CircuLar Economy Approach in River pollution by Agricultural Nutrients with use of Carbon-storing Ecosystems

Intelligent Buffer Zone. drone photo SEGES

Policy and civil society: barriers and opportunities

Survey report: Economic principles and instruments to support restoration of Wetland Buffer Zones (WBZ) and paludiculture in a circular economy approach

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Survey on Economic Instruments for Wet Buffer Zones

Motivation

The “CircuLar Economy Approach in River pollution by Agricultural Nutrients with use of Carbon-storing Ecosystems” (CLEARENCE) project aims at using wetland buffer zones (WBZ) for water purification, re-use of captured nutrients and the development of sustainable agricultural practices (www.moorwissen.de).
Private owners do not restore wetlands if it’s not viable. They need to be supported, not only financially, but supplied with information of available funding sources and innovative technologies. On the other hand governments want to achieve environmental goals. This report serves both groups, as it presents economic instruments which help to secure compliance with environmental policies, but also describes funding opportunities for ecofriendly measures.

Introduction

The first chapter explores the neoclassical thinking behind the idea of economic incentives in sustainable environmental management, referring to instruments such as taxes and subsidies. The interaction between economic instruments and wetland restoration is displayed in chapter 2. In the third part the role of the EU in environmental economics is described. Labels and standards which might be relevant for wetland measures and products are introduced in chapter 4. Alternative solutions that have incentivising functions for wetland ecosystems take the center stage of chapter 5. Previous projects provide a multitude of information, how Wet Buffer Zones could be implemented in an economically successful way. Experiences from case studies and recommendations for the future development of wetlands are given in chapter 6.

1 Environmental Economics and Market-Based Instruments

Environmental economists study the lifecycle of natural resources from their extraction and use until the waste products are returned to the nature or a new product cycle. They also study how incentives affect the environment and how they can be used to create sustainable solutions for environmental policies.

The market economy fundamentally relies on the distribution of scarce resources used for production – land, labour, capital – which are allocated based on the price mechanism, containing information for market participants. As a rationing system, the market price allocates resources, moving them from one group to another. Because this system of distribution naturally allows some groups to benefit over others, other rationing systems exist to counteract initial market distributions. The most common mechanisms to achieve that are government interventions.

Price ceilings, price floors and various forms of taxes and subsidies skew the distribution of resources and enable initially disadvantaged groups to benefit from the new allocation of resources. While resources are being rationed within the market system, non-market aspects are not taken into account by the market price mechanism. Without government intervention, some crucial aspects are not factored into production and consumption costs, creating societal resource allocation inefficiencies (i.e. deadweight loss).

Another, in a market economy often disregarded, yet fundamental factor, is the natural environment – or more specifically, ecosystem services. The concept of ecosystem services was coined by the UN in the Millennium Ecosystem Assessment in 2005. The Economics of Ecosystems and Biodiversity (Russi et al. 2013), published by the UN Environmental Programme, classifies ecosystem services (ESS) as "provisioning, regulating, cultural and supportive". These include, among others, drinking water, climate regulation, protection of settlements from erosion and heat waves, and carbon sinks such as forests or wetlands. The degradation of these services through excessive carbon-dioxide emissions, unsustainable agricultural practices, the construction of hydropower dams, and emissions of toxic gases into the air has proven to be highly detrimental for human livelihood. This type of market failure – an instance where resources are not allocated efficiently – happens because so-called "negative externalities", which create associated social costs, are excluded from price determination.

Environmental pollution happens in cities as well as rural areas. Agricultural practices affect the latter in particular, overtaking settlements and industries as the main source of water pollution (FAO 2017). Excess nutrient runoffs (nitrates and phosphorous) contaminate ground and surface waters, while chemicals such as pesticides that pollute water bodies can have detrimental health effects on humans. Equally crucial water-related ecosystems are wetlands, which serve as a nutrient filter and carbon sink and as such constitute a tremendous ecosystem service for humans. However, due to pressures from agriculture and climate change, these ecosystems are continuously being desiccated and are losing their biodiversity. This issue will be further explored in another subchapter assessing the effects of the EU Common Agricultural Policy and its economic incentives.

Left on its own, nature has long served as a dumping ground for producers. That is why it was necessary for it to become a fundamentally valuable asset in the market system, to at least internalise some of its societal value. This idea led to the development of environmental economics and a more proactive role of the government. In the past decades, the increasing role of the government has led to

the creation of different instruments through which biodiversity, habitats and natural resources could be managed sustainably. Besides direct funding of the restoration of the natural environment the government can control pollution and promote the sustainable use of ecosystem services in several ways. According to Kling (2008) most notable of them are:

1. Moral suasion
2. Preventing pollution by funding R&D and eco-friendly technologies
3. Regulatory instruments
4. Economic incentives

In the following the instruments are described from a theoretic point of view. Their implementation in policies as well as in wetland projects is displayed in the subsequent chapters.

1.1 Moral suasion

The term “moral suasion” is used to describe government attempts to influence behavior without actually stipulating any rules. Its effectiveness depends upon the extent to which individuals believe it is in their collective interest to change their habits (Kling 2008).
The intention to provide information on environmentally benign farm management practices is to encourage the use of such practices. This is done by making farmers aware of the environmental effects of their activities and promoting the benefits of more sustainable alternatives. As compliance is voluntary, burden falls on people who feel a greater responsibility and not necessarily on those who contribute most to the environmental problems (Weersink 1998).

1.2 Funding eco-friendly technology

Technology funding is designed to address market failure of imperfect information, in some cases there may be technologies that could be developed that save firms` money and improve the environment. Basic assumption is that cooperative efforts of government agencies, national labs, universities and private companies can lead to the development of innovative and beneficial technologies. These programs are proactive in reducing pollution.
These two categories of instruments are easy to understand. As restrictions and incentives are both broadly based and of great interest in the context of wetland measures, a more detailed explanation of the instruments is followed by a description of their application on ecosystems.

1.3 Regulatory instruments

1.3.1 Command-and-control

Regulatory instruments impose restrictions on the behavior of households and firms. They place limits on inputs or outputs in the consumption or production process. Command-and-control (CAC) refers to interventions where the government prohibits excessive pollution of an environmental good. While the 'command' part demands compliance with strict criteria, the 'control' part imposes sanctions, often in the form of fees, if an emitter does not comply. The advantage of this approach is that generally, pollution emissions are reduced in a relatively short time period. In addition, if compliance needs to be high and certain emissions must be prevented from polluting the environment at all cost, CAC is the most optimal solution. Furthermore, if a producer's costs incurred through pollution, reduction – either through technology or performance standards – rise slowly (i.e. are inelastic), CAC instruments might also prove to be a valid approach.

The drawback of command-and-control regulation is, however, that it offers no incentive to improve the quality of the environment beyond the standard set by a particular law. In addition, an environmental law demands the reduction of certain emission across all producers. The consequence is that some producers will incur greater costs than others because different firms have different production practices, different sizes, and other factors that determine their abatement (i.e. pollutionreducing) costs (see figure 1).

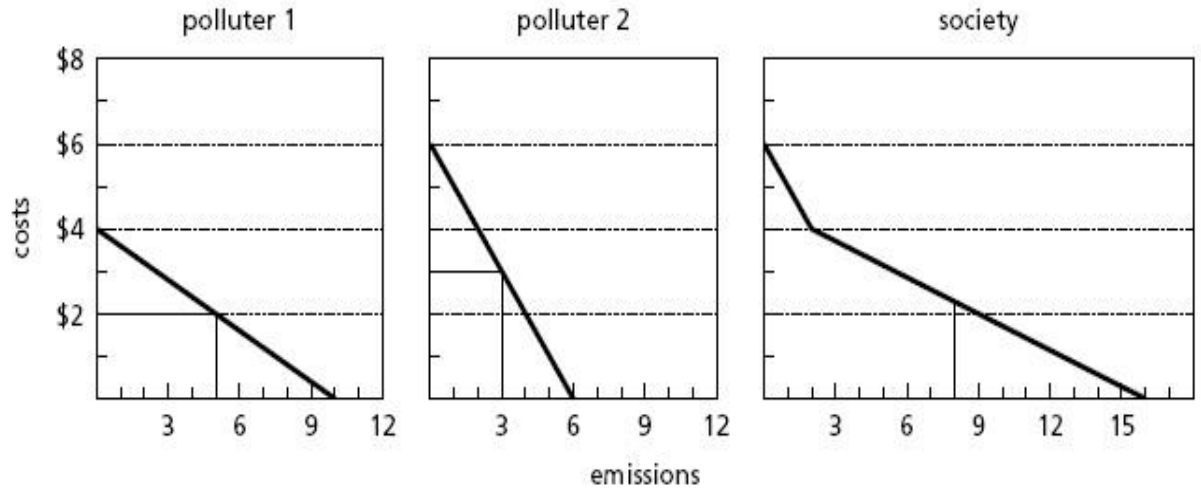


Figure 1: Emission reduction costs under command-and-control regulation (Kling, 2008)

1.3.2 Emission taxes

Emission taxes are charges on a unit of pollution. Their goal is to internalise pollution into production costs by making the emitter abate his or her pollution up until the point where the tax per unit of pollution equals the abatement costs of a unit of pollution. In order to avoid the tax, the polluter can abate by either reducing output (and hence pollution), changing inputs, or investing in new

technologies and cleaner production methods. **This motivation for technology development is an advantage of taxes over command and control** (Kling 2008).

If there are remaining emissions that do not comply with the set goal after marginal abatement costs equal the tax, the producer will pay the tax rather than to abate further. The revenue earned by government agencies can be used to reduce pollution elsewhere. In addition, user charges are applied on firms for the use of pollution-reducing technologies.

The complexity of setting the right environmental tax per unit of pollution lies in the fact that it is difficult to: a) accurately estimate emissions and; b) measure exact social damages incurred by producing one more unit of pollution in monetary terms. Setting a uniform tax on a level of pollution across industries may lead to inefficiencies if abatement costs are too heterogeneous. In figure 2, the government wants to attain certain emission targets. Since it has little information about the true abatement costs of different producers, it sets taxes at level pL, pM and pH in three different scenarios based on available information. For a firm with high abatement costs (MS_H), low taxes mean it will pollute more than desired (left side). Conversely, if the tax is set too high, it will result in firms with low abatement costs (MS_L) paying more than necessary, while the reduction of social damage from pollution might not yield any additional benefits due to diminishing returns (right side). A general problem is that high-cost firms have an incentive to misrepresent their cost as being low.[1]

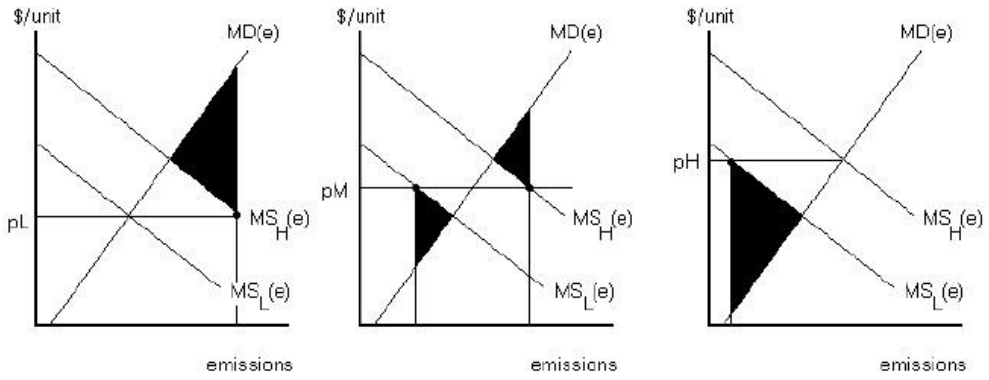


Figure 2: Emission taxes and different bounds of marginal abatement cost for two producers (Kling, 2008)

1.4 Economic Incentives

Since the late 1980s, economic incentives have increasingly taken centre stage as a potential solution to environmental problems (Harrington and Morgenstern 2004). Where abatement costs are not uniform across producers, the approach of incentives exploits the heterogeneous cost structure. While it is possible to set different pollution standards via the CAC approach, an economic incentive does that without requiring additional information about a company's cost structure. There are several economic incentives that are used in environmental economic policy as per the U.S. EPA (2010):

[1] MD – Marginal Damage Function; marginal damage is the additional damage caused by an additional emission

a. environmental subsidies
b. marketable permits
c. hybrid price regulations and tax-subsidy combinations

1.4.1 Subsidies

While taxes incentivise producers by "punishing" them for polluting, subsidies encourage producers or consumers to emit less by paying them per unit of pollution abated. Similarly to taxes, the polluter would reduce pollution to the point where the subsidy is equal to the marginal cost of abatement. However, subsidies paid per unit of abated pollution run the risk of reducing a firm's total and average costs, encouraging market entry of new polluters and discouraging market exit of polluters that would leave the market under a tax. Subsidy payment could force strategic behavior which would lead to higher initial levels of pollution in order to obtain the subsidy. Additionally, subsidies are a form of government expenditure and might not enjoy broad public support (U.S. EPA 2010). By partially reimbursing producers for proven abatement, rather than making it an instrument of per unit payment for abatement, market entry of new polluters would be discouraged. Other types of subsidies may take the form of reduced interest rates for investments in new technologies, loan assistance or subsidizing firms for reusing materials.

1.4.2 Marketable permits

Marketable pollution permits are allowances which give a firm the right to emit a set number of units of pollution. The most well-known system is the cap-and-trade system, where the government sets the level of total emissions across all producers and distributes emission permits that can be traded on the market. Since abatement costs are heterogeneous, different producers are willing to pay different prices for pollution allowances. Polluters whose marginal abatement costs are lower than the price of allowances per unit of emission will tend to sell their permits, while those polluters whose marginal abatement costs are greater than the price of allowance per unit of emission will purchase them to continue emitting. Since emitters with high abatement costs are commonly relatively smaller and newer firms with relatively lower emissions, their continued emissions might have less of an impact on the environment. In theory, to reduce deadweight loss from environmental pollution, the buying and selling will last until the equilibrium allowance price per unit of emission equals across producers, which should match the marginal social damage cost (U.S. EPA 2010).

A marketable pollution permit system can minimize emission reduction costs and achieve the desired level of pollution emissions, while providing flexibility in the choice of used mechanism (Kling 2008).

1.4.3 Hybrid price regulations and tax-subsidy combinations

A common strategy of governments to curb excessive emissions is to set emission standards (command-and-control) and to impose a tax on emissions at the same time. While total social welfare might not be maximised, a hybrid approach is a safe way to ensure a desired level of environmental protection and people's health by mandating compliance with environmental standards (U.S. EPA 2010). Simultaneously setting a tax level encourages producers with low abatement costs to reduce pollution, while those with high abatement pay the tax, which is used to fund other environmental programmes.

As for tax-subsidy combinations, a prominent example is the deposit-refund system. The deposit part serves as a tax, while refunds partially reimburse the costs. The system mainly encourages the recycling of materials to be used as inputs, but provides economic incentives for producers to use alternative input materials altogether if the deposit is greater than the cost of returning the product or switching materials. A refund is provided once materials are disposed of or proof is provided about switching to cleaner production inputs or the introduction of clean technologies (U.S. EPA 2010).

Another possible instrument to reduce pollution in case of heterogeneous cost structures is to set pollution standards and set subsidy and penalty (a form of tax) rates at the same time. Figure 3 depicts this relationship. For producers with low pollution reduction costs (MS_L), subsidies will encourage them to emit less than the pollution level mandated by the government because their marginal abatement costs will be less than the collected subsidy, meaning the producer gains a surplus (triangle a). For producers with high abatement costs (MS_H), emitting more than is allowed means they have to pay a penalty, which is still less than the marginal abatement cost that would be incurred if the producer reduced pollution up until the desired level (triangle b).

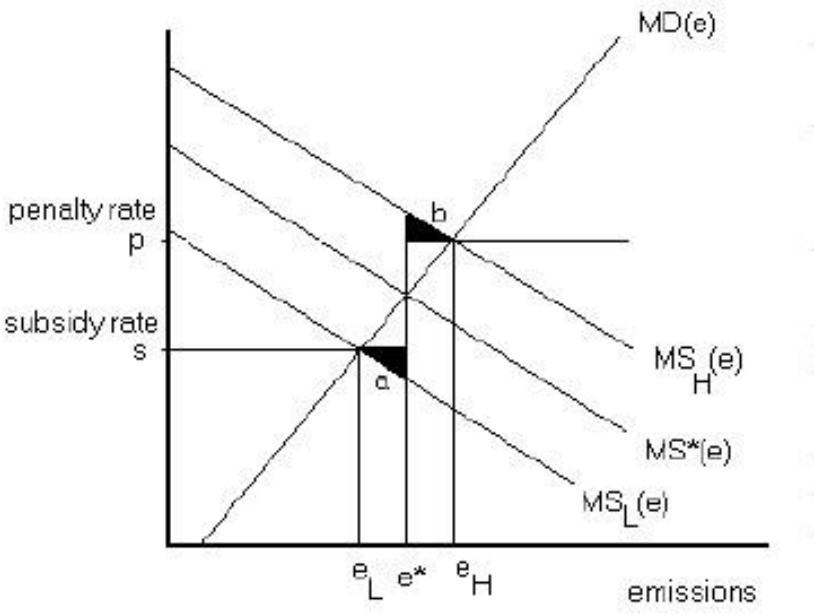


Figure 3: Hybrid model – an emission standards and subsidies/penalties combination as an incentive to reduce pollution (Kolstad 2000)

While industry-specific cost structures determine the degree to which CAC and economic instruments are used simultaneously, the application of these instruments also has to be considered in the context of the nature of environmental problems. More concretely, a major challenge in using the right instrument lies in the fact that point and non-point sources of pollution require different economic approaches to curb emissions. While point sources, such as wastewater from sewer systems, can be controlled through a combination of CAC standards and taxes, non-point sources – in particular agriculture – cannot easily be taxed. In such cases, a CAC standard as well as subsidies to encourage the reduction of emissions may be a better solution (U.S. EPA 2010). The next section explores pollution from agricultural (non-point) sources and demonstrates possible solutions to incentivise sustainable use of rural ecosystem services.

2 Economic Instruments and Wetland Restoration

Agricultural land use provides societies with a wide range of benefits. Provisioning services, mainly food, provide direct benefits expressed through market prices, such as food and raw material prices, while regulating or cultural services – water purification, aesthetic value, and others – find no immediate consideration within the market system. To fully capture the benefits of all ecosystem services – as well as costs incurred through their degradation – and to accommodate the rising demand for cheap produce, coupled with intensifying farming practices, government interventions are necessary to preserve the environment compromised by unsustainable management of rural ecosystems (see figure 4).

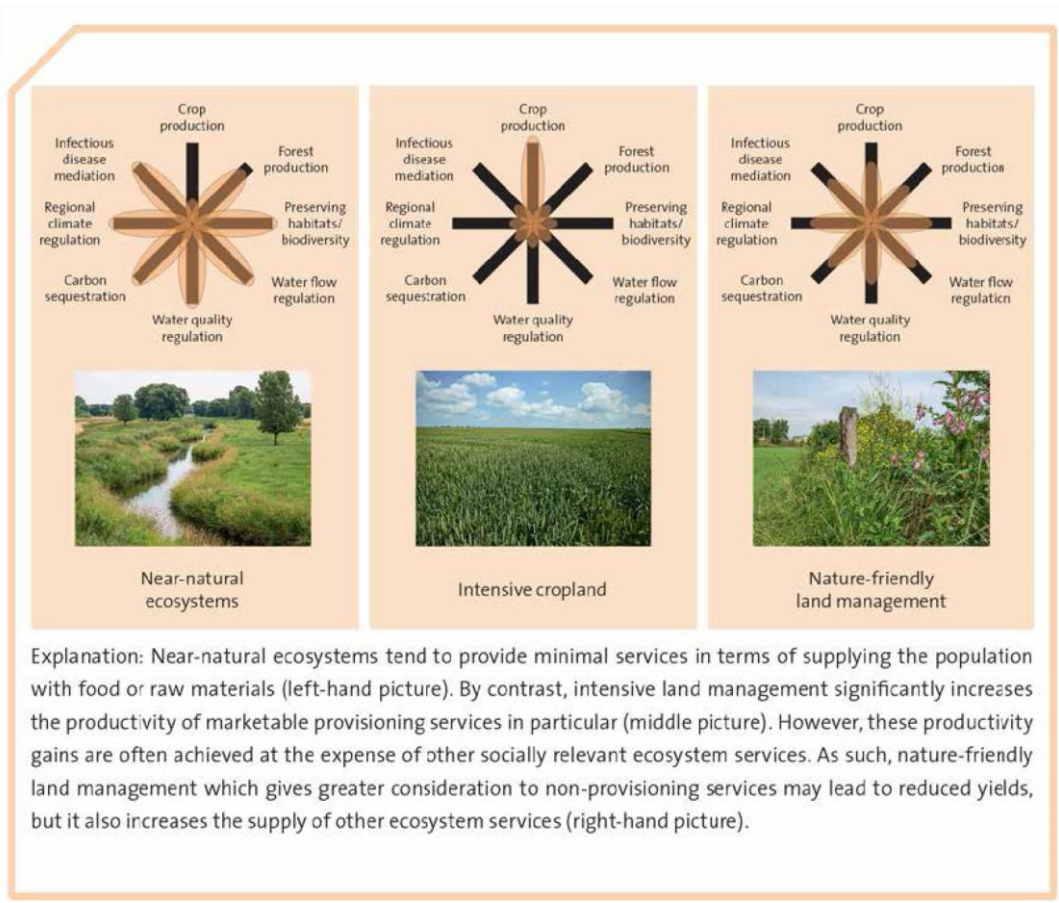


Figure 4. Trade-offs and synergies between crop production and other ecosystem services (TEEB DE 2016)

Since agricultural production is usually a major culprit behind water pollution, biodiversity loss and climate change (excluding transportation), economic instruments aimed at sustainable farming may seem as an effective mechanism for reducing the bulk of ecosystem degradation.

Pollution is primarily associated with water runoff, seepage, and soil erosion, making it difficult to estimate origins of pollutants. Furthermore, obtaining information about individual farms' pollution contribution is costly. Monitoring costs are also high because it is difficult to verify that emissions are related to observable inputs such as fertilizers (Weersink et al. 1998). Locational and temporal factors also play a role here. A farm causing little eutrophication but operating next to a river could cause greater harm than a farm farther away, while excessive nutrient use might deteriorate groundwater quality only years after its application.

Finally, a problem with limiting emissions from agricultural land is that marginal **abatement costs are high** – technological capacity to curb emissions is scarce, forcing farmers to change farming practices (apart from crop choice and changing tillage practices).

While it is difficult to implement a tax as a mechanism to minimise pollution due to informationrelated problems, a combined tax-subsidy systems could provide a better incentive. In particular, a **mixture of emission charges and subsidies** would pay farmers for attaining environmental goals beyond a given standard and penalise those who do not comply with the standard. Since it is difficult to estimate individual producers' emissions, a uniform tax-subsidy system would encourage farmers to reduce

eutrophication to avoid the penalty or collect the subsidy. The main advantage is that this scheme does not require constant monitoring and full information on residuals from individual farms because the system penalises or subsidises aggregate emission levels (Weersink et al. 1998). Despite its advantages, this incentive mechanism is useful for smaller, more homogenous and well-monitored farms.

Another instrument to curb emissions are charges set on certain inputs that can incentivise a shift towards more efficient applications of fertilisers and pesticides. An **input tax** is relatively straightforward as it is implementable into existing tax schemes. In theory, this tax encourages farmers to change production patterns towards more nitrogen-fixing crops rather than nitrogen-intensive ones (Weersink et al. 1998). However, the effectiveness of input taxes is still disputed (Böcker and Finger 2016). The Danish example demonstrates that before the pesticide tax was revised in 2013, no significant reductions in pesticide use were evident. The newest reform taxes pesticides based on health and environmental load indicators aimed to reduce pesticide load by 40% by 2016. In addition, the tax scheme also compensates farmers by reducing property taxes (Pedersen 2016). Pesticides with the highest impact on health and the environment are charged the most, while the fees for some less harmful pesticides were reduced. It is expected that the pesticide tax will have more profound impacts in terms of reducing groundwater pollution and curtailing environmentally harmful behaviour by farmers. Generally, however, demand for pesticides is relatively inelastic, so even a large tax might have little impact on input (Pearce and Koundouri 2003).

In reality, sustainable agricultural production is incentivised mainly through **subsidies** aimed at fostering alternative farming practices. Agricultural subsidies have long been a mechanism to encourage food production. In past decades, however, they have been used as an instrument to steer agricultural production in a more sustainable direction in order to take into account the benefits of other ecosystem services. By tying production subsidies to desired ecological outcomes (e.g. crosscompliance), and considering farmers' need for financial assistance, landowners are more inclined to fulfil regulatory requirements. For example, financially supporting farmers to improve the efficiency of fertilizer usage reduces tremendous pressure on surface and groundwater. With current levels of nitrogen emissions (in Germany up to 110 kg/ha/year (Umwelt Bundesamt 2014)), expensive water purification systems need to be installed. By promoting water-friendly farming, water purification ecosystem services would be maintained, while preserving drinking water provision (TEEB DE 2016).

Subsidies supporting farmers for sustainable farming practices are usually described as output subsidies. These kinds of subsidies tie payments to a desired environmental outcome. Payments for Ecosystem Services (PES) may offer a solution to conserving and restoring ecosystems. The PES mechanism consists of market-based programmes where beneficiaries of ecosystems pay users of to preserve ecosystems. Put differently, the monetary transfer from beneficiaries compensates resource users, often farm owners, for forgone opportunity costs incurred through the sustainable management of an ecosystem (Smith et al. 2013, see figure 5). The scheme is voluntary, but mandated by a desired

outcome, such as the restoration and management of wetlands, making monitoring a crucial component of the mechanism.

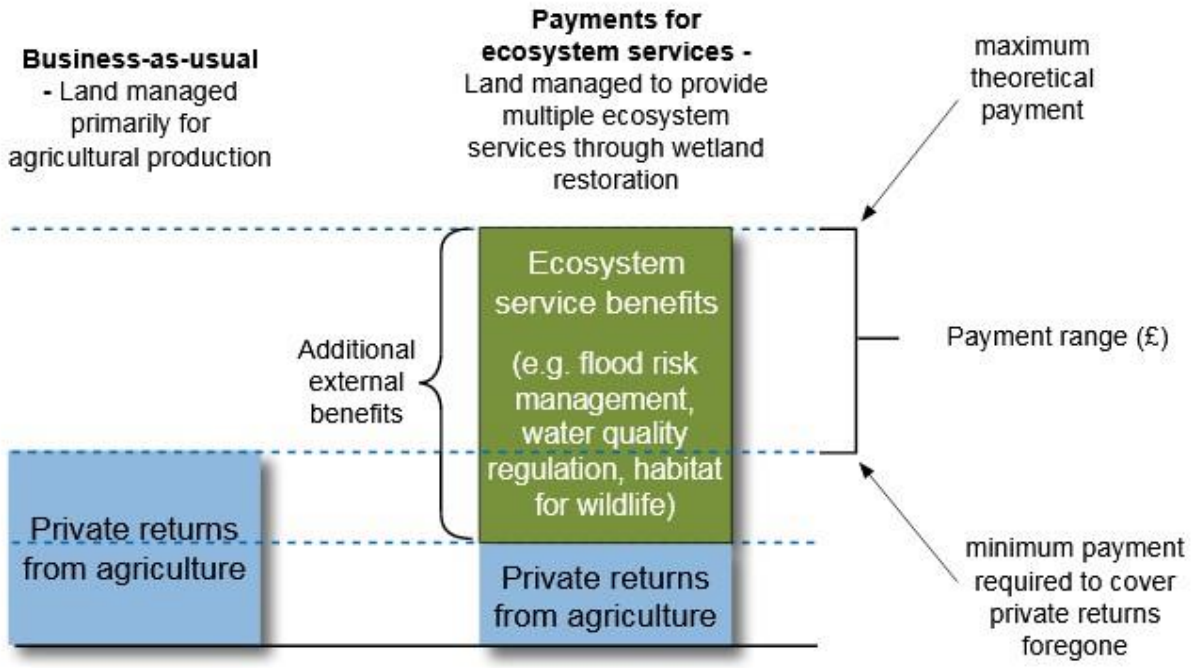


Figure 5: Benefits of land managed for agricultural production vs. land managed to provide ESS under a PES scheme (Smith et al. 2013)

The PES mechanism is more extensive than a simple output subsidy paid for the production of certain crops or livestock because it involves a wide range of stakeholders, such as small communities, (local) governments, private companies and land owners. Often the government pays resource users to maintain ecosystems and their services on behalf of the public, although in some cases private companies pay the price, for example when Nestlé paid farmers in North-Eastern France to stop using chemicals (Perrot-Maître 2006). Payments to land owners that handle a specific ecosystem are ideally as large as the combined losses of sustainable maintenance/restoration and forgone profits, although assessing the real value of ecosystems through valuation methods and thereby determining the beneficiaries' (i.e. public) willingness to pay is often difficult and costly. An additional issue that arises is that transfers should occur when evidence is provided that an ecosystem service has been restored or maintained. This is however difficult because in many cases, it may take years until the results of ecosystem renewal are visible. Alternatively, funds can be transferred once observable measures that lead to less pollution, such as the planting of nitrogen-fixing crops, have been implemented.

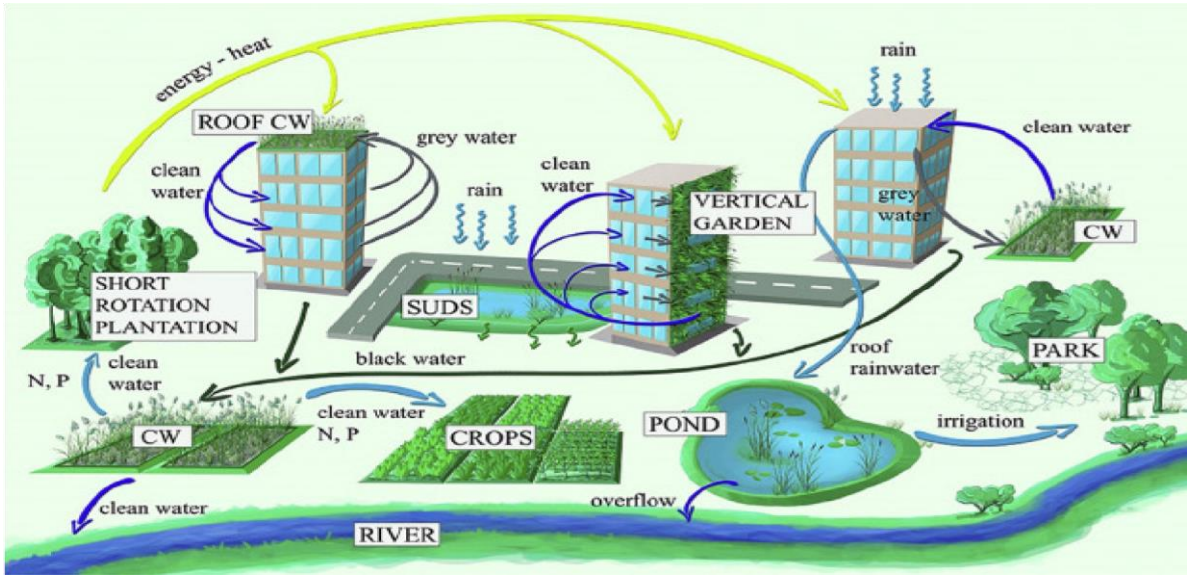
Many of the restorative measures in agricultural areas pertain to services such as nutrient-recycling, particularly in wetlands. Nutrients – mainly nitrogen emissions – cause tremendous water pollution. Nitrogen emissions from farms are especially bad – for example, they cause 57% of all nitrogen emissions in Germany (TEEB DE 2016). Wetlands offer tremendous services and benefits to counteract this pollution.

They can in some cases also be cultivated for agricultural production. Agricultural production on peatlands (paludiculture) is increasingly touted as a smart solution to destructive drainage of peatland for increased crop yield on private farms. The concept involves the rewetting of peatland to incorporate crop production with other ecosystem services that wetlands provide. So far there exist few to none classical or alternative economic schemes explicitly aimed at incentivising paludiculture (Wichmann 2018). But in order to consider how innovative approaches to sustainable farming practices – including paludiculture – can be realised, it is necessary to take a look at the supranational level at which financial incentives influence landowners' secision-making with regards to their land management.

Wetlands come in different forms (see one of examples in box 1), their ecosystem functions are subject to locational and temporal factors, so their renewal cannot be fostered by a single mechanism or scheme.

Box 1: Constructed wetlands in urban areas

In urban areas constructed wetlands offer opportunities for biomass production, greywater and rainwater treatment and removal of pathogens. They treat water from stormwater runoff, combined sewer overflows and industrial effluents towards reuse as clear water or sludge for agricultural aplication (Masi et al. 2017). Moreover, wetlands provide ecosystem services for cities, like cooling function (via evapotranspiration) or recreational one.



Economic instruments discussed in part 1 can encourage wetland creation to some degree, especially subsidies have been shown to produce effective results. For example, between 2000 and 2010, approximately 30 million Euros have been given to Swedish landowners to renew wetlands, mainly covering construction and maintenance costs (Hansson et al. 2012). This resulted in the construction of over 7000 ha of wetlands, although it fell short of the 12 000 ha goal set by the Swedish government.

In the UK, the Environmental Stewardship Scheme (ES) financed by the government offers payments for the creation, restoration and management of wetlands and peatlands as well.

While subsidies can encourage wetland renewal and their continuous maintenance, it is important to point out that based on the type of subsidy the outcome can differ greatly in terms of socially efficient resource allocation as seen from a classical market perspective. Apart from receiving maintenance payments, the example of Swedish farmers shows that landowners gain nothing if they cannot economise on wetlands by producing crops. In this case, payments for ecosystem restoration do not cause additional incentives for wetland renewal beyond a mandated goal. Indeed, business considerations of landowners working on agricultural production play in most cases the decisive role in the restoration of wetland ecosystems. The restriction of nutrient and fertilizer use may be seen as the solution if yield output is not reduced as a result, but input charges such as nutrient and pesticide taxes simply make these products more expensive for farmers if they cannot substitute them for other inputs.

The next sections explore not only which incentives are feasible to help restore wetland ecosystems and their services, but which additional measures exist as an alternative to classical economic solutions.

3 Relevant EU Legislation and Financing Mechanisms

3.1 Common Agricultural Policy and Opportunities for Wetland Renewal Financing

As of 2013, when the latest CAP reform was negotiated, European farmers receive support in the form of two pillars. Payments from the 1st pillar are, tied to certain minimum conditions, primarily those that promote environmentally friendly agricultural practices. Cross-compliance rules – statutory management requirements and obligations for good agricultural and environmental condition – apply to farmers receiving direct payments from the 1st pillar. The EU lists a wide range of regulations farmers must comply with, such as protecting nitrate-vulnerable zones, decreasing sewage sludge, protecting biodiversity and ensuring groundwater replenishment. 30% of the direct payments are given to farmers who engage in ‘greening’ measures, namely crop diversification, grassland maintenance and ecological focus areas. If requirements are not upheld, farmers must pay non-compliance fees according to the polluter pays principle. In so far it can be seen as a **Command-and-control instrument**.

While the 1st pillar seeks to tie minimum environmental standards and retroactively punishes landowners for failing to practice sustainable farming, the 2nd pillar actively encourages maintenance and construction of natural ecosystems on agricultural land. It finances rural development programmes (RDP) through the **European Agricultural Fund for Rural Development (EAFRD)**. Table 1 lists relevant articles from the Regulation on support for rural development by the European Agricultural Fund for Rural Development (1305/2013) pertaining to wetland ecosystem restoration.

The programmes include agri-environment measures. They are akin to Payments for Ecosystem

Services schemes, where farmers who voluntarily go beyond compulsory requirements set by the European Commission get subsidised for the protection of natural ecosystems. Coupled with national support, the EAFRD has financed several initiatives whose goal has been to renew wetlands. Payments from the 2nd pillar can be attributed to the **subsidy instrument**.

Table 1: Articles of the Rural Development Regulation (Pillar 2) with Relevance for Implementation of Wetland Buffer Zones (CIS WG AGRICULTURE 2014)

Rural Development Regulation - Articles	Examples of measures eligible for funding
Art. 17 – Investments in physical assets	Artificial wetlands for treatment and reuse of waste water
Art. 28 – Agri-environment-climate	Wetland creation, restoration and management Riparian buffer strips (with vegetation or woodland)
Art. 30 – Natura 2000 and Water Framework Directive payment	Large buffers, wetlands, conversion of arable to forestry or extensive grassland

In Denmark, for example, EU rural development programmes financed through the EAFRD have cofunded the creation of wetlands. The goal was to create large wetlands that would retain nitrogen and phosphorous emissions, involving several landowners in multiple municipalities. In addition, smaller wetlands would reduce agricultural sludge, while intensively farmed lowland areas with carbon rich soils should be used extensively. Implementation and management costs are covered by the RDP, whereby the programme finances 100% of construction costs (Hartvigsen 2014). As is common for PES schemes, funding is tied to inputs (i.e. implemented measures) rather than proven outcomes. However, in order to maximise effectiveness, the Danish RDP programme incentives projects in areas relevant for water protection as per the Water Framework Directive (WFD).

Another relevant national programme co-funded by the EU'S RDP is the Scottish Agri-Environment Climate Scheme. With its £350 million budget, the programme's goal is to protect biodiversity, enhance water quality under the EU WFD, mitigate flood risks and reduce carbon emissions between 2015 and 2020. Funding options pertinent to wetland restoration and management encourage moorland and lowland bog management, as well as wetland creation and management (reedbed, salt marsh, fens). In addition, there is a management option for buffer areas for fens and lowland bogs whose main objective is to increase water levels and reduce nutrient inputs. Opportunities for the creation/restoration of wetland buffer areas are also offered (https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climatescheme/management-options-and-capital-items/wetland-management).

Other projects have also been encouraged by Article 28 of the Rural Development Regulation (1305/2013) to explore different options for managing and constructing wetland and peatland ecosystems. The UK Countryside Stewardship Scheme (CS) is an extensive programme that offers various opportunities to manage restore and create peatland ecosystems. Similarly to the Environmental Stewardship (ES) scheme, the CS scheme provides payments for the higher tier management and creation of wetlands. Unlike the ES scheme, it is co-financed through the EU EAFRD (Wichmann 2018).

Moreover funding opportunities may exist for small enterprises that process paludiculture products, in terms of establishment, product diversification, and production facility expansion, according to Art. 19 Regulation 1305/2013. The programme wants to "encourage farmers to apply agricultural practices that contribute to climate change mitigation and adaptation" (Art. 22). Projects eligible in the area of tourist-oriented environment could, for example, include the establishment of an information centre (e.g. on sustainable peatland use) or a signposted trail with guided tours on demand (Art. 20 section 1 e, Art. 35 section 2 b of the Regulation on support for rural development by the European Agricultural Fund for Rural Development 1305/2013).

As shown through the few examples above, the 2nd pillar of the EU Common Agricultural Policy offers crucial funding for wetland restoration and management, which would, in its absence, unlikely produce the same degree of successful wetland-related projects. With its goal to enhance famers' competitiveness, foster knowledge transfers and promote innovative farm technologies, RDPs only give some leeway to the restoration and preservation of ecosystems and the reduction of carbon emissions.

3.2 ***European Regional Development Funds and Green Infrastructure***

In addition to the EAFRD, the European Union offers cohesion funds to foster social and regional development. Of particular interest is the **European Fund for Regional Development (EFRD)**. With its goal to reduce inequalities among regions within the EU, it offers incentives for landowners to invest in low-carbon innovations. Green infrastructure projects (also nature-based solutions or NBS), and especially natural water retention measures (NWRM) play a vital role in wetland restoration. Because solutions that improve wetland ecosystems are some of the most expensive NWRM, they are almost never funded solely by national programmes, but by EU funds (NWRM 2013). Other than LIFE projects (see chapter 3.3), which finance biodiversity preservation, funds from EFRD can be used to boost green infrastructure projects that would allow for continued provision of several ESS and other social benefits. In order to further ensure this objective, PES programmes are also considered as an innovative approach in the context of EFRD funding.

Several wetland restoration projects exist that have been funded by the EFRD, for example:

- Sphagnum farming in Lower Saxony

- MOORuse in Bavaria
- EFRD and land use in Bavaria

The Sphagnum farming project aimed at replacing peat in horticultural substrate for the production of a renewable, high–quality raw material. A heavily degraded topsoil of drained agricultural bog grassland has been removed, Sphagnum mosses spread and a water management system installed. After one and a half years, Sphagnum palustre, S. papillosum and S. fallax have covered 95% of the area. The results approved the feasibility of large-scale Sphagnum farming (https://www.moorwissen.de/en/paludikultur/imdetail/torfmooskultivierung.php).

The Bavarian MOORuse project deals with the establishment of paludiculture and the development of a regional supply chain for its products. Furthermore the effects on biodiversity are investigated (https://www.hswt.de/forschung/forschungsprojekte-alt/vegetationsoekologie/mooruse.html).

The EFRD Bavaria supports measures to reduce the emission of CO_2 from carbon rich soils. The main focus is on the design of rewetting projects, from planning to implementation (https://www.efre-bayern.de/klimaschutz).

The criteria under which funding is granted to these projects are specified in the regulation on EFRD funding (EC Regulation 1305/2013). The sixth investment priority is environmental protection and the promotion of resource efficiency. Investments in the water sector are a relevant criterion, aiming at serving additional populations with improved water supply. The issue with EFRD funding is that it is country-dependent, meaning that each EU member state decides on its own how to invest the money for its regional development.

3.3 LIFE programme

Another funding option is the EU LIFE programme, whose main objective is to finance environmental and climate projects. Contributing to the achievement of these goals are also wetland restoration projects. The Swedish Good Stream project is a good example of how LIFE projects support the renewal of wetlands in the context of enhancing, conserving and managing ecosystems. The project was initiated in order to solve the problem of floods, a moderate ecological status and low biodiversity in flood plains. Its aim was to achieve good ecological status of agricultural streams and introducing integrated buffer zones. Lasting from 2015 to 2021, the project's expenses are about €2 million, where 49% of total costs are funded by the EU (www.goodstream.se).

In the current programming period two sub-programmes were introduced, which can be relevant for implementation of Wetland Buffer Zones. The sub-programmes support measures for environment and resource efficiency (with a focus on water, waste and air) and climate action (https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes_en). LIFE also includes the Natural Capital Financing Facility (NCFF), which aims at promoting the development of

innovative funding schemes for the preservation of natural capital. Measures to protect **Natura 2000 areas**, especially bog woodlands, can also be co-funded by the NCFF.

3.4 European Innovation Partnership

Five European Innovation Partnerships have been launched to speed up innovations that contribute to solving today's challenges. For this purpose innovation actors from research and practice are brought together. The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) facilitates the development of sustainable agriculture by managing of the natural resources (https://ec.europa.eu/eip/agriculture). The EIP Water supports the creation of market opportunities for innovative solutions for water challenges, inside as well as outside of Europe (http://ec.europa.eu/environment/water/innovationpartnership).

4 Labels Relevant for Wetlands

Apart from governmental funding producers have the chances to boost their income by gaining higher market shares, higher prices or improving of the company's image (NWRM, 2013). As establishing a new label entails high additional costs, certification by an existing label is a cheap alternative. Referring to the criterion "Buffer strips around waterways" some practices and products may be labelled by the Food Alliance Certified (http://foodalliance.org). Therefor it is evaluated in how far these strips help to prevent migration of soil and farm chemicals into surface waters and to maximize riparian habitat for wildlife. Measures to "protect waterways from erosion and contamination" could be labeled by the Rainforest Alliance Certified (https://www.rainforest-alliance.org/business/solutions/certification/agriculture/). Greywater needs to be treated and not discharged to be allowed to apply for the Sustainable Agriculture Standard. The most important label for land use projects is the Verified Carbon Standard (VCS). "Wetlands Restoration and Conservation" is one carbon trading category in VCS (https://verra.org/project/vcsprogram) and hence might be relevant for market creation approaches, which will be described later. The "Wild Rivers Site" label, initiated by WWF and European Rivers Network France, to counter the threats from unsustainable hydroelectric power projects.The label is awarded if a river passes the Wild River evaluation grid, which comprises 47 social and ecological criteria. The label creates a dynamic between local actors to come together to contribute to the development and promotion of the local "river capital" (www.wildrivers.eu).

5 Alternative Approaches for Effective Wet Buffer Zone Management

An alternative approach to environmental solutions aims to utilise public institutions as marketcreators. Rather than being 'market-fixers', as pointed out by Mazzucato (2015), public entities can create markets that foster an exchange and preservation of public (environmental) goods.

If uncertainty is high, e.g. business case unclear, private owners do not take the financial risk to restore wetlands, a non-excludable public good, unless regulatory agencies intervene by creating ecosystem service exchange markets. When governments step in to create markets, they reveal the real value of ecosystems and encourage farmers to take into account ecological services that exist on their property by paying for the degradation of these services (polluter pays principle). In this market, a lack of units of trade needed for ecosystem restoration could inhibit the creation of market exchange, so in order for the mechanism to work, regulators must introduce units of trade and compensation. In the case of wetland buffer zones, these could for example be credits for filtered nitrogen measured in pounds per acre.

In the United States, a government-led market scheme, called wetland mitigation banking, has been widely used as an instrument to compensate wetland loss. Anchored in Section 404 of the Clean Water Act, the impact mitigation regulation requires wetlands to be created, restored or enhanced to replace lost wetlands in development projects (Campbell 2009). The land area, measured in acres, is divided into credits that can be bought. By buying these credits, developers are practically paying for wetland restoration without having to renew them at a separate site in the same hydrological region themselves. Rather than renewing only patches of destroyed wetlands, this scheme encourages the restoration of a large fully functional wetland. The value of the credits is determined by wetland functions or the restored area of the wetland.

Voluntary initiatives to environmental restoration are an often overlooked but highly effective approach to managing hazardous emissions. Germany's "MoorFutures" programme is similar to the US wetland mitigation scheme, with the major difference being that a) the unit of exchange are carbon credits that represent a project's value in terms of abated carbon emissions and b) the initiative is voluntary with little governmental involvement. By bundling carbon sequestration with other ecosystem services, a certificate can incorporate multiple benefits attained through buying and selling of credits. This, in turn, requires precise, albeit costly, valuation of other ESS provided by wetlands. The price of the carbon credit differs based on the costs of specific rewetting projects (Wichmann 2018). Besides their alternative approach, MoorFutures can be classified as **marketable permits** (belonging to the incentives).

6 Recommendations

The central demand of various studies dealing with financial opportunities for sustainable agriculture, or wetlands in particular, is the **consequent implementation of the polluterpays-principle under CAP**. Direct payments from the 1st pillar have to phase out and transferred into environmental and nature conservation measures. The nationwide basis of money distribution lead to windfall gains, which reduced the efficiency and needs to be reconsidered (TEEB DE 2016). Cross-compliance with WFD goals is needed, and therefore it is appreciated to include WFD nitrate and phosphate goals as well as buffer strips as part of CAP conditionality. Therefor buffer zones should be defined functionally in terms of effective nutrient removal (CLEARANCE 2018).

EU regional rural development finance should be considered systematically as an opportunity for wetland restoration and wet agriculture as a land consolidation 2.0, as the example of Denmark suggests. Misuse of regional development finance for so-called "river maintenance" and "dredging" should be stopped and likewise CAP subsidies for agriculture on drained wetlands. Instead, restoration and wet agriculture as alternatives for local economy actors should be promoted. **Good agricultural practices** (including fertilisation limits) have to be defined and effectively enforced in implementation. Climate mitigation and adaption measures are also very welcome in CAP conditionality (CLEARANCE 2018).

Moreover a sharper focus on performance-based rewards should be drawn. The payments should depend on the level of target achievement per unit of land. Additionally a **drainage fee** could be a suitable instrument to support wetland rehabilitation (Grüne Liga 2011).

An EU-level **expert group** should be found to ensure knowledge sharing between Member States and joint action for meeting European water and climate protection goals. This group should assess the state of the art in research and practice, develop results-oriented methods and indicators as well as an effective communication strategy to improve awareness of wetland restoration options and capacity building across Member States. It is important to move from good but often isolated projects and new ideas to effective strategies with structural impact at the scale of catchments and landscapes (CLEARANCE 2018).

The *MoorFutures* follow an own standard familiar with the global VCS. Especially for small scale projects regional standards serve as very good alternative to reduce costs. They facilitate proximity and regional identification by being more personal and transparent (MoorFutures). On the other hand higher prices of certified and labelled products might discourage consumers (NWRM 2013). That's why it has to be weighed accurately whether it's viable and feasible to join or create a label.

For the creation of a trading market, it is recommended to exclude the costs of acquiring land from setting the price of carbon credits (MoorFutures). The provision of multiple ecosystem services within the same PES scheme diversifies its financing sources (NWRM 2013).

A key finding of the GoodStream project is that consultation free of charge was a trigger for farmers to join the programme. The duration of the management contracts of 20 year was another characteristic securing the success of the project.

The European Innovation Partnerships for Agricultural productivity and Sustainability (EIPAGRI) and EPI Water may also come into play as sources for funding of Wet Buffer Zones.

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floodplains of the Narew River, photo by Ewa Jablonska

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