 2 millions start up funding to support the establishment of Catchment Partnerships. These partnerships have engaged with a number of local and national stakeholders at catchment level while creating the basis for the adoption of PWS through bottom up approach. In fact many of

[20] *Ley 21/2013, de 9 de diciembre, de evaluación ambiental*
[21] For more information UK compliance on WFD: http://www.eeb.org/?LinkServID=B1E256EB-DBC1-AA1C-DBA46F91C9118E7D&showMeta=0

the first 20 funded partnership corresponds with the existing payments schemes. Partnerships now exist in all catchments across England.

Another major driver in England has been the removal of a regulatory barrier. In fact, in the past, OFWAT the UK public water regulator did not allow water utilities to invest on catchment schemes because of concerns about subverting the “Polluter Pays Principle”. After the learning experience coming from the first two PWS in the country (SCaMP and Upstream Thinking, see paragraph on case studies) OFWAT now encourage private water utilities to invest on catchment management schemes to secure raw water quality where they believe this is an effective and cost efficient approach. As a result, water utilities responded investing € 77 millions on more than 100 catchment management schemes and investigations around the country in between 2010 and 2015 (OFWAT, 2011). We will therefore assist to an explosion of new schemes in the next two years as many PWS are still in the investigation phase.

England thus becomes a hotspot of PWS in EU. The government under pressure of the WFD and environmental lobbers is creating an enabling policy framework while providing funding for investigation, best practices and pilot of catchment partnerships and payment schemes. The private water utilities are willing to invest millions of pounds in order to save operational and capital investments and deliver multiple benefits at catchment level, changing the traditional approach to chemical water treatment toward a more integrated catchment management. The water regulator, allows these investments only if they demonstrate to be cost effective in term of achieving water quality goals, thus inducing private companies to carry out baseline assessment study, investigation on pollutant dynamics at catchment level, and cost benefit analysis[22] of the payment schemes in order to ensure the best value for money (Natural England, 2014; OFWAT, 2011). On the other hand, a very well organized civil society engages and sets up collaborative learning processes through farmer’s organizations, wildlife and river trusts, national parks and local authorities.

[22] The Benefit Assessment Framework is a tool that potentially allows catchment schemes to be evaluated in a standard way and its use is encouraged http://www.waterrf.org/ExecutiveSummaryLibrary/4393_ProjectSummary.pdf

Other key drivers

A key identified driver is the risk of non-compliance with increasingly demanding drinking water quality standards and coupled with increased uncertainty derived from climate change. Both water quality and quantity are often perceived at risk and operational and capital cost for delivering drinking water and other services are becomes a playground for competitiveness and profitability. Some water utilities have reported to adopt PWS for potential future water-quality risk, where they see that in 10-25 years time there might be and increased probability of nitrates or pesticide risks.

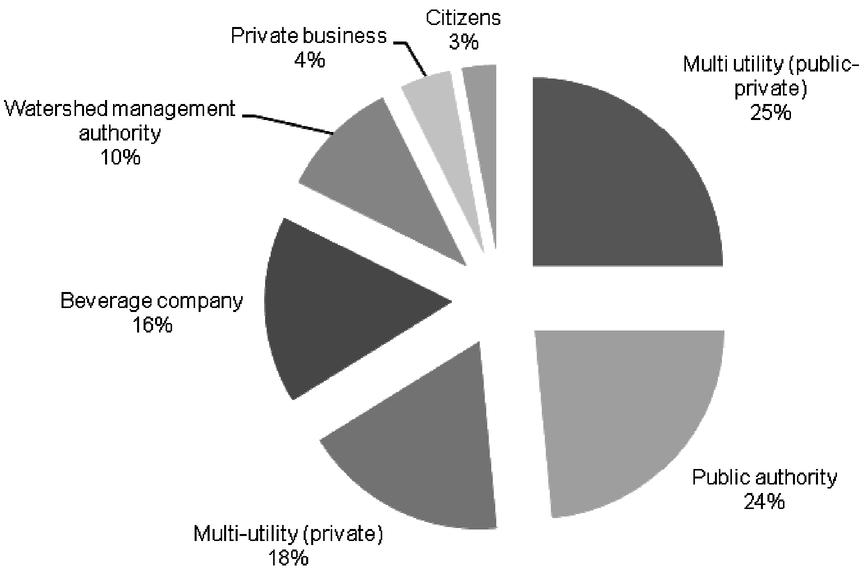
Within water utilities payments schemes are in some cases reported as part of a broad CSR organization strategy, to increase social acceptability and the overall sustainability. For example, United Utilities is a company listed in the Down Jones Sustainability Index and the SCaMP programme is one of the elements that contribute to its sustainability performance evaluation. Both Upstream Thinking and SCaMP, as first best practices in the UK, have won several awards for sustainability performances and wetlands restoration.

Actor’s analysis

Service providers are mostly private (81%), only 22% are public, mostly forest managers. Civil society organization and partnership account only for 7%. Most of service providers are farmers for 43%, 21% of programmes targets both farmers and forest owners, while only 13% targets forest managers only. Farmers often manage the most sensitive areas in term of water quality and they are often the source of water issue targeted by the PWS, through overgrazing, use of fertilizer, pesticides and herbicides. Therefore, they are the most frequent service supplier. Public suppliers are mainly water utilities, which directly own or manage the land or natural ecosystems that provide raw water. In some cases public suppliers are local municipalities often owner of forest lands such as in the case of Romagna Acque spa scheme in Italy which pays forested municipalities around the reservoir to improve forest management and deliver other forest-hydrologic engineer works (Pettenella *et al.*, 2012). Non-profit suppliers are found only in United Kingdom, they are mainly charity organizations owning or managing high conservation values lands (parks, forest, wetlands, etc.) such as in the case of RSPB and Wildlife Trusts.

Although PES are often described as market based mechanisms for environmental conservation in this research we prefer to see them as a mix governance model between market and hierarchy (Muradian and Rival, 2012). In fact, most of the considered schemes are public managed. Service buyers are mostly dominated by public sector (about 60%), 25% are private multi-utility but publicly owned, 24% are public authorities such as municipalities, and 10% are public watershed management authorities. Private sector account for almost 38% including private businesses, beverage companies (distributed among water bottle companies such as Vittel, Danone or other beverage companies such as Coca Cola Portugal and Bionade in Germany) and private multi-utility. Citizens that directly pay for the service provision account only for 3%, therefore in just one case. Figure 23 summarises the share of main buyer types. PWS have always multiple buyers, however for this category we choose the most important buyer in term of investments for each of the PWS.

Figure 23: Share of main buyer types



Intermediaries and project support

European PWS work with a very high spectrum of organizations starting from Civil Society Organization (CSO) (environmental charities, river trusts, farmers association, etc.), public sector (government agencies, local authorities, parks and protected areas offices), universities and consultancies. According to our analysis, the main intermediary is often a CSO for the 39% of the schemes, a public sector organization for the 30%, and for the 31% it is a partnership of several organizations, where the local authority, charities, regional parks and farmers associations form a formal association for the management of the scheme.

Farmers associations and their advisors are essential both in design and implementation phases in order to adapt PWS schemes to farmer's needs and views, i.e. increasing system's acceptability (such as Coldiretti in Italy in the case of Land Stewards, code IT5). In the case of Munich PWS, the acceptability of the scheme has increased thanks to the collaboration with organic farmers associations, as they could provide marketing co-benefits for those farmers that entered into organic agriculture schemes funded with water levy (code DE1). Many private and public investors (buyers) lack of local knowledge both in term of social (knowing how to engage with locals and using the right approach/wording) and ecological perspective (micro-scale catchment morphology and functioning). Their non-profit nature often increase the trust with landowners, therefore many private investors contract these associations to deliver payments or to carry out farm advice plans, monitoring and promotion. Environmental charities, depending on their level of activities, sometimes provide a similar role to farmer's associations. However, they are reported to be more active in political support to increase the scheme acceptability by national and regional agencies, such as the Royal Society of Protection of Birds in the UK, which was fundamental in the development of SCaMP of United Utilities (code UK20). They often provide start-up funding and are able to engage with a number of local, national and international stakeholder groups, such as in the case of WWF in the Danube PWS pilot (codes BH1, RO1, RO2).

Government agencies are often providing funds (for example, DEFRA pilot funds) legal advice and back up regulations (all PWS based on Water Acts). They are reported to be one of the main actors for schemes that provide joint PWS - CAP payments. Sometimes for public subsidies or programmes that provide match funding with CAP, monitoring activities are delegated to government payment agencies. Environment agencies are often taking part of monitoring the hydrological outcomes of some programmes. While local authorities, mainly parks and protected areas authorities, engage at design and implementation level, providing a very similar role as of farmers associations.

Eventually, universities and consultancies are often taking part of design process, for example in the case of Fowey River scheme, University of East Anglia was contracted to create an auction based system, and in most of the pilots project in England. They often carry out monitoring activities and support the cost benefit analysis of programmes. Consultancies are in some cases contracted to create participatory mapping approaches, elaborating viability studies, and trying to integrate PWS goals with other national policies and local planning tools.

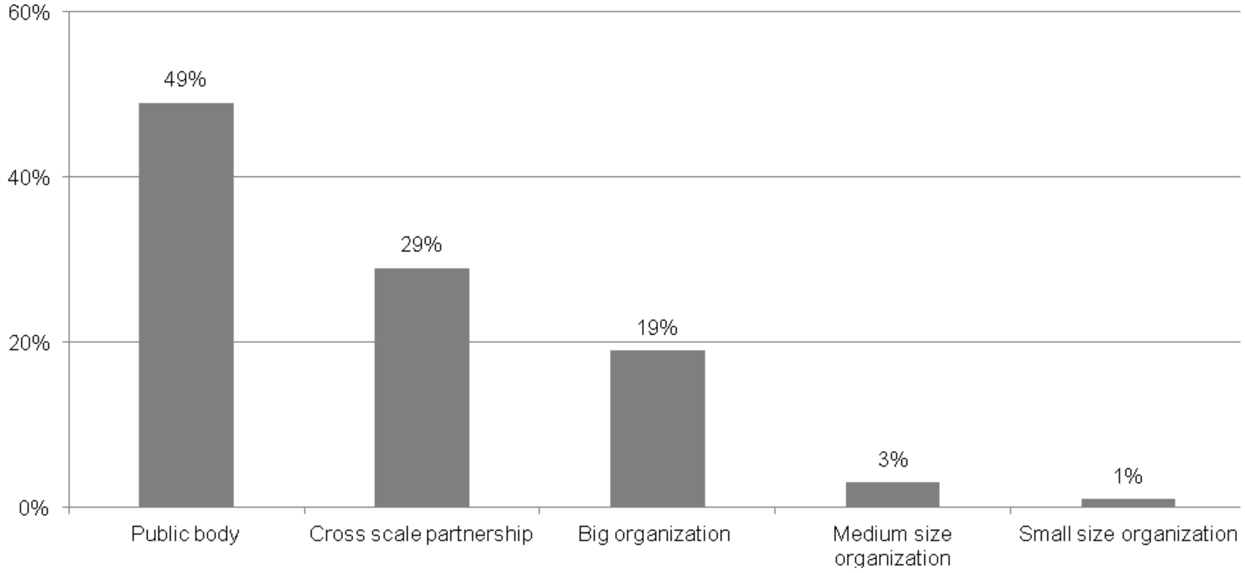
Each intermediary organization is often participating within the scheme in order to represent its own institutional goals and views. From farmer's lobby, to scientific interests, to biodiversity related goals, for profit business, etc. Most of the considered PWS, thanks to intermediaries organizations and their "glue role", has proved to be a "social infrastructure" useful to aligning different interest into community shared plans and goals to deliver multiple benefits projects, among multiple actors.

Capacity and scale

The concept of scale is central in analyses of institutions for environmental governance. Figure 24 thus analyzes all PWS depending on their institutional scale of the programme administrator. We considered the institutional scale a proxy for determining their capacity. The assessment shows that public bodies directly manage 49% of schemes; however, 29% are managed by cross scale partnership, which through collaborative approaches provide better coverage and capacity. When the private sector is involved, mostly only big organizations such as multinational companies such as CocaCola, Danone, Bionade are managing PWS.

Small and medium size organizations account only for 4% of the total. Therefore, we can draw a simple conclusion that successful and existing schemes in Europe are mostly managed by organization with strong financial, territorial and technical capacity such as national, regional and municipal authorities and big private organizations.

Figure 24: PWS type institutional scale of the administrator



PWS schemes are implemented at different spatial and administrative scales; they vary from small catchments areas of a municipality to national wide programs. However, whatever the administrative boundaries, they tend to be applied at significant hydrological scale in order to have an impact on the ecosystem provision, and fit the peculiarity of each hydrological services and spatial conditions. Therefore, they are often implemented at catchment level, aquifer level, or river basin level. Some programs are acting also in more than a river basin but they adopt specific and targeted measures. **Table 17** shows the share of programs by administrative and spatial scale. All local classified programs (catchment or sub-catchment) are private driven and voluntary programs, where a specific interest of a water company is funding the program at local level. Most of municipal programs are related to cities that are paying or investing for securing water quality provision, especially for groundwater quality protection. All 11 public national wide programs are enforced under a regulated framework and half of them are mandatory.

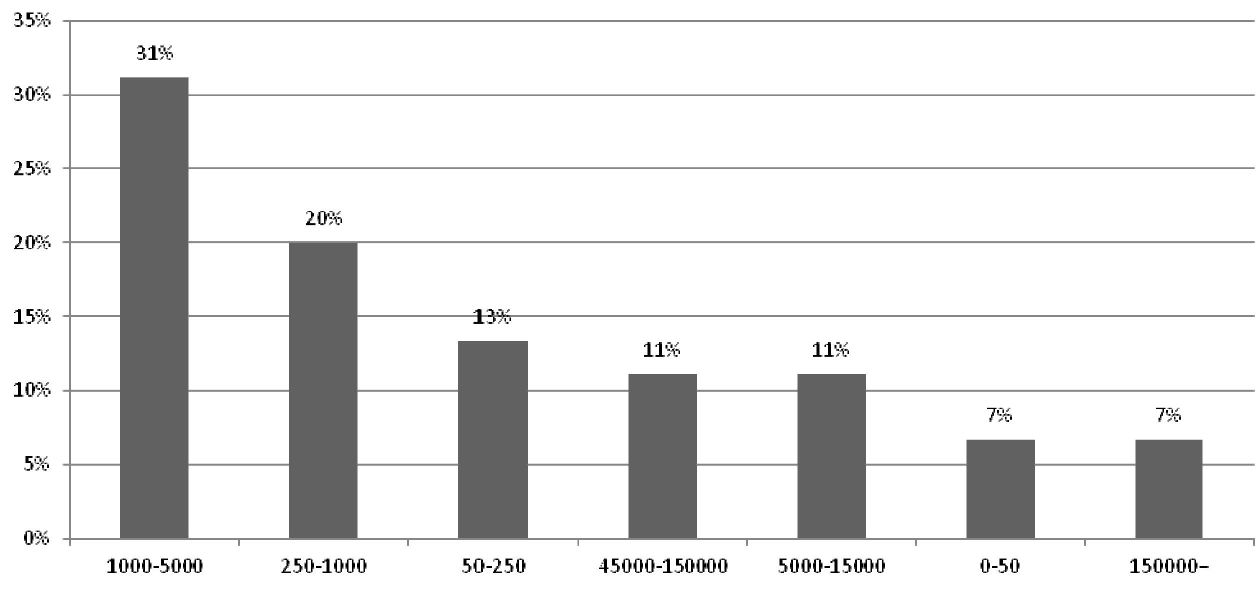
Table 17: PWS programs by administrative and spatial scale

Type of scale	Spatial administrative			Spatial implementation		
Level	National	Regional	Local (Catchment)	National	Regional	Local (Catchment)
Percentage	17%	45%	38%	5%	17%	79%
Observations	11	30	25	3	11	52

Therefore, the river basin and or the catchment are the preferred spatial scale for the implementation of programmes. When programmes have regional or county scale, they are often targeting specific sensitive areas or catchment within the region. Also in the case of national programmes such as the Catchment Sensitive Farming programme in England, the scheme is targeting 66 priority catchments to help meet the requirements of the Water Framework Directive (WFD) and improve freshwater Sites of Special Scientific Interest (SSSIs), where evidence suggests that pollution from farming practices impacts significantly on water quality and aquatic habitats. Overall, PWS are catchment specific and within the same programme we find several adaptation and design mechanisms which are strictly connected with the scale of the catchment[23] (large catchment are more suitable for auction design system, while small areas are better addressed with advisory-led schemes), the type of ecosystem (agricultural, forest or wetlands) and the targeted hydrological services.

We then analysed the area covered by each PWS, and classified them as shown in Figure 25. Almost 30% of schemes cover areas in between 1.000 to 5.000 hectares; other 20% cover an area in between 250-1000 hectares. Therefore, most of the programmes are small or medium sized. However, both large scale (>150.000) and micro scale (0-50) account only for 7% each.

Figure 25: Frequency of spatial scale of PWS programmes (hectares)



[23] Day, B., Couldrick, L., 2013. Payment for Ecosystem Services Pilot Project: The Fowey River Improvement Auction. Norwich, UK.

Schemes were also assessed against their time scale and there is an equal distribution among those that are considered long-term (more than 10 years of activities), medium term (in between 5 and 10), and short term (less than 5 years). Historically taking into account the self declared data on survey and data provided in the literature review PWS in EU have covered around 2.360.582 hectares.

EU snapshot on PWS transactions

Across the 76 identified programs in 2013, data on payments for 2013 are available only for 19 out of 68 ongoing projects, totalling around € 44.7 millions (Bennett *et al*., 2014b). Actual figures are probably much higher, as accurate data are missing for 50% of the active programmes and transactions are still not available for pilot projects. However, if we consider all transaction from the last year available we make up to € 164 million/year (considering values reported by 28 projects out of 68)[24]. Similarly, making a projection on number of years of activity per scheme, declared last annual payments and/or historical transaction reported, historical payments are conservatively estimated to be up to € 1.64 billion.

In many cases, the nature of PWS in EU makes very difficult to give an exact estimation of transactions, especially when the programmes are collecting funds from more than one source or when they are implemented by several organizations, as in the case of multiple benefit partnerships (see next paragraph for typologies of governance models). Besides, some PWS are targeting rivers, providing data on kilometres of watercourses restored instead of providing data in hectares, such as in the case of “Land Stewards” in Italy (IT5) and the “Angling Passport Schemes” in England (UK2).

Transactions by type of buyer/investor

In 2013 public sector, still keep the leading on demand and finance of PWS. However, compare to the last 2012 State of Watershed Markets private sector consolidate its position in term

[24] Transactions have been collected both from the data provided on the online survey and in the literature review.

of both number of investors and share of total funding, accounting for 35% of total transactions. Business is a major force behind investments in natural infrastructure for water in Europe, delivering almost € 7.7 millions in 2013 to PWS. National government schemes provide the bigger share in term of funding while other non-profit, households and other public funding are not significant in term of transactions. Public investors are often national, regional or local governments or their public owned water utilities. Private investors are equally distributed between private water utilities and beverage companies (such as Coca-Cola France and Portugal, Bionade in Germany, Vittel and Danone in France, and Norda in Italy). However, the latter are often not significant in term of transactions, and in some cases, the schemes are better described as CSR projects than as investment/payments on watershed.

Figure 26: Investors by sector, by share of all investors, and by share of total funding in 2013

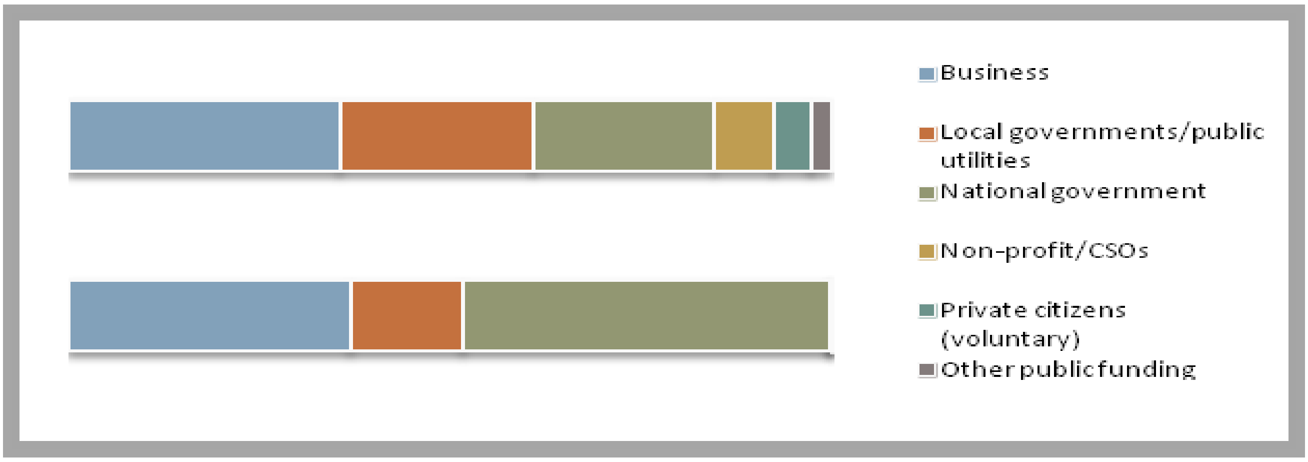
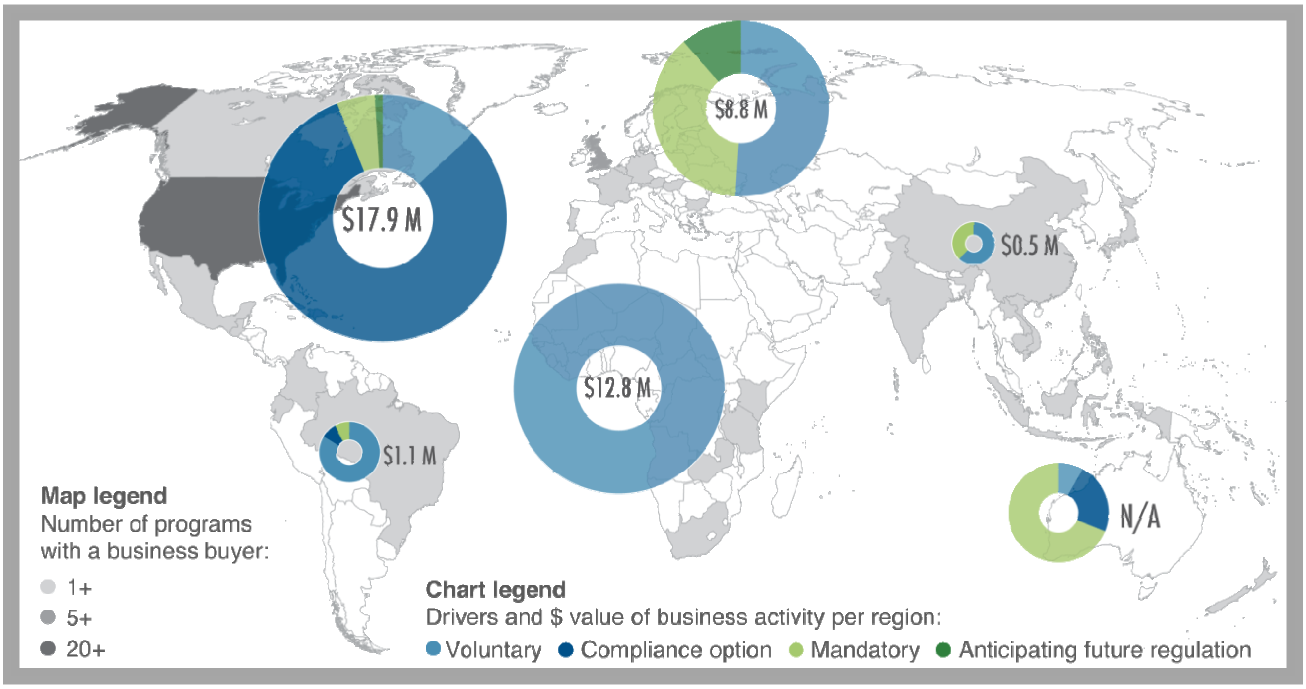


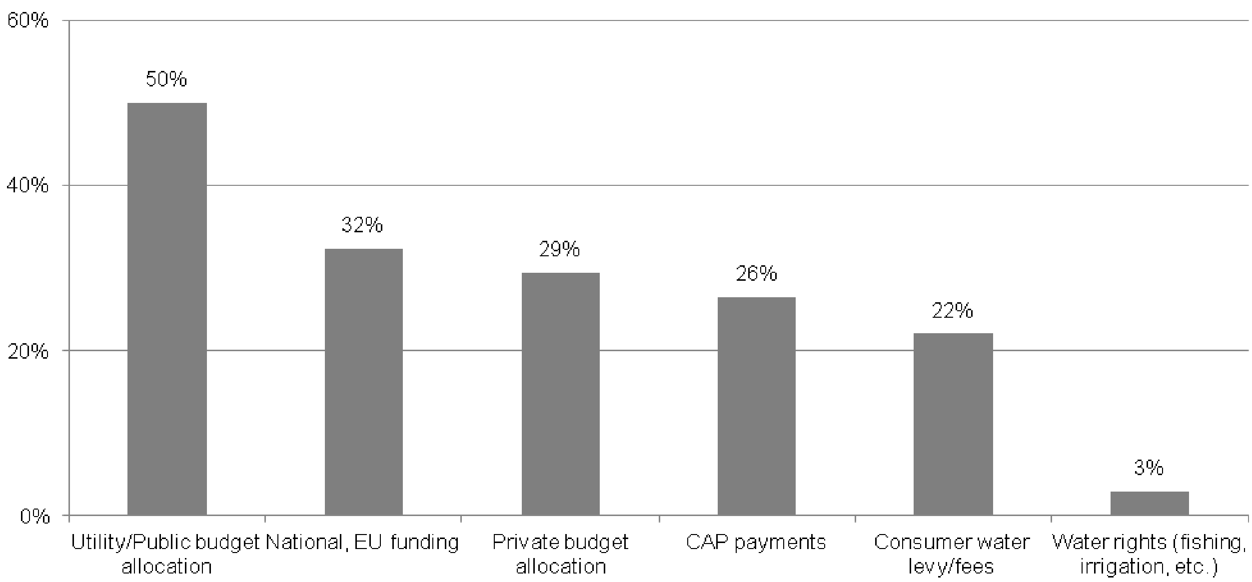
Figure 27 compare the European private investments with investments worldwide. Contrary to what it was expected we can see how EU plays a major role within PWS transactions. In fact EU has been always seen as mainly public driven market for watershed services. However, the role of private water utilities in United Kingdom backed up with some private bottle water companies pushed up private investments.

Figure 27: Private investments by continent, role of EU (2013)



In total 55% of inventoried programmes declared to use multiple source of funding, while the remaining counts on one main financial source. Figure 28 shows the frequency of source of funding. With the emergence of partnership schemes and match funding systems PWS have generally declared a main investors per project; however many schemes have reported the use of funds from EU projects, CAP payments and other local spot-donors which are more difficult to track.

Figure 28: Frequency of source of funding of PWS



The most frequent source of funding is the utility or public budget allocation, accounting for half of the schemes. National EU funds are also the second most frequent source of funding and these are usually helping on the start up phase of new PWS. CAP payments are also coupled with other public and private sources and are usually a component of the payments. Consumer's water levies, although they are less frequent, they are capable to collect the biggest amount of investments. Just to mention the lower Saxony scheme invests by its own almost half of the total budget invested in EU (about 20 million euro/year).

Overall investors have already committed € 38.6 million in between 2014 and 2020. The share of project investors who have committed future funding is around 38%. Private sector seems to provide more certainty on future funding commitments. It is worth noting that (out of fourteen totals) five private sector investors have committed 100% of project funding. Perception in regards to public sector funding is often undermined by political instability and funds are uncertain especially in between the last EU funding period (2007-2013) and the new one (2014-2020).

All business buyers tracked are either private water utilities (mainly in England) or beverage companies. Beverage companies include Coca-Cola bottling companies in France and Portugal, Bionade in Germany, Vittel and Danone in France, and Norda in Italy. Contrary to other regions where private sector contributions are relatively small, business delivers at least two-thirds of funding in half of the programs in which it participates.

Among the top five motivations reported by investors, we found a clear link between water quality and biodiversity protection, followed by water availability risk as the major drivers for investments. This is certainly in line with the policy context where both water and biodiversity agenda are creating synergies and match funding opportunities.

Regulatory compliances, Corporate Social Responsibility, reputational concerns are also very important drivers that emerge from European investors. Revenue opportunities connected with saving on operational and capital investment is certainly the first driver for private water unities, which is strictly connected with the water quality/quantity risks and regulatory compliance duties.

Payments

Service suppliers are paid following the modality "input-based" rather than out-put based. Farmers and forest owner are paid based on the management practices they implement regardless the outcomes in term of services. And this confirm the trend found in other studies (Martin-Ortega *et al.*, 2013; Schomers and Matzdorf, 2013). Only in 2 cases out of 68, suppliers are paid based on real programmes outcomes. These are the case of the Angling Passport Schemes in UK (code UK2) and the Visitor Pay Back scheme (code UK15), as in both cases buyers are paying for the recreational services they actually enjoy, such as access to fishing areas and recreational services around the lake areas. Therefore, most of the schemes are based on rewarding proxy management practices that in theory should increase the level of service provision.

Cash is the most frequent way to reward service providers, accounting for 49% of the schemes. Only 7% are providing in-kind only, in forms of training and inputs, such as in the case of substitution of traditional pesticides with more water-friendly ones or through the instalment of capital works investments at farm level. Compared to other studies where schemes reward by cash or by providing in-kind inputs (Martin-Ortega *et al.*, 2013; Sattler *et al.*, 2013), Europe provide a very clear trend where payments are usually (44% of schemes) coupled with in-kind services or inputs.

Pay frequency is periodical (annually) in the 70% of cases while in 30% is considered one-off payments, especially for those capital works investments that aim to improve the farm infrastructures conditions, in order to improve water quality. Also in the case of afforestation we find one-off payment mode.

Considering the pay time, it's interesting to note that only 19% of schemes pay upfront, while 77% pay after the adoption of management practices, and only in very few, the payment is delivered after the provision of the service (corresponding to those two above mentioned case studies were payment is output based). In order to increase the efficiency and additionality of the payments almost 92% of schemes have proved to have a sort of system to target payments to those suppliers or areas, which are likely to be more effective, for soil or specific baseline conditions. Table 18 provides an estimate of average minimum and maximum payments per-hectare based management practice or for no-hectare based, such as capital works, fencing, etc.. We used both data collected through the online survey and the literature, extrapolating some values when both the value of total yearly transaction and land covered were available. Although the number of observations is not high, the reported figures are quite realistic. Many schemes apply price differentiation, providing a portfolio of different management practices, sometimes the adoption of two or more management practice bring an increase of the payment, although not always linear.

Table 18: Buyer payments and seller receipts (last year available) - (€/year/ha)

	Units	Min	Max
Hectare based management practices	Average €/ha	69	839
	Min/Max €/ha	15	6.936
	N° of observations	11	24
Capital works or other no hectare based practices (fencing, capital works, etc.)	Average €/Intervention	1.404	29.900
	Min/Max €/Intervention	35	60.000
	N° of observations	8	10

Many are the factors that influence the payments and these are found in the literature of other inventories reviews: the type of management practices, land features, the number of adopted management practices, the size of the area landownership, previous interventions in the area, or the environmental quality of an area.

We also tried to analyse payment amount in relation to costs of ES provision, therefore not providing an economic estimate but considering the aim of the payment. Payments aim to pay above the cost of the service provision (therefore tending to provide a profit to farmers) only in 19% of the cases. While in the majority (44%) the payment is direct to fully cover the cost of service provision (implementation of management practices, or opportunity cost): However, 35% is providing only a partial cover of the cost.

We tried to classify the main aim of payments in each scheme and 27% of PWS aim to avoid negative externalities of farmers, while 13% compensate the opportunity costs for loss of income for legal restrictions (where farmers have to respect a more strict environmental standards compared to others), and 9% aims to compensate negative impacts, such as in the case of CSR investments/offsetting of beverage companies (CocaCola or Bionade in Germany). Only 17% has as a main goal to provide additional positive externalities, such as an improvement or maintenance of hydrological services. These results show how weak are the fundamental basis of many PWS schemes in EU. They are often not funding the direct provision or maintenance of an ecosystem services, on the contrary they are paying to avoid water contamination, to compensate both opportunity costs and water footprint. Can we consider all these schemes at the same level? This is a question better addressed within the next paragraph on typologies of governance models, where the aim of the scheme is a main factor to distinguish and classify them.

Water outcomes: do investments pay back?

Overall, 50% of European programmes (without considering the pilots case studies) have reported to be successful and therefore meeting water quality goals in a cost effective way. Most of the programmes seem to have conducted a sort of piloting phase or feasibility study before the actual implementation. 35% of programs have measured direct outcomes; however, outcomes are often measured in term of proxy management practices rather than effective hydrological monitoring. According to the attached report from Ecosystem Marketplace, program administrators have reported between 10-30% reductions in nitrates, 871,503,531 tons of avoided sediment loading (~33,500 Titanics full of sediment) and 429 ML of groundwater recharge (~172 Olympic swimming pools). However, these figures are far to be accurate, as many program managers have reported that results from monitoring is often catchment and climate dependent. Hydrological indicators change depending on the morphology and rainfall, project manager usually stated that outcomes are site and year specific. Especially when working on diffuse pollution, a change on the behaviour of few farmers in the catchment can provide significant changes on hydrological outcomes of the PWS. Outcomes are often under a high level of uncertainty. This has been a major limit reported by several programmes, uncertainty is not recognized by regulation and water quality standards, therefore many water utilities cannot rely only on catchment management to ensure water quality as for their low level of assurance. It is interesting to note that in the UK, OFWAT the economic regulator, ask water utilities to conduct hydrological baseline and cost benefits studies before undertaking catchment management schemes. If hydrological outcomes are difficult to demonstrate, the utilities will not be able to invest.

Multiple benefits outcomes

Almost all programmes are in a way persecuting climate change and/or biodiversity co-benefits. Some have specific link with biodiversity conservation programmes especially those schemes that use the ecological restoration of natural water rich ecosystem such as wetlands, rivers, peatlands and moorlands. In the United Utilities SCaMP programme, modelling of peatlands carbon fluxes predicts that restoration measures undertaking on 57.000 hectares will reduce greenhouse gas emissions by up to 544 tCO_2e/yr[25]. However, these co-benefits are always covered under the same funding as watershed protection activities. Same project managers have reported that biodiversity and climate co-benefits increase social and political acceptability of the schemes and increase the number of stakeholders interested to engage or willing to provide funding. Collective action funds are examples where climate and biodiversity organization are aligned with private companies to pursuit different aims but through a common project.

Social outcomes are also considered multiple benefits; as previously mentioned PWS in Europe represent a consistent environmental fund for farmers (€ 44.7 million in 2013 for land owners), especially for those located in upstream catchments often related with low accessibility and income level.

Some programmes based on local partnership reported the benefits in term of increased social capital and collective learning. Increasing the collaboration and trust among different organization, at horizontal and vertical level, certainly bring both benefits for the success of the scheme and the society as whole.

---

[25] United Utilities corporate presentation based on Worrall (2012).

Economic outcomes

Economic drivers are certainly important within European programmes; many water utilities are driven by the increasing operational and capital cost of water treatment. The potential business risk associated to non-compliance with drinking water quality standard is reported as inestimable value. Moreover, there is an increasing request from regulators and or investors for performances monitoring and cost benefit analysis.

Land stewards project in Italy has reported a saving in operational cost of 1 to 4 (with or without project scenario). In fact, farmers provide a decentralized monitoring and management of water channels avoiding all cost of displacement within the large mountain catchment.

South West Water indicates that reducing pollution at source rather than investing in engineering solutions to treat polluted water downstream has a benefit-cost ratio of some 65 to 1. In addition, the scheme is expected to deliver up to twenty percent savings in the operational expenditure of existing water treatment plants.

United Utilities CBA demonstrate how the positive cost-benefit ratio is given by the inclusion of multiple benefits such as carbon and biodiversity. Operational and Capital saving were considered very law because the methodology took into account only those investments and operational cost directly linked with the color removal and waste treatments, thus not considering BAU investments in new machineries. Therefore, climate and biodiversity SCaMP co-benefits strongly contribute to the economic sustainability of the programme, providing suggests a range of benefit to cost ratios between 2.24 to 25.38 (considering different optimistic and pessimistic scenarios in term of GHG, biodiversity and water quality response).

Wessex Waters, with its Metaldehyde focused programme documented a benefit-cost ratio 6:1 compared to the water treatment plant option[26]. In fact conventional water treatment methods are not effective to remove this particular pesticide, therefore the entire cost of a new treatment plant was considered in the “without catchment approach” scenario.

---

[26] Wessex Water, 2013. Catchment management managing water – managing land, 2013. Bath, UK.

Overall, results on cost-benefits analysis depend on case by case and on the boundaries of cost and benefits considered during the study. PWS are not always a better economic option compared to conventional water treatment, however if we consider the co-benefit in term of social, biodiversity and climate outcomes, payment schemes are certainly a valuable options to address water quality and other policy goals.

Monitoring and evidences of ES provision as successful factors

All water utilities are by law monitoring water quality and potential shortage risks. However, when it comes to monitoring the effects of a catchment management scheme, project managers experience problems on setting the baseline scenarios. In fact, high variability of climate conditions (abnormal increase of annual rainfall, draughts, etc.) might change the hydrological baseline for certain parameters. Yet, the annual monitoring of the effects of a certain indicators might vary depending again on climate conditions. Under the uncertainty of climate change, it is rather difficult for project mangers demonstrating project outcomes in term of hydrological response to the management practices induced with the payments. Therefore, monitoring and outcomes results are often reported in terms of hectares of woodlands, wetlands restored, hectares of farmlands under the schemes, etc. rather than in term of hydrological attributes and services.

Hydrological monitoring is relatively costly. As an example, United Utilities has reported a monitoring cost of 10% of the whole programme for the phase 1 of the project (out of $15M for 2005-2010). However, in the second phase (2010-2015), by selecting only some model catchments and concentrating monitoring only on few hydrological parameters cost decreased to 4% of the total programme investment.

Projects located in small catchment or with a relative small number of service providers suggested that increased trust (among scheme participants) decreases the cost of compliance control regarding the actual implementation of management practices. In this situation, the “community control” increase and free riders are often reported by “good farmers” to the scheme manager.

Some scheme managers have reported the use of commodity certification standards as a tool for decentralized compliance monitoring and to increase win-win benefits for farmers & forest owners. Lower Saxony scheme and City of Munich in Germany are providing, among the portfolio of management practices, a payment for organic agriculture on groundwater recharge areas. Norda water (Monticchio Gaudianello) in Italy has a scheme based on organic certification of spring water catchments and promoted on the bottles' label, using it to show corporate environmental responsibility to its customers. Fowey River scheme in South West England is also exploring to set a payment for pesticide risk control by using organic agriculture for upstream farmers. In Portugal, Coca-Cola is paying Forest Producers Association of Coruche (APFC) for improving the forest management of cork forest using FSC certification standards.

Schemes that work through match funding with CAP payments often let the compliance monitoring to be executed by the payment agency in charge of controlling the correct use of EU funds. Therefore, the scheme manger relies on the activity of the government agency, saving on monitoring and enforcement cots.

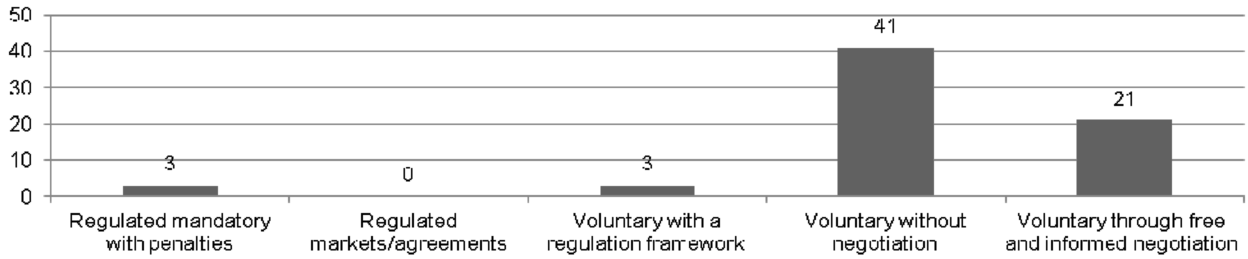
4.3. Characterization and description of identified governance models

In this paragraph, we assess the PWS against the four principles of PES theory using the method explained in paragraph 3.6.2 (Governance assessment for PWS schemes). Secondly, following the conclusions of the first assessment we identify several typologies of PWS in Europe and characterize the main governance models.

All inventoried PWS but those in design phase have been assessed (n°=68) against the four principles of PES theory, namely voluntariness, directness, commoditization and additionality. The following tables show the results of the evaluation and characterise the distribution of PWS according to the classified governance arrangements.

Most of PWS in EU are voluntary (41 out of 68) but agreements are set without a proper free and informed negotiation process. This means that there is a main buyer (often a public authority) that sets the price at which the service suppliers have to provide the service. Usually, programmes are designed without a participation process but through a “take or leave” approach. In some cases especially where farmers associations and other CSO are involved in the process, service suppliers obtain more room for negotiation and to design the scheme and set a fair prices that correspond to their cost or willing to stay in the agreement (21 out of 68). Three schemes are mandatory by law and associate with penalties for those that do not respect restrictions, such as use of fertilizers or chemicals in groundwater protection areas. Figure 29 shows the distribution among different categories.

Figure 29: PWS degree of voluntariness



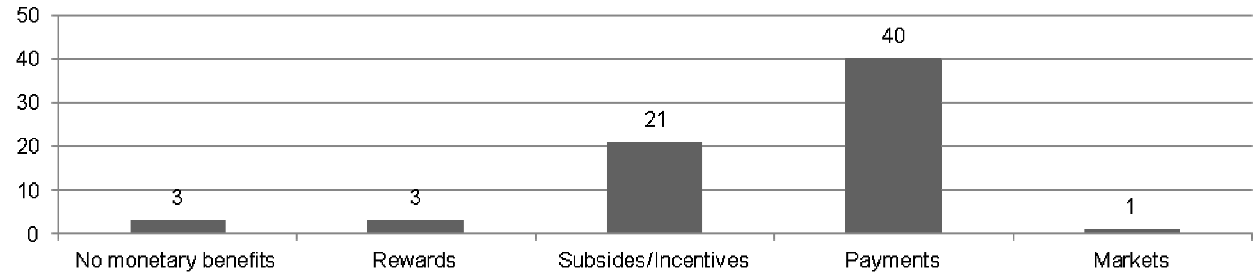
Regarding the level of directness, we found two main groups, the public and the private driven schemes. The public-driven are divided into “public procurement” (26 out of 68) and “scope taxes” (11 out of 68) based schemes. The former are the less direct payments, with public budget allocation where the municipalities or the public water utility pay service providers on behalf of the final beneficiaries (citizens). Final beneficiaries are not willing to pay more for the service they receive nor are aware of the payment scheme. The “scope taxes” (water charge) related schemes have more directness between service suppliers and beneficiary. The link between the two parties is based on the application of a “scope- tax”, such as in the case of German schemes (Lower Saxony, Munich, etc.). Water bill payers find in their invoices a charge that goes directly to fund the PWS scheme. In this case, final beneficiaries are aware and “willing” to pay farmers and forest owners to improve hydrological service provision.

The second group is related with private schemes. Beneficiary pay funds (12 out of 68) are less direct of bilateral agreement as an intermediary is connecting the beneficiary to the service providers, while the private bilateral agreements are payments directly from the final beneficiary to the service providers (17 out of 68). Figure 30 shows the distribution among different categories.

Figure 30: PWS degree of directness

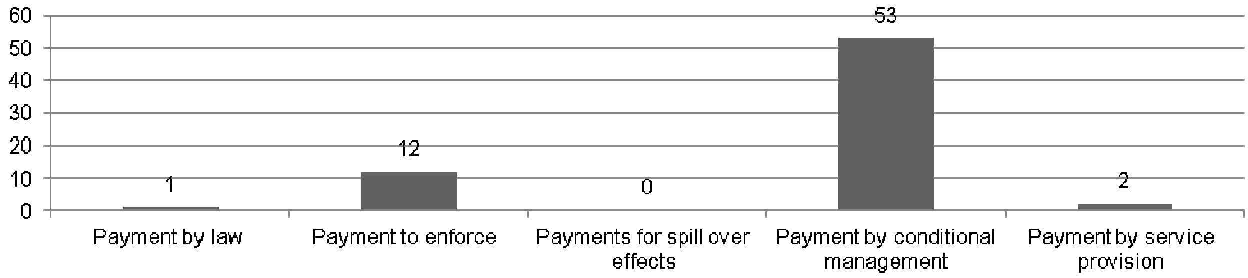
The degree of commoditization is related with the payment amount in relation to the cost of the service provision. As we previously stated many schemes cover or partially cover the cost for service provision, others provide in-kind services only. However, 40 out of 68 have been classified as payments, therefore providing monetary payments that aim at cover the full cost of service provision and in some cases providing a monetary benefit for the service providers. The following figure provides the distribution among different categories.

Figure 31: PWS degree of commoditization



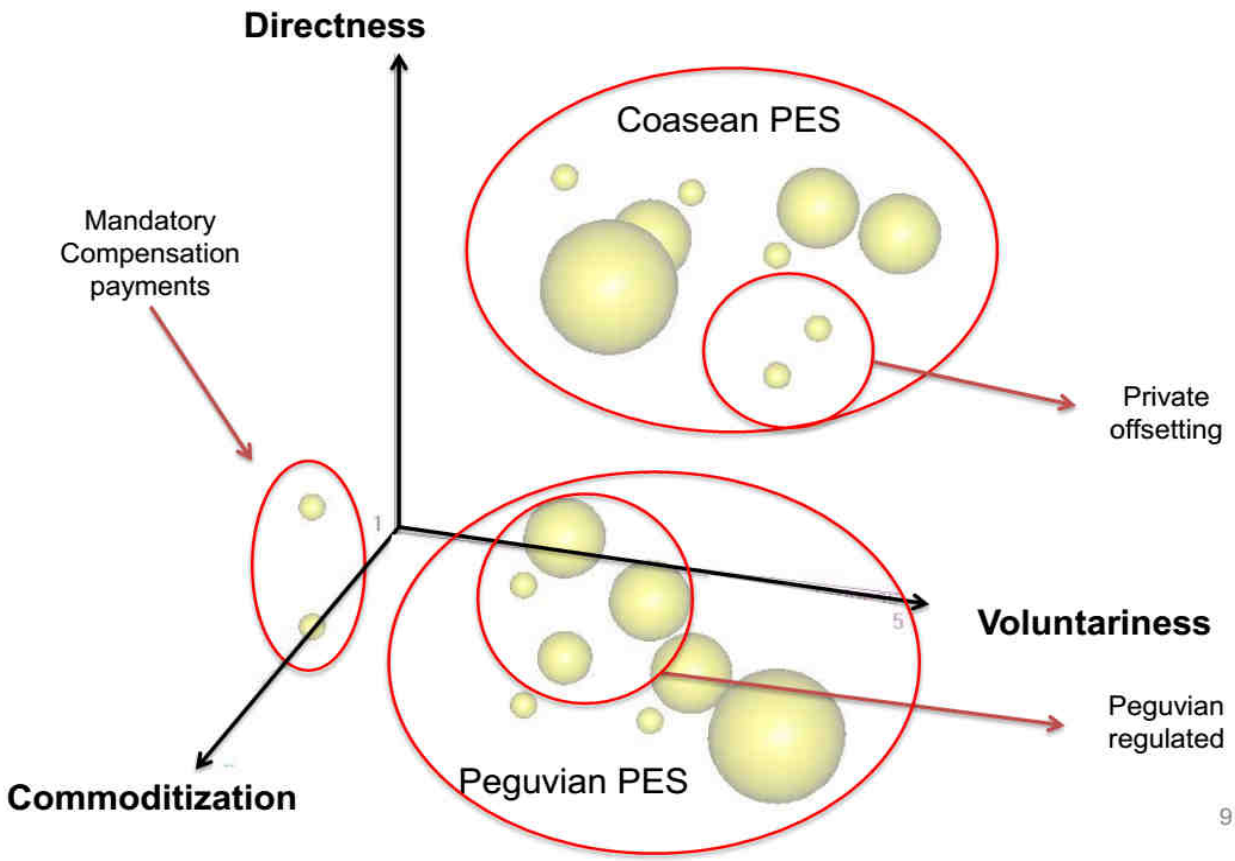
The analysis of additionality does not show a high diversification. Mostly, we find two types of schemes, the ones where the payment is related to the enforcement of the law (where therefore the additionality is theoretically very low, as service providers should already meet the requirements) and the ones where the payment is conditional to the implementation of the management practices. The latter is the most common type of payment. Only in two cases, Angling Passport Schemes in UK (code UK2) and the Visitor Pay Back scheme (code UK15), the payment is conditional to the service provision, as in both schemes buyers are paying for recreational services they actually and immediately enjoy, such as access to fishing areas and recreational services around the lake areas. The following figure provides the distribution among different categories.

Figure 32: PWS degree of additionality



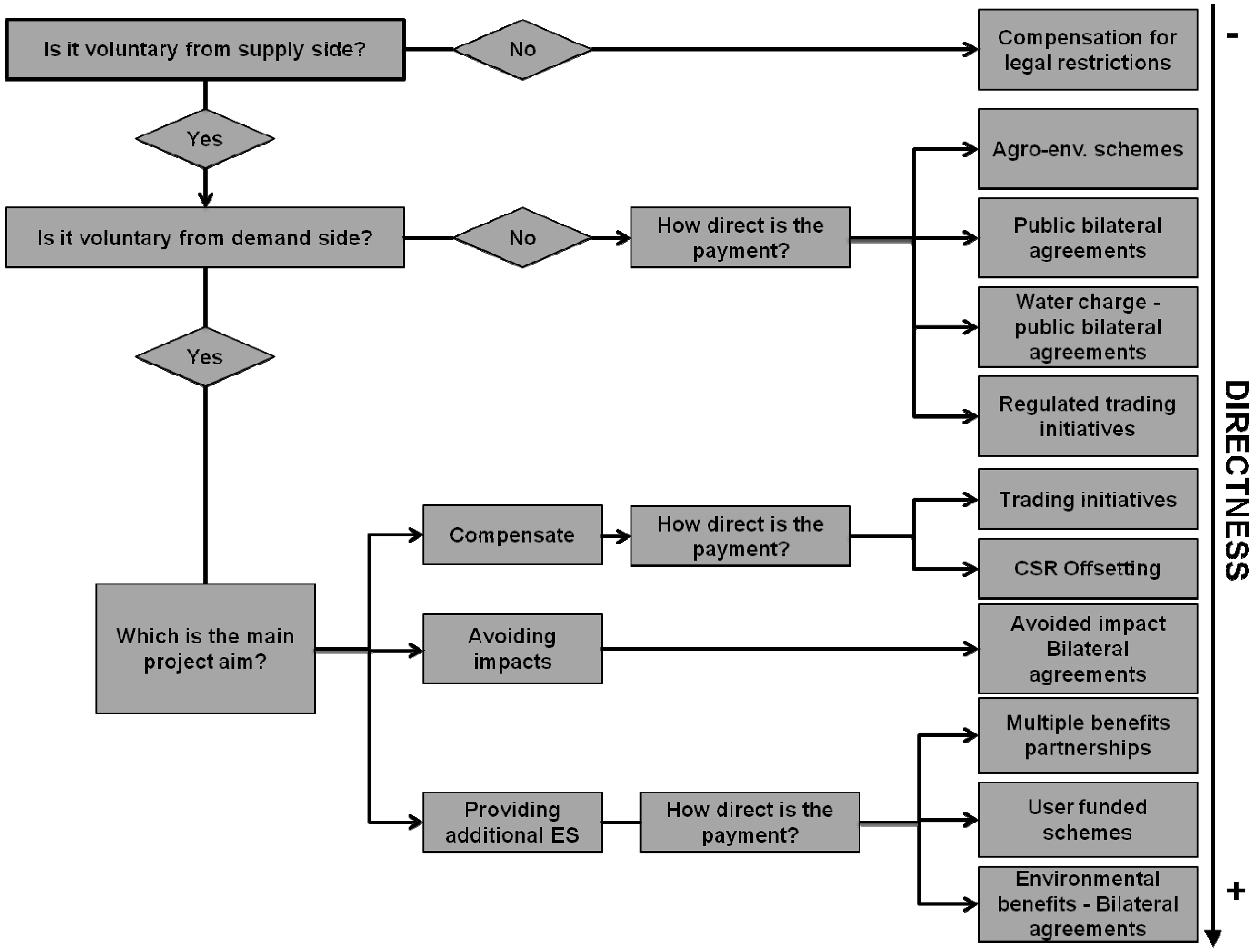
Therefore, if we exclude additionality from our analysis and we cross the other three dimensions in the governance cube, we can see that the graphic representation results into different group distributed within the cube space. We can then identify the main PES groups that are already identified in the literature. Namely, the Coasean PWS, with private offsetting as a subgroup. The Pigovians, with the regulated and no regulated. Mandatory payments are outside the main groups, as they are almost not considered PES as for their lack of voluntariness. This first assessment represented in Figure 33 put the basis for a more in detail classification of different typologies of governance models.

Figure 33: Governance cube: results of the assessment at EU level



After the first assessment, there is the need for the integration of the PES theory with a critical assessment of the aim of PWS, in order to better define their typologies. Figure 34 shows a diagram for logical assessment of PWS typology of governance models.

Figure 34: Diagram for logical assessment of PWS typology of governance models



Regarding the voluntariness principle, a main distinction not frequent in the literature is related to the differentiation of supply and demand (Sattler *et al.*, 2013). The first part of the diagram therefore separates all PWS that are not voluntary from the supply side, from those that are. This category (involuntary suppliers) corresponds only with mandatory schemes, therefore, service suppliers are obliged to take part of the scheme and they receive compensation for imposed legal restrictions. If the scheme is voluntary from the supply side and it is not from the demand side, we follow under the group of public driven PWS. Where beneficiaries are not voluntary paying service providers, instead public authorities do that on their behalf, without their prior informed consent. However, if we classify this large group of public driven PWS, according to the directness principle, we can distinguish four main categories: agro-environmental schemes, public bilateral agreements, water charge based public bilateral agreements, regulated trading initiatives.

Finally, if both demand and supply side are voluntary, we fall into the private driven PWS. A main element to distinguish this broad category is the main aim of the scheme. Therefore, we identified three main motivations, namely compensation (after the loss of ecosystem services), avoided impact (to avoid the future loss of ecosystem services), and ecosystem service provision (provide additional services, through ecosystem enhancement and maintenance). Table 19 describe more in detail all identified typologies of governance models.

Within the compensatory payments, if we again apply the principle of directness we find two subgroups: trading initiatives (such as the peatland code UK14) and CSR offsetting (such as CocaCola (FR11) and Bionade (DE3) payments.

Avoided impacts payments are usually targeted payments to a specific water quality issues, such as chemical or nitrates. The approach followed by the utility or the buyer is focused on eliminating the cause of the impact instead of enhancing the hydrological functions of the ecosystems, therefore multiple benefits are often missing within these projects, for example in the case of Wessex Water (UK24), with the substitution of metaldehyde pesticides with more water friendly one.

Leading and emerging mechanism

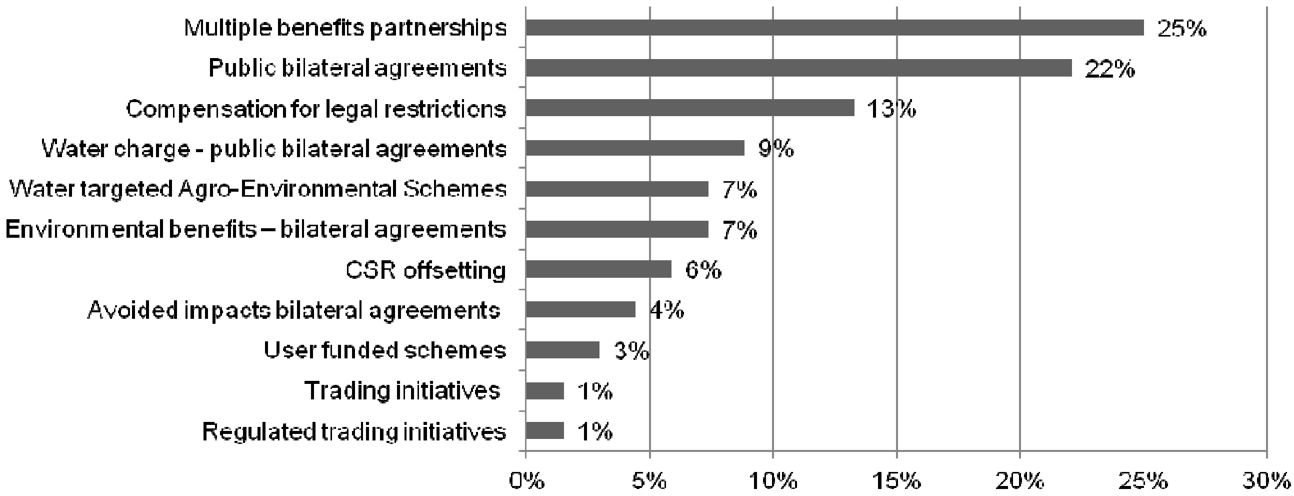
We identified several design characteristics but programmes are often a combination of two or more design options. Besides, some programmes diversify and adapt their governance structure depending on the type of catchment, actors involved and existing regulations. An in depth study of PWS shows how frequent is this mix-model nature. Schemes that use a combination of design features and policy tools have proved to be successful in term of outcomes and amount of transactions, according to our survey. However, following the theoretical classification framework presented in the previous paragraphs we assessed all inventoried PWS with the aim of better understanding the frequency and the characterization of the main PWS typologies.

Table 19: Typologies of PWS in Europe

Programme typologies	Sub-type	Major drivers	Examples
Public – non voluntary	Compensation for legal restrictions	Increase acceptance of legal restrictions through compensation of opportunity costs	AU1, FR12, FR13, FR14, IT2, IT4, SH1, NL1, NL2
Public regulated	Agro- environmental schemes	Public goods provision and partial cover of adoption of management practices	UK1, UK23, IT7, IT8
	Public bilateral agreements	Local public goods provision	DK1, DK2, DK4, UK26, UK29, FR7, FR8, FR9, FR10, IT5, SE1, NL3, NL4, NL5, IT3
	Water charge - public bilateral agreements	Investing on water quality. Charging costumers for water related services via water charges.	DE1, DE2, DE4, DE5, DE6
	Regulated trading initiatives	Regulatory compensation	ES1
Compensatory private initiatives	Trading initiatives	Standardized water footprint voluntary compensation	UK14
	CSR offsetting	CSR water footprint voluntary compensation	HU1, FR11, DE3, PT1
Private voluntary payments	Avoided impacts bilateral agreements	Avoid use of chemical inputs through paying for opportunity cost incurred (no associated benefits)	UK24, UK27, UK28
	Multiple benefits partnerships	Improve hydrological service provision through natural capital maintenance and improvement. Based on partnership model.	BH1, RO1, RO2, UK3, UK4, UK5, UK6, UK7, UK8, UK13, UK20, UK21, FR2, FR3, FR4, FR5, IT1
	User funded schemes	Charging final beneficiaries to invest on targeted hydrological services.	UK2, UK15
	Environmental benefits – bilateral agreements	Improve hydrological service provision through natural capital maintenance and improvement. Based on bilateral agreement.	FR1, BE1, UK18, UK25, IT6

Figure 35 shows the frequency of the main typologies of governance models. The main groups are then characterised in the following pages.

Figure 35: Frequency of typologies of governance models



Well known categories have already been addressed during the introduction, therefore we focused only on the new proposed and identified models, such as the "Multiple benefits partnerships".

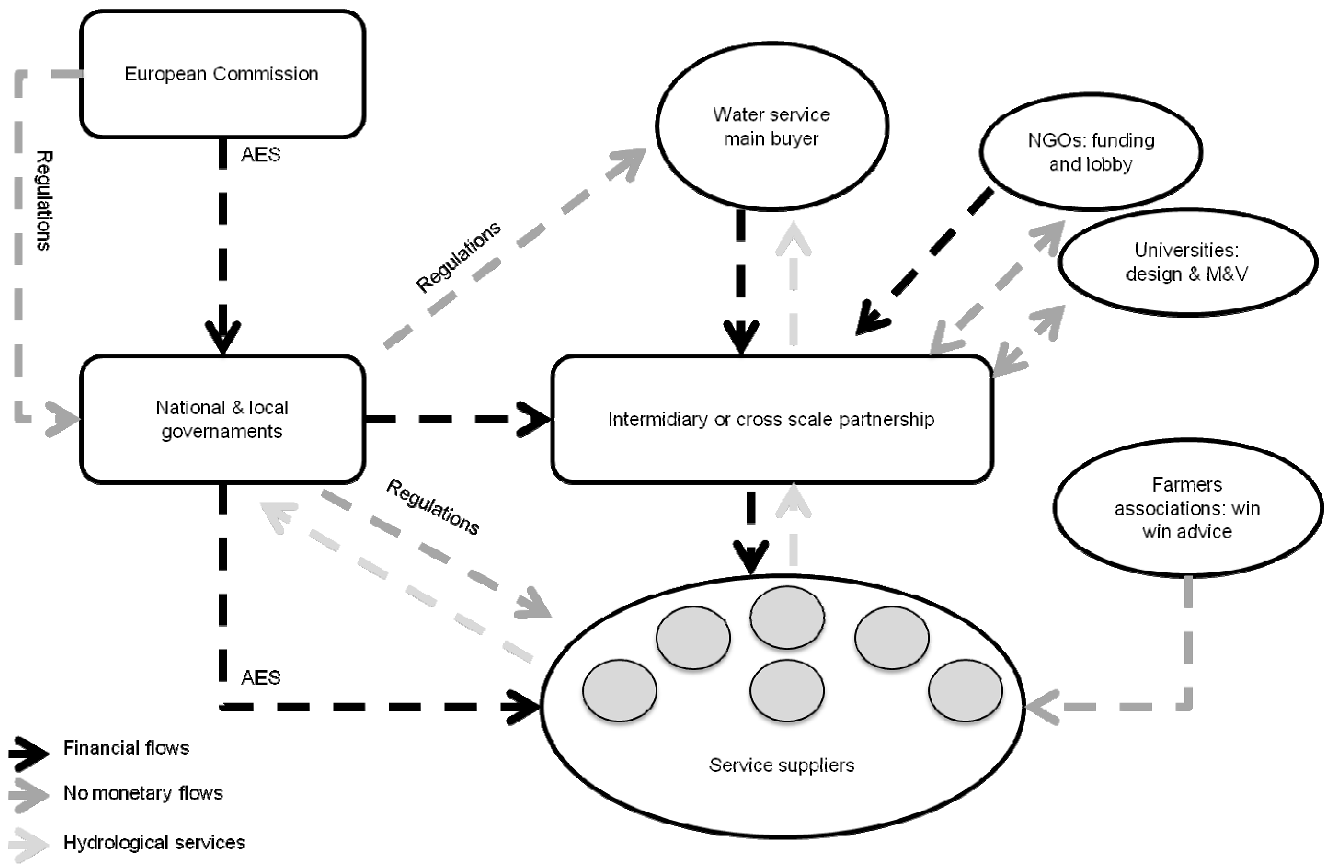
Multiple benefits partnerships

Multiple benefit partnerships represented 25% of schemes and the 16% of total transactions in 2013. An emerging and promising category that includes all those projects that have:

- participatory and collaborative local-national governance including private companies, public regulators, charities organizations and local authorities. These actors are often organized under an umbrella organization, a partnership or a crosscutting institution;
- more than one source of funding and are often base on the principle of match funding; and,
- multilateral agreements (contracts are signed by more than an organization);
- a focus on water related issues, however targeting also biodiversity, carbon and social benefits.

In fact networks and collaborative approaches at local level seem to be a characteristics of existing successful case studies, where regulators, private companies, local authorities, technical and civil society organizations share their expertise and -through match funding- deliver high level watershed schemes around the region. For example, Upstream Thinking, is an "umbrella" programme initiated by South West Water, which includes several sub-programmes (Exmoor Mires, Dartmoor Mires Project, WRT, Working Wetlands, Wild Penwith, Otter Valley, Fowey River, etc.) targeted to different catchments and water issues with a panel of different intermediaries, local authorities and suppliers. In some countries, partnerships emerge also in response to the requirements of Article 14 of the WFD on Public information and consultation, river, aquifer catchment partnerships/contracts movements are emerging. This is the case of River Contracts in Italy were many stakeholders interacting with the river system develops a political and economic agreements on long term planning of the river basin. The Italian case study of Forest Infiltration Areas is indeed part of a more broad “Aquifer contract” were public, private and civil society organization are committed to sustainable management of a specific aquifer. In England Catchments partnership are funded by a special government funds with the aim to meet the requirements of article 14. These local based partnership/contracts are a promising fertile ground for the emergence of new PWS around EU. Figure 36 represents a schematic model of multiple benefit partnership.

Figure 36: Schematization of the PWS partnership model



Bilateral agreements

Bilateral agreements are direct contracts between service suppliers and buyers. In this category, we grouped all those schemes where transactions (and therefore agreements) are mainly between two main actors. We divided bilateral agreements in the following subgroups:

- *Public bilateral agreements*: those enforced by public bodies, on behalf of taxpayers, where suppliers (private or public) participate in the agreement on voluntary bases. They are mainly managed by municipality or public utilities. The funding mechanism is the direct budget allocation.
- *Water charge bilateral agreements*: as above, but the funding mechanism is based on the adoption of water charges, which increase the directness between suppliers and beneficiaries. For example, in Lower Saxony Cooperative Agreements, funds are collected by utilities through a levy on water costumers' bills (thanks to the Lower Saxony - Federal and Provincial States' Water Acts), the funds are then transferred to Lower Saxony Government which sign individual "grant contract" with utilities on the basis of planned cooperative agreements to be signed with farmers. Eventually, utilities sign a bilateral contract with single farmers and forest owners.
- *Avoided impacts bilateral agreements*: those leaded by a private organization (often a private utility or a bottled water brands), where the main aim of the programme is to avoid a specific hydrological issue, such as nitrates or agro-chemicals. The water company focuses on water related issues that can threaten its business, without a special attention to other important co-benefits. The focus is not providing improved ecosystem service based but simply avoiding a human impact. Cooperation with other actors is often missing in this model. The PWS managers usually work directly with suppliers, without collaborating with intermediaries or support organizations.
- *Environmental benefits – bilateral agreements: always managed by private entities unlike the previous*, these bilateral agreements focus on improving hydrological services while increasing the provision of other co-benefits. These PWS adopt an

ecosystem approach to catchment management. Cooperation with other actors is often missing in this model. The PWS managers work directly with suppliers.

Other types of schemes

Compensation for legal restrictions are schemes used by state of regional authorities to compensate farmers opportunity cost to meet certain agricultural practices restrictions within drinking water protected areas. They are quite specific for the European context and they are often used to improve the acceptance of regulations or due to equity concerns. An example comes from the "Mutual Agricultural Claims Water extraction" in Netherland, where the public water utility (Water Bedrijf Groningen) compensates income loss for restrictions on the use of pesticides imposed by law to groundwater recharge catchments in the Drentsche Aa National Park.

Regarding water targeted AEP we identify only 4 programmes which account for the 16% of transactions. As EC itself understood there is a lack of integration between the CAP payments and water quality goals, therefore most of AEP schemes lack of direct link with water quality goals set by the WFD. Two schemes were found in Italy directly providing payments for establishment of wetlands (one of which was for phytodepuration of wastewater purposes). Another national wide – although targeted to priority catchments- is the Catchment Sensitive Farming Capital Grant Scheme, which funds capital improvements that have a direct impact on water quality, with specific focus on nitrates and sediments. This last scheme has been found to provide match funding for many PWS in the UK.

CSR offsetting still counts very little at EU level. Out of four identified programmes, two are still in a pilot phase, and two are related with voluntary offsetting of water footprint, but with very little link between the actual impact and the compensative intervention. They lack of a proper methodology for compensation and they are usually related with a "spot" intervention. They all involve private beverage companies, such as Coca Cola, Bionade, etc.

From the trading initiatives side a promising DEFRA pilot is the Peatland code. It is a voluntary standard for peatlands restoration projects in the UK, which tries to create a trading system for multiple benefits provided by peatlands. The only regulated trading initiative in EU is located in Spain, within the Special Plan for the Upper Guadiana, where the basin authority has established a trading system for water abstraction rights. However, according to WWF Spain the system has failed under corruption and over allocation of water rights that led to groundwater depletion (WWF, 2012).

User funded schemes are usually private schemes managed by an intermediary that from one side collect money from beneficiaries (anglers, tourists, etc.) and on the other side pay directly the service providers or directly implement restoration projects. Under this category, we can find the "tourist pay back schemes" or angling passport in the UK.

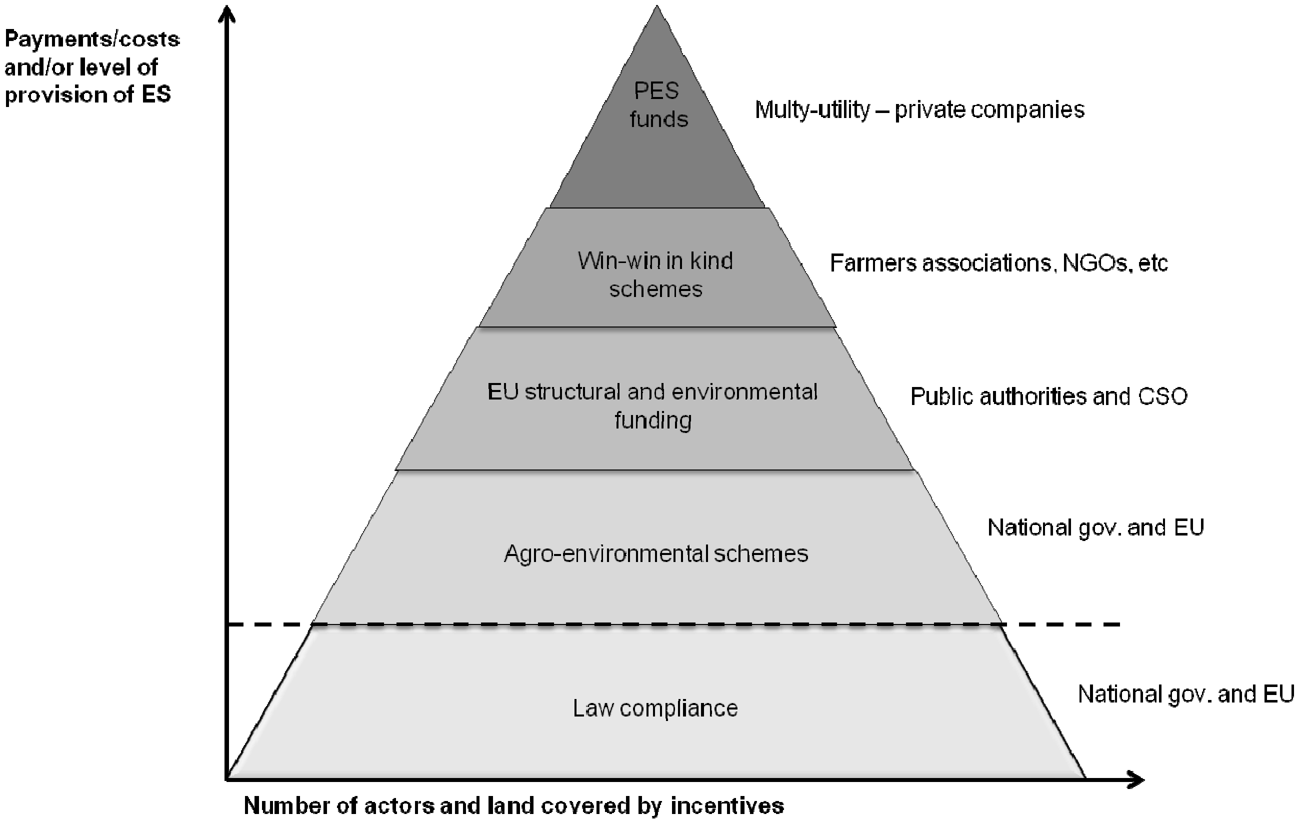
PWS as mix policy-operational tools

Figure 37 represents the stratification and complementarities of policies, funding sources and payments tools that PWS uses, particularly in the case of multiple benefit partnership models. PWS are not stand-alone policy tools; they are indeed posing on an rather complex regulation framework that sets compulsory legal requirements on diffuse pollution under the principle of "polluter pay". The first stratum represents the baseline in the provision of hydrological services, i.e. water related environmental regulation compliance.

Secondly, most of PWS that develop on agricultural and forest lands rely on match funding coming from the adoption of good agricultural practices with "cross compliance" tied to the CAP subsides from the EU. In most of the cases these subsides cover from 50-80% of the cost of implementing a certain management practice or infrastructure improvements. PWS then, coupled with partnerships, win-win farm advice and capacity building services, are meant to supply additional funding to cover the co-funding of CAP subsides and the additional cost of providing targeted environmental services such as higher water quality for drinking purposes.

The mix-model situation represented in Figure 37 has proved to be successful in the main catchment schemes in England such as SCaMP and Upstream Thinking and approximately 64% of PWS in EU directly or indirectly use CAP payments as match funding. Sometime scheme manager do driver the CAP payments to farmers and in other cases, they facilitate famers' applications to obtain co-funding from CAP related payment agencies. As explained in the previous paragraphs, almost 50% of PWS couples payments with in-kind support, through training and free-advice that are likely to maximize the results.

Figure 37: Mixed funding source model



4.4. Comparison of case studies from England and Italy: an institutional analysis

This section presents the research finding from the institutional analysis of selected case studies. We first provide a description of each single selected PWS and then we proceed with the comparison among the four cases. Table 20 summarizes the selected schemes for institutional analysis and reports the main characteristics.

Table 20: Summary table of selected case studies

Programme	Type of service	Main buyer	Funding source	Governance model	Funding 2013 (€)
SCAMP	Water quality	Private water utility	Mixed: Budget allocation, EU funding, CAP.	Multiple benefit partnership	2.300.000
Upstream Thinking	Water quality	Private water utility	Mixed: Budget allocation, EU funding, CAP.	Multiple benefit partnership	1.000.000
Land Stewards	Flood control	Public watershed authority	Mixed: Budget allocation, EU funding, CAP.	Public bilateral agreement	70.000
Romagna Water Fund	Water quality and avoided dam sedimentation	Private water utility (public owned)	Budget allocation (4% of revenues)	Compensation for legal restrictions & Bilateral agreement	838.308

4.4.1. United Utilities SCaMP in North West England

United Utilities (UU) is the UK's largest water company that manages the regulated water and wastewater network in North West England. UU owns 56,385 hectares of land to protect the quality of water entering the reservoirs, which help to supply nearly 7 million people. Around 30% of its land is designated as a Site of Special Scientific Interest (SSSI) constituting a nationally significant habitat for biodiversity conservation. However, many of the fragile habitats such as moorlands and peatlands in the upland catchment areas have been damaged by historical industrial air pollution, agricultural activities and climate change. Agricultural policies have encouraged farmers to drain the land and put more livestock on the fells. This has been at the expense of water quality, the landscape and wildlife. Therefore, over the last thirty years UU has experienced substantial increase in the levels of colour of raw water in many upland catchments[27]. The removal of colour requires additional process plant, chemicals, power and waste handling to meet increasingly demanding drinking water quality standards and costumers satisfaction. Consequently, annual operational costs of water treatment have significantly increased.

In order to address watercolour and turbidity issues, UU began its innovative Sustainable Catchment Management Programme (SCaMP) to benefit both water and wildlife. Between 2005 and 2010, the project allowed working with farm tenants, providing them with € 14.1 million funding in moorland restoration, fencing, woodlands, farm infrastructure and protecting watercourses, across 27,000 ha of UU water catchment areas. However, at the beginning of the program OFWAT, the UK public water regulator who is in charge of approving water utilities' management plans every 5 years, objected because of concerns about subverting the Polluter Pays Principal. At that time, SCaMP was the first existing payment for sustainable catchment management of its type in the UK and it was discussed in detail by regulators, who had to ensure that "best value for money" principle was respected. Based on its cost-benefit analysis and demonstrated multiple benefits[28] (water quality, biodiversity and carbon storage), SCaMP was then approved by OFWAT, opening the door to the catchment approach within the water sector.

SCAMP can be categorized as multiple benefit partnership. However, the PWS is managed within the own UU lands, therefore the utility exercise a "top-down" approach with tenants that are likely to enter in the scheme. Sometimes entering in the scheme is a condition to keep the tenant agreement. Nevertheless, in order to create a collaborative learning process on catchment management, UU made the case for a vast collaboration forming a National Stakeholder Group (crosscutting institution). The group includes the Department for Environment Food and Rural Affairs, Consumer Council for Water, Natural England, Forestry Commission, Environment Agency and Drinking Water Inspector, which eventually supported the project with new regulations,

[27] Colour is realised by the peatland degradation into water.

[28] Water utilities in the UK are considered private companies but public bodies under the s28G of Wildlife & Countryside Act. The Natural Environment and Rural Communities (NERC) Act, which came into force on 1st Oct 2006, requires all public bodies, including United Utilities, to have regard to biodiversity conservation when carrying out their functions. As a result of the SCaMP programme the company exceeded government Public Service Agreement targets for SSSIs returning 98.6% of its land into a favorable or recovering condition by 2010. In fact, the UU SSS duty was one of the main legal reasons that allowed at first OFWAT to approve SCaMP investments.

guidance documents and match funding through agri-environmental schemes. Besides, an intermediary organization RSPB (Royal Society for the Protection of Birds) was contracted to carry out the development of SCaMP Farm Plans together with helping explain the plans to tenants and submitting grant applications. Moreover, RSPB was essential in the first phase of lobbying with existing water authorities.

UU also contracted a local consulting firm to provide the baseline for main hydrological indicators (e.g. Colored dissolved organic matter (CDOM), Turbidity Units (NTU), Dissolved Organic Carbon and level of water table). Annual monitoring has shown that SCaMP land management treatment does have a positive effect on water quality (United Utilities, 2012). Despite of its positive impact on water colour, a detailed and participatory Cost Benefit Analysis (CBA) of SCaMP has indicated how the main benefit is overwhelmingly GHG due to the small capital and operational expenses savings (CAPEX and OPEX), with biodiversity also generating considerable benefits. The CBA model suggests a range of benefit to cost ratios between 2.24 to 25.38 mainly as a result of the error margins for net changes in GHG fluxes, future market values for carbon and potential variation in expected biodiversity benefits. The study considered very low operational and capital saving because the methodology took into account only those investments and operational cost directly linked with the colour removal and waste treatments, thus not considering BAU (Business As Usual) investments in new machineries (Higginson and Austin, 2014). Therefore, climate and biodiversity SCaMP co-benefits strongly contribute to the economic sustainability of the programme. Moreover, co-benefits helped to reach the socio-political and institutional acceptability of the scheme.

SCaMP is now on its phase 2 (2010-2015) covering the remaining 30.000 hectares of United Utilities. In almost ten years of work it has created a national and local wide partnership and has encouraged regulators and other water utilities to promote catchment management schemes to secure raw water quality. In 2014, United Utilities has started to extend SCaMP approach in non-owned land, working with Catchment Partnerships around the North West England through the newly created funding schemes Catchment Wise and Safeguard Zones. UU demonstrated high replicability of the scheme and SCAMP is now an example at UK level.

4.4.2. Upstream Thinking in South West England

South West Water (SWW) is a private company that manages the regulated water and waste water network serving nearly 600.000 customers in South West England. In the past years intensive mixed livestock farming, moorlands and peatlands degradation have decreased water quality in many reservoir, rivers and aquifers around the region. In 2008, SWW understood the potential for a catchment wide approach and started a pilot project (Exmoor Mires Project) to restore 326 hectares of peatlands within a SSSI. Additionally, Westcountry Rivers Trust (a charity organization devoted to rivers restoration and protection) through the EU funded WATER project demonstrated the success of payments and advice for farmers for sustainable catchment management. Following the success of these projects, SWW has started an “umbrella initiative” (grouping many different PWS under the same brand) called Upstream Thinking, which aims to improve water quality in river catchments in order to reduce water treatment costs and provide multiple benefits such as climate change mitigation and biodiversity conservation. In 2010 OFWAT approved SWW’s Upstream Thinking project with a budget of nearly € 12 million for 2010 to 2015 (equivalent to 65p/year on each customer's bill considering an investment period of 25 years) to be spent in several sub-projects for restoring moorlands, fencing water courses, improving farm’s infrastructures and reducing use of chemicals in agriculture. Each single project share the same vision, representing a revolutionary approach by the UK water industry, by allowing capital investment on third-party land, for the first time (United Utilities in fact was previously investing but on its own tenants farmers). The initiative also contributed to move from the “water treatment” industry-based approach toward a more integrated and holistic catchment and ecosystem approach.

The initiative is a categorized as a multiple benefit partnership where SWW delivers conservation funds in collaboration with a wide range of national and local organizations. Devon Wildlife Trust and the Cornwall Wildlife Trust are the main partners for moorlands restorations while the the Westcountry Rivers Trust with its deep technical experience delivers programmes targeting diffuse pollution from agriculture in West Penwith, the River Fowey, the Tamar, Wimbleball and Roadford catchments and the Otter Valley. Natural England, Environment Agency, English Heritage, National Farmers Union have all supported the project through match funding with agro-environmental payments schemes, monitoring and policy advice. Universities such as Exeter and East Anglia were involved in the monitoring and design of the payments schemes. SWW has overall responsibility for managing the project and reporting progress against targets to regulators. Each individual project has its own management team and reporting arrangements and formal management agreements was established with each individual delivery partner. Financial governance and reporting is undertaken by SWW's Finance and Regulatory function. The project has experimented two different types of payment delivery mechanisms:

- *advisor-Led PES mechanisms*, where farmers were identified by advisors, and offered a fixed-price deal in which South West Water would pay 50% of the costs of the capital investments;
- *auction-based PES mechanisms*, where farmers were asked to enter in competitive bids were the best value for money principle allocates the final grant request.

A comparison between the two systems has shown that the auction-based system delivered between 20% and 40% better value for money than the fixed-price alternative. However, the advise–led system turned to be more appropriate for small scale projects where site-specific considerations are needed, while the auction were preferred for large scale catchments, particularly where there is little detailed local knowledge and the eco-hydrological conditions are quite homogenous around the sub-catchments. Beside the payment mechanisms, SWW has designed a "Conditional Grant Agreement", which sets out the project, period, grant and terms, and a "Deed of Covenant" which ensures the Conditional Grant Agreement is passed on in the event of a sale or change of tenants. These agreements are to guarantee the permanence of the investments in a third party land, maintaining a legal interest in the capital works (paid with bill payers money) and securing that the investment will provide long term effects on water quality, therefore ensuring the best value for money. South West Water indicate that reducing pollution at source rather than investing in engineering solutions to treat polluted water downstream has a benefit-cost ratio of some 65 to 1.

4.4.3. Land stewards in Tuscany (Italy)

In Tuscany, in the hilly areas of Media Valle del Serchio, a public authority in charge of managing over 115 000 ha of mountain areas and about 1500 km of streams, has established agreements with about 40 farmers and forest owners in order to improve flood risk monitoring and control over 500 km of water courses within the mountain basin. Farmers and forest owners received a fixed payment (€ 6.000 per year during the initial phase and € 4.000 per year during the following years) for monitoring and evaluating the degree of risk and for providing an alert-report service to the public authority on any situation regarding slope instability or waterways obstruction. Based on the identified flood risk and slope instability related problems, landowners can provide a first maintenance works negotiating case by case with the public authority the terms and conditions of the interventions. Landowners usually contribute to remove trees and other sediments from riverbeds to avoid overflowing, together with the management of riparian vegetation. Land Stewards scheme has contributed efficiently to decrease the flood risk and the occurrence of water damage related costs, providing the society with an environmental benefit resulting from farmer training, organizational arrangements and networks. According to the public authority, the scheme has allowed 80% saving on the annual total cost for management interventions in the area. The alert and control system of landowners works through an interactive Information and Communication Technologies (ICT) system (IDRAMAP) which helps land owners report and alert the public authorities and eventually deliver hydro-geological risk control of the district. The scheme has also a high level of social co-benefits, providing an alternative source of income for marginalised landowners located in remote areas in the Serchio Valley. It also has improved the community participation in hydrological landscape management.

Land Stewards, in the absence of a national law that regulate payments for ecosystem services, has made use of a national Law 29 that establish the possibility for public bodies to contract private and public entities (thus including also farmers) to deliver landscape management works. This law was conceived in order to promote multifunctional agriculture but the concept of

[29] Decreto Legislativo 18 maggio 2001, n. 228 "Orientamento e modernizzazione del settore agricolo, a norma dell'articolo 7 della legge 5 marzo 2001, n. 57“ and Legge 97/1994 - Art. 17.

"provision of ecosystem services" is not properly achieved. Therefore, the contracts between public bodies and farmers refer to the number of hours of labour to carry out planned conservation works.

The scheme can be categorized as a public bilateral agreement, where the public authority directly pays (on behalf of taxpayers, through budget allocation) landowners for the provision of hydrological services. Therefore, regarding the directness we can classify the scheme as a "public procurement". Regarding the voluntariness, the scheme has carried out several workshops to negotiate with service suppliers and to define the design, the type and amount of payment. Thus, the scheme is characterized by free and informed negotiation between the two parties. Land Stewards has also a high conditionality as the payment is divided in two types, a flat rate for being part of the scheme, and on demand/service based payment. This division create an incentive to meet the requirements of the scheme. The small number of landowners allows checking and monitoring the performance of each service supplier, while covering a vast remote area otherwise difficult to manage. A main weak institutional aspect of Land Stewards is related with the source of funding. The watershed authority decided on a yearly base the amount to be invested on the scheme, therefore service suppliers have very little trust on the long-term commitment of the public authority. The project manager reported the difficulties of managing a scheme with political instability and recent public austerity measures. Therefore, the "life" of the scheme is decided on a yearly base, depending on the financial availability and national and local political decisions. A change on the board of the authority can easily led to the termination of the scheme.

4.4.4. Romagna Acque water fund in Emilia Romagna (Italy)[30]

Romagna Acque S.p.A., is a public owned company managing all drinkable water resources of Romagna sub-regional area. It has started as a consortium of municipalities to reduce the cost of drinking water supply in 1966. Twenty years later, it was able to cover the distribution of water of the whole Romagna area and in 1994, Romagna Acque S.p.A. was founded, becoming owner of water resources in 2004. The most important water source of the company is a dam-basin in the central Apennines (Ridracoli, municipality of Bagno di Romagna), which covers 50% of

[30] The case study has been updated and elaborated starting from Pettenella et al., (2012).

the Romagna tap-water supply (108 M m3/year). The economic profitability of the dam has soon been undermined by high level of sedimentation and water quality maintenance.

In 1993, the company invested in research to understand how catchment management could have minimized soil erosion as well as improved water quality. The research shows the clear impact of forest operations such as clear-cut or forest conversion from coppice to high stands on soil erosion, while minimal silvicultural treatments or natural evolution of stands strongly reduce the erosion. These last two practices demonstrated to have a positive influence on nitrogen reduction and pH stability. Therefore, Romagna Acque Spa decided to invest part of annual revenues (4%) deriving from the water bill payers to set up an environmental fund to compensate landowners in the catchment areas, helping them to cover the costs related with management practices changes[31].

Romagna Acque Spa, in 1988 started to allocate 2% of its revenues (recently became 3% in 2008 and 4% in 2012), to the mountain towns of Santa Sofia, Premilcuore and Bagno di Romagna, where treatment plants of water resources are located. The utility allocate the funds to the municipalities to sponsor programs and initiatives to improve environmental conditions of the valleys and promote economic and social development of the municipalities. In 2010, the funds provided to the three municipalities surrounding the reservoir € 782.370, in 2011, €661.959, in 2012, € 531.921, in 2013, € 838.308. The Romagna Acque Spa fund makes up a very important source for environmental protection of the valley.

The positive impact of the PES scheme was accounted in a general decrease in soil erosion of 25% (from an initial 40 000 m3/year to the ongoing 30 000 m3 /year), and a consistent nitrogen reduction as well as pH stabilization. In terms of performance, both Romagna Acque S.p.A. and the landowners have increased their utility: the company has reduced its costs for water purification and assured longer dam life, while the landowners have increased or maintained their annual forest revenue.

[31] Bagnaresi U, Minotta G, Vianello G, Barbieri A, Simoni A, Tedaldi G, Busetto R (1999). Rela- zione conclusiva del progetto di ricerca: effetti dei diversi tipi di trattamento dei boschi sul de- flusso idrico afferente al bacino di Ridracoli (anni 1993-1999). Dip. Colture Arboree, Univer- sity of Bologna, Italy.

The Romagna Acque Spa can be categorised as a public-public bilateral agreement, with a utility budget allocation source of funding system. The level of directness is still very low, falling under the definition of “public procurement”. The commoditization is very law as the actors involved is almost close to the situation of “one to one”, where there is just one main buyer and only three suppliers. The payment is based on the percentage that is applied to the annual revenues, not to the level of service provision or implemented management practices. Moreover, this scheme is one of the few that provides up-front payment to municipalities. In fact, the fund on yearly base transfers the money to the municipalities and they will use them to fund environmental restoration projects around the valley.

The voluntariness of the scheme is very low, as the municipalities cannot decide to have a management that may affect reservoir water quality and sedimentation. In fact, among others, one of the reasons to create the fund was to compensate municipalities for the economic loses and additional costs related to the dam and the reservoir. Therefore, the Romagna Acque fund is a hybrid scheme in between a bilateral agreement and a compensation for legal restrictions. Moreover, another design characteristic that has allowed the fund to be successful in the long-term is the systematic application of a charge on the total revenues. This 4% charge, although not applied directly to costumer’s bills, allows having long-term assurance on financial resource, increasing the trust toward the fund and the general stability of the scheme.

Table 21: Key findings of the institutional analysis of selected case studies

Dimensions	Upstream thinking	SCaMP	Land Stewards	Romagna water fund
Ecosystem structure, process and services	Lowland intensive mixed livestock farming, underlain by mudstone and sandstone.	Moorlands, peatlands, forests and pasturelands, hay meadows	Mountain, slopes, rivers and water channels	Mountain forests and artificial reservoir and dam
	Decrease of water quality treatment cost for South West Water (For reducing N, P, algae booms and sedimentation) Increase biodiversity and fish stock of rivers. Improve landscape beauty	Decrease of water quality treatment cost for United Utilities (Dissolved Organic Carbon) Reduce runoff rates, sediment load and downstream flooding. Biodiversity conservation in SSSI areas	Decreased flood probability and reduced costs of hydro geological monitoring and infrastructure maintenance Provide economic opportunity for low income farmers	Avoided dam sedimentation, nitrogen reduction as well as pH stabilization Provide economic and environmental development opportunities for mountain municipalities
Actor interactions	Buyer: South West Water (SWW) Suppliers: land owners and commons (300 farmers) Intermediary: Westcountry River Trust (WRT)	Buyer: United Utilities (UU) Suppliers: 53 land owners and commons Intermediary: Royal Society for Protection of Birds (RSPB)	Buyer: Unione Comuni Media Valle del Serchio Suppliers: land owners (30 farmers and forest owners and local service cooperatives) Intermediary: Coldiretti (farmer association)	Buyer: Romagna Acque Spa Suppliers: public forest owners (three municipalities) Intermediary: Universities provided support for scientific basis of PWS
	WRT is originally an anglers association, which lobby for river quality improvement, it became the main Upstream Thinking intermediary working with farmers, and design the programme. Staff sharing or exchange within SWW and WRT for guarantee technical and political coherence. Regulators such as Natural England, Forest Commission, Environmental Agency have provided funding, regulation, monitoring and control support.	RSPB has an high interest on biodiversity protection, however water quality improvements through peatland and moorland restoration provide evident biodiversity co-benefits. RSPB had a key role for lobbying with water regulators (OFWAT) to accept catchment approach as a strategy to obtain water quality OFWAT initially opposed to SCaMP but then took the approach as a reference standard for England. Staff sharing between UU and RSPB for guarantee technical expertise Regulators such as Natural England,	Universities sometimes have helped the scheme design process but they have demonstrated to have a spot approach, focused on publishing rather than contributing to the territorial process. Coldiretti (farmer association) provides support to work with farmers and University to organize the participation workshops and design	Romagna Acque Spa has just recently changed the procedures to allocate the funding to Santa Sofia, Premilcuore e Bagno di Romagna. An auction system will improve the performances of the interventions funded by the water fund. Univerisity of Bologna has scientifically proved the effect on catchment management on the reservoir and dam sedimentation and water quality.

		Forest Commission, Environmental Agency have provided funding and regulation support.		
Institutional interplay	Environmental lobbers have pushed the UK government to meet art. 14 of WFD for increasing participation within RBMPs. A fund to create catchment partnership has been set by DEFRA and it positively interacts with PWS in England. Tenants and commons related institutions.	Environmental lobbers have pushed the UK government to meet art. 14 of WFD for increasing participation within RBMPs. A fund to create catchment partnership has been set by DEFRA and it positively interacts with PWS in England. The Natural Environment and Rural Communities (NERC) Act which came into force on 1st Oct 2006 requires all public bodies, including United Utilities, to have regard to biodiversity conservation when carrying out their functions. This requirement has been the main driver that helped OFWAT to approve the first SCaMP investment. Tenants and commons related institutions.	The PWS is base on Decreto Legislativo 18 maggio 2001, n. 228 "Orientamento e modernizzazione del settore agricolo, a norma dell'articolo 7 della legge 5 marzo 2001, n. 57" and Legge 97/1994 - Art. 17. *Incentivi alle pluriattività*". It establishes the possibility for public bodies to contract private and public entities (thus including also farmers) to deliver landscape management works. The watershed authority can charge the land and households to recover the cost of watershed management thanks to the Art. 860 of the Civil Code.	Voluntary compensation, following the Galli's Act indications (art.18 and 24, Law 36/1994). The act formally introduced the concept of catchment area compensation (art. 18), even though it was just addressed to public or collective lands (art. 24).
	Water Management Plans of utilities have to be approved by OFWAT. Therefore, investments work only by 5 years cycles and they extremely depend on OFWAT approval.	Water Management Plans of utilities have to be approved by OFWAT. Therefore, investments work only by 5 years cycles and they extremely depend on OFWAT approval.		ND
	There are several conflict within existing territorial planning instruments. Upstream Thinking aims to harmonize them. A set of different instruments interact with the scheme: - River Basin Management Plans - Catchment partnership - Catchment Sensitive Farming Initiative - Local Nature Partnerships and Nature Improvement Areas - Safeguards zones	The scheme makes use of CAP payments to partially support the realization of some interventions. A set of different instruments interact with the scheme: - River Basin Management Plans - Catchment partnership - Catchment Sensitive Farming Initiative - Local Nature Partnerships and Nature Improvement Areas - Safeguards zones	The scheme makes use of CAP payments and EU structural funds to partially support the realization of some interventions.	ND

	The scheme makes use of CAP payments and EU structural funds to partially support the realization of some interventions.	The scheme makes use of CAP payments and EU structural funds to partially support the realization of some interventions.		
	Win-win interplay among different institution is the strategy of Upstream Thinking.	Difficulties to work with commons. Need for expert staff for engagement.	Creating a trust relationship between farmers and empowering them was the main focus of the programme. Now farmers would keep monitoring the areas also without payments as they feel a responsibility on their "watch out" role.	The scheme is facilitate for the good relations between the publicly owned private utility and the municipalities that are also part of the company itself.
Institutional design (already addressed within previous paragraphs)	The scheme was created by SWW, through the approval of OFWAT and with the help of the intermediary WRT. The main element is the use of the intermediary that facilitates the work between the utility and landowners. The multiple benefit partnership model has engaged with many actors that have all contributed to the success of the scheme. Both in financial and technical terms.	The scheme was created by UU who first believed on catchment approach to solve water quality problem. The approach is much directed to capital works investments and try to match CAP payments with UU funds.	Landowners can interact with the management authority through an interactive Information and Communication Technologies (ICT) system (IDRAMAP) which helps land owners report and alert the public authorities and eventually deliver hydro-geological risk control of the district. Training and trust with farmers is the main element for ensuring compliance with payments. Payments are based on performances and are agree time by time.	Romagna Acque set up a dedicated fund that uses 4% of total annual revenues to funds the municipalities surrounding the reservoir.
Capacity and scale	SWW has a strong capacity in term of financial resources. It lacks technical and participatory capacity to work with farmers as historically it never dealt with the sector. This lack has been compensated by working with WRT. The partnership model allows SWW to have the right skills and to cover a huge areas working in cooperation with a set of different conservation organizations.	UU has a strong capacity in term of financial resources. As a land owner it has the knowledge about the land it manage for water purposes. Therefore UU has just partially used a intermediary (such as RSPB), working directly with farmers, at least for the negotiation phase. UU made the case for a vast collaboration forming a National Stakeholder Group (crosscutting institution).	It's a public body of a very remote mountain area in Tuscany. Institutional changes and economic crisis have undermined the capacity of self-funding and political instability always undermined decision-making processes.	The company (publicly owned) has a strong financial capacity and the long-term duration of the scheme confirm that the management is convinced about the benefits of the PWS.
	The PWS has a regional scale (South West) although it splits up in	The PWS has a regional scale (North West) although it split up in	Province of Lucca and Pistoia, 35 Municipalities, 3 Unione dei Comuni	Santa Sofia, Premilcuore e Bagno di Romagna are the municipalities that

	many smaller schemes, which change and adapt depending on the water issue and on the catchment peculiarities. Geographical scale: 22.000 hectares of farmlands)	two main areas: SCaMP 1 (2005-2010): 27,000 ha of water catchment in the Peak District and Bowland areas SCaMP 2 (2010-2015): 30,000 ha of land in the Northern and Central team areas which includes 53 separate farms, bare land lets and commons between 2010 and 2015.	(Garfagnana, Media Valle del Serchio e Altaversiglia) 1.500 km of water channels 2.600 opere idrauliche (briglie, argini, ecc.). 115.000 ha extension, 60% forests. Although the project focus on the problematic areas in 700 kmq 40% of the total land and 30% of water channels.	benefit of the fund: 47.000 hectares.
Institutional performances	Increasing permanence: SWW has designed a “Conditional Grant Agreement”, which sets out the project, period, grant and terms, and a “Deed of Covenant” which ensures the Conditional Grant Agreement is passed on in the event of a sale or change of tenants Cost benefits: South West Water indicate that reducing pollution at source rather than investing in engineering solutions to treat polluted water downstream has a benefit-cost ratio of some 65 to 1. 65p/year on each customer's bill.	Despite of its positive impact on water color, a detailed and participatory study on Cost Benefit Analysis (CBA) of SCaMP has indicated how the main benefit is overwhelmingly GHG due to the small capital and operational expenses savings (CAPEX and OPEX), with biodiversity also generating considerable benefits. The CBA model suggests a range of benefit to cost ratios between 2.24 to 25.38 mainly as a result of the error margins for net changes in GHG fluxes, future market values for carbon and potential variation in expected biodiversity benefits.	According to the public authority, the scheme has allowed 80% saving on the annual total cost for management interventions in the area. Compared to the other schemes the investment is very low, around 60.000 euro per year. This small amount allow to provide a hydrological service in a vast areas as mentioned above.	From 1988 to 2013 the water utility has funded the 3 municipalities with 11.966.016 €. The positive impact of the PES scheme was accounted in a general decrease in soil erosion of 25% (from an initial 40 000 m3/year to the ongoing 30 000 m3 /year), and a consistent nitrogen reduction as well as pH stabilization. In terms of performance both Romagna Acque S.p.A. and the landowners have increased their utility: the company has reduced its costs for water purification and assured longer dam life, while the land-owners have increased or maintained their annual forest revenue.

5. CONCLUSION

The Chapter discusses the main outcomes of the research. It is divided in four sections that follow the main areas of analysis: service provision, policy drivers and markets, governance models and institutional analysis of PWS. Each section starts by summarizing and discussing important background information and results, and provides conclusions and considerations on the topic. Finally, the last section highlights future challenges and research needs for PWS in Europe.

Conclusions on service provision

In this section, we discuss the results of the assessment of water services provision based on the production-theory framework presented in paragraph 3.5.2. Within the introduction, we started from clarifying the main areas of confusion on PES wording such as the interchangeable use of "ecosystem" and "environmental" adjectives and the differences between ecosystem structures, processes, functions, services and final benefits. Using an input-output approach, we thus argued that the services targeted within PWS schemes are the result of two main inputs, natural and human capitals, with different degrees of substitution. Moving within the entire range of possible combinations between the two types of input factors, we identified three main different categories of services generated by PES schemes depending on the type of inputs. The first category, ecosystem services, corresponds to those services generated directly by natural capital, with very low use of human capital. The second, human services, on the contrary, is related to those services that originate from human capital with very low use or interaction with ecosystem structure and functions (natural capital), but eventually deliver a perceived environmental benefit. The third middle-ground category, environmental services, refers to those services generated with high level of both natural and human capital. The proposed framework and the categorization has been then applied to 68 inventoried case studies of PWS in EU.

Results show that none of considered PWS schemes deals with "pure" ecosystem services, 25 cases actually pay for environmental services, while 43 out of 68 pay for human services that finally generates environmental benefits. Without pretending to be representative, these case studies and the assessment results certainly highlight the human component and human dependent nature of the services targeted within PWS. We therefore developed a production theory based definition of PES: PES schemes involve production systems and/or networks/clusters that use different combinations of natural and human capital, to produce the desired services (ecosystem, environmental, human) in order to satisfy a certain environmental need and increase society wellbeing (environmental benefit). The different degrees of substitution between the two main types of capital investment (natural and human) within the service production process characterize the service and thus the PES scheme that pays or compensates for changes in the use of the production systems.

Most attempts to classify PWS schemes and evaluate their successfulness refer to the design of the payment mechanism (Postel and Thompson, 2005; Sattler *et al.*, 2013). The research contributed to increase the discussion about PES through the application of the production theory model and suggested a new category of human service-based PES. We therefore highlighted the role of human capital, as essential input factor, within the systematic provision of environmental services in PES schemes. Certainly, from a theoretical point of view, many could argue if this new PES category - since dealing mainly with human based inputs - can fall under the PES definition. From a practitioners' perspective, as the considered case studies showed, PES based on human capital that result into a desired environmental benefit, are already a widespread environmental policy tool. Our refinement of the PES definition started from a provision perspective that complements the usual market perspective of PES defined by Wunder (2005) and Muradian *et al*. (2010). It enhances the currently existing classification schemes (e.g. Sattler, 2013) by integrating elements concerning drivers of the production process.

Eventually, the production theory framework integrated with a supply chain approach of environmental benefits (the pathway from ecosystem structure to human well-being), helped us to identify inputs (natural and human based), outputs (ecosystem, environmental and human services) and outcomes (environmental benefits) that should properly be highlighted when designing, contracting and implementing PES schemes for the correct monitoring and performance evaluation. Thanks to this clarification, we can assess if a considered PES scheme aims to capture benefits from natural or human induced processes or a combination of the two. This gives elements to legitimate the payment mechanism such a paying to change practices, create infrastructures or maintain practices that are not anymore economically viable. It is especially relevant when the aim of the payment is to offset the providers' opportunity costs.

As other authors have shown (Corbera *et al.*, 2009), financial, institutional and social capitals are variables for PES success. In our framework they are considered as production inputs for environmental service provision. Therefore, during the feasibility, contracting and designing phase of PES, minimum level of institutional, financial and social capitals have to be assessed and identified, and linked to conditionality of the payment, in order to ensure the delivering of outputs and outcomes, thus ensuring additionality.

Conclusions on policy drivers and markets

Investments in watershed services in Europe are increasingly gaining importance as a tool to meet water policy targets and biodiversity conservation. All 15 schemes identified during 2012 inventory remained active, while the 2014 inventory reported up to 50 active PWS. Existent successful schemes are consolidating and expanding in size and transactions, and new pilots projects will continue to spread in the coming years. For example, Danone scheme in Evian catchment in France has extended the payment system to other three new catchments (Volvic, Badoit, La Salvetat). United Utilities, after moving to the second phase of SCaMP (doubling the scale of intervention), in 2014 has activated two new programmes (Catchment wise and Safeguard Zone projects) to extend the same approach in non-owned land all around the North West England. From 2015 Upstream Thinking will enlarge the programme creating 17 catchment-specific schemes around South West England (tripling the area of intervention). Existing schemes, therefore, demonstrates their effectiveness and expand both in term of investments and area covered.

Regarding upcoming PWS, our inventory identified 15 pilots or PWS that are in design phase, most of them are likely to success and proceed to a more mature phase, as for the favourable policy context, especially in the UK. Besides, DEFRA has published the new call to fund between 4 to 6 pilot projects of average funding € 24,000 to € 36,000. Therefore, new pilots are expected to emerge in 2015 and 2016. Dozens of other schemes are expected to emerge in UK from 2014 OFWAT pricing review of water utilities[32].

In our survey we identified several drivers that increase the adoption of PWS as a governance tool to achieve water regulation standards and internalize negative and positive externalities. The following are the main ones:

Driver 1: Securing water quality and quantity: the first main driver that affects all type of actors (involved in PWS especially from the buyer side) is to secure water quality and quantity under increasingly climate variability. Most of PWS dealt with improvement of extractive water supply (79%) and water damage mitigation (29%). More than 80% of PWS targeted agricultural land and nitrates were the main hydrological issue for more than 70% of inventoried schemes, while at global level only 21% of buyers aimed to reduce agricultural water use and pollution (Bennett *et al.*, 2014b). Our survey identified a main cultural and policy shift that involved many PWS: the water sector, pushed by the WFD, is shifting from the old industry based chemical treatment approach toward a more holistic and integrated catchment approach. Similarly, water quantity related issues (flooding, groundwater recharge, etc.) are gradually been tackled by using green solutions rather than investing on grey-infrastructures. However, although catchment management and green-infrastructure often offer a cost effective solution as shown by analysed case studies, they usually provide outcomes that are context specific. Regulatory standards rarely accommodate uncertainty related to outcomes, meaning that many water utilities cannot rely on catchment management or green infrastructures alone to ensure water quality or flood protection. This means that PWS will not substitute old fashion technology based solutions; they will rather complement them to seek for more co-benefits.

Driver 2: EU funding opportunities: our survey showed that around 55% of inventoried programmes declared to use multiple sources of funding, 32% used EU funding, and 1 out of 4 used CAP payments. Considering that the majority of schemes targeted diffuse pollution in

---

[32] The new formed Natural Resource Wales is committed to deliver a country action plan on the use of PES for natural conservation, probably following the path of DEFRA in England.

agriculture, EU sources of funding were thus a major driver that allowed the start-up of many schemes and that ensured their economic sustainability through match funding of PWS scheme with existing agro-environmental measures. However, the greening of CAP is likely to raise the baseline of hydrological service provision higher than it was. Therefore, if environmental standards to obtain CAP payments are quite high, many private actors will act as free riders, enjoying the benefits deriving from public EC payments, without contributing directly to enhance the already high hydrological service provision of some areas.

As shown in the paragraph 4.2, EU funds are likely to keep and increase their driving role in the new programming period (2014-2020). LIFE+, EU structural funds, CAP payments, the upcoming Green Infrastructure Fund, etc. are some of the funds that could positively contribute to existing and future schemes. However, most of them look for incentivising projects that are economically viable and seek to fund projects that ensure co-funding from multiple sources. PWS therefore, can compete with other projects and approaches only if they will base their strategy on multiple funding sources.

Driver 3: CSO support toward multiple benefits based PWS: PWS have demonstrated in many cases to reach hydrological service while providing other important co-benefits, such as carbon stock, biodiversity conservation and providing economic opportunities for landowners. According to our analysis, 56% of PWS directly targeted biodiversity co-benefits, 41% social co-benefits related with increasing economic opportunities of landowners, while carbon was only a targeted co-benefits in 25% of the projects.

Environmental organizations are often concerned about biodiversity conservation rather than drinking water quality issues. However, they understood that through collaborating with water utilities and agriculture sector, they could maximize their impacts and successfully collaborate for delivering multiple benefit projects. In some cases, CSO pushed for adopting PWS as a main donors’ approach, such as in the Danube related pilot projects by WWF. In other cases, such as RSPB in the UK or WRT in South England, environmental organization lobbed for national and local political support, allowing the development of emerging schemes and triggering water utilities and policy makers to adopt PWS as catchment approach.

Conclusions on typologies of governance models

Our governance assessment framework provided an important contribution to understand and assess PWS against the main principles of PES theory, namely, voluntariness, directness, commoditization, and conditionality. For each of the principles we characterised the main scheme design arrangements, providing a scoring system that allowed us to understand how a given scheme meet the considered principle.

The assessment framework helped us to characterise the identified PWS and to further refine a diagram for a logical assessment of PWS typology of governance models. We used the voluntariness (supply and demand), the main project aim regarding (compensate, avoid impact, providing additional ecosystem services), and directness of the transfer between supplier and beneficiary to built the diagram. We thus identified four main groups of PWS (public – non-voluntary, public regulated, compensatory private initiatives, private voluntary payments) divided into eleven typologies. We then described and characterised these eleven typologies, taking several examples and descriptions from inventoried case studies at EU level. The framework thus provides a simple and clear guide to classify the variety of existing PWS governance models. It also identified new proposed categories, such as the "multiple benefit partnership" which represented the 25% of assessed schemes. The multiple benefit partnership is defined as a PWS scheme that is characterised by a partnership-based model, aiming at providing projects with clear multiple co-benefits (biodiversity, carbon and social). The model bases its viability on guaranteeing multiple source of funding, and ensuring territorial collaborative learning processes, through the establishment umbrella organizations, partnership or crosscutting institutions, representing the interests of all involved actors.

Main findings and conclusions on institutional analysis

The institutional analysis allowed us to complement the study of policy and market drivers, governance arrangements and typologies, and future challenges of the schemes. The refined institutional framework initially provided by Prokofieva (2013) and Corbera (2009) helped to systematically assess all inventoried case studies and to provide a detailed analysis of selected case studies. The main goal of the institutional analysis was to relate several PWS characteristics, such as ecosystem services, actors' interactions, scheme design, institutional interplay, capacity and scale to the performances and outcomes. The qualitative analysis has raised some PWS features and governance arrangements that can improve performances and outcome and increase the success of a scheme. However, we understand that these characteristics are case specifics and sometimes cannot be generalized. The following are the main findings from our institutional analysis.

Ecosystem structures, functions and services: the geographical scale of the scheme shall be proportionate to the scale to which hydrological services are provided by nature. However, the scheme shall take into account all type of ecosystems involved within the catchment and provide a differentiated portfolio of management practice. For each desired hydrological services, the scheme should identify the structures (ecosystems), functions and type of final environmental benefits. Qualitative and quantitative indicators, using hydrological services attributes should be appointed in order to create a baseline and facilitate final monitoring of outcomes.

Actors' interactions: the first assessment of partners (buyers, intermediaries and suppliers) has to be based not only for their willingness to participate but also for their capacity (readiness) and scale. Technical capacity is fundamental and better if it is linked with the right geographical and/or territorial scale for hydrological service provision. Project managers should design PWS in order to allow key actors that have an interest on conservation of water related ecosystems to be part of the design and implementation process. The inclusion of key actors such as intermediaries, universities, farmers associations, etc. is a prerequisite for the scheme success. The coordination of all actors through cross-cutting institutions or partnerships allows the implementing organization to increase the scheme acceptability, technical and financial scale. Choosing the right intermediary or the organization with high local acceptability and recognition is the most fundamental step in the development of a PWS.

Institutional interplay: PWS schemes in Europe have high transaction costs, as they are relative new approaches to communicate in a very intricate and multi-layered institutional context. Communicating the idea of PWS in the right way and at the right actors is fundamental as first step. The second fundamental step in order to obtain a positive institutional interplay is to identify and involve key experts from national/regional administrations at an early stage. This will help to have a clear picture of the natural assets and its relations with existing actors and institutions.

PWS should study accurately all institutions that could affect the development of the scheme, not only within the water sector but also within those institutions that deal with agriculture, biodiversity conservation and environmental compensations. One of the main success factors of PWS seemed related to how the scheme is able to engage and create synergies with institutions from other sectors (horizontal interplay), such as Natura 2000, environmental compensations funds, CAP, etc. Moreover, at political level, it should be able to aligning and harmonize all EU, national, regional and local institutions that related with the scheme focus.

Design: win-win approaches with farmers are one of the best solutions to decrease negotiation costs together with reducing the times of negotiation process. Farmers want to be farmers; they want to see which benefits they can gain through being part of the scheme; not only through the payment they receive but also how their farming activities can be improved. Rationalization and chemical input saving, organic farming, capital works improvements are examples that have demonstrated to be effective within the inventoried schemes.

Since the scheme managers (utilities and municipalities) do not have perfect information about the individual farmer's cost baseline, the farmers have an opportunity to obtain over-compensation. Therefore structuring the right design system is of a paramount importance. For example, in the case of Fowey River in South West England, the auction system stimulated competition between farmers by only funding bids that offer the best value for money for South West Water. In particular, the Fowey River Improvement Auction delivered between 20% and 40% better value for money than the fixed-price alternative (Day and Couldrick, 2013). However, the advisor-led schemes are to be preferred when an advisor's expert judgement is needed on the ground to distinguish between different alternative options. Auctions also have a considerable advantage in that they scale-up with relatively little additional cost. Accordingly, an auction might be preferred for large-scale schemes, particularly where there is little detailed local knowledge of a region through which farms can be effectively targeted. Advisor-led schemes fit best where the scale of the scheme is small and where advisors have a good local knowledge to understand where the watershed investments have better return in term of service provision.

Some scheme managers have reported the use of commodity certification standards as a tool for decentralized compliance monitoring and to increase win-win benefits for farmers & forest owners. Lower Saxony scheme and City of Munich in Germany are providing, among the portfolio of management practices, a payment for organic agriculture on groundwater recharge areas. Norda water (Monticchio Gaudianello) in Italy has a scheme based on organic certification of spring water catchments and promoted on the bottles' label, using it to show corporate environmental responsibility to its customers. Schemes that work through match funding with CAP often let payment agencies in charge of controlling the correct use of EU funds to carry out the compliance monitoring.

Compared to other studies where schemes reward either by cash or by providing in-kind inputs (Martin-Ortega *et al.*, 2013; Sattler *et al.*, 2013), Europe provides a very clear trend where payments are usually (44% of schemes) coupled with in-kind services or inputs.

Capacity and scale: capacity and scale matters as the assessment shows that public bodies directly manage 49% of schemes; however, 29% are managed by cross scale partnership, which through collaborative approaches provide better territorial coverage, technical and financial capacity. When the private sector is involved, mostly only big organizations such as multinational companies such as CocaCola, Danone, Bionade are managing PWS. Therefore, PWS shall preferably be managed either by public organization or by organization with strong financial, technical and management capacity. PWS based on public budget allocation are often undermined by political instability that could affect the allocation of resources depending on availability and political decisions. To avoid instability public PWS should be coupled with regulations that set financial instruments such as water charges or funds that systematically raise financial sources to run the scheme. Considered schemes based on water charges are run on long-term and seemed to have bigger scale and impacts.

Performances and outcomes: many factors influence performances and outcomes, among others, those above mentioned. The difficulties to monitor and assess hydrological service performances of a scheme make also difficult to assess its outcomes and performances. The definition of a hydrological baseline, with specific hydrological indicators, attributes and related quantities shall be the first step to allow a fair performance and outcomes assessment. However, performances and outcomes in PWS are dominated by uncertainty related to how management practices impacts on hydrological services, as the relation is always site and context specific. Especially when working on diffuse pollution, a change on the behaviour of few farmers in the catchment can provide significant changes on hydrological outcomes of the whole PWS.

In all four considered PWS, we found positive performances regarding cost benefit/saving of the scheme, compared with BAU scenario, taking into account co-benefits. However, results on cost-benefits analysis depend on case by case and on the boundaries of cost and benefits considered during the study. PWS are not always a better economic option compared to conventional water treatment, however if we consider the co-benefit in term of social, biodiversity and climate outcomes, payment schemes are certainly a valuable options to address water quality and other policy goals.

Future challenges of PWS development

PWS are likely to be soon replaced by cross-compliance and tightening of legal requirements for groundwater protection. Avoided impact bilateral agreements that only deal with decreasing the use of fertilizers (thus not providing many multiple benefits) are those that are more likely to be replaced by cross-compliance. Moreover, it is difficult and expensive to monitor the use of chemical inputs and identify those farmers that do not meet the scheme requirements. Several water utilities would prefer other types of investments such as afforestation or establishment of wetland as they are easy to control. However, the latter are more feasible when the number of service suppliers is low, and for which the negotiation process for the land use change is not that demanding. When the number of farmers is high, the system used by the city of Munich can be a good example to negotiate among farmers' interests and water quality goals. The adoption of organic agriculture as proxy management practice has provided farmers with more market opportunities at no additional certification cost (as organic farming certification is paid by the scheme) while allowed the water utility to achieve important water quality targets. Monitoring and design process where easily achieved as organic farming has its own system which could be used within the PWS of Munich city. However, the PWS had to invest to promote a marketing strategy for farmers' products, as originally there were not markets for them.

Water Trading Initiatives, although almost absent in EU, may have a future development. The UK peatland code it's on pilot phase, however an extensive public consultation and broad management team is ensuring participatory design. On the other side, the Spanish initiative on groundwater trading rights, according to WWF who was initially part of the process, failed because speculation occurred during the acquisition and selling of water abstraction rights. These schemes have to be carefully considered as they draw from the experience of biodiversity offsetting, which is at European level a very controversial issue. The mechanisms shall ensure that there is a clear offset and distribution of trading rights in order to ensure the real conservation of the water related ecosystem. Environmental NGOs have to be consulted and involved since the beginning of each pilot project, the initiatives shall partner with universities to ensure that correct and reliable metrics systems are adopted.

When developing PWS, practitioners should be imaginative and not tied to the theoretical idea of PES. Very few pure PES do exist and this is the first indicators to say that a pure PES is likely not to be successful. This is particularly true in the context of Europe and within the water sector, where there is sedimentation of actors and institutions with different roles and uses regarding water resources, at local, regional, national and European level.

Finally, while implementing PWS there are a number of scientific and institutional challenges founded within the considered case studies and little evaluation of the transaction costs of addressing these challenges. However, the development of PWS increases the institutional capacity of the actors and improves trust and local knowledge among watershed institutional networks. When evaluating the cost of PWS special attention has to be paid to value these co-benefits, in term of social capital and other ecosystem services.

Multiple benefit partnerships are successful as they recognise the multiple benefit nature of PWS, which are implemented locally with the participation of all relevant actors, providing an extensive identification of potential buyers/beneficiaries and a diversified and locally adapted portfolio of service providers and management practices. The recognition of the multiple benefit partnership provides social collaboration among different actors, improve synergies among CSO, regulators, private business and existing institutions and policy tools.

Therefore, the multiple benefits concept, bring the idea of co-funding and networking and transform the traditional idea of PES (bilateral agreement between a service provider and a service buyer) into a watershed network where shared hydro-geological goals are funded and supported by multiple actors that collaborate in a win-win based relationship.

Future research is needed to assess the performance of PWS schemes based on a detailed transaction costs analysis and/or cost benefit analysis. However, the same type of PWS should be selected in order to obtain results that can be comparable; the framework provided within this research can be helpful to identify similar typologies of PWS. Moreover, the boundaries of cost-benefit analysis should be well defined both in term of which costs are calculated and in term of accounted co-benefits.

REFERENCES

Agrawal, A., 2001. Common Property Institutions and Sustainable Governance of Resources. World Dev. 29, 1649–1672.

Alcamo, J., Döll, P., Henrichs, T., Kaspar, F., Lehner, B., Rösch, T., Siebert, S., 2003. Global estimates of water withdrawals and availability under current and future " business-as-usual " conditions. Hydrol. Sci. Sci. Hydrol. 48, 339–348.

Barataud, F., Aubry, C., Wezel, A., Mundler, P., 2014. Management of drinking water catchment areas in cooperation with agriculture and the specific role of organic farming. Experiences from Germany and France. Land use policy 36, 585–594.

Bennett, D.E., Gosnell, H., Lurie, S., Duncan, S., 2014a. Utility engagement with payments for watershed services in the United States. Ecosyst. Serv.

Bennett, G., Nathaniel, C., Katherine, H., 2012. Charting New Waters State of Watershed Payments 2012. Washington, D.C.

Bennett, G., Nathaniel, C., Leonardi, A., 2014b. Gaining Depth State of Watershed Investment 2014. Forest Trends Ecosystem Marketplace, Washington, D.C.

Bluemling, B., Horstkoetter, M., 2007. Agricultural Groundwater Protection through Groundwater Co-operations in Lower Saxony, Germany, a multi stakeholder task. L'avenir l'agriculture irriguée en Méditerranée 6–7.

Borowski, I., Bourhis, J. Le, Pahl-wostl, C., Barraqué, B., 2008. Spatial Misfit in Participatory River Basin Management: Effects on Social Learning, a Comparative Analysis of German and French Case Studies. Ecol. Soc. 13, 7.

Bourdieu, P., 1986. The forms of capital, in: Handbook of Theory and Research for the Sociology of Education. New York, Greenwood, pp. 241–258.

Boyd, J., Banzhaf, S., 2007. What are ecosystem services? The need for standardized environmental accounting units. Ecol. Econ. Coast. Disasters Coast. Disasters Spec. Sect. 63, 616–626.

Brauman, K. a., Daily, G.C., Duarte, T.K., Mooney, H. a., 2007. The Nature and Value of Ecosystem Services: An Overview Highlighting Hydrologic Services. Annu. Rev. Environ. Resour. 32, 67–98.

Brouwer, F., Heinz, I., Zabel, T., 2003. Governance of Water-Related Conflicts in Agriculture. Springer Science & Business Media.

Brouwer, R., Tesfaye, A., Pauw, P., 2011. Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. Environ. Conserv. 38, 380–392.

Brunner, P., 2008. Sustainable Groundwater Management. Handbook of best practice to reduce agricultural impacts on groundwater quality.

Bryson, J.M., 2004. What to do when Stakeholders matter. Public Manag. Rev. 6, 21–53.

Butler, D.W., 2009. Planning iterative investment for landscape restoration: Choice of biodiversity indicator makes a difference. Biol. Conserv. 142, 2202–2216.

Ciscar, J.-C., Iglesias, A., Feyen, L., Szabó, L., Van Regemorter, D., Amelung, B., Nicholls, R., Watkiss, P., Christensen, O.B., Dankers, R., Garrote, L., Goodess, C.M., Hunt, A., Moreno, A., Richards, J., Soria, A., 2011. Physical and economic consequences of climate change in Europe. Proc. Natl. Acad. Sci. U. S. A. 108, 2678–83.

Coase, R.H., 1960. Problem of Social Cost, The. J. Law Econ. 3.

Corbera, E., Soberanis, C.G., Brown, K., 2009. Institutional dimensions of Payments for Ecosystem Services: An analysis of Mexico's carbon forestry programme. Ecol. Econ. 68, 743–761.

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, 253–260.

CTFC, 2012. Working report on ecosystem services that mediterranean forests provide in the water issue. Sylvamed.

Dankers, R., Feyen, L., 2008. Climate change impact on flood hazard in Europe: An assessment based on high-resolution climate simulations. J. Geophys. Res. 113, D19105.

Day, B., Couldrick, L., 2013. Payment for Ecosystem Services Pilot Project: The Fowey River Improvement Auction. Norwich, UK.

De Groot, R.B. a. A., Hermans, L.M., 2009. Broadening the picture: Negotiating payment schemes for water-related environmental services in the Netherlands. Ecol. Econ. 68, 2760–2767.

De Groot, R.S., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P., van Beukering, P., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst. Serv. 1, 50–61.

De Groot, R.S., Wilson, M. a, Boumans, R.M.. J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. 41, 393–408.

DEFRA, 2011. The Natural Environment White Paper: an analytical perspective. London, UK.

DEFRA, 2013a. Payments for Ecosystem Services : A Best Practice Guide. London, UK.

DEFRA, 2013b. Payments for Ecosystem Services: A Best Practice Guide. Annex - PES Case Studies. London, UK.

DEFRA, 2013c. Developing the potential for Payments for Ecosystem Services : an Action Plan. London, UK.

Derissen, S., Latacz-Lohmann, U., 2013. What are PES? A review of definitions and an extension. Ecosyst. Serv. 6, 1–4.

Ellis, F., 1993. Peasant Economics: Farm Households in Agrarian Development. Cambridge University Press.

Engel, S., Pagiola, S., Wunder, S., 2008. Designing payments for environmental services in theory and practice: An overview of the issues. Ecol. Econ. 65, 663–674.

England, R.W., 2000. Natural capital and the theory of economic growth. Ecol. Econ. 34, 425–431.

Essam Yassin, M., 2013. Economic Incentives for Marine and Coastal Conservation. IIED, London.

European Commission, 2012. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A blueprint to safeguard Europe's water resources.

Falconer, K., 2000. Farm-level constraints on agri-environmental scheme participation: a transactional perspective. J. Rural Stud. 16, 379–394.

Fisher, B., Turner, R.K., Morling, P., 2009. Defining and classifying ecosystem services for decision making. Ecol. Econ. 68, 643–653.

Fletcher, R., Breitling, J., 2012. Market mechanism or subsidy in disguise? Governing payment for environmental services in Costa Rica. Geoforum 43, 402–411.

Fu, B.-J., Su, C.-H., Wei, Y.-P., Willett, I.R., Lü, Y.-H., Liu, G.-H., 2010. Double counting in ecosystem services valuation: causes and countermeasures. Ecol. Res. 26, 1–14.

Fung, A., 2006. Varieties of Participation in Complex Governance. Public Adm. Rev. 66, 66–75.

García-Amado, L.R., Manuel Ruiz Pérez, F., Reyes Escutia, Sara Barrasa García, E.C.M., Pérez, M.R., Escutia, F.R., García, S.B., Mejía, E.C., 2011. Efficiency of Payments for Environmental Services: Equity and additionality in a case study from a Biosphere Reserve in Chiapas, Mexico. Ecol. Econ. 70, 2361–2368.

Garin, P., 2012. Why are there so few cooperative agreements between farmers and water services in France? Water policies and the problem of land use rights. Irrig. Drain. 61, 95–105.

Giani, P., 2012. I custodi del territorio. Intersezioni 19, 6–7.

Gibbons, J.M., Nicholson, E., Milner-Gulland, E.J., Jones, J.P.G., 2011. Should payments for biodiversity conservation be based on action or results? J. Appl. Ecol. 48, 1218–1226.

Gleeson, T., Wada, Y., Bierkens, M.F.P., van Beek, L.P.H., 2012. Water balance of global aquifers revealed by groundwater footprint. Nature 488, 197–200.

Gong, Y., Bull, G., Baylis, K., 2010. Participation in the world's first clean development mechanism forest project: The role of property rights, social capital and contractual rules. Ecol. Econ. 69, 1292–1302.

Greiber, T., van Ham, C., Jansse, G., Gaworska, M., Ham, C. Van, Jansse, G., Gaworska, M., 2009. Final report study on the Economic value of groundwater and biodiversity in European forests. Brussels.

Grolleau, G., McCann, L.M.J., 2012. Designing watershed programs to pay farmers for water quality services: Case studies of Munich and New York City. Ecol. Econ. 76, 87–94.

Groot, D.R., Fisher, B., Christie, M., Aronson, J., Braat, L., Gowdy, J., Haines-young, R., Maltby, E., Neuville, A., Polasky, S., Portela, R., Ring, I., Blignaut, J., Brondízio, E., Costanza, R., Jax, K., Kadekodi, G.K., May, P.H., Mcneely, J., Shmelev, S., 2010. Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation, in: The Economics of Ecosystems and Biodiversity: The Ecological and Economic Foundations.

Hack, J., 2011. From Hydrological Ecosystem Service Valuation to Participatory Integrated Water Resource Management, in: AGUA 2011 Ecosistemas Y Sociedad.

Haines-Young, R., Potschin, M., 2007. The links between biodiversity , ecosystem services and human well-being. In: Raffaelli, D. Ecosystem Ecology: a new synthesis. BES Ecological Reviews Series, CUP, Cambridge (in press).

Haines-Young, R., Potschin, M., 2011. Common International Classification of Ecosystem Services (CICES). Paper prepared for discussion at the expert meeting on ecosystem accounts organised by the UNSD, the EEA and the World Bank. London, UK.

Hardin, G., 1968. The tragedy of the commons. Science 162, 1243–8.

Hauck, J., Görg, C., Varjopuro, R., Ratamäki, O., Maes, J., Wittmer, H., Jax, K., 2013. “Maps have an air of authority”: Potential benefits and challenges of ecosystem service maps at different levels of decision making. Ecosyst. Serv. 4, 25–32.

He, X., Junying, C., Jiahong, L., Dayong, Q., 2011. Wetland Ecosystem Service Evaluation of Fenhe River. Procedia Environ. Sci. 10, 2118–2122.

Heikkila, T., Schlager, E., Davis, M.W., 2011. The Role of Cross-Scale Institutional Linkages in Common Pool Resource Management: Assessing Interstate River Compacts*. Policy Stud. J. 39, 121–145.

Hein, L., Koppen, K. Van, De Groot, R.S., Ierland, E.C. Van, 2006. Spatial scales , stakeholders and the valuation of ecosystem services. Ecol. Econ. 57, 209–228.

Hejnowicz, A.P., Raffaelli, D.G., Rudd, M.A., White, P.C.L., 2014. Evaluating the outcomes of payments for ecosystem services programmes using a capital asset framework. Ecosyst. Serv.

Higginson, M., Austin, P., 2014. A Review of United Utilities Sustainable Catchment Management Programme and Cost Benefit Analysis.

Hussey, K., Pittock, J., 2012. The Energy – Water Nexus : Managing the Links between Energy and Water for a Sustainable Future. Ecol. Soc. 17.

J.B.Ruhl and Juge Gregg, 2001. Integrating Ecosystem Services into Environmental Law: A case Study of Wetlands Mitigation Banking 365, 365–392.

Keeler, B.L., Polasky, S., Brauman, K.A., Johnson, K.A., Finlay, J.C., O’Neill, A., Kovacs, K., Dalzell, B., 2012. Linking water quality and well-being for improved assessment and valuation of ecosystem services., in: Proceedings of the National Academy of Sciences of the United States of America. pp. 18619–24.

Kemkes, R.J., Farley, J., Koliba, C.J., 2010. Determining when payments are an effective policy approach to ecosystem service provision. Ecol. Econ. 69, 2069–2074.

Knight, F.H., 1924. Some Fallacies in the Interpretation of Social Cost. Q. J. Econ. 38, 582.

Kosoy, N., Corbera, E., 2010. Payments for ecosystem services as commodity fetishism. Ecol. Econ. 69, 1228–1236.

Kroeger, T., 2013. The quest for the “optimal” payment for environmental services program: Ambition meets reality, with useful lessons. For. Policy Econ. 37, 65–74.

Leonardi, A., Pettenella, D., 2012. Impronta idrica e servizi ecosistemici. I pagamenti ecosistemici quali fonti di reddito per le imprese agroforestali. Intersezioni 20, 1–5.

LIFE+ TRUST, 2012. Acqua in cassaforte. Una sperimentazione sulla ricarica artificiale della falda nel bacino del Brenta. Vicenza, Italy.

Lockie, S., 2013. Market instruments, ecosystem services, and property rights: Assumptions and conditions for sustained social and ecological benefits. Land use policy 31, 90–98.

Lu, Y., He, T., 2014. Assessing the effects of regional payment for watershed services program on water quality using an intervention analysis model. Sci. Total Environ. 493, 1056–64.

Lyytimäki, J., Sipilä, M., 2009. Hopping on one leg – The challenge of ecosystem disservices for urban green management. Urban For. Urban Green. 8, 309–315.

Ma, S., Swinton, S.M., Lupi, F., Jolejole-Foreman, C., 2012. Farmers' Willingness to Participate in Payment-for-Environmental-Services Programmes. J. Agric. Econ. 63, 604–626.

Maille, P., Collins, A.R., 2012. An index approach to performance-based payments for water quality. J. Environ. Manage. 99, 27–35.

Marneffe, W., Vereeck, L., 2010. The meaning of regulatory costs. Eur. J. Law Econ. 32, 341–356.

Martin-Ortega, J., Ojea, E., Roux, C., 2013. Payments for Water Ecosystem Services in Latin America: A literature review and conceptual model. Ecosyst. Serv. 6, 122–132.

Matzdorf, B., Sattler, C., Engel, S., 2013. Institutional frameworks and governance structures of PES schemes. For. Policy Econ. 37, 57–64.

MEA, 2005. Millennium Ecosystem Assessment. Ecosystems and human well-being: synthesis, World Health, The Millennium Ecosystem Assessment series. Island Press, Washington, DC.

Miranda, M., Porras, I.T., Moreno, M.L., 2003. The social impacts of payments for environmental services in Costa Rica.

Mitchell, R.B., 2003. Young, O. R., The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale. Int. Environ. Agreements 3, 191–194.

Mitchell, R.B., 2008. Evaluating the Performance of Environmental Institutions: What to Evaluate and How to Evaluate It ? 79–114.

Muñoz Escobar, M., Hollaender, R., Pineda Weffer, C., 2013. Institutional durability of payments for watershed ecosystem services: Lessons from two case studies from Colombia and Germany. Ecosyst. Serv. 1–8.

Muñoz-Piña, C., Guevara, A., Torres, J.M., Braña, J., Munoz Pina, C., Brana, J., 2008. Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. Ecol. Econ. 65, 725–736.

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. Ecol. Econ. 69, 1202–1208.

Muradian, R., Rival, L., 2012. Between markets and hierarchies: The challenge of governing ecosystem services. Ecosyst. Serv. 1, 93–100.

Natural England, 2014. A Catchment Approach for PR14 – A Joint Statement from the Drinking Water Inspectorate , Environment Agency and Natural England.

OECD, 2013. Providing Agri-environmental Public Goods through Collective Action. Geneva, Switzerland.

OFWAT, 2011. From catchment to customer. Can upstream catchment management deliver a better deal for water customers and the environment?

Ojea, E., Martin-Ortega, J., Chiabai, A., 2012. Defining and classifying ecosystem services for economic valuation: the case of forest water services. Environ. Sci. Policy 19–20, 1–15.

Ostrom, E., 1999. Revisiting the Commons: Local Lessons, Global Challenges. Science (80-.). 284, 278–282.

Ostrom, E., 2000. Collective Action and the Evolution of Social Norms. J. Econ. Perspect. 14, 137–158.

Ostrom, E., 2011. Background on the Institutional Analysis and Development Framework. Policy Stud. J. 39, 7–27.

Pagiola, S., 2008. Payments for environmental services in Costa Rica. Ecol. Econ. 65, 712–724.

Pannell, D.J., Roberts, A.M., Park, G., Alexander, J., 2012. Improving environmental decisions : a transaction- costs story 1–17.

Parish, E.S., Kodra, E., Steinhaeuser, K., Ganguly, A.R., 2012. Estimating future global per capita water availability based on changes in climate and population. Comput. Geosci. 42, 79–86.

Pattanayak, S.K., Wunder, S., Ferraro, P.J., 2010. Show Me the Money: Do Payments Supply Environmental Services in Developing Countries? Rev. Environ. Econ. Policy 4, 254–274.

Perrot-Maître, D., 2006. The Vittel payments for ecosystem services: a “perfect” PES case? London, UK.

Pettenella, D., Vidale, E., Gatto, P., Secco, L., 2012. Paying for water-related forest services: a survey on Italian payment mechanisms. iForest - Biogeosciences For. 5, 210–215.

Pirard, R., 2012. Payments for Environmental Services (PES) in the public policy landscape: “Mandatory” spices in the Indonesian recipe. Emerg. Econ. Mech. Glob. For. Gov. 18, 23–29.

Porras, I., Aylward, B., Dengel, J., 2013. Sustainable Markets Monitoring payments for watershed services schemes in developing countries.

Postel, S.L., Thompson, B.H., 2005. Watershed protection: Capturing the benefits of nature’s water supply services 29, 98–108.

Prokofieva, I., Gorriz, E., 2013. Institutional analysis of incentives for the provision of forest goods and services : An assessment of incentive schemes in Catalonia (north-east Spain). For. Policy Econ. 37, 104–114.

Reed, M.S., Moxey, A., Prager, K., Hanley, N., Skates, J., Bonn, A., Evans, C.D., Glenk, K., Thomson, K., 2014. Improving the link between payments and the provision of ecosystem services in agri-environment schemes. Ecosyst. Serv.

Rojas, R., Feyen, L., Watkiss, P., 2013. Climate change and river floods in the European Union: Socio-economic consequences and the costs and benefits of adaptation. Glob. Environ. Chang. 23, 1737–1751.

Rovai, M., Vanni, F., Brunori, G., 2013. Co-producing environmental services through ICT: the case of IDRAMAP, in: XXVth ESRS Congress 29. pp. 199–200.

Russi, D., ten Brink, P., Farmer, A., Badura, T., Coates, D., Förster, J., Kumar, R., Davidson, N., 2013. The Economics of Ecosystems and Biodiversity for Water and Wetlands. London and Brussels, Ramsar Secretariat, Gland.

Salanié, B., 1997. The economics of contracts: a primer. MIT press, Cambridge.

Sandin, L., Solimini, A.G., 2009. Freshwater ecosystem structure-function relationships: from theory to application. Freshw. Biol. 54, 2017–2024.

Sattler, C., Matzdorf, B., 2013. PES in a nutshell: From definitions and origins to PES in practice—Approaches, design process and innovative aspects. Ecosyst. Serv. 6, 2–11.

Sattler, C., Trampnau, S., Schomers, S., Meyer, C., Matzdorf, B., 2013. Multi-classification of payments for ecosystem services: How do classification characteristics relate to overall PES success? Ecosyst. Serv. 6, 31–45.

SCBD, 2011. Possible Indicators for Water and Water Related Ecosystem Services for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets, UNEP/CBD/SBSTTA/15/INF/10.

Schomers, S., Matzdorf, B., 2013. Payments for ecosystem services: A review and comparison of developing and industrialized countries. Ecosyst. Serv. 6, 1–15.

Secco, L., Da Re, R., Pettenella, D.M., Gatto, P., 2013. Why and how to measure forest governance at local level: A set of indicators. For. Policy Econ.

Serna-Chavez, H.M., Schulp, C.J.E., van Bodegom, P.M., Bouten, W., Verburg, P.H., Davidson, M.D., 2014. A quantitative framework for assessing spatial flows of ecosystem services. Ecol. Indic. 39, 24–33.

Smith, L., Hiscock, K., Porter, K., 2011. Integrating Science and Governance for Catchment Management The catchment management problem : How to protect and manage water resources in a.

Taylor, P., Maltby, E., Acreman, M.C., 2011. Ecosystem services of wetlands : pathfinder for a new paradigm 37–41.

TEEB, 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: Asynthesis of the approach, conclusions and recommendations of TEEB.

Ten Brink P., Badura T., F.A. and R.D., Note, A.B., 2012. The Economics of Ecosystem and Biodiversity for Water and Wetlands. A Briefing Note.

Tognetti, S.S., Aylward, B., Mendoza, G.F., 2005. Markets for Watershed Services.

Tognetti, S.S., Mendoza, G., Aylward, B., Southgate, D., Garcia, L., 1999. A Knowledge and Assessment Guide to Support the Development of Payment Arrangements for Watershed Ecosystem Services (PWES) 1–87.

Tracy Stanton, Marta Echavarria, Katherine Hamilton, and C.O., 2010. State of Watershed Payments An Emerging Marketplace, Ecosystem Market Place - Forest Trend.

Turner, R.K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., Georgiou, S., 2003. Valuing nature: lessons learned and future research directions. Ecol. Econ. 46, 493–510.

Turpie, J.K.K., Marais, C., Blignaut, J.N.N., 2008. The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. Ecol. Econ. 65, 788–798.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., James, P., 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landsc. Urban Plan. 81, 167–178.

United Nation, 2013. The value of forests. Payment for Ecosystem Services in a Green Economy, Forestry and Timber Section,. Geneva, Switzerland.

United Utilities, 2012. United Utilities Sustainable Catchment Management Programme water quality monitoring results - July 2012.

Van Hecken, G., Bastiaensen, J., 2010. Payments for ecosystem services: justified or not? A political view. Environ. Sci. Policy 13, 785–792.

Vatn, A., 2010. An institutional analysis of payments for environmental services. Ecol. Econ. 69, 1245–1252.

Vlachopoulou, M., Coughlin, D., Forrow, D., Kirk, S., Logan, P., Voulvoulis, N., 2014. The potential of using the Ecosystem Approach in the implementation of the EU Water Framework Directive. Sci. Total Environ. 470-471, 684–94.

Vörösmarty, C.J., 2000. Global water resources: vulnerability from climate change and population growth, Science.

Wendland, K.J., Honzák, M., Portela, R., Vitale, B., Rubinoff, S., Randrianarisoa, J., 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. Spec. Sect. - Payments Ecosyst. Serv. From Local to Glob. 69, 2093–2107.

Wessex Water, 2013. Catchment management managing water – managing land, 2013. Bath, UK.

Williamson, O.E., 1979. Transaction-Cost Economics: The Governance of Contractual Relations. J. Low Econ. 22, 233–261.

Williamson, O.E., 1981. The economics of organization: the transaction cost approach. Am. J. Sociol. 548–577.

Williamson, O.E., 2007. The New Institutional Economics : Taking Stock , Looking Ahead. J. Econ. Lit. 38, 595–613.

Wilson, D.S., Ostrom, E., Cox, M.E., 2012. Generalizing the core design principles for the efficacy of groups. J. Econ. Behav. Organ.

Witt, U., 2005. “Production” in nature and production in the economy—second thoughts about some basic economic concepts. Struct. Chang. Econ. Dyn. 16, 165–179.

Wittwer, G., Dixon, J., 2013. Effective use of public funding in the Murray-Darling Basin: a comparison of buybacks and infrastructure upgrades. Aust. J. Agric. Resour. Econ. 57, 399–421.

Wunder, S., 2005a. Payments for environmental services: some nuts and bolts. CIFOR Occasional Paper No. 42. Bogor, Indonesia.

Wunder, S., 2005b. Payments for environmental services : Some nuts and bolts. Bogor, Indonesia.

WUNDER, S., 2007. The Efficiency of Payments for Environmental Services in Tropical Conservation. Conserv. Biol. 21, 48 – 58.

Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econ. 65, 663–674.

WWF, 2012. El fiasco del agua en el alto Guadiana.

Young, R.H., 2000. Institutional interplay: the environmental consequences of cross-scale interactions.

Zhang, W., Ricketts, T.H., Kremen, C., Carney, K., Swinton, S.M., 2007. Ecosystem services and dis-services to agriculture. Ecol. Econ. 64, 253–260.

ANNEXES

Annex 1: List of inventoried case studies

Scheme name	N°	Code	Programme administrator	Region
The water sanctuary Taugl	1	AU1	Provincial Governament of Salzburg (Landeshauptfrau) through the Directorate for Agriculture and Forestry	Salzburg
Spa Watersource Protected Area	2	BE1	SPADEL water company	Walloon Region
Liberty Island	3	HU1	WWF Hungary	Danube
Persina Nature Park - pilot	4	BH1	WWF Danube-Carpathian Programme	Bulgarian Lower Danube
Iezer fishponds - pilot	5	RO1	WWF Danube-Carpathian Programme	Romanian Lower Danube
Ciocanesti fishponds - pilot	6	RO2	WWF Danube-Carpathian Programme	Romanian Lower Danube
Aalborg cooperative agreements	7	DK1	Aalborg City Council (Drastrup project)	North Jutland
Copenhagen Energy Corporation	8	DK2	Copenhagen Energy Corporation	Region Hovedstaden
Danish reforestation project	9	DK3	Public water works	National wide
Danish groundwater protection agreements	10	DK4	Public water works	National wide
The English Woodland Grant Scheme	11	UK1	Forest Commission Yorkshire and The Humber Region	Yorkshire and The Humber Region
Voucher angling schemes (7 schemes in UK)	12	UK2	The Wild Trout Trust and the The Rivers Trust	National wide
Westcountry Rivers Trust's Upstream Thinking	13	UK3	South West Water	South West England
The Fowey River Improvement Scheme - Upstream Thinking	14	UK4	South West Water	South West England
Exmoor Mires Project - Upstream Thinking	15	UK5	South West Water	South West England
Working Wetlands Upstream Thinking	16	UK6	South West Water	South West England
Otter Valley - Upstream Thinking	17	UK7	South West Water	South West England
Wild Penwith - Upstream Thinking	18	UK8	South West Water	South West England
Hull Flood risk - Pilot	19	UK9	Land Trust	East Riding of Yorkshire
Poole Harbour - Pilot	20	UK10	RSPB	Dorset
The Tortworth Brook Project - Pilot	21	UK11	Bristol Avon Rivers Trust	South Gloucestershire
Canal and River Trust - Pilot	22	UK12	JBA Consulting	North West of England
Pumlumon Project	23	UK13	Montgomeryshire Wildlife Trust	Wales
Peatland code	24	UK14	Birmingham City University	National wide
Visitor Payback - Nurture Lakeland Scheme	25	UK15	Birmingham City University	North West of England
Improving the River Lea in Luton	26	UK16	Cranfield University	East of England

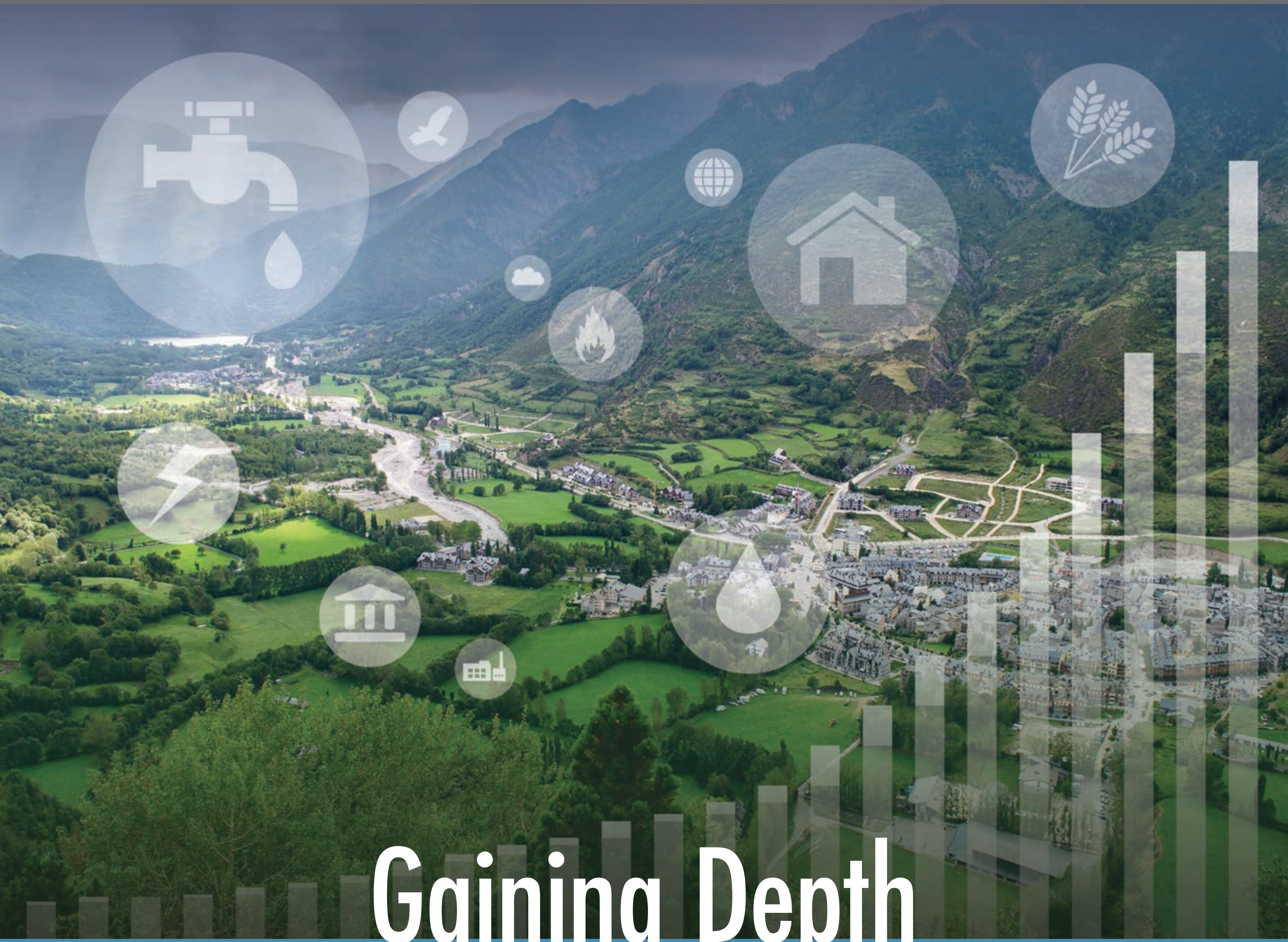
Cotswold Catchment Pilot	27	UK17	FWAG South West	South West England
Slowing the Flow at Pickering	28	UK18	Forest Research	North Yorkshire
Bassenthwaite Ecosystem Services Pilot	29	UK19	The Bassenthwaite Lake Restoration Programme	North West of England
Sustainable Catchment Management Programme (SCaMP)	30	UK20	United Utilities	North West of England
Catchment Wise	31	UK21	United Utilities	North West of England
Safeguard Zones	32	UK22	United Utilities	North West of England
The Catchment Sensitive Farming Capital Grant Scheme (CGS)	33	UK23	Environment Agency and Natural England	National wide
Wessex Water's catchment management programme	34	UK24	Wessex Water	South West England
Ouse Upstream Thinking Project	35	UK25	South East Water	South East England
Yorkshire Water catchment investment	36	UK26	Yorkshire Water	Northern England
Wicksters Brook nitrate scheme	37	UK27	Bristol Water	South West England
Metaldehyde action project	38	UK28	Bristol Water	South West England
Flood Resilience Community Pathfinder Pilot	39	UK29	DEFRA	National wide
The Vittel Scheme	40	FR1	Vittel (Nestlé Waters)	Lorraine
Evian Catchment Protection Partnership	41	FR2	Association for the Protection of the Impluvium of Evian Mineral Water (APIEME) (Evian Company - Danone Group)	Rhône-Alpes
Volvic Catchment Protection Partnership	42	FR3	Environment Committee for the Protection of Impluvium Volvic (CEPIV) - (Volvic - Danone Group)	Auvergne
Badoit Green Bubble Partnership	43	FR4	Badoit (Danone Group)	Loire
Salvetat PEP'S Partnership	44	FR5	PEP'S Association (La Salvetat - Danone Group)	Salvetat
Naussac and Villerest dams schemes	45	FR6	Etablissement Public Territorial de Bassin Loire (EPTB Loire)	Loire
Masevaux water scheme	46	FR7	Municipality of Masevaux (Haut Rhin)	Haut Rhin
Golfe de Saint Tropez fire protection scheme	47	FR8	Union for the drinking water distribution of the Corniche des Maures (SIDECM)	The Var
Rennes Protection Project	48	FR9	Syndicat Mixte de Protection du Bassin Rennais (SMPBR)	Haut-Rhin
SIEM water protection project	49	FR10	The Syndicat Intercommunal des Eaux des Moises (SIEM)	Haute Savoie
Coca Cola -Pennes-Mirabeau Partnership	50	FR11	Coca Cola France	Bouches-du-Rhône
Lons le Saunier	51	FR12	Municipality of Lons le Saunier	Jura department
Eau de Paris drinking water protection zones	52	FR13	Eau de Paris	Paris
Saulce Plain cooperation agreements	53	FR14	Association pour la qualité de l'eau potable de la Plaine du Saulce	Yonne
Munich water protection payments	54	DE1	Stadtwerke München (SVM or Munich City Utilities)	Bavaria State
Kaufering scheme	55	DE2	Kaufering municipal water utility	District of Landsberg in Bavaria
Bionade-Trinkenwasserwald	56	DE3	Bionade Corporation	Rhoen region
Lower Saxony cooperation model	57	DE4	Lower Saxony Governament (NLWKN)	German provincial state of Lower Saxony (Niedersachsen)

SchALVO - Baden-Wurttemberg	58	DE5	Baden-Wurttemberg Governament	Baden-Wurttemberg State
Augsburg scheme	59	DE6	City of Augsburg	South-west of Bavaria
Forest Infiltration Areas	60	IT1	Lowland Basin Authorities	Veneto Region
Piedmont and Veneto Region water levies	61	IT2	Piedmont Region Council	Piedmont Region
Romagna Acque Water Fund	62	IT3	Romagna Acque Spa	Emilia Romagna Region
Hydroelectric power compensation	63	IT4	Mountain Basin Authorities (FEDERBIM)	National wide
Land stewards	64	IT5	Comunità Montana Media Valle del Serchio	Tuscany
Norda Bottle Water	65	IT6	Monticchio Gaudianello S.p.A. (Gruppo Norda)	Basilicata
Stewardship and improvment of water resources: Misura 214/g	66	IT7	Veneto Region	Veneto Region
Integrated Constructed Wetlands - Lombardy Region	67	IT8	Lombardy Region	Lombardy Region
Coca Cola Groundwater Compensation	68	PT1	APF Certifica Group Scheme (APFC)	Alentejo and Ribatejo regions
Special Plan for the Upper Guadiana (SPUG)	69	ES1	River Basin Authority (RBA)	Castilla la Mancha
Nordic Shell Holdings	70	SE1	Lysekil local authority	Lysekil
Switzerland's National Nitrate Strategy	71	SH1	Federal Government, cantons and water supplier	National wide
Dutch groundwater protection zones	72	NL1	Water companies	National wide
Agricultural Claims Water extraction Drentsche Aa	73	NL2	Groningen water	Province of Groningen
Nature friendly banks Oude Rijn	74	NL3	Oude Rijn water boards	Oude Rijn
Active strips management Brabant	75	NL4	Brabant water boards	North-Brabant
Nature friendly banks Midden Delflan	76	NL5	Midden Delflan water boards	Midden Delflan

Annex 2: Publication 1 - Gaining Depth State of Watershed Investment 2014

Leonardi, A., Bennett, G., Nathaniel, C., 2014. European Chapter - Gaining Depth State of Watershed Investment 2014. Forest Trends Ecosystem Marketplace, Washington, D.C.

Ecosystem Marketplace
A FOREST TRENDS INITIATIVE



Gaining Depth

State of Watershed Investment 2014

Donors:

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

PROFOR

The Grantham Foundation
For the Protection of the Environment

Gaining Depth

State of Watershed Investment 2014

A Report by Forest Trends' Ecosystem Marketplace

Genevieve Bennett and Nathaniel Carroll

Contributing authors: Michael Bennett, Alessandro Leonardi, and Kevin Moull

December 2014

Preferred citation: Bennett, G., and N. Carroll. (2014). *Gaining Depth: State of Watershed Investment 2014.*
Available online at www.ecosystemmarketplace.com/reports/sowi2014.

7. Europe

Table 14: Summary Details - Europe

	2011	2013
Operational programs	15	44
Programs in development	3	8
Values	$2.7M	$60.8M
Total land area managed for watershed services	65,030 ha	1.8M ha
New land area managed for watershed services, per annum	n/a	35,000 ha

Notes: *Given our data collection cycle (which takes place every other year), data on ha protected in 2012 is unavailable, as the survey asks respondents to indicate total ha under management and ha added in the last twelve months.

Source: Forest Trends' Ecosystem Marketplace. *State of Watershed Investment 2014.*

Key Findings

- 2012 and 2013 saw major expansion and consolidation of watershed investment across the EU, with more than $60M transacted in 2013.
- New pilots in the UK were a major source of growth, driven by private water company demand and backed by receptive policy. The island nation accounted for a third of European programs and nearly two-thirds ($24.3M) of all European transactions.
- Overall, program investors committed $45.6M to watershed investment between 2014 and 2020. Thirty-eight percent of buyers pledged future funding, a relatively high proportion compared to other regions around the world. But much of that money is front-loaded in 2014 and 2015. Just one program reported secure funding for three or more years.
- Programs in Europe frequently estimate cost-benefit ratios and cost-effectiveness of watershed interventions. As a result, many programs have been able to conclusively demonstrate the benefits of IWS, compared to alternatives like built water treatment infrastructure. A major driver is the UK Water Services Regulation Authority (known as "Ofwat") requiring a strong evidence base for approval of watershed investment.
- At the EU level, policymakers appear ready to correct a long-standing mismatch between water policy and agricultural, rural development, and energy policy frameworks. More than $167B in Common Agricultural Policy (CAP) funding between 2014 and 2020 has been committed to subsidies for land management practices that safeguard and enhance healthy ecosystems. Common goals shared by new watershed and biodiversity agendas could also open up additional funding for IWS.

Lead author of this chapter: Alessandro Leonardi, Department of Land Environment Agriculture and Forestry, University of Padua, and ETIFOR associate[68]

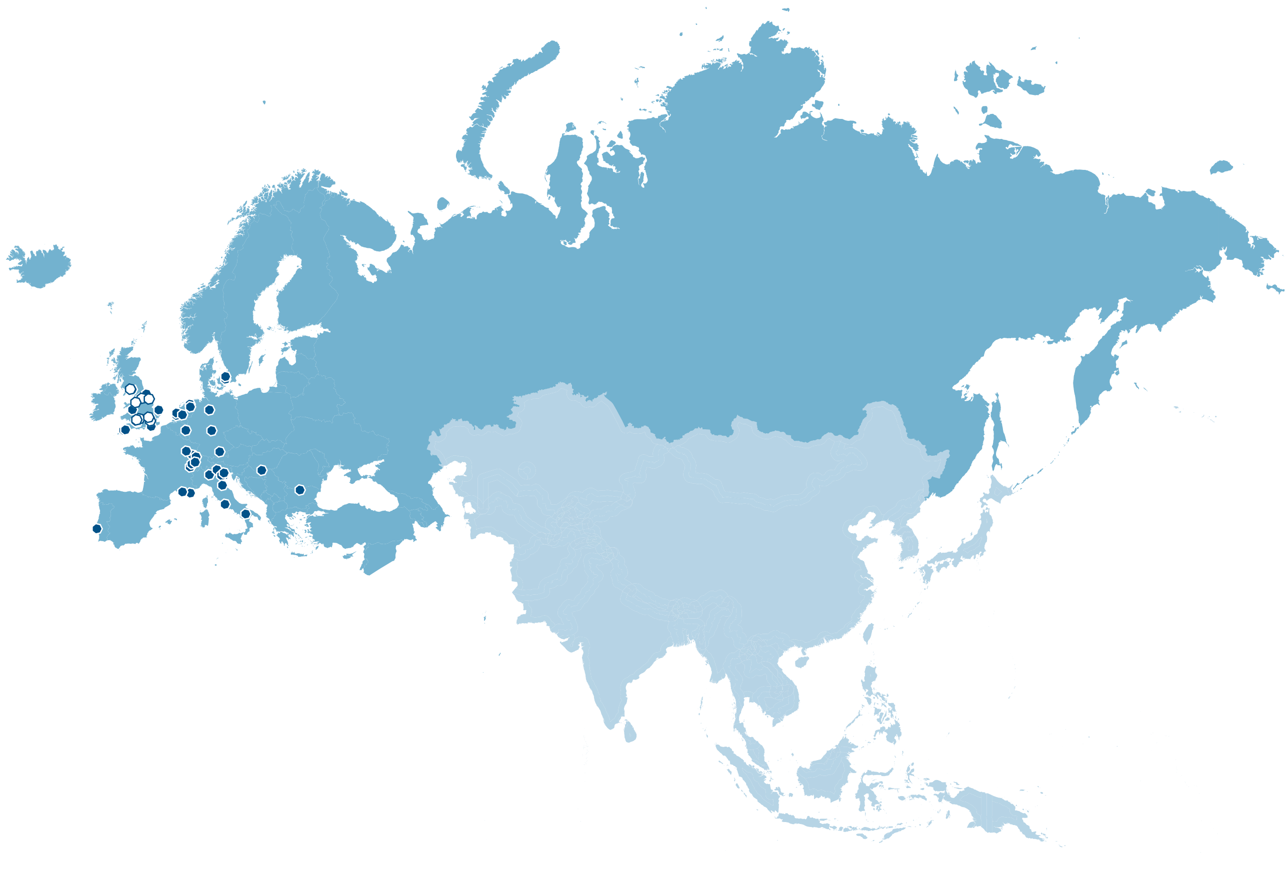
[68] This contains information taken from a PhD thesis: Characterizing governance and benefits of Payments for Watershed Services in Europe. Alessandro Leonardi, Department of Land Environment Agriculture and Forestry, University of Padua, and ETIFOR associate.

7.1 Introduction

UK government throws its weight behind nature-based approaches for water security

IWS grew rapidly in the UK, and particularly in England, in 2012-2013 thanks to supportive policy from Ofwat and the UK Department for Environment, Food and Rural Affairs (Defra). Every five years, Ofwat reviews private water companies' business plans to maintain

Map 6: Active and Developing Programs in Europe, 2013



Source: Forest Trends' Ecosystem Marketplace. *State of Watershed Investment 2014.*

assets, meet regulations, and ensure secure supplies. Historically, Ofwat hesitated to allow water utilities to invest in watershed management for fear of subverting the "polluter pays" principle. But following positive experiences by the first two utility-led IWS programs (**Sustainable Catchment Management Program** and **Upstream Thinking**), in 2009 Ofwat approved catchment management plans by more than 100 water companies representing more than $100M in funding for IWS program development and investment. Roughly 90 initiatives receiving Ofwat approval for catchment management planned to simply "investigate" watershed approaches between 2010 and 2015, meaning that activities initiated during this period may not yet be fully felt on the ground.

Additional policy and financial support was provided by Defra between 2011 and 2013 on several fronts. In 2011 Defra established an Ecosystem Markets Task Force, to be led by stakeholders from the private sector. The Task Force is charged with developing an action plan to expand PES around the country, including a best practice guide on how to design such projects. Defra also funded eleven IWS pilots during this period to demonstrate IWS mechanisms. Finally, the department sponsored the Ecosystem Knowledge Network, which engages practitioners in sharing experiences on projects taking an ecosystem approach.[69]

Water Framework Directive compliance drives interest in watershed health

Policy change has been partly driven by legal challenges brought by conservation organizations. In 2010, the WWF-UK and the Royal Society for Protection of Birds sued the UK government for non-compliance with the Water Framework Directive (WFD). The suit was primarily over the lack of public consultation in river basin management planning.

To account for this gap in watershed management, Defra in 2013 released a Catchment Based Approach policy framework, which requires better coordination between the government and other stakeholders in basin planning. Defra has also allocated more than $2M in start-up funding for catchment partnerships. While not necessarily driving IWS, these partnerships engage with a number of local and national stakeholders at the catchment level, creating relationships and shared knowledge that can underpin watershed investment. Out of the first 20 partnerships that received funding, at least 17 of them today are involved in an active IWS project. As of 2014, partnerships have been funded in about 80 catchments across England.

[69] British Ecological Society, January 10, 2012.

At the national level, retrofitting regulations for IWS initiatives

Policymakers and NGOs in the last few years focused efforts on crafting IWS-friendly policy at the EU level. Not much national-level policy emerged in 2012-2013, with the exception of strong support at the national level for catchment management in the UK.

Instead, practitioners have made use of existing frameworks to propel nature-based solutions forward, sometimes in creative ways. For instance, many countries offer compensation for legal restrictions on land use due to water source protection.[70] Compensation covers the opportunity cost for farmers facing loss of income from fertilizer use restrictions.

In Italy, where legislation regarding PES doesn't exist, the **Land Stewards** program uses an existing national law as a means to implement and operate PES programs. The law is meant to promote multifunctional agriculture and authorizes public bodies to contract with private and public entities for landscape management.[71] The text of the law doesn't, however, permit compensation for ecosystem services. IWS contracts instead must link payments to activities associated with conservation projects rather than to the delivery of specific ecosystem services.

European Commission looks to ecosystem-based approaches to close the gap on Water Framework Directive implementation

In late 2012 the European Commission (EC) published a 'Blueprint' on water, calling for better integration of water goals with agricultural, energy, and development policy.[72] Despite significant improvements on water quality in the last decade, only 53% of EU waters are expected to achieve the WFD goal of good status by 2015.

The Blueprint attributes this implementation gap to poor local governance and limited uptake of economic instruments. The document sets an agenda and timetable for establishing guidance on market-based environmental approaches, including water trading

[70] Germany: Article 14 Para.2 of the German Basic Law, Lower Saxony (Federal and Provincial States' Water Acts) and in Bavaria (Art. 36 a Para 2 of the Bavarian Nature Protection Act); Italy (Galli's Act indications - art.18 and 24, Law 36/1994); the Netherlands (Groundwater Act 1981); Austria (Austrian Water Rights Act. article 34) and Switzerland (article 62 of the Federal Law on the Protection of Waters).

[71] Decreto Legislativo 228 on agriculutral modernization, May 18, 2001.

[72] http://ec.europa.eu/environment/water/blueprint/index_en.htm

schemes, water catchment accounts, Natural Water Retention Measures (NWRM), and PES.

Linking water and biodiversity policy agendas

In recent years EU-level policy on biodiversity—such as the Birds and Habitats Directives, which collectively cover almost 18% of the EU's territory—has offered IWS program developers opportunities to couch watershed protection in terms of biodiversity conservation goals. In the UK, for example, watershed areas protected by United Utilities' **Sustainable Catchment Management Program** (SCaMP) in North West England and South West Water's **Upstream Thinking** programs overlap with Habitats Directives land. These areas have had program approval fast-tracked by Ofwat (see Case Studies 7.1 and 7.2). The EC also encourages private-public match funding to meet Directives requirements through a website that provides guidance and financing tools, encouraging member states to employ financing instruments like PES, visitor payback schemes, and trust funds for Natura 2000 sites.[73]

7.2 Impacts

Supply: Funding flows to 1.8M ha in Europe, with a focus on productive landscapes

Buyers of watershed services in 2013 paid for the protection and restoration of more than 1.8M ha of land, with 35,000 ha coming under new management that year. Two-thirds of watershed services suppliers in Europe are private landowners, mainly farmers and forestland owners. Public suppliers (mostly municipal and public utility-owned lands) account for another 27%, with the remainder made up of NGOs and civil society organizations managing high conservation value lands.

There is a very strong emphasis on funding productive landscapes in Europe. Most programs involve payments for either sustainable agricultural methods or sustainable forest management (typically either the conversion of pine to broadleaf forests or hazardous fuel reduction to mitigate wildfire risks). Reforestation in agricultural catchments is a frequently used intervention to enhance groundwater recharge and flow regulation, though these projects are usually small, accounting for around 3% of reported transactions in 2013.[74]

In 2013, 35% of programs reported measuring direct hydrological outcomes. (More often, programs monitor for implementation of management practices or use 'hectares under management' as a proxy for impacts.) Where direct performance data is available, programs reported an average of 10%-30% reductions in nitrates pollution, and a total of 871.5M tons of avoided sediment loading (equal to 33,500 Titanic ships full of sediment) and 429 ML of groundwater recharge (roughly the volume of 172 Olympic swimming pools) in 2013.

Monitoring challenges constrain performance evaluation – and regulatory approval

Effective monitoring remains a challenge for programs in Europe. Program developers reported common difficulties for M&E, including inherent uncertainty around measuring outcomes and the fact that monitoring results are highly site- and time-sensitive.

But the implications of these M&E challenges in Europe are important since the WFD is a major driver of programs: Regulatory standards rarely accommodate uncertainty related to outcomes, meaning that many water utilities cannot rely on catchment management alone to ensure water quality. For example, in the UK, Ofwat requires water utilities to conduct hydrological baseline and cost-benefit studies before undertaking catchment management schemes. Often these baseline studies are altered by specific annual climate conditions like abnormal rainfall or drought—so demonstrating a program's effectiveness may become a major hurdle in the context of increased climate variability.

Cost-benefit analysis strongly in favor of IWS, especially when co-benefits count

While monitoring IWS projects for hydrological outcomes proves difficult, many programs have been able to measure the cost-effectiveness of their schemes and have found them to be financially viable. One in five programs report using cost-effectiveness or cost-benefit analysis (CBA) to justify implementation.

[73] http://www.financing-natura2000.eu/

[74] They're also relatively expensive: The Oldenburg and East Frisian Water Association (OOWV)—a water utility in Lower Saxony—reports that compared to other management practices (like grasslands protection or nitrate restrictions), reforestation has a lower cost-benefit ratio in terms of reduction of nitrate concentration in groundwater (though only if other multiple benefits, like carbon storage, are not included in the analysis). The study indicates that a kg of N removed by reforestation costs the water utility around $15, while farm advice and restrictions on fertilizer uses at farm level have a slightly low cost, around $1-2 per kg of removed/avoided. Source: N. Benjamin Görlach, Ecologic. Cost-effective groundwater protection: the Thülsfelde Water Protection Area.

Box 7.1: Matching Cap Payments with Private Watershed Investment

A number of programs tracked in this report use CAP agro-environmental match funding to augment existing financing streams. In the past, agricultural and water policy in the EU have often been at odds, with CAP payments for many years essentially subsidizing agricultural intensification. However, the latest CAP phase (2014-2020) finds clearer support for watershed protection in its two agricultural and rural development funds.

The first pillar, the European Agricultural Guarantee Fund (EAGF), aims to provide ecosystem services to the public through its Green Direct Payment initiative, which becomes operational in 2015. Accounting for 30% of the budget, the Green Direct Payment will fund permanent grassland, 'ecological focus areas', and crop diversification. Its total budget from 2014-2020 is $427 billion. The second pillar, the European Agricultural Fund for Rural Development (EAFRD), includes in its six priorities restoring and conserving ecosystems on agricultural and forested landscapes. It focuses specifically on biodiversity, water, and soils management. These measures account for one-third of the total EAFRD budget, which is $130.6B between 2014 and 2020.

South West Water, for example, found that reducing pollution at its source instead of investing in treatment equipment offered the company a benefit-cost ratio of some 65 to 1. Watershed management is also expected to deliver up to 20% savings in operational costs for South West Water's existing treatment plants.[75]

The **Land Stewards** program in Italy (see Case study 6.4) reports four-fold savings in operational costs, as well as reduced monitoring costs thanks to participating farmers taking on decentralized monitoring and management of water channels.

And **Wessex Water** documented a benefit-cost ratio of 6:1—when compared to the treatment option—for a catchment approach that addresses metaldehyde pollution. Metaldehyde, a common pesticide for slugs and snails, is difficult to remove through conventional methods.[76]

Research also found that incorporating co-benefits into programs can make a huge difference in terms of economic appraisal. A CBA of United Utilities' **SCaMP** suggested that operational and capital cost savings would be low.[77] Here, climate and biodiversity co-benefits strongly contributed to the economic case for the program, providing benefit-cost ratios between 2.24-25.38:1 (under different scenarios for greenhouse gas sequestration, biodiversity and water quality response).

Biodiversity a significant driver, but unclear if effective M&E in place

At present, co-benefits are virtually always 'bundled' with watershed protection; that is, all activities are covered under a single funding stream, rather than allocating separate payment levels or investment pools for each ecosystem service. South West Water reports, however, that they are considering monetizing multiple benefits. This could mean selling carbon credits generated from wetland restoration projects.

Biodiversity is a big part of the co-benefit and 'bundling' aspect of IWS. Forty percent of programs report biodiversity goals, while 21% list carbon sequestration objectives. Yet only 14% provided information on their monitoring of biodiversity. The data provided is uneven in terms of clarity regarding metrics and frequency of monitoring. Around half of reported programs suggested that buyers require monitoring as a condition of payment. But it is not at all clear that proper monitoring and evaluation of biodiversity impacts are in place.

7.3 Investment

Demand: $60.8M transacted in 2013, led by a surge in English investment

Projects reported at least $60.8M in transactions across Europe in 2013, largely thanks to a burst in activity in England.[78] Twenty-two programs were operational in

[75] Smith 2013.

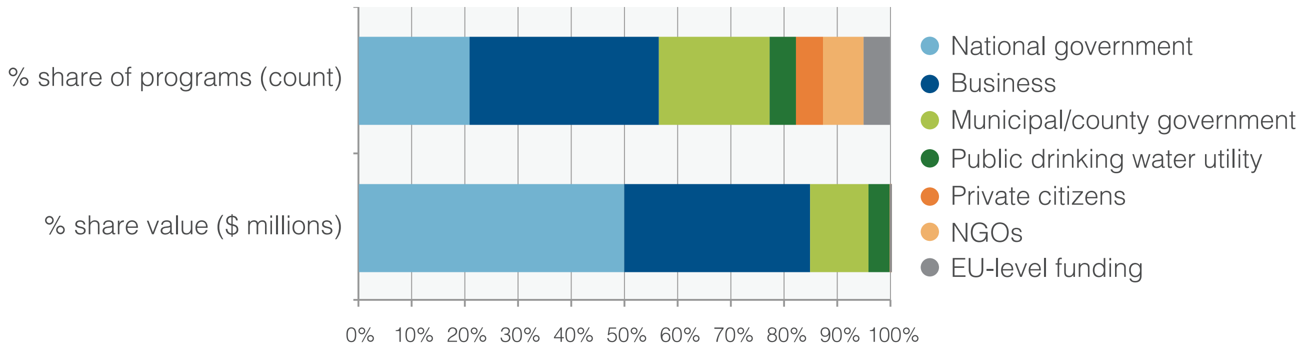
[76] Wessex Water 2013.

[77] Estimates were low in part because the methodology took into account only investments and operational costs directly linked with color removal and waste treatment, and not considering business-as-usual investments in new plant.

[78] The significant increase in transaction value between 2011 and 2013 is also largely a function of improved data collection in Europe.

Figure 50: European Buyers by Prevalence and Value of Investment, 2013

(% share of total buyers; % share of $ transacted in 2013)



Note: Data on NGO and 'Other public' funding is not available for 2013. Private citizen contributions are <1% of total investment.

Source: Forest Trends' Ecosystem Marketplace. *State of Watershed Investment 2014*.

England as of 2013, accounting for a third of the projects in Europe and almost two-thirds of all transactions. [79]

Demand: Beverage industry and water companies a key source of conservation finance in EU

Business was also a major force behind investment in natural infrastructure for water in Europe, delivering at least $8.7M in 2013 (Figure 50). All private-sector buyers tracked in this year's report were either private water utilities (mainly in England) or beverage companies. Beverage companies include Coca-Cola bottling companies in France and Portugal, Bionade in Germany, Vittel and Danone in France, and Norda in Italy. Contrary to other regions where private-sector contributions make up a relatively small share of programs' total financing, in Europe business delivers at least two-thirds of funding for half of the programs in which it participates.

Demand: WFD is a key driver – but for business, so are reputational concerns

As Defra discovered, non-compliance with the WFD can lead to litigation and other expenses. Buyers appear to understand this: As WFD implementation proceeds, most programs report that a key driver is the risk of non-compliance with increasingly demanding drinking water quality standards. Some utilities surveyed for this report expect pollution problems—especially nitrates and pesticides—to worsen in the next ten to twenty-five years, related to both ongoing diffuse pollution and climate change uncertainties. In the face of all of these regulatory, operational and capital cost risks, IWS is seen as a potential tool to enhance competitiveness and profitability.

For private water utilities, watershed investment is also often linked to corporate social responsibility strategies. United Utilities in the UK for example is listed in the Dow Jones Sustainability Index, with the **SCaMP** program one of the core elements in its environmental sustainability performance evaluation. Both **Upstream Thinking** and **SCaMP** have won several awards for sustainability performance and wetlands restoration.[80] Strategies such as these often succeed in generating favorable public opinion for a company. But there can be deeper drivers: Ofwat, for instance, requires businesses to demonstrate customer support when assessing their catchment management plan through surveys and willingness-to-pay analysis.

Mechanisms: A regional shift underway from bilateral to mixed funding models

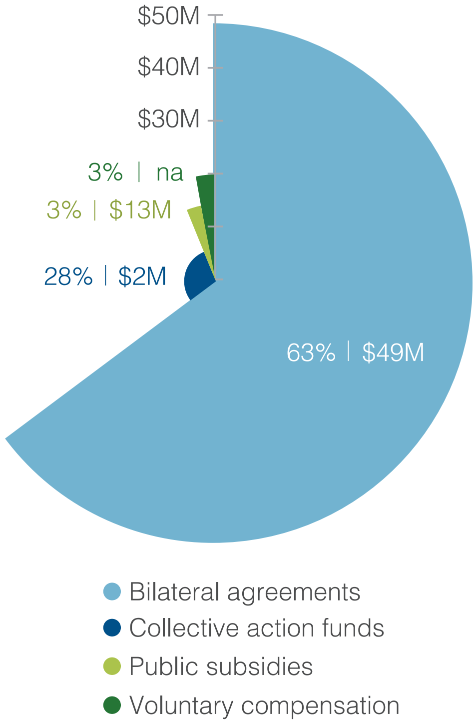
In France, **Vittel's** (now Nestlé's) bilateral watershed protection agreement to safeguard mineral water stands as a classic PES arrangement, wherein a downstream water user voluntarily contracts with upstream farmers to practice sustainable agriculture. This model remains popular in Europe. Most city and utility-driven programs—as in **Munich**, **Alborg**, and **Basel**—are

[79] Actual figures are probably much higher, since accurate transaction data are missing for roughly half of active programs. Many landowners participating in programs also appear to be receiving matching agri-environmental subsidy funds from EU-level bodies, which are not necessarily reported to us by IWS program administrators.

[80] United Utilities' Upstream Thinking was commended in Defra's Water White Paper last year and won the 2012 Partnership Initiative of the Year award at the Water Industry Achievement Awards. An initiative to improve wildlife habitats and water quality on the gathering grounds of some of the North West's reservoirs has won two national ecology awards.

Figure 51: Program Types in Europe by Prevalence and Transaction Values, 2013

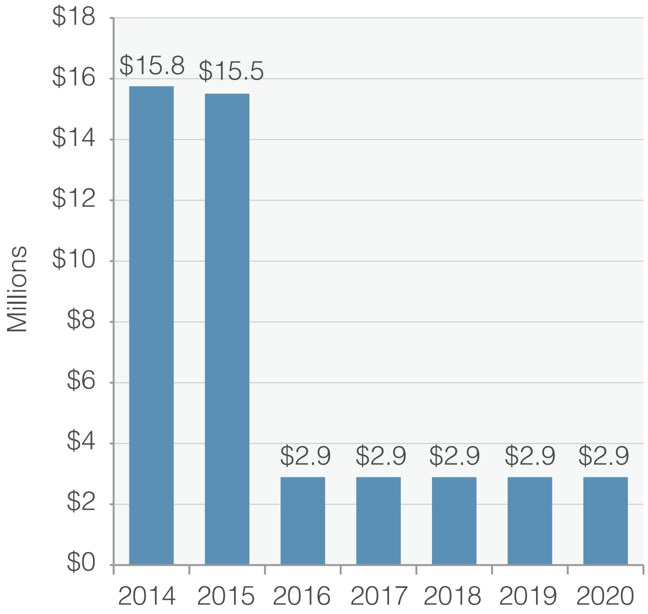
(Interior circle: % share of programs; Exterior radius: $ value invested)



Source: Forest Trends' Ecosystem Marketplace. *State of Watershed Investment 2014.*

Figure 52: Funding Commitments by European Buyers, 2014-2020

($ value by year reported by buyers)



Source: Forest Trends' Ecosystem Marketplace. *State of Watershed Investment 2014.*

bilateral in form. But collective action models combining funding from multiple buyers are on the rise.

At present, collective action mechanisms remain a tiny slice of activity, both in terms of the number of programs and the share of total finance delivered (Figure 51). But half of new programs since 2010 take this form.

Many bilateral agreements have also shifted toward a more 'mixed model' in recent years, leveraging matching funds from agri-environmental subsidy programs (mainly the CAP) and other watershed stakeholders. IWS payments are typically used to cover the remaining costs of agricultural practices or capital improvements after CAP subsidies (which typically cover around 50%-80% of project costs). We estimate that nearly two-thirds of programs in this report's dataset directly or indirectly harness CAP payments, though actual payment values are difficult to uncover.

Finance: Program finance through 2020 carried by private sector commitments

Private-sector buyers report significant commitment to watershed investment. In fact, in 2013 the sector provided programs with more certainty on future funding than the public sector did: More than a third of private investors pledged 100% funding to their respective programs in 2014. Meanwhile, uncertainties around the public sector's political will to ramp up environmental protection renders future EU funding support unclear—especially during the transition between the last EU funding period (2007-2013) and the current one (2014-2020).

Overall, program investors committed $45.6M between 2014 and 2020. Thirty-eight percent of buyers pledged future funding, a relatively high proportion compared to other regions around the world. But much of that money is front-loaded in 2014 and 2015. Just one program reported secure funding for three or more years (Figure 52)

Market infrastructure: Programs turn to commodity certifications for project guidance, verification

Six programs reported the use of commodity certifications (such as FSC or organic agricultural certification) to verify program activities and increase the value of participation for farmers and forest owners. It's an intriguing development, given the lack of widely used project standards or third-party verification options for IWS.

In Germany, the **Lower Saxony** and **Munich** source-water protection programs offer to help to cover costs of organic agriculture certification. For **Munich**, organic certification has been shown to reduce transaction costs.[81] Meanwhile **Monticchio Gaudianello**, a subsidiary of Norda Water in Italy, funds organic certification among farmers in its source areas as well—and promotes these sustainability efforts on their bottles' labels. In the UK, the **Fowey River** program is also investigating payments for pesticide control via organic agriculture.

United Utilities uses FSC standards for woodlands in catchment lands owned by the company. And in Portugal, Coca-Cola pays the **Forest Producers Association of Coruche** (APFC) for improving cork forest management using FSC certification standards.

7.4 Outlook

The next few years will prove an interesting time for watershed investment in Europe. Continued growth in investment appears likely; the question is whether EU level policy (and national implementation of that policy) will facilitate nature-based solutions or obstruct them.

At the EU level, better policy integration and deeper pockets

The new European Green Infrastructure Strategy approved by the EC in 2013 will integrate natural infrastructure into existing funding mechanisms such as the CAP, the Cohesion Fund, the European Regional Development Fund, Horizon 2020, the Connecting Europe Facility, the European Maritime and Fisheries Fund, the Financial Instrument for the Environment (LIFE) and the Program for the Environment and Climate Action (LIFE+). According to the strategy, the EC together with the European Investment Bank will set up an ad hoc EU financing facility by 2014 for publicly and privately led natural infrastructure projects. All of these public funds will look for possible match funding mechanisms on the ground.

Another major source of funding is the new LIFE program. Between 2014 and 2020 the fund is expected to provide $4.6B, mostly directed to Natura 2000 protected areas, with specific preference for activities that will attract innovative governance/financing systems for conservation and climate adaptation.

[81] Grolleau and McCann, 2012.

A new type of EU regional funding vehicle under the LIFE+ umbrella, the Integrated Project, will fund large-scale interventions ($13-26M per project) advancing the Habitats Directive, Birds Directive, and WFD. Such funding is directed at projects able to show a link between biodiversity conservation and the implementation of River Basin Management Plans.

Dozens of new programs anticipated in England, France

Program growth is anticipated in 2014 and beyond in France and the UK. In France, **Danone** is extending its PES efforts beyond the Evian catchment to three new watershed areas (Volvic, Badoit, La Salvetat). In 2014, United Utilities, having recently moved to the second planned phase of **SCaMP** (which doubled the scale of its intervention), plans to activate two new programs (the Catchment Wise and Safeguard Zone projects) to extend the same approach in non utility-owned land in North West England. And in 2015 **Upstream Thinking** will launch 17 catchment-specific projects in South West England, nearly tripling its watershed protection footprint by area.

Defra published a call for four to six new pilots in February 2014, with $25,000-$40,000 available per project. Dozens of other utility-driven programs are expected to emerge in the UK following 2014's Ofwat pricing review and Defra's statement of obligations for utilities.

Also within the UK, the newly formed government body called Natural Resources Wales committed in its 2014-2015 business plan to identifying funding streams for PES and to begin implementing funding mechanisms in 2016.

Compensation law in Spain offers promise of new funds for natural infrastructure

In Spain, a new law for environmental compensation was approved in 2013. The law established ground rules for a habitat banking system, which could deliver additional finance for restoration and protection of natural infrastructure like wetlands and coastal areas.[82] As this report was written in mid-2014, wetland and habitat banks appeared poised to open in the Iberian Peninsula. The emergence of biodiversity offsetting in the EU might provide additional investment for wetlands, though initial pilots in the UK have sparked strong opposition from some environmental organizations.[83]

[82] Environmental Assessment Law 21/2013 December 9.

[83] For example, FERN 2014.

Case Study 7.1: Upstream Thinking in South West England

South West Water (SWW) is a private company that manages the regulated water and waste water network serving nearly 600.000 customers in South West England. In the past years, intensive mixed livestock farming and degradation of moorlands and peatlands has decreased water quality in regional reservoirs, rivers, and aquifers. In 2008, SWW funded the Exmoor Mires pilot project—a rare move for a water utility at the time—to restore 326 ha of peatlands designated a Site of Special Scientific Interest. SWW partnered with a variety of local delivery groups, such as Exmoor National Park Authority, to deliver the work in coordination with a catchment-based approach facilitated through the NGO Westcountry Rivers Trust, which had experience in sustainable catchment management through the EU-funded WATER project.

Building on that relationship and the pilot experience, SWW launched an umbrella IWS initiative called **Upstream Thinking in 2011.** The project aims to reduce water treatment costs while providing co-benefits like climate change mitigation and biodiversity conservation.

To implement these projects, SWW works in collaboration with a wide range of national and local organizations. South West Waters deliver moorlands restorations while the Westcountry Rivers Trust, Devon Wildlife Trust, and the Cornwall Wildlife Trust oversee efforts that target restoration of culm grassland and stemming pollution from agriculture in West Penwith, Rivers Taw and Torridge, River Fowey, Tamar, Wimbleball and Roadford catchments, and the Otter Valley. Natural England, the Environment Agency, English Heritage, and the National Farmers Union have all supported the project through match funding with agro-environmental payments, monitoring and policy advice. Exeter and East Anglia Universities were involved in the monitoring and design of the payments schemes as well.

The project has experimented with two different types of water quality improvement payment mechanisms: i) a system where farmers identified by an advisory group are offered a fixed-price deal in which South West Water pays 50% of the costs of the capital investments; and ii) an auction-based mechanism asking farmers to submit competitive bids for funding.

A comparison between the two systems suggests that the auction-based system delivers 20%-40% better value for money. But the advisory model may be more appropriate for small-scale projects for which site-specific considerations are needed.[84] A 2015-2020 program is currently under development; information about the design, monitoring, and implementation of the 2010-2015 work will be used to improve on-the-ground delivery.

[84] Citation: Day and Couldrick 2013. Day, B., Couldrick, L., 2013. Payment for Ecosystem Services Pilot Project: The Fowey River Improvement Auction. Norwich, UK.

Case Study 7.2: United Utilities Manages for Multiple Benefits

United Utilities (UU) is the UK's largest water company, supplying drinking and waste water services to nearly 7 million people. UU owns 56,385 ha of land surrounding its reservoirs to protect water quality. Around 30% of its land is designated as a Site of Special Scientific Interest (SSSI), constituting a nationally significant habitat for biodiversity conservation. However, fragile moorland and peatland habitats in the upland catchment areas have been damaged by historical industrial air pollution, agricultural activities, and climate change.

Agricultural policies have encouraged farmers to drain the land and increase livestock grazing on the fells at the expense of water quality, landscape values, and wildlife. Over the last 30 years UU has also experienced substantial increase in discoloration of raw water in many upland catchments. The removal of color requires additional processing, chemicals, power, and waste handling to meet drinking water quality standards. As a result, annual operational costs of water treatment have significantly increased.

UU's **Sustainable Catchment Management Program** (SCaMP) primarily aims to address water color and sedimentation issues. Between 2005 and 2010, UU worked with farm tenants, investing $18M in moorland restoration, fencing, woodlands, farm infrastructure, and protecting watercourses across 27,000 ha of catchment areas. Initially Ofwat expressed concerns that it violated the 'polluter pays' principle. But regulators later approved SCaMP on the basis of cost-benefit analysis and UU's demonstrating the multiple services and co-benefits (water quality, biodiversity, and carbon storage) delivered by watershed approaches.[85]

UU's annual monitoring of the management program shows a positive effect on water quality. CBA suggests the main benefit has overwhelmingly been in terms of GhG mitigation and biodiversity benefits—capital and operational expense savings for water treatment are relatively small.[86,87]

Phase 2 targets in the 2010-2015 period include covering the remaining 30,000 ha owned by United Utilities and extending investment to non utility-owned land. Working with catchment partnerships in the North West England region using the newly created funding schemes, Catchment Wise and Safeguard Zones, is also an objective. Nearly ten years old, the program is used as a model for water utilities across England in designing their own watershed protection programs.

[85] Water utilities in the UK are considered private companies but public bodies under the s28G of Wildlife & Countryside Act. The Natural Environment and Rural Communities (NERC) Act, which came into force on October 1, 2006, requires all public bodies, including United Utilities, to have regard to biodiversity conservation when carrying out their functions. As a result of the SCaMP programme the company exceeded government Public Service Agreement targets for SSSIs returning 98.6% of its land into a favorable or recovering condition by 2010. In fact, the UU SSSI duty was one of the main legal reasons that allowed at first OFWAT to approve SCaMP investments.

[86] United Utilities 2012.

[87] Higginson and Austin 2014.

Case Study 7.3: A New Role for Farmers and Forest Owners in Tuscany (Italy): The Land Stewards

In the hilly regions of Tuscany's Media Valle del Serchio, a public authority is tasked with managing more than 115,000 ha of mountain land and 1,500 km of streams. In an attempt to maintain this land effectively, since 2007 the authority has established agreements with about 40 farmers and forest owners to improve flood risk monitoring and control water courses in the mountain basin. These agreements are part of a program called the Land Stewards.

Farmers and forest owners received a fixed payment ($8,000 per year during the initial phase and $5,000 per year in subsequent years) to assess risk and provide an alert-report service to the public authority on instances of slope instability or waterway obstructions. An interactive Information and Communication Technologies (ICT) system (IDRAMAP) manages reports.[88] Landowners also have the option to contract with the public agency for maintenance. This typically involves removing trees and sediments from riverbeds and managing riparian vegetation.

According to the public authority, the Land Stewards program has resulted in 80% annual cost savings for management interventions in the area. The project also provides an alternative source of income for low-income landowners living in remote areas in the Serchio Valley as well as increased community awareness and participation in hydrological landscape management.

Case Study 7.4: Wessex Waters Finds a Smart, Simple Solution to Combat Metaldehyde

Wessex Water supplies drinking water to 1.3M people in South West England. Most of its water comes from groundwater sources in Wiltshire and Dorset. In recent years, the company has found that increasing levels of treatment were required to maintain and further improve water quality, due to rising levels of nitrates and pesticides including metaldehyde. Extensive monitoring and catchment studies indicated that diffuse pollution from agriculture was actually made up of several concentrated 'point sources' of pollution.

Wessex Water already has several treatment plants in the area. But since conventional treatment methods are not very effective at removing metaldehyde from water supplies, the company decided to work at the catchment level. Wessex Waters estimates the catchment program costs six times less than building a new plant, which would have to be specially designed to treat metaldehyde.

The program works by providing in-kind funding for nitrate management practices at twelve sites and pesticide management in three areas. Wessex Water also pays farmers for substituting metaldehyde with a more water-friendly pesticide [89]

[88] Rovai et al. 2013.

[89] Wessex Water 2013.

Annex 3: Publication 2 - Impronta idrica e servizi ecosistemici

Leonardi, A., Pettenella, D., 2012. Impronta idrica e servizi ecosistemici. I pagamenti ecosistemici quali fonti di reddito per le imprese agroforestali. Intersezioni 20, 1–5.

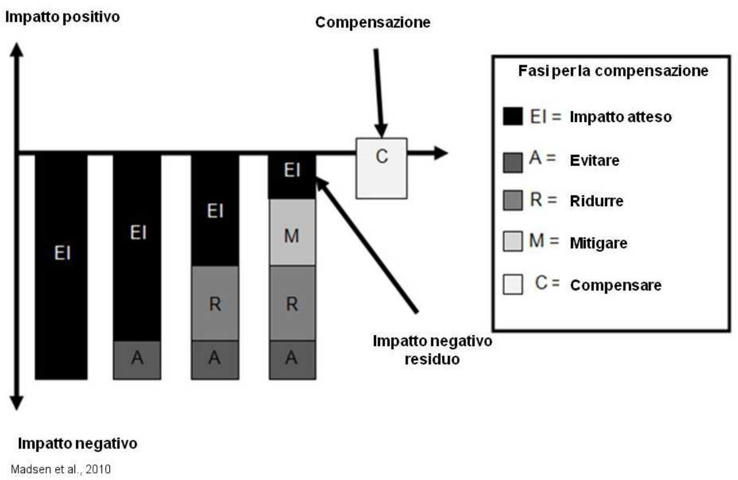
Percorsi e processi

Impronta idrica e servizi ecosistemici

Alessandro Leonardi
Davide Pettenella

I pagamenti ecosistemici quali fonti di reddito per le imprese agroforestali.

L'impronta ecologica quantifica la superficie di territorio necessaria alla rigenerazione delle risorse naturali utilizzate da una certa popolazione umana.
Il concetto affermatosi alla fine degli anni Novanta grazie all'opera *Our ecological footprint: reducing human impact on the Earth* di Mathis Wackernagel e William Rees è stato studiato specificatamente per i consumi energetici e idrici. Mitigazioni e compensazioni ambientali sono importanti, dunque, al fine di ridurre il più possibile l'impronta.
La metodologia proposta da Madsen et al (2010) per diminuire le esternalità ambientali negative contempla quattro fasi procedurali: evitare, ridurre, mitigare, compensare [1]. Pertanto, l'azione di compensazione è l'ultima di una fase di pianificazione e progettazione che, attraverso scelte alternative, dovrebbe limitare "a monte" le ricadute negative arrecate da un'opera o da un'organizzazione. In secondo luogo, è opportuno ridurre le ripercussioni di un'opera – per esempio, mediante l'aumento di efficienza – e, infine, mitigare gli effetti negativi attraverso idonei accorgimenti progettuali. La compensazione fa riferimento alle attività che dovrebbero bilanciare i danni creati dalla realizzazione di un progetto, generando valori ambientali almeno uguali a quelli persi. Per citare un esempio relativo al settore forestale, la compensazione della *Carbon footprint* (Cf) – ossia la quantità di emissioni di anidride carbonica associata a un prodotto, a un'azienda o a un processo – può avvenire attraverso opere di riforestazione e/o di gestione forestale migliorata, in modo da creare un aumento del carbonio sequestrato nei suoli forestali pari o superiore alle emissioni prodotte.



L'impronta idrica

Nel contesto della risorsa idrica, il concetto di "impronta" è relativamente nuovo. In primo luogo, questo è dovuto alla complessità di calcolo del consumo della risorsa idrica in relazione alle diverse qualità di acqua impiegata (verde, blu e grigia, cfr. *infra*) e ai diversi tipi di uso (agricolo, industriale, domestico). L'impronta idrica è definita come il volume totale di acqua necessaria a un'organizzazione per produrre un bene o servizio. A livello internazionale, il *Water footprint network* ha sviluppato delle linee guida per il calcolo dell'impronta idrica (*Water footprint*, Wf) [2]: il manuale offre una serie di metodologie standard per il calcolo della Wf su diverse scale: a livello nazionale, comunale, di bacino idrografico oppure di prodotto o di processo. Un'altra iniziativa di rilievo è in corso di realizzazione da parte dell'Organizzazione mondiale della normalizzazione (Iso) mediante la nor-

ma Iso 14046 (*Life cycle assessment* – Wf – *Requirements and guidelines*) [3].
Secondo le due iniziative la Wf corrisponde alla somma di tre componenti:

- acqua blu (composta dalle acque superficiali e sotterranee, rappresenta il volume d'acqua di superficie o di falda evaporata durante il processo produttivo): Wf blu = acqua blu evaporata + acqua blu incorporata + acqua che non viene riutilizzata in quanto non disponibile in termini sia di spazio sia di tempo;
- acqua verde (composta da acque piovane conservate nel suolo impiegato, rappresenta il volume di acqua piovana evaporata durante il processo produttivo): Wf verde = acqua verde evaporata + acqua verde incorporata;
- acqua grigia (composta da acqua inquinata, quantificata come il volume di acqua dolce necessaria per assimilare il carico inquinante sulla base di norme idriche esistenti di qualità e ambiente):
  Wf grigia = L / (Cmax + Cnat)[1].

Un'altra caratteristica peculiare dell'impronta idrica rispetto alla *Carbon footrprint* è la sua dimensione locale o *site specific*. Risulta infatti meno ragionevole compensare gli effetti sul ciclo dell'acqua di un determinato bacino idrografico attraverso la creazione di opere di compensazione in altri bacini, non collegati dal punto di vista idrogeologico o geografico a quello d'interesse. Nonostante ciò, Hoekstra [4] dimostra che ogni nazione ha un'impronta idrica che si può schematicamente calcolare attraverso la sommatoria di Awu (*Agricultural water use*), Iww (*Industrial water withdraw*), Dww (*Domestic water withdraw*), Vwe (*Virtual water export*), dove Vwe sta per la Wf legata all'esportazione dei prodotti agricoli e industriali verso altri Paesi pari, in media, al 16% dell'impronta idrica totale del Paese. Secondo il medesimo studio, l'Italia ha una Wf tra le più alte al mondo, pari a 2300-2400 m^3/anno/pro capite. Dunque l'impronta idrica ha anche una rilevante dimensione globale veicolata dal commercio internazionale che sposta la Wf dal luogo di produzione al luogo di consumo. Studi autorevoli hanno stimato che entro il 2025 il consumo pro capite di acqua aumenterà del 13% e che la disponibilità sarà fortemente condizionata dall'aumento della popolazione e dallo sviluppo economico. Considerando che meno del 3% dell'acqua mondiale è potabile e che l'83% di questa non è disponibile all'uomo, si prevede che nei prossimi decenni più di un terzo della popolazione mondiale andrà incontro agli effetti di scarsità d'acqua [5].

I servizi ecosistemici come compensazione

Date queste premesse, è plausibile che nel prossimo futuro siano sempre più frequenti iniziative di compensazione dell'impronta idrica a carattere sia locale che internazionale[2]. Nel mercato Italiano e internazionale molte aziende, tra le quali Coca Cola, si propongono come "*Water neutral*" o "*Water free*" o hanno l'obiettivo di diventarlo nel breve termine. Le iniziative di compensazione esistenti, tuttavia, presentano molti aspetti controversi dovuti alla mancanza di metodologie riconosciute per la certificazione e/o garanzia di efficienza ed efficacia degli interventi compensativi. Una soluzione interessante che alcuni Paesi europei e americani hanno già adottato è quella della creazione di "Banche verdi" (*Compensation banking*) che – gestite da un'autorità (pubblica o pubblico-privata) chiamata a raccogliere e selezionare i progetti compensativi – facciano da intermediari con le organizzazioni che devono compensare e diano trasparenza al processo garantendo il carattere preventivo e possibilmente coordinato degli interventi, monitorandoli e dando una comunicazione obiettiva. È il caso delle *Wetland mitigation banking* negli Stati Uniti, dove, prima di iniziare un'opera, l'organizzazione deve acquistare una certa quantità di crediti per compensare l'effetto del progetto su aree umide e biodiversità.

[1] Questa componente può essere quantificata calcolando il volume d´acqua necessario per diluire gli agenti inquinanti immessi nel sistema idrico durante il processo produttivo, ossia dividendo il carico inquinante (L, in massa/tempo) per la differenza tra lo standard di qualità ambientale delle acque di un tale inquinante (concentrazione massima accettabile, in massa/volume) e la sua concentrazione naturale nel corpo idrico ricevente (Cnat, in massa/volume).

[2] Nel caso della compensazione delle emissioni di CO_2 sono ormai decine gli standard internazionali (Cdm, Vcs, Ccb, Cfs & Plan Vivo) che propongono linee guida per progetti di riforestazione in aree tropicali e non. Questi progetti, se debitamente certificati da standard credibili, garantiscono una serie di accorgimenti progettuali quali l'addizionalità e la permanenza, l'assenza di eventuali effetti di *leakage*, e producono crediti spendibili nel mercato internazionale della compensazione delle emissioni di CO_2.

È dunque lecito immaginare che sempre più spesso le compensazioni dell'impronta idrica di organizzazioni pubbliche o private potranno avvenire attraverso il finanziamento o il pagamento diretto di progetti, iniziative e/o proprietari che contribuiscano alla conservazione e/o alla creazione di habitat in grado di garantire nel tempo esternalità positive rispetto alla risorsa idrica. Le aree umide e/o forestali sono un valido esempio di questi habitat. Il *trading* o finanziamento può avvenire sia con modalità imposte da regolamenti elaborati dalle istituzioni pubbliche (si veda, nel caso del carbonio, il Protocollo di Kyoto), sia attraverso meccanismi di libero mercato (standard e mercato volontario delle quote di CO_2).

Nel caso della gestione delle risorse idriche, negli ultimi vent'anni si è assistito a uno spostamento significativo di attenzione dagli strumenti di regolamentazione, generali e vincolanti per i diversi soggetti economici coinvolti, agli strumenti basati su incentivi e compensazioni e, più di recente, su iniziative ad adesione volontaria legate alla creazione di nuovi mercati. Questa evoluzione può essere letta alla luce della maggiore efficacia ed efficienza di questi strumenti rispetto a quelli di regolamentazione, ma anche in relazione alla tendenza attuale di ritenere che la creazione di nuovi mercati – accompagnata da un ruolo pro-attivo delle imprese e della società civile (approcci *bottom up* in contrapposizione a quelli tradizionali *top-down*) – rappresenti una forma di intervento innovativa ed estremamente promettente nell'ambito delle politiche ambientali. Secondo Ecosystem market place[3] il mercato dei cosiddetti *Water ecosystem services* (Wes), ossia i servizi idrici degli ecosistemi, ha un valore pari a oltre 9 miliardi di euro, secondo solo a quello dei crediti di carbonio che equivale a circa 117 miliardi di euro [6].

Pagamenti per servizi ecosistemici (Pes)

Un mercato è costituito da una serie di transazioni. I *Payment for ecosystem services* (Pes) rappresentano un insieme di iniziative (schemi di pagamento) accomunate dall'idea che anche un servizio ambientale, in questo caso il miglioramento della qualità e disponibilità idrica, possa essere acquistato sul mercato con un tradizionale atto di scambio. Seguendo la definizione proposta da Wunder (2005) [7], uno schema Pes può essere definito generalmente come un accordo volontario e condizionato da alcune regole concordate tra almeno un fornitore (venditore del servizio) e almeno un acquirente (beneficiario del servizio) in riferimento a un definito servizio ambientale. Alcuni autori, tuttavia, restringono la definizione di Pes al caso in cui:

- la transazione sia volontaria;
- riguardi un preciso servizio ambientale, o una forma d'uso del suolo che garantisca la fornitura del servizio stesso;
- il servizio sia acquistato da almeno un consumatore;
- il servizio sia venduto da almeno un produttore;
- il produttore garantisca continuità nella fornitura (Engel et al., 2008) [8].

In effetti, in molte applicazioni dei Pes, una o più di queste condizioni non sempre sussistono, per cui spesso si fa riferimento a progetti e iniziative "quasi-Pes".

I pagamenti per i servizi idrici degli ecosistemi in Italia

Nel contesto italiano si possono individuare alcune interessanti esperienze di quasi-Pes, soprattutto per quanto riguarda la gestione delle risorse idriche e la compensazione dei prelievi a uso agricolo, industriale e domestico. In effetti, il sistema di pagamento di un sovra-canone per la produzione di energia idro-elettrica (Regio decreto 11 dicembre 1933, n. 1775 e successive modifiche) può essere considerato un quasi-Pes *ante litteram*. Per i servizi acquedottistici, la legge Galli (legge 5 gennaio 1994, n. 36, art. 24, comma 2), implementando un principio già affermato nella legge 18 maggio 1989, n. 183, ha previsto la possibilità di una compensazione per i gestori del bacino di captazione di cui tenere conto nella definizione delle tariffe per l'erogazione dell'acqua potabile. Solo nelle Regioni Piemonte e Veneto tale possibilità è stata resa pienamente operativa. Per tutti gli esempi ricordati un punto di debolezza dei quasi-Pes italiani è legato ai beneficiari dei pagamenti, non sempre chiaramente costituiti dai gestori diretti delle risorse e compensati in misura delle attività svolte [9].

3 Il progetto di Forest trend è un'iniziativa su scala mondiale che si occupa della promozione e dello studio del mercato dei servizi ecosistemici. Per maggiori informazioni: http://www.ecosystemmarketplace.com/

Il caso del fiume Brenta e le aree forestali di infiltrazione

Un caso interessante di compensazione della Wf è costituito dal Modello strutturale degli acquedotti della Regione Veneto. Questo prevede di disattivare progressivamente tutti gli attuali piccoli impianti di potabilizzazione che prelevano dall'Adige e dal Po, sostituendoli con prelievi diretti dalle falde pedemontane[4].

Nell'ambito di questo progetto, Veneto Acque spa ha ottenuto l'autorizzazione per il prelievo massimo di 950 l/s congiuntamente all'attuazione di una serie di misure di monitoraggio, compensazione e ricarica delle falde già attualmente compromesse dagli eccessivi prelievi idrici a uso agricolo, industriale e domestico.

Nell'accordo di programma per la tutela delle risorse idriche superficiali e sotterranee del fiume Brenta – siglato dalla Regione, dalle Province di Padova e Vicenza, dai 12 comuni interessati dall'abbassamento del livello di falda, dall'Alto Consorzio di Bonifica, da Veneto acque Spa, da Etra Spa e da Arpav – appaiono misure compensative interessanti e innovative. L'accordo prevede la realizzazione di aree forestali di infiltrazione (Afi) tra le misure di compensazione a maggiore carattere strutturale e idraulico, per un importo di 15,5 milioni di euro. Le Afi sono superfici boscate messe a dimora e coltivate allo scopo di favorire l'immissione di acqua superficiale nel sottosuolo per la ricarica delle falde. I filari di alberi sono alternati da canalette che vengono sommerse di acqua superficiale durante i periodi di abbondanza di acqua, prevenendo così il deflusso superficiale verso il mare e immagazzinando la risorsa idrica nelle falde sotterranee. Veneto Agricoltura da anni ha sperimentato l'efficacia di questi impianti attraverso sette progetti pilota, ottenendo risultati molto incoraggianti. In media, nelle aree più vocate, le Afi possono infiltrare fino a un milione di m^3 di acqua all'anno. Secondo le stime di Veneto Agricoltura sarebbero necessari dai 50 ai 100 ha nella zona compresa tra Astico e Brenta per supplire all'abbassamento della falda, compensare l'aumento del prelievo e rivitalizzare le risorgive [10]. Le Afi sono quindi un chiaro esempio di compensazioni volte a produrre in modo sistematico un servizio idrico proprio delle aree umide.

Dal 2012 sono state attivate misure del Programma di sviluppo rurale di Regione Veneto che permettono di finanziare le Afi: in particolare la misura 221 (Azione 4, Impianti ad alta densità per il disinquinamento dell'acqua; Azione 5, Impianti ad alta densità per la ricarica delle falde), la misura 222 (Azione realizzazione di sistemi silvoarabili) e la misura 223 (Imboschimento di terreni non agricoli; Azione 4, Impianti ad alta densità per il disinquinamento dell'acqua; Azione 5, Impianti ad alta densità per la ricarica delle falde).

I finanziamenti del Piano di sviluppo rurale per compensare l'aumento dei prelievi del sistema acquedottistico veneto e, quindi, la Wf dell'intera Regione Veneto, si possono configurare come un quasi-Pes: un accordo tra un agricoltore, fornitore del servizio ecosistemico di ricarica della falda, e la Regione Veneto, acquirente del servizio di compensazione della Wf dei beneficiari dell'acquedotto regionale. L'adeguata remunerazione delle funzioni produttive e ambientali svolte da questi impianti, *in primis* dei servizi legati all'acqua, può contribuire a rendere economicamente sostenibile la loro diffusione, costituendo anche un'interessante opportunità integrativa di reddito per il mondo agricolo.

Riferimenti bibliografici

[1] Madsen B., Nathaniel C., Kelly. M. B., 2010. *State of biodiversity markets report: offset and compensation programs worldwide*. http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf.

[2] Hoekstra A. Y., 2008. *The Water Footprint Assessment Manual*, Unesco-Ihe Institute for water education. http://www.waterfootprint.org/Reports/Report28-WaterNeutral.pdf

[3] Catalogo Iso, *Life cycle assessment, water footprint, requirements and guidelines*. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=43263

[4] Hoekstra, 2007. Water footprints of nations: Water use by people as a function of their consumption pattern. *Water Resource Manage*, 21, 35-48

[4] In modo particolare nel Comune di Carmignano di Brenta all'interno del sito Sic (Sito di importanza comunitaria) e Zps (Zona protezione speciale) IT3260018 denominato "Grave e zone umide del Brenta".

[5] Charles J. Vörösmarty et al., 2000. Global water resources: Vulnerability from climate change and population growth. *Science* 289, 284.

[6] Stanton T., Echavarria M., Hamilton K., Ott C., 2010. State of watershed payments: An emerging marketplace. *Ecosystem Marketplace*.
http://www.foresttrends.org/documents/files/doc_2438.pdf

[7] Wunder S., 2005. Payments for environmental services: some nuts and bolts. Cifor Occasional Paper No. 42.
http://www.cifor.cgiar.org/publications/pdf_files/OccPapers/OP-42.pdf

[8] Engel S., Pagiola S., Wunder S., 2008 Designing paymens for environmental services in theory and practice: an overview of the issues. *Ecological Economics*, 65, 663-674.

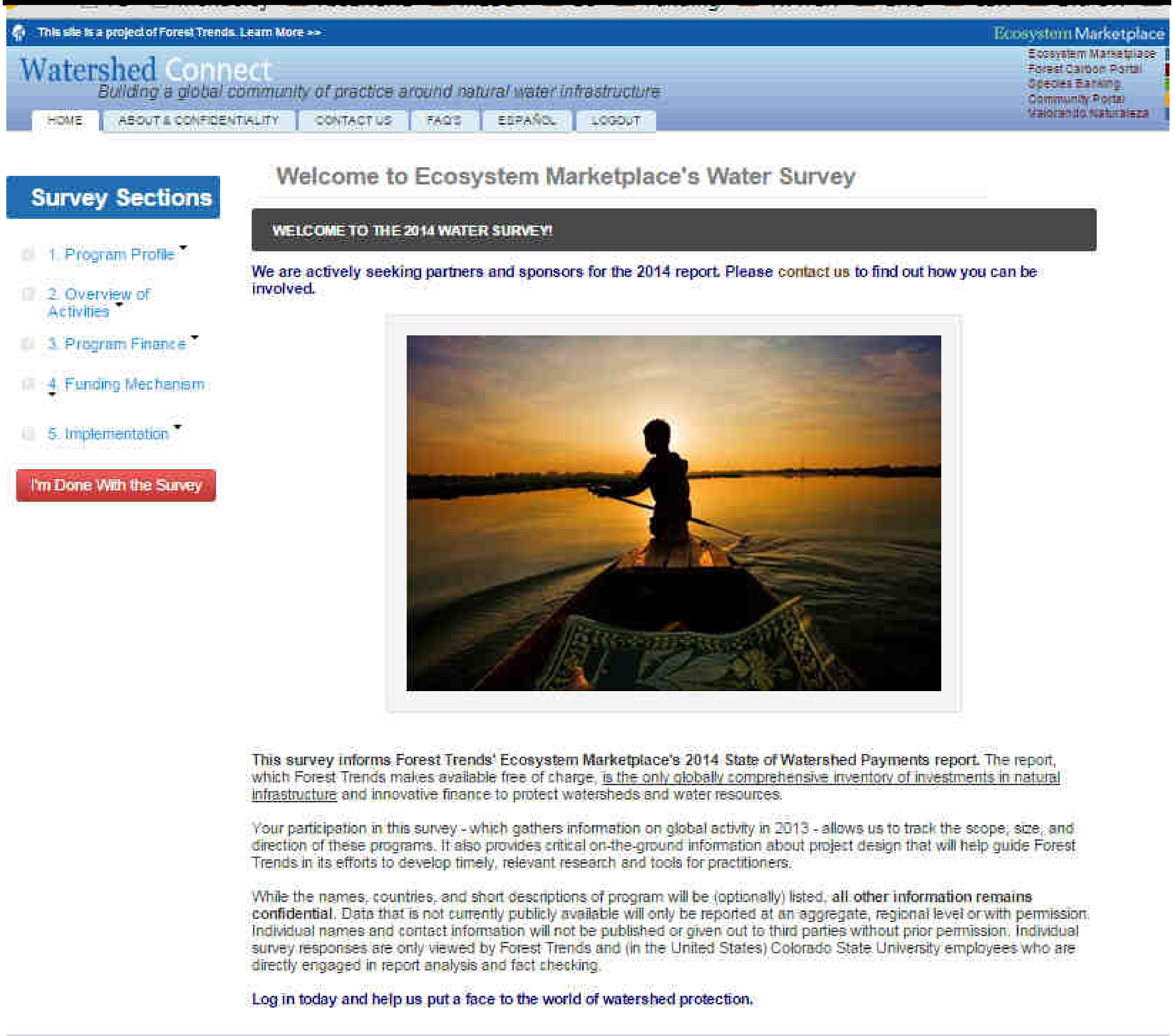
[9] Pettenella D., Vidale E., Gatto P., Secco L., 2012. Paying for water-related forest services: a survey on Italian payment mechanisms. iForest (early view): e1-e6
http://www.sisef.it/iforest/ contents? id=ifor0626-005

[10] Aa.Vv., 2012. Le aree forestali di infiltrazione. *Veneto Agricoltura*.

Alessandro Leonardi è dottorando di ricerca presso il Dipartimento Territorio e Sistemi agro-forestali dell'Università di Padova.
Davide Pettenella, dottore forestale, è professore associato presso il Dipartimento Territorio e Sistemi agro-forestali dell'Università di Padova.

Annex 4: Online Water Survey

0. Introduction


This site is a project of Forest Trends. Learn More >>

Ecosystem Marketplace

Watershed Connect

Building a global community of practice around natural water infrastructure

HOME | ABOUT & CONFIDENTIALITY | CONTACT US | FAQ'S | ESPAÑOL | LOGOUT

Ecosystem Marketplace
Forest Carbon Portal
Species Banking
Community Portal
Valorando Naturaleza

Survey Sections

1. Program Profile
2. Overview of Activities
3. Program Finance
4. Funding Mechanism
5. Implementation

I'm Done With the Survey

Welcome to Ecosystem Marketplace's Water Survey

WELCOME TO THE 2014 WATER SURVEY!

We are actively seeking partners and sponsors for the 2014 report. Please contact us to find out how you can be involved.

This survey informs Forest Trends' Ecosystem Marketplace's 2014 State of Watershed Payments report. The report, which Forest Trends makes available free of charge, is the only globally comprehensive inventory of investments in natural infrastructure and innovative finance to protect watersheds and water resources.

Your participation in this survey - which gathers information on global activity in 2013 - allows us to track the scope, size, and direction of these programs. It also provides critical on-the-ground information about project design that will help guide Forest Trends in its efforts to develop timely, relevant research and tools for practitioners.

While the names, countries, and short descriptions of program will be (optionally) listed, **all other information remains confidential.** Data that is not currently publicly available will only be reported at an aggregate, regional level or with permission. Individual names and contact information will not be published or given out to third parties without prior permission. Individual survey responses are only viewed by Forest Trends and (in the United States) Colorado State University employees who are directly engaged in report analysis and fact checking.

Log in today and help us put a face to the world of watershed protection.

1. Program profile

* = required question

Primary Survey Contact

Who in your organization is primarily responsible for your survey response?

Your Name* | Email address* | Telephone (country code) ###-###-####

(Optional) Secondary Survey Contact

Name | Email address | Telephone (country code) ###-###-####

Contact Information

Organization*

Address | City/Locality*

State/Province | Country* | Postal code

Name of watershed(s) in which your program operates:

Program Basics

Program Title*

Program Status*

- Active
- Demonstration/pilot stage
- Planning/design stage
- Inactive (never active or no activity for three years)

Year program design began | Year became active

Please tell us the ownership of the lands on which program activities take place. Check all that apply.

- National/Federal
- State/Provincial
- County
- Municipal
- Business
- Civil/Non-profit
- Private (i.e. household,landowner)
- Collective ownership
- Other (please explain)

Please tell us the scale of program activities. Check all that apply.

- Local/Municipal
- Multiple localities/municipalities
- County
- Multiple counties
- State/Provincial
- Multi-state/province
- National
- International

Overview

Please give us a brief description of the program, including its history, objectives, the environmental problems seeks to address, and outcomes to date.*

2. Overview of activities

Tell us about the big picture.

Total amount of money spent on watershed protection activities by your program:

In 2013: | In 2012: | Total funds to date | EUR - Euro Memb ▾

Total land area under active watershed management as of the end of 2013:

For example, 200 | hectares ▾ | ☐ This question doesn't apply to me.

Did any land newly come under active management in 2013? If yes, please tell us how much:

For example, 200 | hectares ▾ | ☐ This question doesn't apply to me.

What are the primary water-related challenges which your program seeks to address? Check all that apply.

- ☐ Drinking water protection
- ☐ Stormwater management
- ☐ Waste water management
- ☐ Other types of watershed risk

Drinking water protection: Please rate the importance of the following on a scale of 0 to 3, with 0 being "not important," and 3 being "very important."

Restoring/augmenting flows	Groundwater recharge	Nitrogen loading	Phosphorus loading
0 - Not important ▾	1 - Somewhat imp ▾	2 - Fairly importan ▾	3 - Very important ▾
Sediment loading	Fecal coliform	Heavy metals	Salinity
0 - Not important ▾	0 - Not important ▾	0 - Not important ▾	0 - Not important ▾
Temperature	Dissolved oxygen	Other (please explain and rate)	
0 - Not important ▾	0 - Not important ▾	Chemicals	

Help us track global outcomes.

Has your program documented water quality or quantity improvements?*

- ◉ Yes
- ○ No

In 2013: [Number]	[units]	of [improvement]
For example, 75	tons ▾	[of improvement] ▾ Row 🗑

In 2012: [Number]	[units]	of [improvement]
For example, 75	[units] ▾	[of improvement] ▾ Row 🗑

Since the program began: [Number]	[units]	of [improvement]
For example, 75	[units] ▾	[of improvement] ▾ Row 🗑

3. Program finance

Tell us about the key actors in your program.

What we mean 'Program Administrator': The organization that oversees the investment/transaction mechanism. If this is not your organization, please tell us who administers program funds.

Program Administrator:

Who pays for protection?

INSTRUCTIONS FOR THIS SECTION:

You'll fill out this section once for each program investor that you have. When you have finished answering questions about Investor #1, click the "Save this Investor/Add Another" button. Then you can enter details about Investor #2. You can enter as many investors as you like.

What we mean by 'Investor': Communities, companies, non-profits, government bodies, or other actors that pay for watershed protection actions. For example, you might write "Water and Sewerage Company of Bogota" or "Mountain Spring Water Company."

Investor name: **Investor profit status:**

What % share of total program funding did this investor provide? Please give us an estimate.

In 2013: % In 2012: % *Currency:* [Select currency]

Has this investor committed any program funding for the future? If yes, please estimate commitments.

- Yes
- No
- I'm not sure

Does this investor voluntarily fund watershed protection? Or are investments driven by some law or regulation?

Strategic motivations: Please rank up to five motives driving the investor's support for watershed protection. A "1" indicates the most important motivation, a "2" the second most important motivation, and so on. Please choose only the top five.

Regulatory compliance	1	2	3	4	5	X
Water availability risks	1	2	3	4	5	X
Water quality risks	1	2	3	4	5	X
Climate change risk	1	2	3	4	5	X
Weather-related disaster risk (such as flooding or storm damages)	1	2	3	4	5	X
Wildfire risk	1	2	3	4	5	X
Energy security risk	1	2	3	4	5	X
Food security risk	1	2	3	4	5	X
Health-related goals: Improving access to safe drinking water, sanitation and hygiene	1	2	3	4	5	X
Cost abatement opportunity	1	2	3	4	5	X
Revenue opportunity	1	2	3	4	5	X
Protection of existing/planned infrastructure	1	2	3	4	5	X
Reputation/brand management	1	2	3	4	5	X
Local livelihoods/local economic development	1	2	3	4	5	X
Social issues: Poverty, gender, tenure security, or other	1	2	3	4	5	X
Lack of good governance of resource	1	2	3	4	5	X
Biodiversity protection	1	2	3	4	5	X
Other (please indicate)	1	2	3	4	5	X

Please refer to the motivation which you ranked #1 in the previous question: Does the investor currently face this risk?

- Yes
- No, this is an expected future challenge.
- No, the investor is acting on behalf of others (i.e. the public, at-risk communities, etc.)

Save This Investor/Add Another

Who's responsible for protection?

INSTRUCTIONS FOR THIS SECTION:

You'll fill out this section once for each program supplier that you have. When you have finished answering questions about Supplier #1, click the "Save this Supplier/Add Another" button. Then you can enter details about Supplier #2. You can enter as many suppliers as you like.

What we mean by 'Supplier': People, households, organizations, or other groups that are paid (in cash or otherwise) for actions that restore or protect watershed resources or functions. If the same actor you listed as the 'Investor' above also owns the land treated or carries out protection activities themselves, you can list them as a supplier too.

Supplier name:

Supplier profit status:

Why is this supplier participating?

Is this supplier a member of an indigenous community?

☐ Yes

Save This Supplier/Add Another

Who supports the work?

INSTRUCTIONS FOR THIS SECTION:

You'll fill out this section once for each program intermediary that you have. When you have finished answering questions about Intermediary #1, click the "Save this Intermediary/Add Another" button. Then you can enter details about Intermediary#2. You can enter as many intermediaries as you like.

What we mean by 'intermediaries': If other organizations also play a role like providing technical assistance, carrying out management actions, monitoring, etc., please list them

Intermediary name:

Intermediary profit status:

[Please select profit status]

What role(s) does this intermediary play? Please select all that apply.

- ☐ Administration
- ☐ Advocacy
- ☐ Compliance/ reporting
- ☐ Information/ outreach/ communications
- ☐ Marketing
- ☐ Monitoring
- ☐ Program design
- ☐ Technical/ scientific support
- ☐ Verification
- ☐ Other

Save This Intermediary/Add Another

4. Funding mechanisms

Help us understand how programs are paying for watershed protection.

How were initial scoping/design phases of the program funded? Please check all that apply.

- [x] Government budget
- [ ] Government grant
- [ ] Government loan
- [ ] Bond issue
- [ ] Private capital
- [ ] Non-profit/foundation funding
- [ ] Micro-credit/Micro-loan
- [ ] Multilateral development institution loan/credit
- [ ] Multilateral development institution grant/funding
- [ ] Funding from program investor(s)
- [ ] Funding from program seller(s)
- [ ] Other

How is compensation to suppliers determined? Please check all that apply.

- [ ] Practice-based, i.e. $25 per hectare of land under management
- [ ] Outcome-based, i.e. $25 per ton of reduced sediment load
- [ ] Land use rights contract, i.e. a conservation easement, land use restriction, etc.
- [ ] Sale of land
- [ ] Water use rights sale
- [ ] Water use rights lease
- [ ] Other

Please explain

What form does investment/compensation take? Please check all that apply.

- [ ] Cash
- [ ] Technical assistance/training
- [ ] Inputs, for example seeds or tools
- [ ] Tenure security
- [ ] Loans/access to credit
- [ ] Other non-cash support (please explain).

Please explain

Please estimate the average rate of payment that suppliers receive.

Amount	per [unit]	of [outcome]
$	[Select unit] ▾	[Select outcome] ▾
		Row

How are funds transacted between investor(s) and seller(s)?

Please check all that apply.

- [ ] Directly between investor(s) and seller(s)
- [ ] Through an intermediary group or third party
- [ ] Through a market exchange or clearinghouse

You selected 'Other'. Please explain.

5. Implementation

Last page! Please answer a few questions about program implementation.

Do you feel your program has been successful so far? Why or why not?

Yes, it helped us to keep our water clean and safe. Reducing costs of purification and improving our im

Have program benefits outweighed its costs?

- (selected) Yes
- No
- I'm not sure yet.

Does the program measure the value of its outcomes (like reduced pollution or increased supplies) in economic terms?

- (selected) Yes
- No
- No, but we plan to.

Did the program developers conduct a feasibility analysis, prior to or during program design?

- Yes
- No
- (selected) I'm not sure.

Does the program consider climate change in decision-making, or use adaptive management?

- Yes
- No
- (selected) I'm not sure.

Does the program have other environmental goals besides water supply and/or water quality? Please check all t apply.

- No
- Species/habitat protection
- Carbon sequestration
- Other

Species/habitat protection: Are these efforts covered under the same funding as watershed protection activities?

- (selected) Yes, program investments cover both water-related and biodiversity goals.
- No, water-related efforts are funded separately from other environmental protection activities.

Almost done! Tell us about what makes for successful programs.

Please rank the most difficult challenges for the program. "1" indicates your greatest challenge, "2" the next most significant challenge, and so on. Please rank up to five challenges.

	1	2	3	4	5	X
Lack of buyers/investors	○	○	○	○	○	●
Lack of suppliers	●	○	○	○	○	○
Raising initial capital/funding	○	○	○	○	●	○
Managing funds	●	○	○	○	○	○
Challenges connecting investors and suppliers	●	○	○	○	○	○
Lack of lands/management options for watershed management	○	○	●	○	○	○
Lack of scientific expertise about watershed	○	○	●	○	○	○
Lack of scientific data on program outcomes	○	○	●	○	○	○
Lack of technical expertise for management	○	○	●	○	○	○
Lack of support from policy-makers/decision-makers	●	○	○	○	○	○
Legal/regulatory barriers to funding watershed protection	●	○	○	○	○	○
Regulatory uncertainty for compliance-driven program	●	○	○	○	○	○
Perceived lack of direct benefits to constituents (such as ratepayers)	○	○	○	○	○	●
Lack of local stakeholder support	○	○	●	○	○	○
Lack of local partners	○	○	○	○	○	●
Lack of useful standards/guidance/tools for program design	○	○	○	○	○	●
Lack of participation/conflicts with basin-level planning	○	○	○	○	○	●
Other (please explain below)	○	○	○	○	○	●

If you selected 'Other' above, please rate and explain this challenge.

What changes or conditions would be most helpful to your program's success? (More support from policy-makers or regulators? More funding? Greater resources for design or monitoring? More sharing of experience between similar programs?)

http://www.gaudianellomonticchio.it/qualita.htm

Is a river basin planning or integrated water resources management framework in place in your watershed?

- ○ Yes
- ○ No
- ○ One is in development
- ● I'm not sure

Additional Materials

Do you have any annual reports, monitoring reports, shapefiles, or other program resources you'd like to share? Please upload them here. Upload limit 8MB.

Add an Attachment

Finally, help us improve our reporting.

Please check here if you do NOT wish for your program to be listed in our online inventory (at http://www.watershedconnect.org/projects).

☐ Do not list my program

Would you be willing to speak with us to reflect on the broad implications of preliminary findings from this survey?

☐ Yes

☐ No, thanks

Please tell us if and how our 2012 "State of Watershed Payments" report has benefited your program or mission.

Tell us here.

Do you have thoughts on how our reports can be improved? Is there more you would like from the report series?

Let us know what you think.

Current Progress

100%

Save My Data - I'll Be Back

I'm Done with this Section!

Annex 5: Analytical framework for qualitative case study interviews

FRAMEWORK FOR THE ANALYSIS OF ECOSYSTEM SERVICES		
Dimension of the analytical framework	**Research questions**	**Variables**
Ecosystem structure, process, functions and services	❖ Which are the ecosystems involved in service supply?	❖ Areas and type of ecosystems (Haines-Young and Potschin, 2011; MEA, 2005)
	❖ Which are the proxy management practices for service provision?	❖ List of rewarded management practices likely to secure the service provision
	❖ Which are the ecosystem functions, process, provisioning and intermediate ecosystem services involved in the service provision?	❖ Make reference to (de Groot *et al.*, 2002; Groot *et al.*, 2010)
	❖ Which are the provided ecosystem services?	❖ MEA categories and Brauman hydrological service classification. (Brauman *et al.*, 2007)f
	❖ Which are the services attributes?	❖ Quality, quantity, probability, timing
	❖ Which are the unit of measurement (metric)	❖ See Kroeger (2013) for a list of metrics (Kroeger, 2013)
Environmental benefits	❖ Where does the service demand come from?	❖ Spatial characteristics of the flow between provisioning and benefitting areas are specific to each service. Representation of benefiting areas and provisioning areas. Area within which services from provisioning area can potentially be delivered.
	❖ Are there any bundled services/benefits?	❖ Carbon, biodiversity, recreational, social benefits.
	❖ Which are the final benefits that contribute to the society well being?	❖ Define the benefits (Keeler *et al.*, 2012; Maille and Collins, 2012)
Spatial temporal characteristics of flow between service provision and consumption	❖ Do supply and demand geographically overlap?	❖ Overlapping between benefiting and provisioning areas (Serna-Chavez *et al.*, 2014)
	❖ Which temporal scale does apply to the service provision?	❖ Seasonal, continual (Brauman *et al.*, 2007)
	❖ Do supply and demand timely coincide?	❖ Describe the timing of demand and supply

FRAMEWORK FOR THE ANALYSIS OF ACTOR INTERACTIONS Elaborated mostly from (Corbera *et al.*, 2009; Prokofieva and Gorriz, 2013)		
Dimension of the analytical framework	**Research questions**	**Variables**
Actors identification and roles	❖ Who are the internal actors of the PWS? ❖ Who are the external actors? ❖ What is their role within the PWS scheme?	❖ Actor names
Actor rights and responsibilities on resources	❖ What de jure or de facto rights or claims do the actors have over using and managing the water resources?	❖ Ownership rights toward the conservation area ❖ Water rights system in the country
	❖ What are the responsibilities of different actors	❖ Management or access rights to

	regarding the use, management, control and conservation of resources?	water related ecosystems ❖ Rights to use/benefit from water related ecosystem services ❖ Responsibility to protect and manage water related ecosystems in a sustainable way ❖ Responsibility to inform landowners and other actors about management or protection decisions
	❖ To what degree do different actors influence how land management is carried out in relation to water services (landowner, environmental department technicians, consultant, forest /farmers associations, NGOs, etc.)?	
Preferences, interests, expectations and values	❖ What are the driving forces that determine the actors' behaviour? ❖ What are their expectations about their own and the others' use and management of resources? ❖ What are the actors' values and preferences with respect to PWS strategies and outcomes? ❖ What are the actors' beliefs about PWS strategy preferences and outcomes of other actors? ❖ What are the actors' actual and perceived costs and benefits from PWS schemes?	❖ Actors'motivations and preferences ❖ Degree of preference homogeneity among the actors ❖ Actors' expectations about the future of the resources ❖ Actors' own views on PWS strategies and outcomes ❖ Actors' perceptions on PWS strategies and outcomes' views of other relevant actors ❖ Stakeholders' actual and perceived costs and benefits from PWS schemes
Actions and interactions Use and management of resources	❖ What ecosystem goods and services do the actors obtain from the resource? ❖ What hydrological services do they provide? ❖ What restrictions do they face over the use of the resource? ❖ What are the forms and degree of management of the resource in question? ❖ What activities can the actors implement and how these activities are related to final outcomes?	❖ Hydrological services used ❖ Hydrological services provided ❖ Restrictions of land use for hydrological service protection ❖ Management rules of the resource PWS activities ❖ Relation of PWS activities to final outcomes
Information sharing	❖ How is information collected and used? ❖ Where does the information come from and how frequently it appears?	❖ Information collection and use practices ❖ Frequency of information distribution/reception ❖ Information channels ❖ Degree and frequency of communications among actor
Lobbying	❖ Which are the coalitions exhibiting strong preferences for the use or management of resources? ❖ Who are the actors participating in these coalitions? ❖ What is the degree of the influence of these coalitions? ❖ Are there other actors with weak preferences, who do not form part of any coalition?	❖ Number and composition of relevant coalitions ❖ Strength of the influence of coalitions and their degree of importance ❖ Number and the degree of importance of non-affiliated actors
Deliberation	❖ Who decides what management operations will be carried out, or what ecosystem services will be produced, what will be conserved, what conservation instruments will be applied? ❖ Which decision-making strategies related to PWS schemes are used?	❖ Authority structure ❖ Distance between rule makers and the participants in the scheme ❖ Decision-making procedures related to PWS

FRAMEWORK FOR THE ANALYSIS OF INSTITUTIONAL INTERPLAY **Elaborated mostly from** (Corbera *et al.*, 2009; Prokofieva and Gorriz, 2013)		
Dimension of the analytical framework	**Research questions**	**Variables**
Institutional interplay	❖ Which existing institutions interact with PWS schemes?	❖ Number and type of institutions influencing or being affected by PWS schemes ❖ Number and type of institutions targeting the same actors, including those from other policy domains, hierarchical levels of governance, geographical scales and across time
Policy interplay	❖ Which existing policies interact with PWS schemes?	❖ Number and type of policies directly interacting with PWS
Instruments interplay	❖ Which existing including policies instruments interact with PWS schemes?	❖ Number and type of policy instruments directly interacting with PWS
Nature of the interplay	❖ How do PWS account for other institutions in their design and implementation? ❖ Which synergies and conflicts exist between the relevant institutions? ❖ Which are the sources of such synergies and conflicts (e.g. compatible/ divergent rationales, goals or implementation approaches)?	❖ TyPWS and effects of institutional interactions ❖ Sources of institutional synergies and conflict

INSTITUTIONAL DESIGN: Are rules conducive to achieve goals? **Elaborated mostly from** (Corbera *et al.*, 2009; Prokofieva and Gorriz, 2013; Sattler *et al.*, 2013)		
Dimension of the analytical framework	**Research questions**	**Variables**
Start up	❖ Which actors shape the rule-design process and how are their interests represented in the final rules?	❖ Descriptive
	❖ Which are the main drivers?	❖ Descriptive
	❖ At what development phase is the scheme?	❖ Exploration, development, implementation, mature phase
	❖ Why is PWS proposed as a policy tool?	❖ Definition and evolution of PWS rules over time ❖ Number and type of actors involved in PWS design ❖ Actors' interests taken into account and excluded in the definition of PWS Underlying reasons of procedural change (Kemkes *et al.*, 2010)
	❖ Is there any study suggesting that the PWS would provide better outcomes than other policy tools?	❖ Descriptive
	❖ How is the PWS idea communicated to external actors?	❖ Descriptive
Contract and procedures	❖ How do scheme procedures work? From the application to the payments.	❖ Description of the procedures, from application, payments, and monitoring and evaluation.

	❖ Which is the duration of contracts with the suppliers?	❖ Descriptive
	❖ Which are the regulations mentioned within the contract?	❖ Descriptive
	❖ How is risk distributed or allocated within the parties?	❖ Risk of no-compliance with water quality
Payments	❖ Pay source	❖ Public, Private, Mixed
	❖ Pay mode	❖ Input - based, Output - based
	❖ Pay type	❖ Cash, In kind
	❖ Pay frequency	❖ One off, Periodical
	❖ Pay time	❖ Upfront, After ES delivery
	❖ Pay eligibility	❖ Horizontal, Targeted
	❖ Pay amount in relation to costs of ES provision	❖ Spill over; Partial cover of costs; Full cover of costs; Above the costs;
	❖ Pay aim	❖ Avoided negative externalities; Compensate negative impacts; Compensate opportunity costs; Provide positive externalities;
	❖ How is the level of compensation to suppliers determined?	❖ Descriptive
Monitoring and evaluation	❖ Are project outcomes (ecological, social, and economic) monitored?	❖ Descriptive
	❖ If monitor occurs, how often?	❖ Descriptive
	❖ If monitor occurs, are results public available?	❖ Existence of website reporting data, monitoring reports, etc.
	❖ What type of monitoring?	❖ Descriptive
	❖ Please describe the scope of monitoring	❖ Descriptive
	❖ Please describe the methods and techniques used for monitoring	❖ Descriptive
	❖ Please describe the indicators for monitoring (what you look for)	❖ Reference indicators (Maille and Collins, 2012)
	❖ Please describe the frequency of monitoring	❖ Descriptive

FRAMEWORK FOR THE ANALYSIS OF CAPACITY AND SCALE: How does scale affect PWS design and performance? Elaborated mostly form (Corbera *et al.*, 2009)		
Dimension of the analytical framework	**Research questions**	**Variables**
Scale	❖ Does an optimal scale of governance exist for the provision of each ES?	❖ Areas and type of ecosystems
	❖ Have there been any cross-scale institutions created to address problems of interplay?	❖ Differences in PWS design, performance and interplay due to governance scale ❖ Type of cross-scale institutional linkages to address interplay (e.g., stakeholder bodies, policy communities) and effects over the other analytical domains
	❖ How do cross-scale institutions benefit PWS design and performance?	❖ How does cross-scale institutions respond to geographical and administrative scale

Capacity	❖ What physical and human resources are required to provide hydrological services in focus? ❖ What knowledge and information do actors have about PWS schemes? ❖ What level of control does each actor have over own actions? ❖ Are the organizational capacities across involved actors sufficient to ensure effective PWS design and implementation?	❖ Labour and capital costs of producing water related ecosystem service (sustainable catchment management) ❖ Actor's knowledge and technical capacity ❖ Distribution of resources among the actors ❖ Degree of control over actor's own actions ❖ Actors' level of organizational capacity

EVALUATION CRITERIA OF INSTRUMENT PERFORMANCE: Is an institution achieving its goals? **Taken from** (Prokofieva and Gorriz, 2013)			
Evaluation criterion	**Definition**	**Dimensions**	**Indicators**
Environmental effectiveness	❖ The extent to which the policy instrument achieves the stated policy environmental objective	❖ Additionality — the extent to which the instrument achieves an improvement over the business as usual scenario ❖ Permanence—the extent to which the induced change is permanent after the finalization of the funding ❖ Side effects — the desirable or undesirable, foreseen or unforeseen impacts of the policy instrument on other sectors and activities ❖ Perverse incentives — the degree to which the policy instrument generates undesirable behavior	❖ Number of applicants ❖ Number of participants ❖ Area covered by the scheme ❖ Number of non-compliant participants ❖ Impacts on targeted environmental goods and services ❖ Number of activities/land management actions executed
Economic efficiency	❖ The extent to which the policy instrument achieves the optimal allocation of resources. In practice, refers to the ability to achieve the stated objective at the lowest possible cost.	❖ Cost-efficiency— the degree to which the instrument achieves the stated objectives at the lowest possible cost ❖ Cost–benefit — the degree to which the benefits associated to the implementation of the policy instrument exceed the implementation costs	❖ Direct programme costs ❖ Indirect programme costs ❖ Transaction costs
Equity	❖ The extent to which the policy instrument achieves equality in access, treatment or outcome in an acceptable manner.	❖ Distributive justice (fairness)—the distribution of costs and benefits among different segments of population	❖ Distribution of costs and benefits among key actors ❖ Eligibility criteria and participation requirements ❖ Participation rates of small and large forest and land owners
Flexibility	❖ The extent to which the policy instrument can retain its effectiveness in changing conditions.	❖ Internal flexibility — The extent to which the instrument can automatically adjust to external changes in environmental, economic, technological or social conditions ❖ External flexibility — The extent to which the instrument can be modified by relevant actors (e.g. government, or regulated agents) to accommodate changes	❖ Sensitivity to changes in external conditions ❖ Re-negotiation and termination clauses ❖ Mechanisms ensuring flexibility
Implementation complexity	❖ The extent towhich the policy instrument is easy to	❖ Information intensity—how much information (e.g. data, predictive	❖ Information and skills necessary

	design and implement.	modelling skills) is necessary to design the policy instrument ❖ Ease of introduction — the extent towhich the policy instrument is easy to implement in the existing context and business environment ❖ Administrative feasibility — the extent to which reliable compliance monitoring and enforcement can be implemented at a reasonable cost	❖ Number and intensity of changes that need to be introduced ❖ Human resources for monitoring and compliance ❖ Technical needs for monitoring and compliance
Acceptability	❖ The extent to which the policy instrument is understood and accepted by the key actors	❖ Awareness (transparency) of key actors about any aspect of the instrument, such as the purpose and the technicalities of the instrument, financial consequences, time of introduction, possible future adjustments etc. ❖ Participation — the involvement of key actors in the design and implementation of the policy instrument ❖ Progressive implementation — the process of gradual introduction of the policy instrument ❖ Predictability— the extent to which the outputs and outcomes resulting from the implementation of the policy instrument can be foreseen	❖ Public awareness of the existence, goals and guiding norms of the instrument ❖ Awareness of forest and land owners, and public officers of the PWS scheme, and of their rights and obligations under this policy instrument ❖ Awareness among public policy makers of how a particular PWS scheme relates to other schemes ❖ Information available on the instrument ❖ Actors' reactions to the instrument ❖ Number of consultations with key actors ❖ Existence of pilot projects ❖ Length of the anticipation period