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How Do Stakeholders Working on the Forest–Water Nexus Perceive Payments for Ecosystem Services?

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Abstract: Nowadays, great emphasis is placed on the relationship between forest and water because forests are considered as substantial sources of many water ecosystem services. The aim of this paper is to analyze the stakeholder opinions towards the relationship between forests and water and the potential development of water-related payments for ecosystem services (PES) schemes.

The study is developed in the context of COST Action CA15206–PESFOR-W (Forests for Water) aimed at synthesizing current knowledge about the PES schemes across Europe. The stakeholder opinions were mapped out using a structured questionnaire consisting of 20 questions divided into four thematic sections. The data were collected through an online survey. The results showed opinions of 142 stakeholders from 23 countries, mainly from Eastern Europe and the Mediterranean Basin. In order to analyze the collected data, the stakeholders were grouped in buyers, sellers, intermediaries, and knowledge providers. The survey results indicated that the most important category of water ecosystem services according to our sample of stakeholders is regulating services followed by provisioning services. Further findings pointed out the highest importance that shared values and direct changes in land management can have when designing water-related PES schemes. The role of public authorities and collective collaboration of different stakeholders, with emphasis on local and expert knowledge, are also identified as of crucial importance. The results show that stakeholder opinions can serve as a starting point when designing PES schemes.

Keywords: forest management; payments for water ecosystem services; stakeholder opinions; questionnaire survey; COST Action

1. Introduction

Forests ensure multiple functions that can be characterized as a subset of ecological processes and ecosystem structures that provide goods and services to society [1–3]. At the end of the 1970s, Westman [4] emphasized for the first time the benefits that natural ecosystems provide to human society, defined as "nature's services." Then, Ehrlich and Ehrlich [5] introduced the term "ecosystem services" within the scientific and decision-making communities in order to indicate the benefits provided by nature to human society.

From a terminological point of view, ecosystem services can be defined as the benefits that human populations derive from functioning ecosystems [6,7]. Forest ecosystem services include raw materials provision, biodiversity conservation, watershed protection, and climate change adaptation and mitigation [8]. At the international level, many classification systems of ecosystem services are available: Millennium Ecosystem Assessment [9], The Economics of Ecosystems and Biodiversity [10], The Common International Classification of Ecosystem Services [11], and the European Union (EU) Framework for Mapping and Assessment of Forest Ecosystems and their Services [12,13], the U.K. National Ecosystem Assessment [14], and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [15].

Within the portfolio of ecosystem services provided by forests and trees, the provision of watershed-related ecosystem services (WES) is considered crucial for human wellbeing [16]. A clean and reliable water supply is one of the most important benefits of well-managed forests. WES provided by forests further include groundwater and surface water flow regulation, water purification, runoff and erosion control, precipitation, evapotranspiration, infiltration, groundwater recharge, runoff and water discharge to streams and freshwater supply [17–19]. In addition, forests play a relevant role in regulating water temperature by intercepting sunlight [20]. As stated by Ellison et al. [20], forest deforestation leads to negative impacts such as soil compaction and hardening, soil erosion, transpiration loss, reduced infiltration and increased runoff that can produce floods.

Several authors highlighted that forest management, forest conservation, afforestation or reforestation practices have an important effect—either positive or negative—on WES supply [19,21]. At the European level, forest management practices seem to focus dominantly on timber production, forest resources, and biodiversity conservation [22–24], leading to a reduced or even compromised provision of the other WES [19]. These trade-offs occur when the provision of one or more ecosystem services is reduced as a consequence of the increased use of another ecosystem service [25]. Recent studies have shown that assessing trade-offs and synergies between ecosystem services can be useful for informing decision-makers on the potential impact of intended land use or land management

[22,25–28]. However, few studies have analyzed trade-offs and synergies between WES as a consequence of afforestation/reforestation and forest management practices.

Managing forests to simultaneously provide both forest- and water-related ecosystem services is a challenge [19]. Market-based instruments such as payments for ecosystem services (PES) have been developed to fund the variety of demands towards forest ecosystem services [29–31]. The concept of PES is gaining increasing attention as a way to compensate forest managers for delivering the societal benefits of sustainable forest management [32]. A payment scheme for WES is an innovative way of using markets—respecting some key criteria [33–35]—to ensure incentives for better natural resource management. The mechanisms of the market are used to shape decision-making over changes in land use and management that are critical to the sustainable use of watersheds [33,36,37]. According to Hanson [17], three common types of payments for WES exist: (1) voluntary payments by downstream entities to upstream landowners to decrease the costs of doing business; (2) payments made to minimize an entity's cost of meeting a regulation; and (3) payments made to generate public benefits. Payments for WES are based on assessments of the costs and benefits of land and water management for upstream and downstream stakeholders [33] and provide landowners financial incentives to conserve, sustainably manage, and/or restore forests specifically to provide one or more WES.

The criteria mentioned above reveal that both the demand and supply sides are important for the implementation of PES schemes. The demand side is formed by the actual beneficiaries of ecosystem services that are the potential buyers (the users) of the ecosystem services, or other stakeholders such as government or environmental nongovernmental organizations [37]. Buyers have a willingness to pay for providing ecosystem services [29]. The supply side is formed by sellers (providers) of the ecosystem services: forest owners and/or forest managers whose interventions potentially secure the supply of the demanded services [29]. Intermediaries serve as agents linking demand and supply and can play a crucial role in both PES design and implementation [29,38]. They define the ecosystem service of interest, identify and define the group of sellers and buyers and often set a predefined price [39]. The last group of social actors typically involved in a PES scheme are knowledge providers. These include stakeholders with essential knowledge for development of the PES schemes, e.g., forest management experts, valuation specialists, regulators, legal advisors or researchers [29].

As Engel et al. [37] stated, PES schemes are not developed in a vacuum by social planners or economic theorists, they are developed in given environmental, economic, social and political contexts. Diverse stakeholders, with different understanding, knowledge, interests, needs, and perceptions of the current state of ecosystem services, are empowered during PES scheme design [32]. Hence, in addition to the role of ecosystems for human well-being, the articulation of the stakeholder interests should be done during (or before) PES scheme design, and the PES scheme should represent stakeholder interests [40,41] and shape their choices and actions. On that basis, the comprehension and analysis of stakeholder perceptions and opinions about PES schemes is needed for further development of payments for WES. Currently, in the international literature there is a knowledge gap concerning the study of opinions, perspectives, and perceptions of diverse groups of stakeholders towards payment for ecosystem services provided by forests.

Starting from these considerations, the aim of the present research is to analyze stakeholder opinions concerning the relationships between forests and water and the potential development of successful PES schemes. The research question is to identify and investigate the different perspectives and points of views of the professional community formally engaged in water-related PES with special regard to trade-offs and synergies between WES and PES design. In addition, this study tries to address the knowledge gap concerning the analysis of opinions and perceptions of diverse groups of stakeholders towards forest-related WES. The study, focused on the stakeholders from countries of Eastern Europe and the Mediterranean Basin, was developed in the context of COST Action CA15206–PESFOR-W (Forests for Water), which aims to synthesize current knowledge about PES and to improve Europe's capacity to use PES in the context of water storage and water bodies' development [42].

2. Materials and Methods

2.1. Survey Design and Data Collection

Data were collected through a structured questionnaire (Appendix A) administered to a sample of stakeholders identified in each country by the members of the COST Action CA15206–PESFOR-W. An online survey approach was adopted as the data administration system in this study in order to save time, allowing a straightforward connection to respondents who are geographically separated, and saving costs for recording equipment, travel, and telephone [43].

In order to identify stakeholders according to the targeted groups, representatives of the member countries of the COST Action CA15206–PESFOR-W (Forests for Water) were asked to disseminate the link of the questionnaire to possible stakeholders. Furthermore, additional stakeholders were identified with the snowball sampling method used in social qualitative research [44,45]. The snowball sampling method was adopted due to the fact that several countries were involved in the survey, and consequently the WES stakeholder population cannot be exactly delimited and enumerated. Therefore, the results of this survey cannot be considered representative of the WES stakeholder population, but only of the sample of stakeholders. According to this method, respondents are identified through the contact information provided by other respondents. This process is, by necessity, repetitive: involved respondents refer the researcher to other potential respondents who could have knowledge about the research problem [46]. In order to correctly interpret the results, it is important to highlight that in our sample of stakeholders only a sub-group of all WES beneficiaries is involved: those stakeholders who are formally involved in the PES formal economy.

The first version of the questionnaire was developed in February 2019 by the researchers involved in the study. This questionnaire was pre-tested in three countries (Italy, Slovakia, and Slovenia) involving one stakeholder in each country. The aim of the pre-test stage was to understand the ease of filling the questionnaire and the clarity of the questions. At the end of the pre-test stage, a couple of questions were changed and simplified. Accordingly, the final version of the questionnaire was formed by twenty questions, divided into four thematic sections, namely:

Section 1. General and personal information
Section 2. Relationship between forests and water
Section 3. Payment for ecosystem services (PES) schemes
Section 4. Stakeholder involvement in PES schemes

The first thematic section was formed by four open-ended questions: "Name of your organization" (Q1.1), "Country/region" (Q1.2), "Role of the respondent in the organization" (Q1.3), "Scientific field of the respondent" (Q1.4), and one closed-ended question: "Years of work in the scientific field" (Q1.5).

The second thematic section was formed by four questions. The first question (Q2.1) investigates the respondent's opinions towards the importance of forests in providing WES along the four ecosystem service categories. In the present study, MA [9] and TEEB [10] classification systems are used distinguishing WES in four categories (Table 1). The respondents indicated their preferences using a 5-point Likert scale format (from 1 = very low importance to 5 = very high importance). The symmetric Likert scale provides independence to a respondent to choose any response in a balanced and symmetric way in either direction [47].

Table 1. Watershed-related ecosystem services **(**WES) considered in the online survey.

Provisioning Services
Recharge of groundwater
Provision of clean drinking water
Regulating Services
Buffering and filtering pollutants in surface water
Reduction of surface runoff

Reduction of soil erosion
Protection from the flooding risk
Supporting Services
Provision of habitats for different species
Maintenance of genetic diversity in water ecosystem
Cultural Services
Provision of scenic landscapes composed by forests and water bodies (aesthetic values)
Provision of recreation and leisure activities by forests and water bodies (recreation and tourism)

Source: modified from UNECE report [19].

In the second question (Q2.2), the respondents compared the importance of forests for water-related services for each ES category using a pairwise comparison method where the respondent nominates the most important out of two categories of WES. The last two questions of this thematic section (Q2.3 and Q2.4) investigated the perception of respondents about trade-offs among WES as a consequence of forest management practices (thinning and cutting) and afforestation/reforestation activities.

The third thematic section was formed by three questions. In the first question (Q3.1), the respondents compared the efficiency of the PES schemes with the use of regulatory policy instruments (command-and-control policies). This approach refers to human societies and their effort to control ecosystems with the aim to make them more predictable for our needs [48] and relies on regulation instead of economic incentive [49]. In the second question (Q3.2), the level of importance for three aspects related to the implementation of PES schemes was investigated: (1) Multilevel governance; (2) Shared values for ES; and (3) Bundling or layering of services across multiple scales. Considering also the theoretical meaning of these aspects, the definition provided by Reed et al. [32] was used as basement for formulation of this question. The third question (Q3.3) investigated the respondent opinions on the environmental effectiveness of PES schemes. The environmental effectiveness is the change in provision of services included in the PES scheme in comparison with provision of ES without the scheme [50] and uses (1) the transaction and implementation costs, (2) the direct changes, and (3) indirect effects as factors to determine the environmental effectiveness. The respondents assigned their preferences using a 5-point Likert scale format (from 1 = very low importance to 5 = very high importance).

The last thematic section focused on stakeholder involvement in PES scheme design through two questions. The first one (Q4.1) considered the respondent points of view about the role of public authorities in PES schemes in the water sector. The second one (Q4.2) investigated the opinions towards the involvement of other stakeholders in the decision-making process connected with PES scheme design and development. The respondents assigned their preferences using a 5-point Likert scale format (from the lowest level of participation to the highest): 1—Non-involved; 2—Information; 3—Consultation; 4—Collaboration and 5—Co-decision. According to Herwig [51] the four levels of stakeholder involvement in the decision-making process can be defined as follows:

1. Information: the level of participation, which provides the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions (e.g., fact sheets, web sites);
2. Consultation: the level of participation, which obtains public feedback on analysis, alternatives and/or decisions (e.g., focus group, surveys, public meetings);
3. Collaboration: the level of participation, which engages the knowledge and resources of stakeholders (e.g., site-based events);
4. Co-decision: the level of participation, which shares power and responsibility for the decisions being made and their outcomes creating management groups.

The final version of the questionnaire was translated into six languages (Croatian, Czech, English, Italian, Slovak, and Ukrainian), and it was administrated to the respondents between March and June 2019. The respondents in each country have been identified considering four stakeholder groups, according to Reed et al. [32], and relevant expertise concerning the relationship between

forests and water. The targeted stakeholder groups considered in the study included buyers (government organizations, NGOs, water utilities), sellers (associations of forest owners, state and non-state forest enterprises), intermediaries/brokers (consulting enterprises and forestry freelancers), and knowledge providers (professors and researchers from universities and research institutes).

2.2. Data Analysis

Data collected with the online survey were analyzed in July and August 2019. The first section was formed by qualitative parameters (countries involved in the survey; scientific fields of the stakeholders; years of work in their scientific field) and the data were used to classify the respondents into four main groups of stakeholders involved in PES scheme design and development: buyers, sellers, intermediaries and knowledge providers. The non-parametric Kruskal–Wallis test was applied to highlight statistically significant differences among the four groups of stakeholders and related to the scientific fields of respondents for WES importance (second section) and aspects of PES implementation (fourth section).

Data from the second thematic section were processed to identify the most important forest-related WES according to the respondent opinions. The level of importance of a forest-related WES was estimated using a symmetric Likert scale from 1 = very low importance to 5 = very high importance. In data processing, the percentages to determine the relevance of each WES were used. Each WES was evaluated separately, to find out what significance respondents attributed to individual values. According to the respondent answers, the position of the specific WES was identified within all categories of WES. In order to define the hierarchical position of the categories of WES, a pairwise comparison was performed. For this comparison, the analytic hierarchy process (AHP) method was applied. AHP is a method that uses pairwise comparisons of the alternatives for solving multi-criteria decision-making (MCDM) among a finite number of alternatives (e.g., WES categories). The matrix of pairwise comparison $A = (a_{ij})$ represents the intensity of the respondent's preference between individual pairs of alternatives (A_i vs. A_j for all $i, j = 1, 2, \ldots, n$). Each respondent compared pairs of alternatives for all the possible pairs and in such a way the comparison matrix A was obtained. In the matrix of pairwise comparison, the relative weight is expressed by a_{ij} located at the right side of the diagonal and its reciprocal as is in the opposite side of the diagonal:

$$A = (a_{ij}) = \begin{pmatrix} w_1/w_1 & w_1/w_2 & \ldots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \ldots & w_2/w_n \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ w_n/w_1 & w_n/w_2 & \ldots & w_n/w_n \end{pmatrix}, \quad (1)$$

In the matrix, the row indicates the relative weight of each category with respect to the other category. When $i = j$, then $a_{ij} = 1$. Afterwards, the transpose of the vector of the weights w is multiplied by matrix A to obtain the vector represented by $\lambda_{max} \cdot w$ that follows the principle:

$$(A - \lambda_{\max} I)w = 0 \quad (2)$$

where λ_{max} is the largest eigenvalue of matrix A and I is the identity matrix of size n. The value of λ_{max} is always positive, equal or higher than n (number of rows or columns in the matrix). The consistency of the respondent information depends on how much the value of λ_{max} deviates from the value of n. The matrix A is, thus, tested for consistency using the following formula:

$$CI = \frac{(\lambda_{\max} - n)}{(n-1)}$$
$$CR = \frac{CI}{RI} \quad (3)$$

where *CI* is the consistency index, *CR* the consistency ratio, and *RI* is the expected consistency index obtained from random generated comparisons of the same order *n*. *CR* is used to measure how consistent the judgments have been relative to large samples of purely random judgments.

The last two questions of the second thematic section (Q2.3 and Q2.4) were processed in linguistic expression. The answers were checked for keywords referring to the WES categories and categorized to identify trade-offs related to forest management, reforestation and afforestation. As responses were put in the appropriate category, some recurring keywords were evidenced, popping up within each general category. These keywords correspond with main WES categories and services that were grouped and tagged together to create sub-categories of stakeholder answers.

In the third thematic section, the most important factors for implementation and defining the environmental effectiveness of the PES schemes were identified according to the respondent opinions. The perceived efficiency of the PES schemes versus regulatory policy instruments to enhance a forest-related WES along the symmetric Likert scale was calculated. The average levels of importance for the implementation aspects (1) multilevel governance, (2) shared values for ES, and (3) bundling of layering of services across multiple scales were also calculated. The importance of aspects influencing environmental effectiveness of PES schemes was estimated by calculating the average Likert score for the factors (1) transaction and implementation costs, (2) direct changes, and (3) indirect effects.

The last thematic section focused on respondent opinions about the involvement of local stakeholders in the design of particular PES schemes. The respondent opinions about the role of the public authorities were investigated using a multi-answer question. The number of variables corresponded to the maximum number of selected options. In the last question, respondent opinions concerning the involvement of stakeholders in the decision-making process related to PES schemes in the water sector were assigned. The respondent answers concerning the level of involvement were elaborated through the simple frequency distribution. The necessary steps in creating the simple frequency distribution are "to identify the lowest and highest variable values in the data set; list in ascending order all single values in the data set from the lowest to highest and to tally the number of times the variable values occurred" [52, p. 293].

3. Results

3.1. Characterization of the Stakeholders

The online data acquisition phase returned 142 completed online surveys from 23 countries, mainly belonging to Eastern Europe and the Mediterranean Basin. In particular, the results show that 27 questionnaires were filled out by Italian stakeholders (19.0% of total respondents), followed by 14 questionnaires from the Czech Republic and Turkey (19.7%), 13 from Slovakia and Slovenia (18.3%), 9 from Croatia and Ukraine (6.3%), and 7 from Algeria and Serbia (4.9%). The remaining countries (Austria, Belgium, Bosnia and Herzegovina, Finland, Georgia, Germany, Greece, Ireland, Japan, Latvia, Luxemburg, Morocco, North Macedonia, and Sweden) were represented in the survey with fewer than 7 respondents per country.

The distribution of the stakeholders involved in the study by group was as follows: (i) buyers (B), 25 respondents; (ii) sellers (S), 28 respondents; (iii), intermediaries (I), 39 respondents; and (iv) knowledge providers (K), 50 respondents. The buyers were mainly represented by governmental institutions (e.g., ministries), environmental NGOs and water utilities. The group of sellers was formed by forest owner associations, state and non-state forest enterprises, and national parks/biosphere reservation authorities. The knowledge providers group was represented by universities and research institutions, while the intermediaries were represented by forestry professionals, private companies responsible for development of forest management plans, state and regional forest administrations and, in some cases, also environmental NGOs according to their performance in this professional field.

Considering the respondent expertise (Figure 1), the majority are experts in forestry sectors such as forest management and planning, forest policy and economics, forest soil science (59.2% of total

respondents). The remaining are expert in water resource management (5.6%), environmental/ecology sciences (10.6%), economics (5.6%) or in other realms (e.g., agriculture, civil engineering, eco-tourism) (Figure 1). Observing the results by groups of stakeholders, in the group of sellers the respondents are mainly experts in forestry (71.4%), while in the group of buyers a more homogeneous distribution by scientific fields is observed: 44.0% in forestry, 12.0% in economics, 16.0% in water resource management, and 4.0% in environmental/ecology sciences.

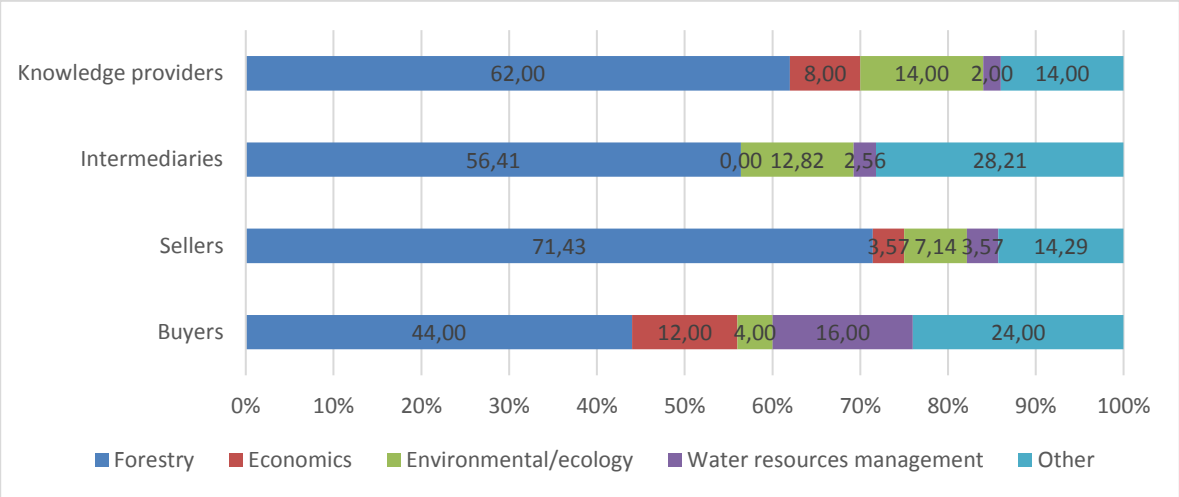

Figure 1. Scientific expertise of the respondents.

The majority of stakeholders involved in the study have a high level of expertise (Figure 2): 53.5%, more than 15 years; 17.6%, 11–15 years of expertise; 12.7%, 6–10 years; and 13.4%, 1–5 years of expertise. Only 2.8% of stakeholders have less than one year of expertise in their scientific field. Observing the results by groups of stakeholders, it is interesting to highlight that the group of buyers is the one with the least experience (24.0% of respondents have less than five years of expertise). Not surprisingly, the group of knowledge providers is the one with the highest level of expertise (70% of respondents have more than 10 years of expertise).

The distribution of data by field and level of expertise suggests that the sample of stakeholders has reached saturation as all the scientific fields related to the water and forest management were involved in the survey. In addition, the respondents have many years of experience in their scientific fields.

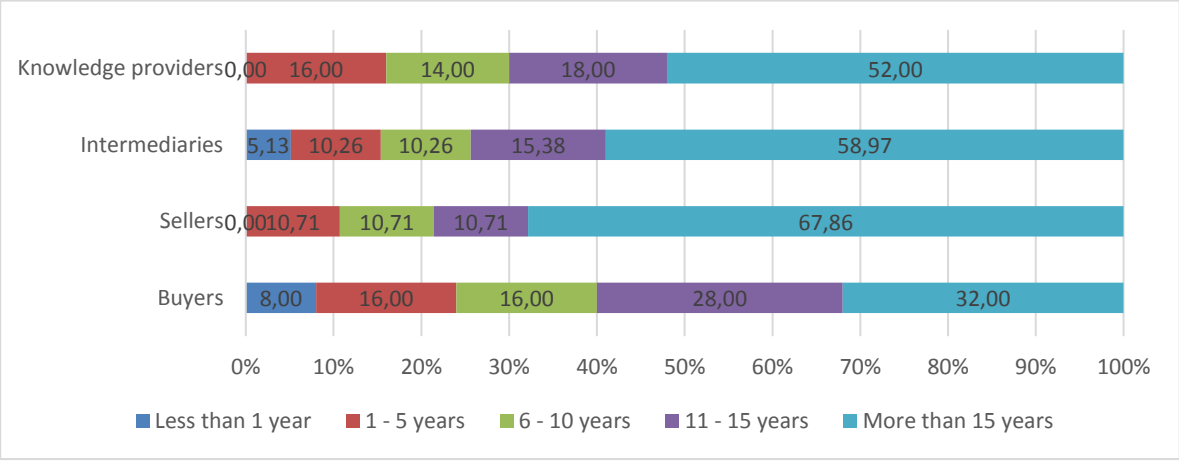

Figure 2. Years of expertise of the respondents.

3.2. Relationship between Forests and Water

The results of pairwise comparison (Q2.1) show that for all respondents the most important category of forest-related WES is regulating services (priority score w = 0.3252) followed by provisioning services (w = 0.2914) and supporting services (w = 0.2325). The cultural services are the category considered least important by the sample of respondents (w = 0.1510).

When observing the results by group of stakeholders (Table 2), interesting differences are emphasized. The intermediaries and knowledge providers assign the highest level of importance to the regulating services (w = 0.3367 and 0.3414 respectively), while provisioning services are the most important WES category for buyers and sellers (w = 0.3235 and 0.3148 respectively). It is arguably interesting to highlight that cultural services are considered the least important WES category by all groups of stakeholders. For all groups of stakeholders, the consistency ratio (*CR*) is less than 0.05 (5%).

Table 2. Priority scores (w) for the categories of ecosystem services by group of stakeholders.

Category/Priority Score	B (n = 25)	S (n = 28)	I (n = 39)	K (n = 50)	Total (n = 142)
Provisioning services	0.3235 [1]	0.3148	0.2866	0.2636	0.2913
Regulating services	0.3110	0.2932	0.3367	0.3414	0.3252
Supporting services	0.2317	0.2344	0.2262	0.2322	0.2325
Cultural services	0.1338	0.1576	0.1505	0.1628	0.1510
Consistency Index (*CI*)	0.001495	0.002280	0.002741	0.018651	0.002269
Consistency Ratio (*CR*)	0.001661	0.002533	0.003046	0.020723	0.002521

[1] In bold the highest priority score for group of stakeholders.

Concerning the level of importance assigned to single WES (Q2.2), the results show that the reduction of soil erosion is considered the most important WES provided by forests followed by the reduction of surface runoff. Both these WES are in the category of regulating services, confirming the importance of the regulating services category for the sample of stakeholders. Conversely, provision of water bodies for recreation and leisure activities and maintenance of genetic diversity in water ecosystems are the two WES considered less important by stakeholders. Aggregating the data by WES category, the results show the following order of importance: regulating services (mean value of 4.42), provisioning services (4.39), supporting services (4.12), and cultural services (3.91). These results are in accordance with the priority scores provided by pairwise comparison between WES categories.

When observing data by groups of stakeholders, the results show that the three most important WES for the buyers are the reduction of soil erosion followed by the reduction of surface runoff and the recharge of groundwater. For sellers and intermediaries the reduction of soil erosion is the most important WES. Nevertheless, it is interesting to highlight that for the intermediaries the second and third WES belong to provisioning services: clean drinking water and recharge of groundwater. The knowledge providers and buyers show a similar order of priority considering the reduction of soil erosion, which is considered the most important forest-related WES, followed by two supporting services: provision of habitats for different species and reduction of surface runoff. However, the non-parametric Kruskal–Wallis test (α = 0.05 with a p-value from 0.149 for recharge of groundwater and 0.942 for provision of habitats for different species) show statistically non-significant differences between groups of stakeholders for all WES considered in the survey.

Concerning the level of importance assigned to a single WES (Q2.2) by a scientific field of respondents, the results show interesting differences for some WES, such as: provision of water bodies for recreation and leisure activities (average values from a minimum of 3.3 assigned by the experts in water resources management and a maximum of 3.8 assigned by experts in economics) and maintenance of genetic diversity in the water ecosystem (average values between 3.5 assigned

by water resources management experts and 4.3 assigned by experts in environmental/ecology sciences). In many cases, the experts of water resource management consider the forest-related ES of low importance except for the following three WES: reduction of surface runoff, reduction of soil erosion, and provision of habitats for different species (Table 3). The Kruskal–Wallis non-parametric test shows statistically significant differences between diverging scientific fields for two forest-related WES: provision of clean drinking water (p = 0.007), and buffering and filtering of pollutants from surface water (p = 0.027). Experts in water resource management assigned significantly lower values to these WES compared to the other groups of stakeholders.

Conversely, the number of years of respondent expertise is a variable that did not influence the answers on the importance of single WES. The Kruskal–Wallis non-parametric test confirms no statistically significant differences (α = 0.05 with a p-value from 0.027—buffering and filtering of pollutants from surface waters—to 0.931—protection of water bodies for recreation and leisure activities).

Table 3. Level of importance (mean and SD) of single WES by groups of stakeholders (5-point Likert scale).

WES/Group	Buyers (n = 25)	Sellers (n = 28)	Intermediaries (n = 39)	Knowledge Providers (n = 50)	Total (n = 142)
Recharge of groundwater (provisioning services)	4.40 (0.76)	4.29 (0.81)	4.54 (0.72)	4.16 (0.87)	4.33 (0.81)
Provision of clean drinking water (provisioning services)	4.12 (1.05)	4.46 (0.92)	4.56 (0.72)	4.30 (0.91)	4.37 (0.90)
Buffering and filtering of pollutants from surface waters (regulating services)	4.00 (0.91)	4.43 (0.69)	4.10 (1.12)	4.16 (1.02)	4.17 (0.97)
Reduction of surface runoff (regulating services)	4.64 (0.49)	4.46 (0.69)	4.51 (0.82)	4.38 (0.90)	4.48 (0.78)
Reduction of soil erosion (regulating services)	4.72 (0.46)	4.71 (0.53)	4.72 (0.56)	4.50 (0.93)	4.64 (0.70)
Protection from the flooding risk (regulation services)	4.40 (0.71)	4.39 (0.83)	4.36 (0.74)	4.14 (0.95)	4.30 (0.83)
Provision of habitats for different species (supporting services)	4.36 (0.91)	4.43 (0.74)	4.38 (0.94)	4.48 (0.81)	4.42 (0.84)
Maintenance of genetic diversity in water ecosystem (supporting services)	3.76 (0.88)	3.79 (0.88)	3.90 (1.10)	3.90 (1.04)	3.85 (0.99)
Provision of scenic and landscape of forests (cultural services)	4.12 (1.05)	4.21 (0.74)	4.18 (1.02)	4.26 (1.03)	4.20 (0.97)
Provision of water bodies for recreation and leisure activities (cultural services)	3.52 (1.19)	3.64 (1.03)	3.74 (1.23)	3.76 (1.27)	3.69 (1.19)

Considering trade-offs among WES (Q2.3 and Q2.4), 52.8% of all respondents indicated potential trade-offs among WES due to forest management practices, while 40.8% indicated potential trade-offs related to the afforestation/reforestation practices. The results show that 75.0% of knowledge providers and 56.0% of intermediaries think that forest management practices (e.g., thinning and

cutting) can generate trade-offs among WES. Conversely, 75.0% of sellers and 56.0% of buyers believe that forest management practices are not potential causes of trade-offs among WES. The results show that according to stakeholder answers forest management generates trade-offs among all four categories (12.0%) and between provisioning and regulating services (10.7%). The majority of stakeholders think that afforestation/reforestation can generate trade-offs between WES: 75.0% of sellers, 68.0% of buyers, 59.0% of intermediaries, and 54.0% of knowledge providers. Conversely, for 20.7% of all respondents, afforestation/reforestation practices cannot generate trade-offs among WES. The majority of respondents think that afforestation/reforestation practices can generate trade-offs among all WES categories (20.7%), and between provisioning and regulating services (17.2%). Summarizing, according to stakeholder opinions the most critical trade-offs are found between provisioning and regulating services for both the management practices considered in the present study (i.e., afforestation/reforestation and thinning).

3.3. Payments for Ecosystem Services Schemes

The results show that 39.0% of respondents consider PES schemes more efficient compared to the command-and-control approach in order to protect WES, while 28.1% of respondents consider that PES schemes are less efficient than regulatory instruments. Besides, the results show interesting differences among groups of stakeholders (Figure 3). Sellers are the group which emphasizes the importance of PES schemes compared to regulation instruments: 46.4% of sellers consider PES schemes more efficient than environmental taxes; while knowledge providers are the group less confident regarding the importance of PES schemes (only 38.0% of total knowledge providers consider PES schemes more efficient than environmental regulation). The high percentage of sellers and buyers who consider PES schemes more efficient than command-and-control instruments is probably due to the specific features of the sample of stakeholders. In particular, it is characterized by a high level of knowledge and direct experience about PES schemes. Supposedly, a larger sample of WES beneficiaries would emphasize less the efficiency of the PES schemes comparted to the command-and-control approach.

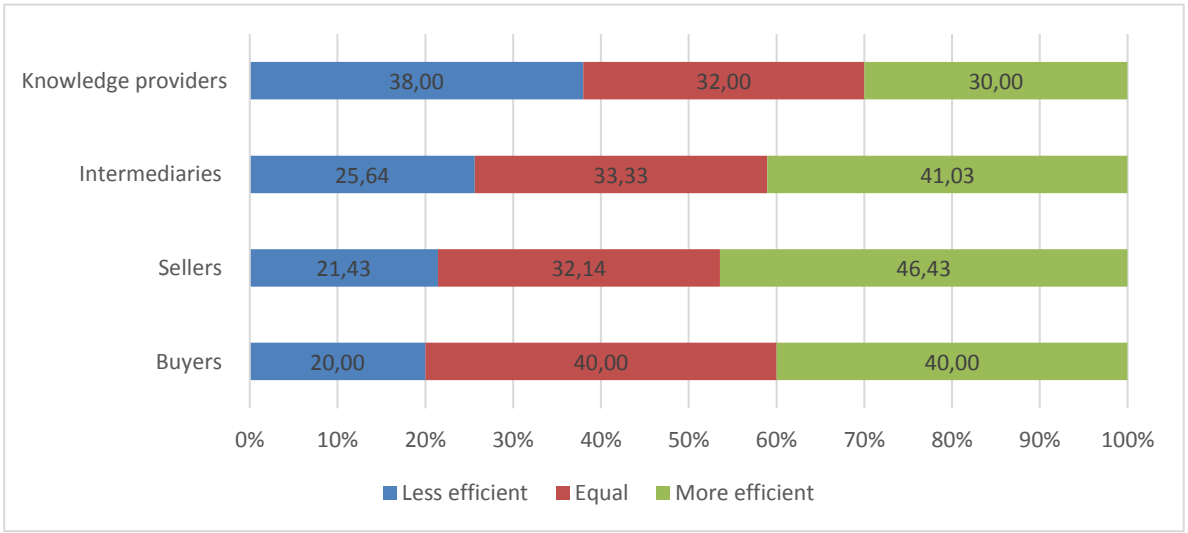

Figure 3. Stakeholder opinions about the efficiency of Payment for Ecosystem Services (PES) schemes compared to regulation instruments to protect forest-related WES.

The results concerning stakeholder knowledge about existing water-related PES schemes show that 80.3% of the respondents are not aware of active water-related PES schemes in their countries. The remaining 19.7% fetched out a few examples such as land tax deductions, Natura 2000 network payments or kinds of payments for sustainable forest management (PSFM) as PES schemes.

Respondent answers about the relevant aspects for PES scheme implementation (Q3.2) show that the two most important aspects for efficient PES are multilevel governance and shared values

for ecosystem services. The multilevel governance approach incorporates local and indigenous knowledge about WES and payment mechanisms in the decision-making process and it has been perceived as a highly important implementation factor for PES schemes (mean value higher than 4 with sellers, knowledge providers, and intermediaries). Bundling of WES across multiple scales is considered the least important aspect in developing PES schemes within all groups of stakeholders. The non-parametric Kruskal–Wallis test ($\alpha = 0.05$ with a p-value from 0.128—multilevel governance—to 0.595—shared values for WES) shows statistically non-significant differences among groups of stakeholders for all aspects related to the implementation of PES schemes (Table 4).

Table 4. Level of importance (mean and SD) of implementation aspects of PES schemes.

Implementation Aspect/Group	B (n = 25)	S (n = 28)	I (n = 39)	K (n = 50)	Total (n = 142)
Multilevel governance	3.76 (0.78)	4.04 (0.88)	4.26 (0.88)	4.06 (1.04)	4.06 (0.93)
Shared values for WES	4.08 (0.81)	3.93 (0.98)	4.26 (0.72)	3.92 (1.14)	4.04 (0.95)
Bundling of WES	3.36 (1.11)	3.89 (0.83)	3.54 (1.25)	3.8 (1.07)	3.67 (1.10)

Setting the targeted environmental outcomes is considered as a crucial factor for designing PES schemes. To shed light on respondent opinions about the level of importance of reaching these outcomes, three main factors that determine the environmental effectiveness of PES were chosen: program costs (transaction and implementation net costs of PES transfers); the direct changes in land/resource management (additionally), and the indirect effects of the scheme outside of contracted lands (spillover), as defined by Börner et al. [50]. According to the stakeholder opinions, all factors of environmental effectiveness have moderate importance in designing PES schemes (Table 5). Direct changes seem to be the most important for achieving environmental outcomes according to stakeholder opinions.

Table 5. Level of importance (mean and SD) of the environmental effectiveness factors of PES schemes.

Factor of PES Schemes/Group	B (n = 25)	S (n = 28)	I (n = 39)	K (n = 50)	Total (n = 142)
Transaction and implementation costs	3.48 (0.92)	3.71 (1.05)	3.79 (1.03)	3.54 (1.22)	3.63 (1.08)
Direct changes	3.52 (1.00)	3.89 (0.88)	4.18 (0.79)	3.94 (1.04)	3.92 (0.95)
Indirect effects	3.40 (0.91)	3.71 (0.85)	3.59 (0.94)	3.50 (1.07)	3.55 (0.96)

3.4. Stakeholder Involvement in the PES Schemes

The results show that the respondents consider the role of public authorities as very important for designing PES schemes (Q4.1). All groups of respondents think that public authorities should be potential buyers, but at the same time they should play the role of potential regulators (Table 6). These findings are supported mainly by the intermediaries, followed by sellers and knowledge providers. Conversely, only a few respondents think that payments for watershed services should be managed without any intervention from the public authorities.

Table 6. Respondent opinions about the role of public authorities in PES schemes (%).

Answer Choice/ Group	B (n = 31)	S (n = 31)	I (n = 49)	K (n = 60)	Total (n = 171)
Payments for watershed services should be managed without any intervention from the public authorities (i.e., user and non-government financed payments)	6.5	9.7	6.1	3.3	5.8

Public authority should be involved as a buyer (i.e., government-financed payments such as the European Union agri-environmental schemes)	12.9	12.9	14.3	15.0	14.0
Public authority should be involved as a regulator (i.e., compliant payments)	32.2	19.3	10.2	25.0	21.1
Public authority should be involved both as a buyer and as regulator (i.e., compensation payments for legal restriction)	48.4	58.1	69.4	56.7	59.1

The level of stakeholder involvement in the decision-making process of the PES schemes (Q4.2) is evaluated by average values between a minimum of 2.93 (single farmers) and a maximum of 3.73 (farmers' associations). Therefore, for the respondents all stakeholders should be involved in the decision-making process through a consultation process, while the farmers' associations should be involved at the collaboration level (Table 7). Comparing the opinions of different groups of respondents, the results do not show substantial differences except for a greater emphasis on the importance of involving single farmers and forest owners by sellers and knowledge providers. Besides, for the group of sellers the local community should be the second stakeholder involved in the decision-making process related to PES schemes.

Table 7. Respondent opinions about the level of stakeholder involvement in the decision-making process related to the PES scheme design and implementation (mean and SD).

Stakeholders Involvement/Group	B (*n* = 25)	S (*n* = 28)	I (*n* = 39)	K (*n* = 50)	Total (*n* = 142)
Single farmers not directly involved in the PES scheme	2.48 (1.00)	3.07 (1.09)	2.90 (1.12)	3.10 (1.05)	2.93 (1.08)
Single forest owners not directly involved in the PES scheme	2.68 (1.14)	3.14 (0.97)	2.97 (1.20)	3.30 (1.09)	3.07 (1.12)
Environmental NGOs	3.12 (1.36)	3.21 (1.07)	3.64 (1.09)	3.62 (1.03)	3.46 (1.13)
Fishing associations	2.88 (1.17)	3.21 (1.13)	3.49 (1.05)	3.60 (1.11)	3.37 (1.13)
Farmers associations	3.28 (1.14)	3.71 (1.05)	3.92 (0.84)	3.80 (1.09)	3.73 (1.04)
Tourism associations	2.48 (1.08)	3.04 (1.20)	3.33 (1.01)	3.24 (1.08)	3.09 (1.12)
Citizens (local community)	3.08 (1.00)	3.43 (1.17)	3.23 (1.25)	3.34 (1.27)	3.28 (1.19)

Summarizing the results of this thematic section, we can conclude that according to the respondent points of view, all stakeholders should at least be involved at the consultation level, while farmers' associations should be involved at the collaboration level. In this context, the public authority should play the roles of buyer and regulator at the same time. The appropriate level of involvement of the different stakeholders is a key point in order to increase the worldwide diffusion of the PES schemes and the social acceptance of these voluntary instruments.

4. Discussion

This study used an online survey to analyze stakeholder opinions and perceptions towards PES schemes within the framework of COST Action CA15206–PESFOR-W (Forests for Water). Studies have shown that the main aspects of PES schemes are: ecosystem services assessments and their promotion, e.g., [32,41,50,53], which can help achieve environmental and socioeconomic targets with PES schemes, e.g., [50,54,55], and institutional contexts of PES schemes, e.g., [38,39,56].

In the present study, the reduction of soil erosion is perceived as the most important forest-related WES. This finding is supported by Calder [57], who stated that the majority of the world's catchment experiments indicate decreased runoff from areas under forests compared to areas under other crops. Cultural services are perceived as the least important category of WES based on pairwise comparison with other categories of WES; this is in contrast with other studies that highlighted that

cultural services are considered one of the most relevant ecosystem services category by society [40,53,58–62].

The four stakeholder groups (Buyers, Sellers, Knowledge providers, and Intermediaries) have different perceptions on which ecosystem services are the most important. That is an interesting point when designing and implementing the PES scheme mainly on local level. As De Vreese et al. observed [26,40], differences among stakeholder group interests and their representations of nature should be overcome by stakeholder analysis, with the aim of finding the ecosystem services that have potential buyers and sellers, whose land provides this service.

Concerning trade-offs within categories of WES, it is interesting to observe that only half of the stakeholders agreed that forest management can generate trade-offs and less than half agreed that afforestation/reforestation practices have an impact on trade-off occurrences. In this regard, Stosch et al. [28] affirmed that PES schemes can be a potential source of conflict among stakeholders involved in the schemes. However, our findings provide hints on how to design PES schemes that are grounded in diverging stakeholder perspectives. Our respondents indicate that forest management and afforestation/reforestation practices can generate trade-offs within all four WES categories, but also between provisioning services and regulating services. These findings are in accordance with various studies, which pointed out that forest management practices focused on provisioning services can generate a decreased flow of other ecosystem services [22,23]. Deniz and Paletto [27] highlighted that, according to Italian and Turkish experts, some forest management practices—e.g., woody residue removal after felling in high forests and clear-cutting of coppices—have a negative effect on some WES (i.e., surface runoff, water infiltration, risk of floods and landslides, use of groundwater for quality drinking water, and sedimentation in streams, lakes and dams). Those authors showed that the negative effects vary based on the intensity of forest management practices applied.

Opinions about the efficiency of PES schemes compared to the "command-and-control" approach vary and no statistically significant differences across the respondent groups were found. The opinion that PES schemes are efficient tools in order to protect the WES provided by forests gained slightly more attention, mainly in the group of sellers. When observing the efficiency of PES schemes, opinions on implementation and environmental effectiveness aspects are essential when designing the PES schemes. Implementation of PES schemes incorporates multilevel governance, bundling or layering of services across multiple scales, and shared values for ecosystem services [32]. All groups of stakeholders involved in the study agreed upon the high importance of shared values for ES in developing the PES schemes, even if it is difficult to distinguish shared values [40] and to express these values in monetary terms [32]. Furthermore, there are problems in imagining how this factor (shared values) could be implemented in the decision-making process [40,63]. According to Börner et al. [50], the criteria covering environmental benefits are the program costs, direct changes, and indirect effect. Our respondents indicated that the most important aspect for developing an effective and efficient PES scheme is facilitating direct and additional changes in land management, compared to the situation without PES schemes. The problem additionally appears when potential recipients of the payment meet the program goals even in the absence of PES program, i.e., without any changes of land use or resource management [50]. That is the reason why the PES designers should ensure that payments reward action that would otherwise not occur and delivery of additional ecosystem services are provided [34].

Another issue of PES scheme design is the role of public authorities. Historically the government has been responsible for ensuring protection of nature and provision of ecosystem services [64] with a wide range of policy instruments [30,65–67]. In the present study, the respondents mostly agreed that public authorities should be involved as buyers and also as regulators, despite the fact that government (as the strongest public authority) represents mostly buyers of WES and acts on behalf of the wider public [29]. Before designing a water-related PES scheme, the involvement of stakeholders in the design and the implementation of the PES scheme should be discussed [35,38,39]. Stakeholder (including local communities and their organizations) participation can enhance the quality of environmental decision-making [68,69]. In this study, the respondents evidenced that

stakeholders and their associations should be involved in designing PES schemes at least on the level of consultation, a level which aims to get feedback from actors on analysis, preparation of alternatives and/or decisions [70].

Summarizing, the first key point is that groups of stakeholders have different perspectives and priorities about the importance of WES provided by forests. In order to take into account all stakeholder points of view in the PES agenda, a participatory process should be organized aimed at including different stakeholder needs and interests and at reducing potential conflicts between groups of interest. The second key point highlighted by the study is potential trade-offs between WES generated by afforestation/reforestation. Therefore, improving ecosystem services by reducing trade-offs should focus more on restoration of degraded areas rather than afforestation/reforestation activities as emphasized by the Bonn Challenge. Finally, the third key point is the central role of public authority in PES schemes highlighted by our sample of stakeholders. This result partially differs from the international literature that emphasizes the need for PES to be community led [71,72].

5. Conclusions

The preferences, opinions, and perceptions of different users and stakeholders are important pieces of information in order to reduce conflicts among groups of interest and to increase the social acceptance of the decisions related to natural resources management. In this line of research, the present study identifies a priority list of WES related to forest management and the trade-offs between them in accordance with the points of view of stakeholders. The category of regulating services—with special regard to reduction of surface runoff and soil erosion—is considered the most important WES (watershed-related ecosystem services) category, while the cultural services (landscape conservation and recreation activities) are considered of secondary importance. However, stakeholders confirm that the enhancement of the category of WES through silvicultural treatments or reforestation/afforestation activities can give rise to trade-offs. Forest management practices can generate mainly trade-offs between provisioning services and regulating services. In order to maintain and improve single WES considered a priority by stakeholders, water-related PES are considered a more efficient instrument than "command-and-control" approaches. In implementing PES schemes, a shared value for WES among stakeholders is considered a key aspect in order to increase the chances of success of this voluntary instrument. In this regard, it is important to highlight that a shared value for WES is strictly connected to local knowledge and feelings, which need to be integrated in the design of the PES scheme. To achieve this, PES scheme design and implementation should be participatory processes incorporating multilevel governance of the management and delivery of ecosystem services across the various scales.

From a methodological point of view, the main advantages of the proposed method used to investigate stakeholder opinions are simplicity, transparency, and speed in data gathering. The online administration system has the main advantage of expediency in filling the questionnaire and sending the responses. The use of a structured questionnaire allowed having comparable answers, but at the same time investigating in detail some key issues.

Conversely, the proposed method might be disadvantageous when a substantial sample of respondents is not reached. In this study, the main limitation of the online administration system—low potential willingness to participate in an online survey—has been overcome thanks to the COST Action network.

The future steps of the study will be to involve a greater number of countries and stakeholders in order to have a more complete overview and a cross-country comparison. In addition, this information will be analyzed jointly with the mapping of the PES schemes active in the countries involved in the COST Action CA15206–PESFOR-W (Forests for Water) with the aim to investigating possible relations between stakeholder opinions and their levels of experience in PES schemes.

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Appendix A

This Appendix contains the questionnaire used to collect respondent answers about opinions towards PES schemes.

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1, Figure S1: title, Table S1: title, Video S1: title.

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