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The Design of the Payments for Water-Related Ecosystem Services: What Should the Ideal Payment in Slovakia Look Like?

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Abstract: Water-related forest ecosystems services (WES) are vital to the functioning of the biosphere, society, and human well-being. In Slovakia, the active support of WES is provided by economic instruments of forest policy, while the market-based solution as payments for water-related services (PWS) is lacking. Starting from this point, the objective matter of the paper is to develop the payments for WES schemes in Slovakia. The study was based on document analysis and stakeholders' opinions towards PWS. Fifteen Slovak stakeholders from forestry, water management, and nature protection were involved in the study. These stakeholders represent potential buyers, seller, intermediaries, and knowledge providers in PWS schemes. Based on the theoretical background and the results of the survey, the authors defined key aspects of the design and implementation of PWS schemes in Slovak conditions such as potential buyers and sellers, important factors for the implementation of PWS schemes, and the role of public authorities.

Keywords: water ecosystem services; payments for water ecosystem services; stakeholders' opinions; payments design in Slovakia

1. Introduction

Forest ecosystems fulfill functions that are a crucial source of benefit for society, mostly known as ecosystem services [1,2]. In the recent years, the ecosystem services arising from forest-water relationship have received global attention [3–5]. Water-related forest ecosystem services, or water ecosystem services (WES), include all main ecosystem service categories (provisioning, regulating, supporting, and cultural) as proposed by The Economics of Ecosystems and Biodiversity (TEEB) [6]. WES are benefits derived from various forest functions (Table 1), including water supply, waste assimilation, recreational opportunities, habitat for different species, and productive biological communities [7]. According to Čaboun et al. [8], WES are divided in benefits from water management and from water protective functions. Water management function is the ability to influence the quantity of water, clean drinking water, and groundwater resources. The water protective function of stream stands is the ability to prevent the erosion of streambanks, and to mitigate pollution and fouling of streams and reservoirs. In addition, forests reduce the surface runoff and create a suitable environment for many organisms. Furthermore, the water protective function provided by forest is also related to its influence

on the content of microbiocidal substances in surface water. Moreover, space, solitude, inspiration, habitat for species, and recreational opportunities for people can be found in the atmosphere created by the forest [9].

Table 1. The list of water-related ecosystem services provided by forests.

Water-Related Ecosystem Services	Function
<i>Provisioning services</i>	<i>Ecological functions</i>
Recharge of groundwater	Accumulation Hydric
Provision of clean drinking water	AccumulationHydric
<i>Regulating services</i>	<i>Ecological functions</i>
Buffering and filtering pollutants in surface water	Water protective
Reduction of surface runoff	Regulatory hydric
Reduction of soil erosion	Anti-erosion function
Protection from the flooding risk	Regulatory hydric
<i>Supporting services</i>	<i>Ecological functions</i>
Provision of habitats for different species	Nature protective
Maintenance of genetic diversity in water ecosystem	Nature protective
<i>Cultural services</i>	<i>Societal functions</i>
Provision of scenic landscapes composed by forests and water bodies (aesthetic values)	Cultural
Provision of recreation and leisure activities by forests and water bodies (recreational values)	Recreational

Source: UNECE 2018 [4]; Sarvašová et al. 2019 [10] (modified).

In Slovakia, the river basin administration is under the Ministry of Environment of the Slovak Republic. The Ministry is responsible for implementation of water policy and international agreements on water and watershed management. Currently, the most important agreement connected with water quality and quantity at European Union (EU) level is the Water Framework Directive (WFD). The WFD (Directive 2000/60/EC) was transposed in Slovakia with the Act on Water (no. 364/2004) and implemented through the Strategy for the implementation of the WFD (2004). The main aim of the WFD is to achieve a good ecological and chemical status for water bodies. Other relevant cross-border agreements are implemented in Slovakia, which target specific water management and river basins, include: Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971, Ramsar), Convention on the protection and use of transboundary watercourses and international lakes (1992, Helsinki), and the Danube River Protection Convention (1994, Sofia).

According to the theory of public goods, WES can be described as benefits from the non-production forest functions (ecological and social), for which integration into the market mechanism is difficult [11–13]. No one owns or has rights to these services, and others persons cannot be excluded from their use [14]. The question of public goods remains: how to motivate forest owners and managers to adopt practices that rise to the level of WES supply. One possibility is the property rights assignment to the quality of non-market ecosystem services from forest and water resources; legal owners could ensure their optimal production in terms of the polluter pays principle [15] or integrate them to the market mechanism as payments for water-related services (PWS) [11,16]. The PWS are considered as leading voluntary market-based mechanisms to enhance WES worldwide [17–20].

According to Wunder [21] the payments for ecosystem services are based on these elements: (i) a voluntary transaction, (ii) a well-defined environmental/ecosystem service or a land use, (iii) minimum one buyer, (iv) minimum one provider, who effectively control service provision, and (v) the service provider secures service provision (conditionality). Furthermore, the additionality is considered as important aspect of PWS [21] even that is not accepted as separate criterion [22]. The additionality is defined as direct management or use changes on contracted land, inducted by the adoption of PWS scheme [23]. Currently, there are also broader definitions of “Payments for Ecosystem Services (PES)” [22,24–26] thus summarized: the PWS scheme offers financial incentives to the individual

or communities, for adopting the practices/behavior, which will lead to enhancing WES according to the agreed contract. The contract is made between two main stakeholders' groups (buyers and sellers), who represent the demand and supply side of the PWS. Moreover, there are other stakeholders that should be involved in PES. Governmental and non-governmental organizations (NGOs), local communities, universities, and research institutions also play an important role in helping to design and implement the PES scheme [27–30].

In Slovakia, the watershed ecosystem services are supported by public forest policy instruments such as: forest tax land relief, compensations for management restrictions, environmental payments from the Rural Development Program (RDP), and Financial support in forestry to ensure the fulfillment of non-wood forest functions [10]. Moreover, the Operational Program Quality of Environment 2014–2020 (Priority 2-Water) draws support for investment in the water sector to meet the requirements of the environmental acquis, which also represents public funding of PWS. However, the main shortcoming is that they only target global WES in general and not the individual WES. As Engel et al. [27] stated, the concept of PES is not intended as a “silver bullet” that can address any environmental problems; however, PES schemes are a promising mechanisms to stimulate forest owners to enhance the WES supply together with existing policy instruments in Slovakia.

Starting from these considerations, the objective of this paper is to develop the PWS in specific conditions of Slovakia according to the PWS design model based on best practices handbooks [30,31] and stakeholders' opinions towards PWS [32].

2. Materials and Methods

According to Fripp [31] and Smith et al. [30], the design of PWS schemes can be summarized into five steps: (i) identification of the subject (service); (ii) identification of involved actors, (iii) setting the institutional context (implementation, actors involved, etc.), (iv) developing factors and indicators of environmental effectiveness, and (v) financing method.

For the purpose of PWS design under Slovak conditions, a mixed method approach was applied. First, a document analysis of scientific literature on the PES and PWS topic [10,12,15,16,33–37] was performed to identify the potential actors of PWS schemes and current situation of ecosystem services support in Slovakia. Document analysis was followed by online survey with key stakeholders starting from data published by Bálíková et al. [32].

2.1. Payments for Watershed Services Design—Theoretical Considerations

In the international literature, there are many studies aimed at designing and implementing PWS schemes [27,29–31,38]. These studies serve us as a foundation for PWS schemes design in Slovakia (Figure 1). The identification of the contract subject represents the essential Wunder's criterion [21,39]. As Smith et al. [30] revealed, the distinction can be drawn between subject of the payments:

- Output-based payments—well-defined single or several specific WES, which will be provided in the contract.
- Input-based payments—well-defined land or resource management practices.

The second step when designing a PWS scheme is to answer the question: “Who are the potential sellers and buyers of the WES?” The potential sellers of WES are the landowners, particularly state and non-state forest owners and managers, while the potential buyers are mainly water management utilities, water companies, public administrations, and local communities. Other actors who could help to develop PWS schemes are the intermediaries and knowledge providers (e.g., state forest administration, research institutions and universities, environmental NGOs).

As PWS are not developed within the vacuum of these groups of actors and have impact on particular environments [27], the participation of other stakeholders is important to reduce transaction costs and increase social acceptance of these market-based instruments. This dimension must be included in the design of institutional framework, as well as the role of the public authorities within

the PWS schemes. The institutional framework also includes the well-defined funding mechanism as well the important implementation aspects of PWS.

Finally, we have to establish the current state (“business-as-usual”) and compare it with the project scenarios [31]. In this part, the collection of biophysical data is required or take advantage of modeling and optimization opportunities [40].

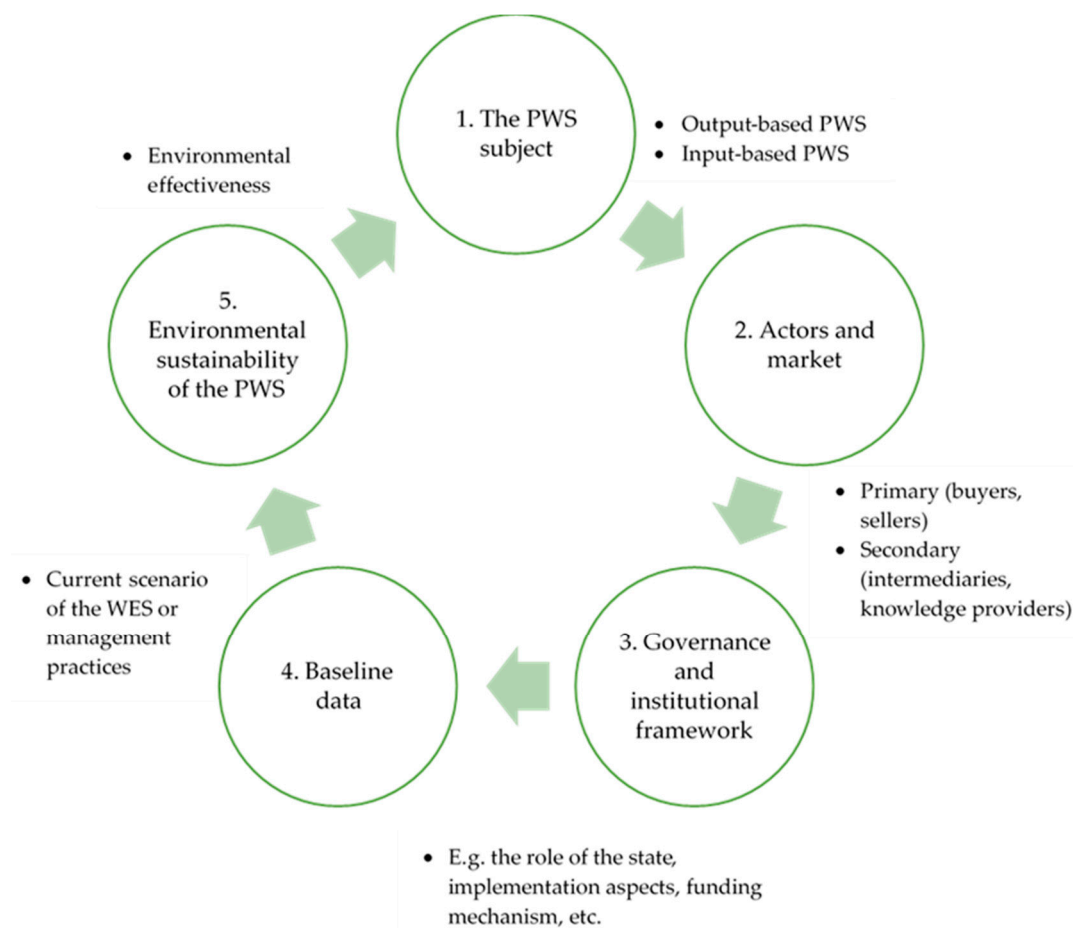


Figure 1. The basic model of payments for water-related services (PWS) design. The PWS design should be described in five basic steps: (1) The identification of PWS subject; (2) The identification of relevant actors, markets and funding mechanisms; (3) The design the key aspects of governance and institutional framework of PWS schemes; (4) Description of the current state of Water-related forest ecosystems services (WES) and management used (“business-as-usual”); (5) The assessment of the environmental outcome of PWS and relevant indicators.

2.2. Questionnaire Survey

The stakeholders’ opinions towards PWS scheme are crucial to design and implement it [27]. The data from a European study were used to understand the Slovak stakeholders’ opinions towards the PWS scheme [32]. The aim of the study was to describe the stakeholders’ views on the development of PWS using an online survey. The authors made a list of 20 key stakeholders with active performance within the fields with the aim to identify potential actors that should be involved in PWS scheme. The listed stakeholders were contacted by phone to describe the study and ask for their availability to participate in the survey. After their consent, we sent them the online survey link. At the end of the data collection, we received 15 completed surveys from Slovak respondents (Table 2) with a level of expertise of more than 15 years in the field (87% of respondents).

Table 2. The main actors in PWS schemes in Slovakia.

Buyers	Director of the Department of Forestry Policy and Economics, Forestry and Wood Processing Section of the Ministry of Agriculture and Rural Development of the SR The Head of Hydrology Department of Central-Slovakia Water Management Company inc. The technical referent of the Slovak Water management Company, state enterprise Initiative "Our Carpathians", environmental NGO
Sellers	The head forester in Mestké Lesy Banská Bystrica (Municipal Forests of Banská Bystrica City, Ltd. Banská Bystrica, Slovakia) The director of Poľana Biospheric Reservation, State Nature Protection of the SR The director of National Park Poloniny, State Nature Protection of the SR The head of the Department of Environment, LESY SR state forest enterprise Professional officer of LESY SR state forest enterprise
Intermediaries and knowledge providers	Researcher from Department of Forest Management and Geodesy, Faculty of Forestry, Technical University in Zvolen The Head of Association of Municipal Forests of the Slovak Republic (ZOL SR) Professional forest manager of the Urbár Bacúrov, Urbárska spoločnosť v Ostrá Lúka and Lesná a pasienková spoločnosť Vápená (forest land communities) Professional forest manager (anonym) The Deputy of General Director of the Forest Management Planning Institute (National Forest Centre) The Director of the Department of Forestry, Policy and Economics of the Forest Research Institute of Zvolen (NFC)

According to the basic model of PWS design, the data collected with the five closed-ended questions were analyzed (Table 3).

Table 3. The Questions relevant to PWS design in Slovak condition adapted from [32].

Step	The Question	The Answer Choice
1. The PWS subject	Q1 What is the level of importance of forests in providing the following WES in your opinion (from 1 = very low importance to 5 = very high importance)?	The list of single WES identical with Table 1
3. The institutional framework	Q2 What the role of the public authorities should be in PWS schemes?	PWS should be managed without any intervention from the public authorities (i.e., user- and non-government financed payments). Public authority should be involved as a buyer (i.e., government-financed payments such as the European Union agri-environmental schemes). Public authority should be involved as a regulator (i.e., compliant payments). Public authority should be involved both as a buyer and as a regulator (i.e., compensation payments for legal restriction).
	Q3 In your opinion, how the following other stakeholders (listed in below) should be involved in the decision-making process related to PWS in the water sector? Please indicate your preference with "x" in each row (1 = not involved, 2 = information, 3 = consultation, 4 = collaboration, 5 = co-decision).	Individual farmers not directly involved in the PWS Individual forest owners not directly involved in the PWS Environmental NGOs Tourism associations Agricultural and farmers associations Fishing associations Citizens (local community)
	Q4 What is, in your opinion, the level of importance of the following implementation factors of PWS schemes (from 1 = very low importance to 5 = very high importance)? ¹	Multi-level governance: incorporating local and indigenous knowledge about ecosystem services and payment mechanisms in the decision-making process Shared values for ecosystem services: understanding the various values (e.g., ecological, ethical values) that can be shared by different groups within the society in relation to the natural environment. Bundling or layering of services across multiple scales: considering the trade-off between ecosystem services provided by forests
	Q5 What is, in your opinion, the level of importance of the following factors to determine the environmental effectiveness of PWS schemes (from 1 = very low importance to 5 = very high importance)? ²	Transaction and implementation costs net of PWS transfers which determine the number of contracts that can be offered from a given program budget. The direct changes in management activities among participants induced by the program compared to the traditional management activities (without PES) The indirect positive or negative effects of the change in management activities on ecosystem services provision outside of contracted land (neighboring areas).
5. The environmental effectiveness		

¹ The implementation aspects and their characterization were adapted from Reed et al. [41]. ² The environmental aspects and their characterization were adapted from Börner et al. [23].

The sample size was limited by the number of the Slovak stakeholders (15) involved in the Cross-European study (144). The non-parametric statistical methods were used to analyze the collected data for two reasons: the sample size is not large enough and the assumption of normality is violated.

Question Q1 focused on stakeholders' opinions on level of importance of single WES (subject of the PWS scheme). The stakeholders assigned the level of importance of single WES using a five-point Likert scale format (from 1 = very low importance to 5 = very high importance). This information can be considered a coefficient of importance during data analysis. In this way, a weighted mean of individual values has created to find out a ranking of WES importance in accordance with the respondents' opinions [42]. The same procedure was used to analyze the data collected with questions Q3–Q5, while the data of the closed-question Q2 was used to calculate the frequency of responses for each option.

3. Results

3.1. Subject of PWS Scheme

The results show that Slovak respondents assigned priority to three WES included in the regulating services category. WES with the highest importance are: (1) Reduction of soil erosion (mean value 4.7), (2) Reduction of surface runoff and Protection from the flooding risk (mean value 4.27); and (3) Protection from the flooding risk (mean value of 4.27). The most important WES listed by stakeholders, could be considered as the subject of the output-based PWS schemes in Slovak condition (Table 4). It is interesting to highlight that all regulating and provisioning WES and one supporting WES (Provision of habitats for different species) reached at least very high level of importance (mean value higher than 4), while cultural and remaining supporting WES were considered of moderate importance.

Table 4. The level of importance of single WES according to the Slovak stakeholders (Q1).

Single WES	Weighted Mean	Standard Deviation	Order of Importance
Reduction of soil erosion (regulating)	4.33	3.32	1
Reduction of surface runoff (regulating)	4.27	3.16	2
Protection from the flooding risk (regulating)	4.27	3.32	2
Recharge of groundwater (provisioning)	4.13	3.00	3
Provision of clean drinking water (provisioning)	4.13	2.74	3
Provision of habitats for different species (supporting)	4.13	2.74	3
Buffering and filtering of water (regulating)	4.00	2.55	4
Provision of scenic and landscape (cultural)	3.87	2.12	5
Maintenance of genetic diversity in water ecosystem (supporting)	3.40	2.12	6
Provision of water bodies for recreation (cultural)	3.00	2.92	7

In the case of the input-based PWS schemes development in Slovakia, WES provision is closely related to primary forest functions. In the Slovak Republic, forests are divided into three main categories considering the primary function: productive, protective, and special purpose forests. Productive forests are intended primarily for the wood production while providing other important ecosystem services, the support of which is provided by specific forestry measures within the framework of integrated forest management. In protective forests, the differential management practices are applied with the aim to enhance wide range of ecosystem services (mainly regulating and supporting ecosystem services). Cultural services are paramount in forests that have been designated as special purpose forests [43,44] (Table 5). The forests with primary functions that fulfill WES represent the potential subject of input-based PWS schemes in Slovakia, where well defined land is connected with specific forest categories.

Table 5. The forest categories in Slovakia.

Forest Categories	Primary Function	Forest Land Area	
		ha	%
Production	Production	1,404,446.00	
	<i>Total</i>	<i>1,404,446.00</i>	<i>72.10</i>
Protection	Anti-erosion ¹	262,411.08	13.47
	Hydric-water management ¹	69,245.54	3.56
	Anti-snowfall ¹	2573.20	0.13
	River basin protecting ¹	529.81	0.03
	Anti-deflation	1763.12	0.09
	<i>Total</i>	<i>336,522.75</i>	<i>17.28</i>
Special purpose	Water protective ¹	15,493.33	0.80
	Recreational	22,074.84	1.13
	Health	2192.78	0.11
	Nature protection	46,340.23	2.38
	Hunting	23,705.64	1.22
	Educational	19,968.04	1.03
	Genetic res. protection	19,140.01	0.98
	Defense (under the Ministry of Defense)	57,868.85	2.97
	<i>Total</i>	<i>206,783.72</i>	<i>10.62</i>
Total SR	<i>1,947,752.47</i>	<i>100</i>	

¹ The potential subject of input-based PWS (well defined forest land). Source: Data from Green report of Slovak Republic 2019 [45].

3.2. The Actors of PWS in Slovakia

Based on the PWS theory, the main stakeholder groups that should be involved in PWS design are from the following sectors: forestry, water-resources management, and forest economics. The potential buyers are represented by the government, water management utilities, and environmental NGOs. The sellers are represented by state and non-state forest owners and their associations. The knowledge providers and intermediaries are representatives from universities, research institutes and professional interest groups (Slovak Forestry Chamber). In Slovakia, licensed forest managers are strong intermediaries. They link the forest owners to the state and are responsible for forestry policy goals fulfillment and regulatory rules in forest management practices [46,47]. These stakeholders addressed with the online survey represent the main actors that should be involved in PWS schemes design in Slovakia.

3.3. The Governance and Institutional Framework of PWS Scheme Design in Slovakia

The institutional framework design of the PWS is aimed at involving various stakeholders [31]. The majority of respondents agreed that public authorities should be involved into PWS schemes both as buyers and regulators (41% of respondents), while for 29% of respondents, public authority should be involved only as buyer and for 24% only as regulator. The results show that only one respondent stated that PWS schemes should be governed without the interference of public authorities (Figure 2). We can conclude that Slovak respondents consider public authority a key actor to design the PWS schemes. This result is not surprising in Slovak condition, as the support of WES is granted from public grants; thus, the stakeholders probably prefer the current system.

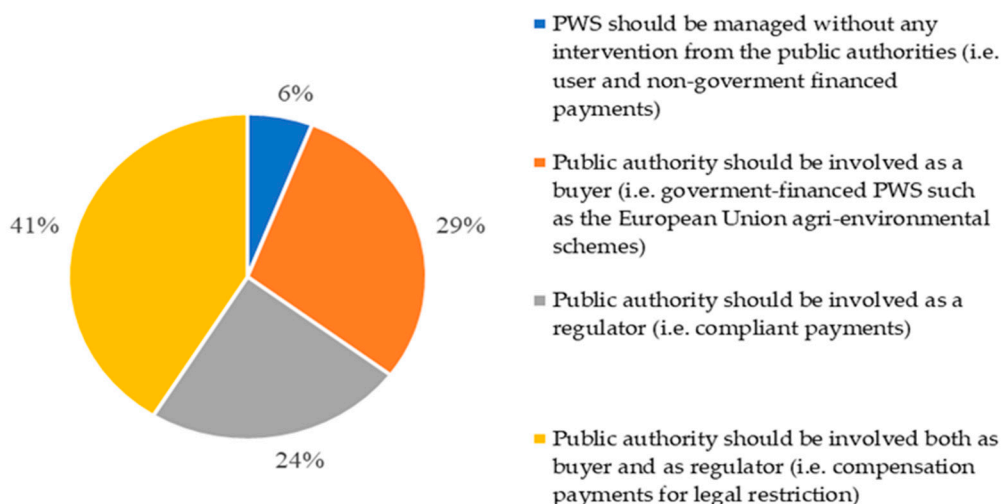


Figure 2. The stakeholders' opinions on what the role of public authorities should be in PWS schemes in Slovakia (Q2).

As mentioned before, the main actors involved in PWS schemes are buyers, sellers, knowledge providers, and intermediaries. The participation of other stakeholders in the PWS schemes in Slovakia is based on the interest of various groups of stakeholders in the use and protection of forests [47]. The results of the present study show that the most important partners in the design of the PWS schemes are forest owners and farmers, who should participate in the collaboration level (Figure 3). Moreover, the fishing associations should be consulted in the PWS design, while the other stakeholders should be informed about the PWS design and its implementation.

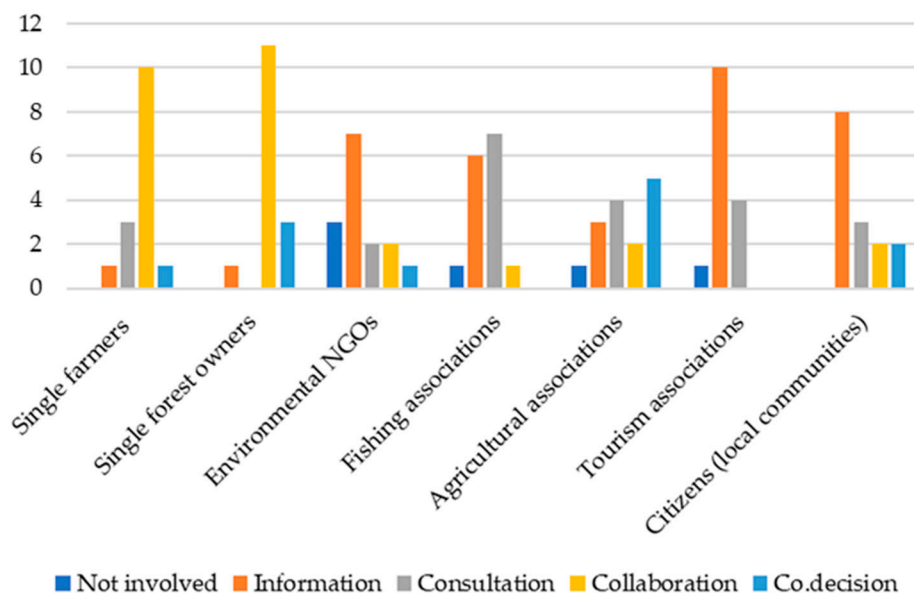


Figure 3. The level of importance of other stakeholders in PWS design (Q3).

The results from the survey concerning the most important implementation factors reveal that (Table 6) the most important are multi-level governance (mean value = 3.93), followed by shared values for ecosystem services (mean value = 3.80). The stakeholders consider all mentioned factors as important, while no one gained worst importance than moderate. The differences between the results are not significant.

Table 6. The level of importance of concerned implementation aspect (Q4).

Implementation Aspects	Weighted Mean	Standard Deviation	Order of Importance
Multi-level governance	3.93	2.45	1
Shared values for ecosystem services	3.80	2.24	2
Bundling or layering of services across multiple scales	3.40	1.58	3

3.4. The Baseline Data of WES Fulfillment and Forest Management in Slovakia

Important for PWS design is to determine the current state of WES implementation, the utilization of land, or forest management practices (baseline scenario without PWS). In Slovakia, forests are managed according to the forest management plan (FMP), which is obligatory for each forest owner or manager. The FMP prescribes the amount of timber that can be harvested in 10 years, silvicultural measures to be applied, afforestation activities to be implemented, etc. [46]. The FMP has a duration of 10 years (periodically) and covers at least 1000 hectares of forest area. As stated in Act on Forests no. 326/2005, the changes may be done after five years with approval of the state forestry administration. The changes in the current state of the forest management can be predicted using various optimization tools as well as by using forest growth simulator SIBYLA [48]. Growth simulator SIBYLA originated on the principles of the model SILVA. It belongs to the category of tree growth simulators [49]. The results of the growth simulator (wood species, stand density, number of story, age of stand) can be used for the calculation of complex WES indicators. By using computer simulation, scenarios can be visualized by deliberately strengthening the fulfilment of certain functions that will increase the specific WES that flow from those functions with consideration also the trade-offs between WES [40,50,51].

3.5. The Environmental Sustainability of PWS Schemes

As claimed by Fripp [31] to ensure sustainability of the WES, all beneficiaries must be prepared to agree to a long-term contract. In this stage, the aspect of environmental effectiveness must also be agreed on [30,31]. We used study on environmental effectiveness proposed by Börner et al. [23] to identify the factors of environmental effectiveness. The results of the survey show (Table 7) that Slovak stakeholders perceive “direct changes in forest management practices caused by PWS adoption” as the most important factors in the PWS design (mean value = 3.73). All environmental effectiveness factors proposed by Börner et al. [23] are perceived at the same level of importance by stakeholders (all mean values between 3.33 and 3.73). We can conclude that the Slovak stakeholders have knowledge about the importance of additionality in PWS schemes.

Table 7. The level of importance of the environmental aspects of PWS schemes design (Q5).

Environmental Effectiveness Aspects	Weighted Mean	Standard Deviation	Importance
The direct changes in management activities among participants induced by the PWS	3.73	2.55	1
Transaction and implementation costs net of PWS transfers	3.46	3.16	2
The indirect positive or negative effects of the change in management activities outside of the contracted land	3.33	3.54	3

The implementation of PWS schemes aim to reach changes in the WES supply; this is monitored through several WES assessment status indicators [1,52]. For regulating WES—identified as the most important by respondents—the indicators for assessment are proposed by Antal et al. [53] and Bošela and Šebeň [54], who developed a set of suitable indicators in Slovak context. Furthermore, the practical application of two indicators associated with WES are at present verified using the SIBYLA tools. These are water quality indicator (index of stand growth) and water quantity indicator, which consists

of the following components: index of wood composition (total value expressed as an average value for wood weighted tree species in the stand), stocking, and flooring [55]. The choice of WES indicators is connected with PWS subject. After all, the proper indicator of WES will show if the environmental aims of the PWS were achieved; thus, it is an important aspect that buyers and sellers must agree on.

3.6. The PWS Design in Slovak Condition

Based on the theoretical background and the results of the survey, we can define the following aspects of potential PWS schemes design under the Slovak conditions (Table 8):

- The subject of output-based PWS schemes represent selected regulating WES (reduction of soil erosion, reduction of surface runoff, and protection from the flooding risk) and input-based PWS represent specific forests categories with functional typing.
- The main actors of the PWS schemes are state forest owners and managers (supply side) and the state and water companies (demand side).
- Additional actors to be involved in the design of PWS schemes are fishing associations and research and education institutions.
- The most important environmental aspect is the definition of direct changes in the management type, which are intended to increase the level of provision of WES (principle of additionality).
- The PWS scheme should be financed by the state (such as PES), with the public authorities acting on the demand side or as a regulator of the PWS schemes.

Table 8. The main features of PWS schemes future development in Slovakia.

The Step	PWS Design Aspect	Specification
1. The PWS subject	Defined water-related ecosystem services	Reduction of surface runoff; Reduction of soil erosion; Recharge of groundwater.
	Defined contracted land	Specific categories of forests according to the Act. on Forests.
2. Actors and markets	Buyers Sellers	State, water-management utilities Forest owners (state and non-state) National Forest Centre (under Ministry of Agriculture and Rural Development), Institute of Hydrology SAS; Technical University in Zvolen, Water Research Institute (under Ministry of Environment)
	Intermediaries, Knowledge providers	
3. The institutional framework	Voluntariness	Voluntary or semi-voluntary.
	The role of the state in PWS	The side of the demand or as regulator of the scheme, or both.
	Funding mechanism	Public, public-private (mixed). The fishing associations and intermediaries should consult the design of PWS schemes.
	Participating actors	Other stakeholder should be informed about the PWS schemes.
4. The base line data	Current state of management	Mapping out the current management practices via Forest management plans, optimization methods, and models (SIBYLA)
5. The Environmental sustainability of PWS	Most important environmental effectiveness aspect	PWS must enhance direct changes in land management compared to scenario without PWS. Assessment of relevant indicators of water-related ecosystem services: Indicators relevant for regulating WES.
	The environmental outcome	

4. Discussion

In Slovakia, the economic instruments of forest policy are used to addressing the problem of fulfilling the water ecosystem services [10,16,33]. Moreover, the term ecosystem services in general is still quite new and has only gained attention in the past few years within policy makers and society [16,36]. Recently, the restatement of Slovak Forest Act (Act on Forests No. 326/2005 Coll.) promotes the active support of ecosystem services, as well as sustainable forest management practices

that generates them. On the other hand, the market-based approach of WES support is still rare in Slovakia [10]. The similar situation could be spotted in Czech Republic, where no specific legislation is directly linked to PWS schemes [56]. The trend is to support the provision of WES by public policy instruments [10]. Conversely, the question of market payments for watershed services in the most developed European countries have been addressed for more than 10 years [4,19,29,57,58], particularly in Germany [59,60], Italy [19,61,62], and the United Kingdom [19,30].

Economic relations between forestry and water management need to be seen as relationships between forest owners (“sellers”) and water management companies (“buyers”) [63], who are the main actors of potential PWS schemes. The state acting on the behalf of its citizens can also act on the demand side. An important role is also played by the state forestry authorities and scientific research and educational institutions [30,64,65]. As the results of a Cross-European study show, the potential subject of PWS schemes in Slovakia are selected services in the regulatory services category, such as the reduction of soil erosion, the reduction of surface runoff, and the protection from the flooding risk. The importance of forests for water regulatory ecosystem services is undisputed [4]. As reported by the EEA, forested areas retain 76% of total rainfall from surface runoff, compared to 28% for non-forest areas, indicating an important forest impact on slowing down surface runoff [66]. Furthermore, the regulating WES are perceived as important also within the society in Slovakia [67]. On the other hand, according to Leonardi [19], most of existing PWS in Europe deal with improvement of water supply.

Although PWS schemes should by their nature be as close as possible to the market mechanism, the role of the state is considered important in the design and implementation of PWS schemes [30,31,68]; the key role of public authority is also confirmed by the results of our study. The Slovak stakeholders involved in the study consider that the public authority has a central role in PWS design and implementation in Slovakia. The development of public financed schemes is also preferred in Poland, according to opinions of wider society [69]. The general trend of funding and implementing PWS schemes in Europe is their funding from public sources, either European or national sources [10,70]. Additionally, WFD addresses the design of effective and efficient PES schemes from public sources, with a specific emphasis on tree planting and woodland creation and management [3]. This is mainly because in most EU countries, high environmental standards are introduced through the regulation of forest and water management [19]. Regarding the implementation factors, the Slovak stakeholders agreed that the most important factor is multi-level governance integrating different local knowledge, institutions, and policy maker into the WES support [41]. Bundling of WES across the scales and shared values, gained only moderate importance, within Slovak stakeholders. Bundling of WES in sense of support of all package WES from the land [30] is common practice in Slovakia [10], while shared values in general have not yet been clearly established even on a European level [71]. The support of WES is a field particularly sensitive to multi-level governance and scales, because hydrological system differs across the scales from local, regional, national, or global levels [15,72,73]. The results show that most important actors when designing PWS schemes are single farmers and forest owners that should collaborate in the PWS design. This level of participation involves the active cooperation of the actors involved throughout the decision-making process, creating alternatives, and identifying possible solutions to the problem of providing WES [47,74]. On the other hand, Slovakia has a long way to go toward adaptive governance practices, and the participation of other actors is still considered weak [75].

The last step in the PWS model refers to design the environmental aspect of PWS [30,31]. As PWS schemes rely on motivation of forest owners’ behavioral change [38], the question of not to pay for behavior that will occur anyway has been discussed broadly [23,27,76]. The results show that for the Slovak stakeholders, the most important environmental factors when designing PWS schemes is direct changes in land management. As stated by Seidl et al. [77], direct changes in management in terms of both “best practices” and “non-intervention” lead to an increase in the WES provision. Generally, forest management taking into account WES requires finer forms of management (e.g., use of small-scale forms of forest management), technical measures (e.g., consolidation of forest roads) and limitation

of some forest activities (e.g., use of chemicals) [15]. The current state of management in Slovakia is monitored through FMP [46] as well as by using computer models for selected areas [48,78,79]. For the final monitoring of PWS environmental objectives, it is important to define qualitative and quantitative indicators that reflect the benefits of environmental schemes [4,80]. In Slovakia, the indicators of water quality and quantity are used [55]. On the other hand, the lack of the input data availability about quality of WES is still considered as a problem when estimating the final benefits for humans [81].

5. Conclusions

Payments for watershed services offer a promising market-based mechanism to increase the quantity and quality of WES provided by forests. Starting from this point, the objective matter of the study is to identify the key aspects of PWS in Slovakia from the stakeholders' point of view, as well as relevant theories for the concept of payments for ecosystem services provided by forests.

Methodologically, the study was based on document analysis and the data provided by a Cross-European study focused on stakeholders' opinions towards PWS. With regard to Slovakia, the survey was administered to 15 key stakeholders that represent potential buyers, sellers, intermediaries, and knowledge providers. The results of this study show that the most important WES belong to the category of regulating services, namely: (1) reduction of soil erosion, (2) reduction of surface runoff, and (3) protection from the flooding risk. Furthermore, respondents agreed that the most important factor to achieve environmental effectiveness is the direct changes in forest management practices. Respondents also highlighted the importance of public authority when implementing PWS schemes. The public authority should have a central role in PWS schemes mainly both as a buyer and as a regulator. Based on the theoretical background and the results of the survey, we defined key aspects to design and implement the PWS schemes in Slovak conditions, such as the well-defined WES, potential buyers and sellers, and important environmental effectiveness aspect of PWS as well as the role of public authorities in PWS. Furthermore, the application of the designed PWS scheme in practice remains an unsolved problem.

Forest policy in Slovakia does not recognize the concept of PWS in policy documents and legislation. Future research is needed to develop suitable PWS schemes. Finally, this issue is currently addressed in Slovakia through applied researches by authors entitled "Testing new policies and business models for the provision of selected forest ecosystem services" known as by its acronym "TestPESLes" (<http://www.ipoles.sk/testpesles/>).

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