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Time to incentivize cost-effective conservation in agricultural landscapes

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Introduction

Most species found in agricultural landscapes are associated with (semi-) natural habitats or wildlife-friendly farming practices (Lüscher et al., 2016). In contrast, high-intensive agricultural land use is generally more profitable for farmers. Therefore, to preserve and promote biodiversity in agricultural landscapes, public payment schemes are often used to motivate farmers to carry out conservation actions (OECD, 2017). This includes preserving and restoring natural habitats, e.g., forest patches and grasslands; and wildlife-friendly farming practices, e.g., flower strips and integrated pest management. The outcomes of such conservation actions can vary depending on target species, land productivity, landscape context, and more. Because resources to conservation are limited, it is important that farmers implement conservation actions that have a high potential to be cost-effective in terms of maximizing conservation outcomes given payments. However, it has been shown that implemented conservation actions often have a low cost-effectiveness compared with what is achievable with an optimal section of action types and locations (Batáry et al., 2015, Börner et al., 2017). This results in a gap between realized and achievable conservation outcomes given payment budgets. This gap risks growing over time as an increasing demand for productive land is making conservation ever more expensive (Phelps et al., 2013).

Below I first discuss why the low cost-effectiveness of implemented conservation actions is due to the inadequate incentive structure of conventional payment schemes. I then describe alternative payment schemes that by design incentivize farmers to implement conservation actions more cost-effectively, and how implementing these can lead to enhanced conservation outcomes.

Conventional payment schemes

Conventional payment schemes are designed to compensate farmers for their management and opportunity costs associated with implemented conservation actions. In practice, policymakers do not know each farmer's costs but offer a set rate that reflects average costs for a given conservation action and used land area. In contrast, payments are not designed to account for conservation outcomes, so farmers have no incentive to improve outcomes, only to reduce their costs. As a result, farmers maximize their profit by selecting types of conservation actions and locations for their implementation that are optimal from a cost-minimization perspective, but not to maximize conservation outcomes. Therefore, conservation actions are often not implemented where they have the highest potential to promote biodiversity (Batáry et al., 2015; Börner et al., 2017), or worse, systematically implemented where conservation outcomes are the lowest, as has been demonstrated for organic farming. Indeed, organic farming has the largest potential to promote biodiversity cost-effectively in high-productive regions, but is mainly employed in low-productive regions where the yield difference compared with conventional farming (i.e., opportunity cost) is the lowest (Tuck et al., 2014; SCB, 2020). The mixed and sometimes mediocre cost-effectiveness of implemented conservations actions incentivized by conventional payment schemes is arguably mainly due to the missing connection between payments and conservation outcomes (Reed et al., 2014).

Context-based payment schemes

Compared to conventional schemes, context-based payment schemes are designed to increase conservation outcomes by conditioning payments, or adjusting the rate, depending on contextual factors that influence the effectiveness of conservation actions. Thus, by only paying, or increasing the rate, for actions in contexts where conservation outcomes are in general high, payments can be directed to where they are most needed. As a result, implemented conservation actions generate higher conservation outcomes per payment (Lundberg et al., 2018). This is particularly needed when conservation outcomes positively correlate with opportunity and management costs (Lundberg et al., 2018). In such cases, context-based schemes can assure that conservation actions are financially attractive to implement by adjusting payments to compensate the high costs, which is not possible with conventional schemes.

There are several examples where the integration of contexts in payment schemes has led to more cost-effective implementation of conservation actions. For instance, in the EU, payments to maintaining grasslands are adjusted based on historical management and biological values, providing stronger incentives to maintaining grasslands that contribute to higher plant species richness (Berg et al., 2019). Another context that has gained traction is neighboring land use. When conservation outcomes are influenced by neighboring land use, context-based payments can provide farmers with incentives to coordinate conservation by conditioning payments on collective efforts (Hardman et al., 2016). This has shown to particularly increase the cost-effectiveness compared with conventional payments when spatially connected habitats are more ecologically valuable than isolated habitats (Drechsler et al., 2010; Bell et al., 2016). In addition to increasing conservation outcomes, coordination among neighbors can enable lower management costs for farmers. For instance, a study found that costs for fences, livestock and labor could be reduced by coordinating across farms to create larger grassland areas (OECD, 2013). A consequence of the lower costs is that farmers can accept lower payments than when enrolling individually, enabling further improved cost-effectiveness of the payment scheme.

While management history and neighboring land use have been integrated to some extent, many other influential contexts, e.g., landscape complexity and climate (Kleijn et al., 2011; Oliver et al., 2016), are still missing in mainstream payment schemes. The rich literature on conservation effectiveness provides information that can be used to integrate such contexts into payment schemes (Batáry et al., 2015; Sidemo-Holm et al., 2021b). Furthermore, for many contexts, including those discussed above, the spatially explicit information needed to implement schemes in practice is available through open access databases. Thus, the needed information to expand context-based payment scheme is already available and can be used to provide farmers with stronger incentives to implement conservation actions cost-effectively.

Result-based payment schemes

Schemes where payments are directly based on conservation outcomes are known as result-based payment schemes. Because result-based payments are conditioned on conservation outcomes (verified by farmers or controllers), they are designed to incentivize farmers to both minimize costs and maximize conservation outcomes. Thus, famers maximize their profit by selecting conservation actions and locations that result in high conservation outcomes given costs.

Result-based payment schemes do not stipulate how farmers should accomplish results. Instead of strictly implementing predetermined conservation actions, farmers can employ their creativity and unique knowledge about local premises to promote biodiversity in the least costly way. Consequently, they can adopt low-cost strategies that are not selectable in convention payment schemes, such as reducing crop sowing density which promotes flowering weeds and pollinators without affecting the crop yield (Sidemo-Holm et al., 2021a). Lower costs for farmers in turn enable reduced payments and thus more cost-effective conservation (Hellerstein, 2017).

In addition to the theoretical evidence, it has been empirically proven that farmers offered result-based payments implement conservation actions more cost-effectively than those offered conventional payments (Matzdorf and Lorenz, 2010; Wuepper and Huber, 2021). Despite their high cost-effectiveness, result-based payment schemes remain uncommon (Herzon et al., 2018). This is mainly due to regulatory barriers, difficulties and costs associated with monitoring results, and a resistance to transfer risk from society to farmers implied by conditioning payments on results (Matzdorf and Lorenz, 2010; Hasund and Johansson, 2016). The latter may also result in a low interest among farmers to enroll in payment schemes. As a result, result-based payments have primarily been applied in small-scale schemes focused on easily monitored conservation outcomes with a high probability to be attained (Matzdorf and Lorenz, 2010; Kaiser et al., 2019; Wuepper and Huber, 2021).

In the near future, increased adoption of technological solutions to collect data at low costs will likely facilitate the application of result-based payments. This particularly includes satellite-based remote sensing, cameras, acoustic recording devices and environmental DNA (Stephenson, 2020). Furthermore, in the EU, previous regulatory barriers are being removed with the new Common Agricultural Policy (2023-2027), and policy designs that incentivize cost-effective solutions are encouraged. Thus, the opportunity to implement and study result-based payment schemes will notably improve in the coming year, enabling considerable gains in conservation cost-effectiveness.

Model-based payment schemes

As with result-based payments, model-based payment schemes are designed to incentivize farmers to maximize conservation outcomes while minimizing their costs, which improves the cost-effectiveness of implemented conservation actions (Bartkowski et al., 2021). However, instead of monitoring results, models are used to predict conservation outcomes of predefined actions and farmers are paid accordingly when they are implemented (Bartkowski et al., 2021). Monitoring difficulties and costs are thus avoided, and farmers avert the risk of being uncompensated for undertaken actions. However, in contrast to result-based payments, farmers cannot increase cost-effectiveness by improvising, but need to adhere to modeled actions. Furthermore, models can never perfectly resemble reality, but will always entail a degree of uncertainty. Thus, farmers will be paid for modeled results that to some extent differ from reality, ultimately reducing the potential to direct payments to where conservation outcomes can be achieved most cost-effectively. Therefore, it is necessary to assess how uncertainty affects cost-effectiveness and determine a maximum level of acceptable uncertainty when informing payments schemes with models. It is also important that models are embedded in an attractive and easily operated application. Then the models have the potential to promote engagement in payment schemes by clearly communicating direct feedback on the environmental consequences and income of farmers' management choices.

It has been shown that model-based payments can incentivize farmers to reduce their agricultural pollution several times as cost-effective (amount reduced pollution per payment unit) compared to conventional payments (Sidemo-Holm et al., 2018). However, there is to my knowledge no study empirically evaluating the cost-effectiveness of model-based payments for biodiversity conservation, which is thus urgently needed to better understand its potential as a cost-effective policy instrument.

Auctions

In auctions, farmers compete for payments with sealed-bid funding claims for detailed conservation actions. When competing for contracts, farmers reveal their costs associated with conservation actions, enabling policymakers to select bids with the lowest funding claims. By adjusting payments based on claimed costs from individual farmers, auctions have empirically proven to considerably reduce the payments for set conservation outcomes compared with conventional schemes (Hellerstein, 2017). Furthermore, auctions can be combined with other payment schemes, such as context- or model-based schemes, to increase their cost-effectiveness further. In such case, farmers can make funding claims, whereupon policymakers select bids depending on their potential to generate conservation outcomes (based on contexts or models) relative to claimed costs, enabling a high cost-effectiveness (Hellerstein, 2017). Auctions can thus be used as a payment scheme per se or as an element to increase the cost-effectiveness of other payment schemes. Auctions need to be carefully designed and implemented to ensure that enough bidders compete for the contracts, and to avoid bidders in repeated auctions to learn how much the government is willing to pay and adjust their bids accordingly (Hailu and Schilizzi, 2004).

Discussion

The available funds for biodiversity conservation are limited, and it is increasingly important that they are used cost-effectively if we are to meet conservation goals (IPBES, 2019). While conventional payment schemes are comparatively simple to implement, they cannot incentivize cost-effective conservation since they lack a mechanism to reward farmers for improving conservation outcomes (Armsworth et al., 2012). Alternative schemes that adjust payments based on conservation outcomes provide farmers with incentives to maximize conservation outcomes, e.g., through spatial targeting, which has repeatedly shown to lead to more cost-effective conservation (e.g., Klimek et al., 2008; Krämer and Wätzold, 2018; Wuepper and Huber, 2021). Alternative schemes that allow for innovation (result-based payment schemes), or use auctions to limit overcompensation, have particularly high potential to increase cost-effectiveness (Wätzold and Schwerdtner, 2005). In general, the gains in cost-effectiveness more than compensate for increased costs entailed with administrating more complex schemes (Armsworth et al., 2012).

Despite the growing scientific support, and increasing feasibility thanks to advances in conservation science, indicator development, empirical modeling and digital platforms for policy administration, schemes that link payments with conservation outcomes, or limit overcompensation, remain rare (Bredemeier et al., 2022). With the ongoing global biodiversity crisis, it is high time to implement policies that increase the cost-effectiveness of payments schemes to maximize the benefits of conservation budgets.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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