Forest Research

User Manual on Developing Woodlands for Water PES

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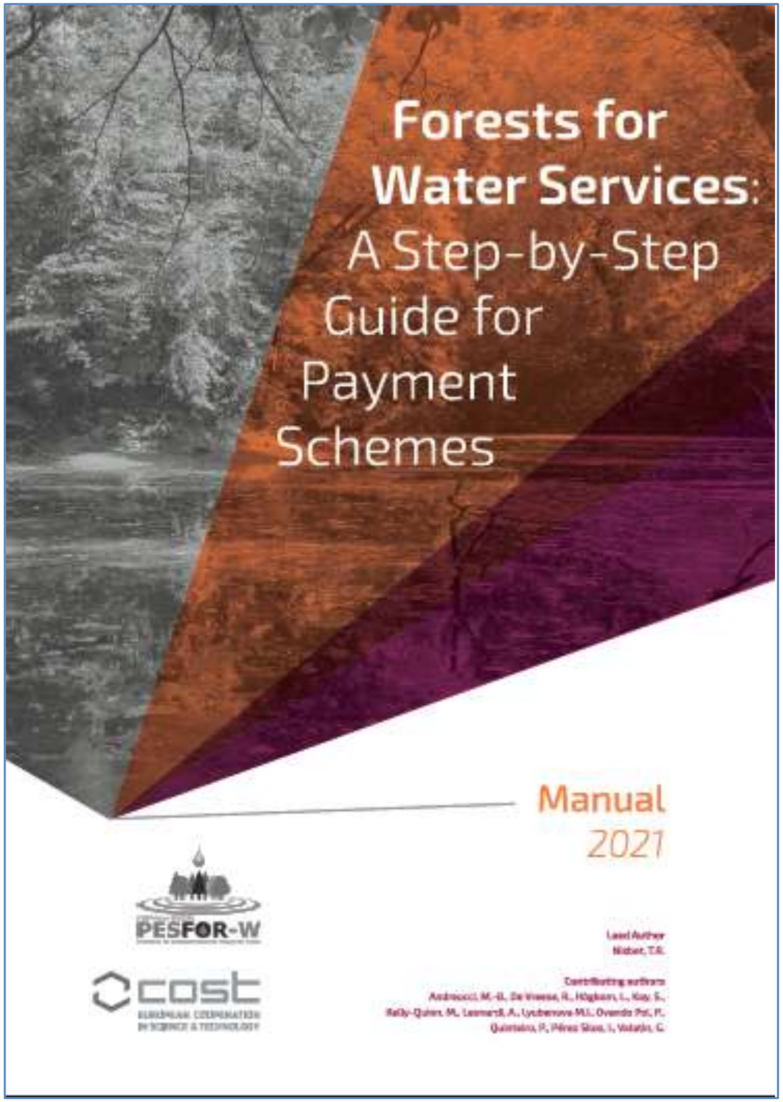
COST EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

COST Action CA15206 PESFOR-W Payments for Ecosystem Services Forests for Water


Forests for Water Services: A Step-by-Step Guide for Payment Schemes

Manual 2021

PESFOR-W

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This publication is based upon work from COST Action CA15206, supported by COST (European Cooperation in Science and Technology)

2 A Step-by-Step Guide for Payment Schemes

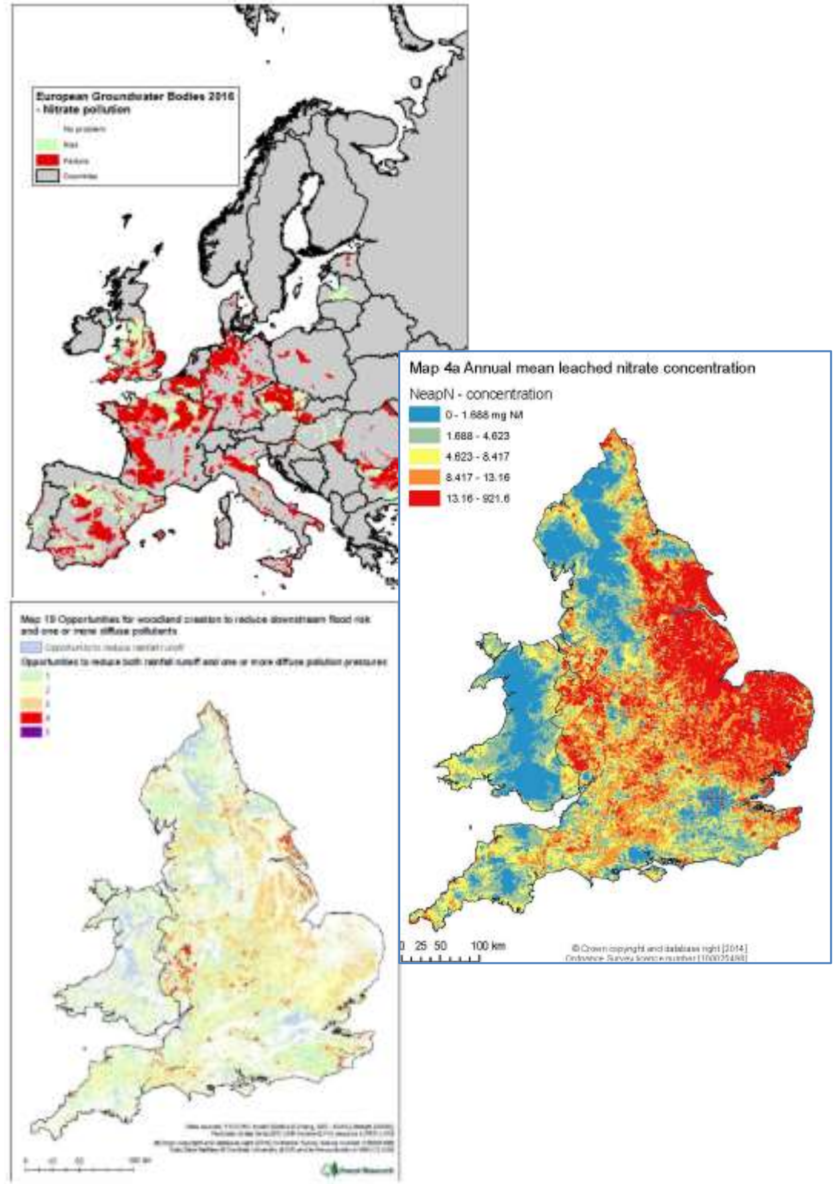
To provide guidance on designing appropriate and cost-effective forests for water payment schemes that support tree planting and forest management to protect and improve water quality

- Introduction
- Aim and Scope
- Identifying the problem
- Role of opportunity mapping
- How can woodland planting help?
- Importance of woodland and forest management
- Managing potential disbenefits
- Identifying and assessing multiple benefits
- How to design a PES scheme
- Monitoring, evaluation and review
- Spreading the word
- References
- Glossary
- Abbreviations

Figure 1
Catchment sources and pathways of agricultural diffuse pollution impacting on the water environment and water users

Understanding the Problem

- Identify water bodies failing good status due to diffuse pollution from agriculture;
- Determine sources and pathways of diffuse pollutants contributing to failure;
- Map constraints and sensitivities to tree planting;
- Consider other benefits and potential trade-offs;
- Identify water bodies at risk of losing forest-water benefits



Target Areas for Planting

1 ALONG WATERCOURSES

Tree planting provides a protective buffer from management activities on the adjacent land, reducing nutrient, sediment, pesticide and FIO inputs to water. A tree cover also provides much needed shade and cooling of watercourses, while tree roots strengthen banksides and reduce channel erosion and siltation.

2 AROUND BOREHOLES

Tree planting protects local groundwater sources from contamination by nutrients and pesticides.

3 ON FLOODPLAINS

Restoring floodplain woodland slows flood flows and retains diffuse pollutants

4 AROUND ANIMAL HOUSING

Tree planting around animal housing captures ammonia and improves air quality.

5 ALONG WATER PATHWAYS

Tree planting along and across water pathways increases infiltration of run-off and pollutant retention.

Figure 2
Preferred locations in a farmed landscape for tree planting to reduce diffuse pollution

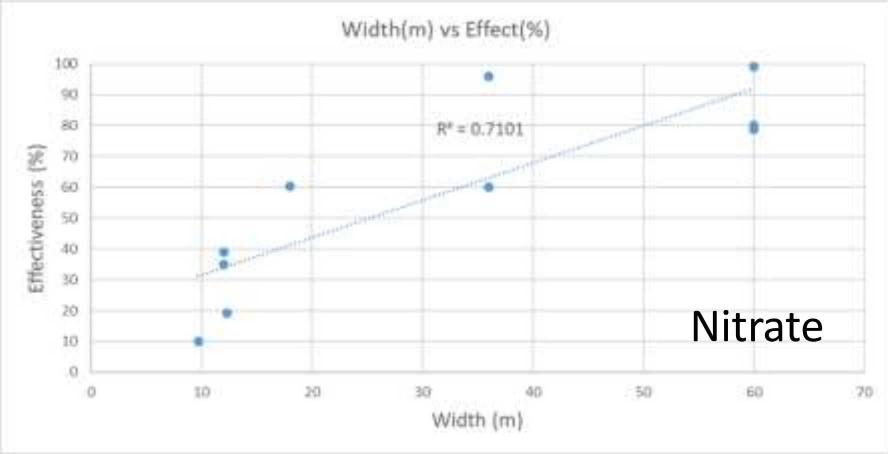
Pollutant inputs are much lower to woodland compared to agriculture

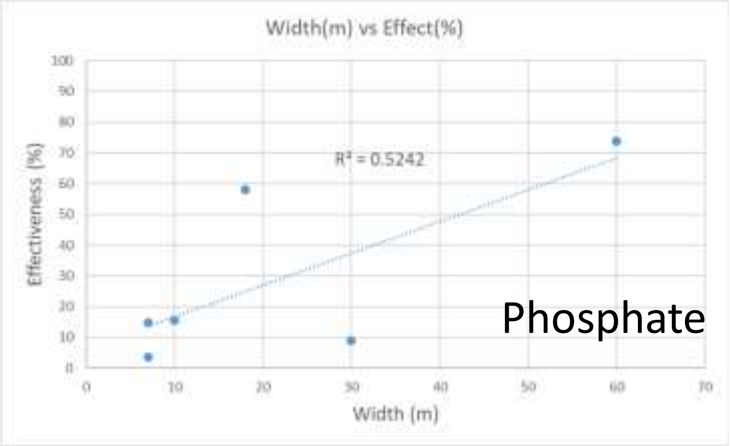
	Permanent Grassland	Rough Pasture	Wheat	Barley	Maize	Oil Seed Rape	Woodland
Nitrogen Input (kg/ha/yr)	94-135	10	131-167	120-132	46-62	155-189	20
Nitrate-N Export (kg/ha/yr)	0.86-10.58	0.02-0.05	1.54-19.72	1.54-19.72	1.52-19.72	3.29-17.4	0.02-0.1
Phosphate Input (kg/ha/yr)	6-16	0	13-35	18-41	27-43	15-37	0
Phosphate Export (kg/ha/yr)	0.012-0.169	0.008	0.038-0.458	0.038-0.458	0.038-0.458	0.15-1.834	0.008

Table 1
Nutrient loads and modelled export coefficients for different crops vs woodland in Great Britain. Nutrient loads taken from the British Survey of Fertiliser Practice for 2000-2011 (BSFP, 2013) and export coefficients based on the same data modelled for the UK National Ecosystem Assessment Follow-on Report (Bateman et al., 2014).

Woodland buffers are effective for removing pollutants draining adjacent land; buffer width is a key factor:

Buffer width	5 m	10 m	20 m	50 m	100 m
Nitrate-N	20%	30%	40%	80%	90+%
Phosphate-P	10%	20%	30%	60%	90+%
Suspended Sediment	80%	90+%	90+%	90+%	90+%



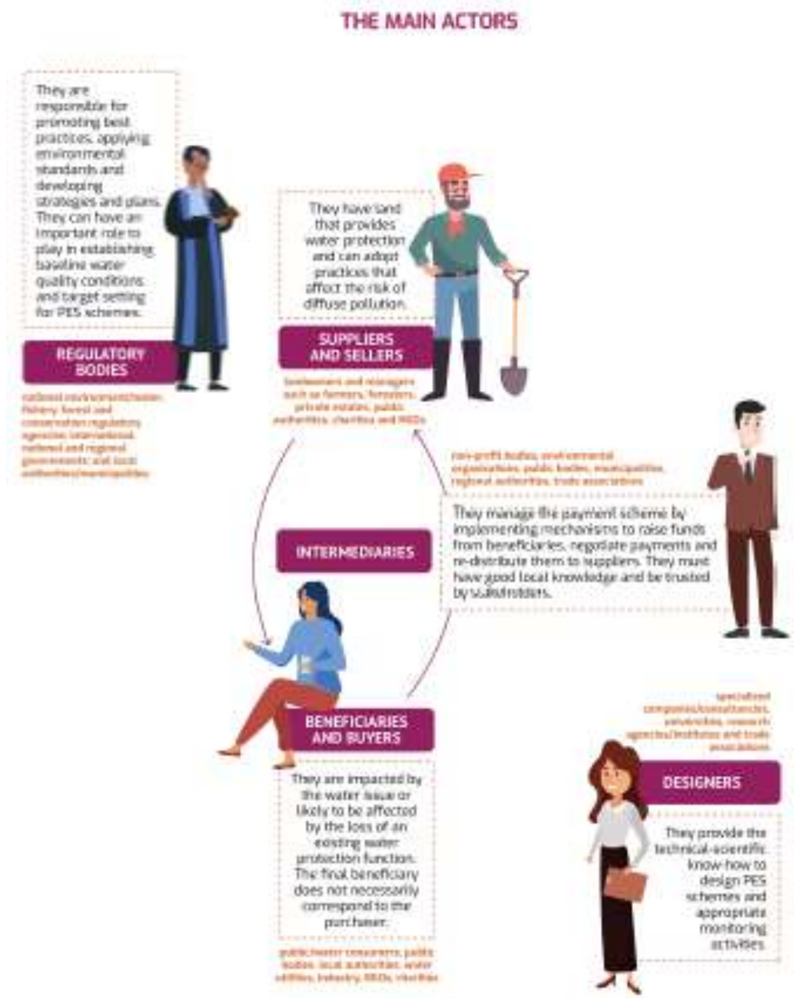


Factors influencing effectiveness:

- Nature of existing land use and management practices;
- Condition of water body
- Scale and location of woodland creation;
- Woodland design, e.g. in terms of type, age, shape and structure;
- Woodland management, including scale and timing of practices such as felling;
- Lag times
- Managing potential dis-benefits.

How to Design a PES Scheme

- Define the water quality issue;
- Identify local actors;
- Assess feasibility of PES scheme;
- Explore potential win-wins;
- Define roles and responsibilities;
- Resolve potential legal issues;
- Draw up technical specifications;
- Formulise scheme contract;
- Monitor, evaluate and review.



CASE STUDY: TREE PLANTING TO PROTECT GROUNDWATER QUALITY

There are three notable woodland for water PES schemes in Denmark. Two of these are located near Odense on Funen and the third near Aalborg on Jutland. All are designed to tackle the growing issue of groundwater pollution by agricultural practices, especially the contamination of drinking water by rising nitrate and/or pesticide levels. The scheme at Aalborg is one of the oldest and established in 1991 with funding from EU LIFE and the Aalborg Municipality to purchase land from farmers within vulnerable groundwater recharge zones. 900 ha of intensive farmland were converted into 500 ha of broadleaved woodland and 400 ha of low-input pasture, primarily to reduce nitrate levels. The drinking water benefit was estimated at a minimum of €489/ha/yr and the net social benefit (excluding drinking water) at €189/ha/yr, which included the provision of local recreation and carbon gain. The two schemes near Odense are Elmelund Skov and Brylle Water, both of which involve woodland creation to reduce pesticide pollution of local groundwater supplies. This is achieved by a voluntary process of land consolidation whereby agricultural land is purchased in low vulnerable areas and used to encourage land swaps with farmers for land within vulnerable groundwater recharge zones. The land is transferred to public or private partners at a reduced price for woodland planting and management, with a permanent change from farmland to forest legally guaranteed. At Elmelund Skov, 380 ha of farmland have been converted to woodland since 2001 under a partnership agreement between the local water utility, the Odense Municipality and the state forestry agency. The Brylle Water scheme is the most recent and commenced in 2014. 156 ha of farmland were purchased and planted with woodland by a private foundation, who met 40% of the cost, with the other 60% funded by the local water utility. The land consolidation process involved a significant transaction cost in negotiating agreements with farmers and building trust. Open access for recreation was a strong component of the schemes and underpinned municipality funding and support.

CASE STUDY: TREE PLANTING TO SECURE WATER BENEFITS

Globally, many water utilities are increasingly recognising the growing threats to water supplies and rising cost of water treatment. Consequently, attention is shifting away from grey to green infrastructure to better secure future water quality and quantity in source catchments. PES schemes are emerging as a more sustainable approach to water management whereby landowners such as farmers and forest owners are incentivised to change land use or management to better protect water supplies. Targeted measures such as tree planting within safeguards zones potentially offer a more cost-effective way of addressing diffuse water pollution issues compared to water treatment. At the European Level, Article 9 of the WFD stipulates that "Member States shall take account of the principle of recovery of the costs of water services, including Environmental and Resource Costs". This has led to some water utilities in the UK (South West Water and United Utilities), Germany (Saxony and Hanover) and Italy (ETRA and Romagna Acque) to charge consumers for the costs incurred in source area protection, with payments passed onto landowners and managers. These schemes are sometimes characterised as 'PES-like' as consumers are not voluntarily paying for the benefit/bill, however, they have proven to be the most effective systems at EU level for improving water quality at the catchment level (UNECE, 2018).

CASE STUDY: TREE PLANTING TO IMPROVE GROUNDWATER INFILTRATION

This PES scheme is located on the edge of the town of Carmignano di Brenta, near Padua in northern Italy. It was established in 2013 as a 'Forested Infiltration Area' (FIA) to help replenish and improve groundwater resources in the area. Overexploitation of the aquifer had led to the disappearance of local springs and streams, while agricultural activities had degraded groundwater quality. A 2.5 ha broadleaved woodland was planted on arable (maize) land and a system of trenches dug to channel surface water (at a rate of ~1 million cubic metres per hectare per year) onto the site during periods of excess flow in the nearby River Brenta. The establishment of the woodland helped to facilitate water infiltration into the aquifer and enhanced phyto-purification, removing nutrients and other contaminants. The woodland also provided a carbon gain to the landowner and woodland products such as firewood, biomass and timber in the longer-term, as well as benefiting the local community as a valuable habitat and opportunities for recreation and education. A group of local and regional stakeholders, including municipalities and local companies, formed a partnership to bid for supporting funds that were used to design and set-up the PES scheme on private farmland. Around 80% of implementation costs were financed by LIFE+ and RDP funds. The loss of income to the landowner from the change in use from maize cropping to woodland was exceeded by payments from the Brenta Land Reclamation Board for the infiltration water service (€1,200/ha/yr), the municipality for community access and related recreation and education events (€1,500/yr), plus the value of generated wood products and carbon gain.

Dissemination

- 550 copies of User Manual being printed in English, mainly for circulation via FR and EFI;
- 200 copies to be printed in Polish;
- ~50 copies to be printed in Ukrainian;
- Other versions being translated into Spanish (done), German, French, Slovakian and Italian, but only to be provided as pdf;
- Promotion via contacts, meetings, workshops and case studies.