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The agglomeration bonus in practice—An exploratory assessment of the Swiss network bonus

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ABSTRACT

Incentivising farmers in the context of agri-environment schemes to provide spatially-connected conservation measures is a challenging task. The idea of an agglomeration bonus – where farmers are paid a bonus on top of a spatially homogeneous payment if they provide spatially connected conservation areas – has been suggested in the literature as a possible solution. Existing literature on the agglomeration bonus focuses on its theoretical analysis whereas we provide an evaluation of an existing policy that exhibits strong features of the agglomeration bonus idea – the Swiss network bonus scheme. We present an evaluation of three conservation projects that include the network bonus scheme using the criteria of ecological effectiveness, monitoring and enforcement, cost-effectiveness and dynamic incentive effects. Given the limited amount of data available and the fact that ours is the first investigation of this policy, we carried out a qualitative, exploratory study.

1. Introduction

The purpose of agri-environment schemes (AES) is to compensate farmers for costly land-use that benefits biodiversity, landscapes and the environment. AES have become an important policy instrument in many European countries but also in other parts of the world. Assessments of their ability to halt and reverse the decline of farmland biodiversity are, however, mixed. While successes are acknowledged (Bullock, PywellL, & Walker, 2007; Uthes & Matzdorf, 2013), there is also plenty of criticism that if AES were designed better, more biodiversity could be conserved for the financial resources spent (Kleijn, Rundlöf, Scheper, Smith, & Tscharntke, 2011; Pe'er et al., 2014; Wätzold, Drechsler, Johst, Mewes, & Sturm, 2016).

One frequent criticism of AES is that they insufficiently take into account that many species benefit if conserved habitat patches are spatially connected and not isolated (Bell, Parkhurst, Droppelmann, & Benton, 2016; Khanna & Ando, 2009). A prominent suggestion made by Parkhurst, Shogren, and Bastian (2002) to incentivise farmers and other land-users to cooperate and provide aggregated conserved patches is to include an "agglomeration bonus" in the design of payment schemes. Land-users receive a base payment for conserving their land and a bonus on top of that if the conserved area is part of a spatial network of conserved patches.

The discussion regarding the agglomeration bonus has gone into two directions. First, the cost-effectiveness of the agglomeration bonus idea has been analysed with conceptual models (Drechsler, Wätzold, Johst, & Shogren, 2010; Drechsler, Smith, Sturm, & Wätzold, 2016; Wätzold & Drechsler, 2014) and with applied models (Bell et al., 2016; Lewis, Barham, & Robinson, 2011). Second, in order to achieve a certain spatial configuration of conserved patches, land-users have to cooperate. The behaviour of land-users in the cooperation process has been investigated mostly by applying experimental game theory (Banerjee, de Vries, Hanley, & van Soest, 2014; Fooks et al., 2016; Parkhurst & Shogren, 2007) but also with choice experiments (Kuhfuss, Préget, Thoyer, & Hanley, 2015).

All this research considers different design aspects of the agglomeration bonus from a purely theoretical or hypothetical perspective. However, how does the agglomeration bonus work in the real world? To our knowledge, there exists only one AES that contains elements of the agglomeration bonus, namely the Swiss network bonus scheme that was implemented in 2001. On top of payments for certain land-use measures, farmers are offered an additional payment (the network bonus), if they participate in a so-called "network project" (Vernetzungsprojekt), which aims to improve the connectivity of local biodiversity conservation areas (Öko-Qualitätsverordnung, 2012).

Here, we present an analysis of the Swiss network bonus scheme using the criteria of ecological effectiveness, monitoring and enforcement, cost-effectiveness and dynamic incentive effects. Our analysis focuses on three case studies. Given the limited availability of data and the fact that ours is the first investigation of this policy, we decided on a

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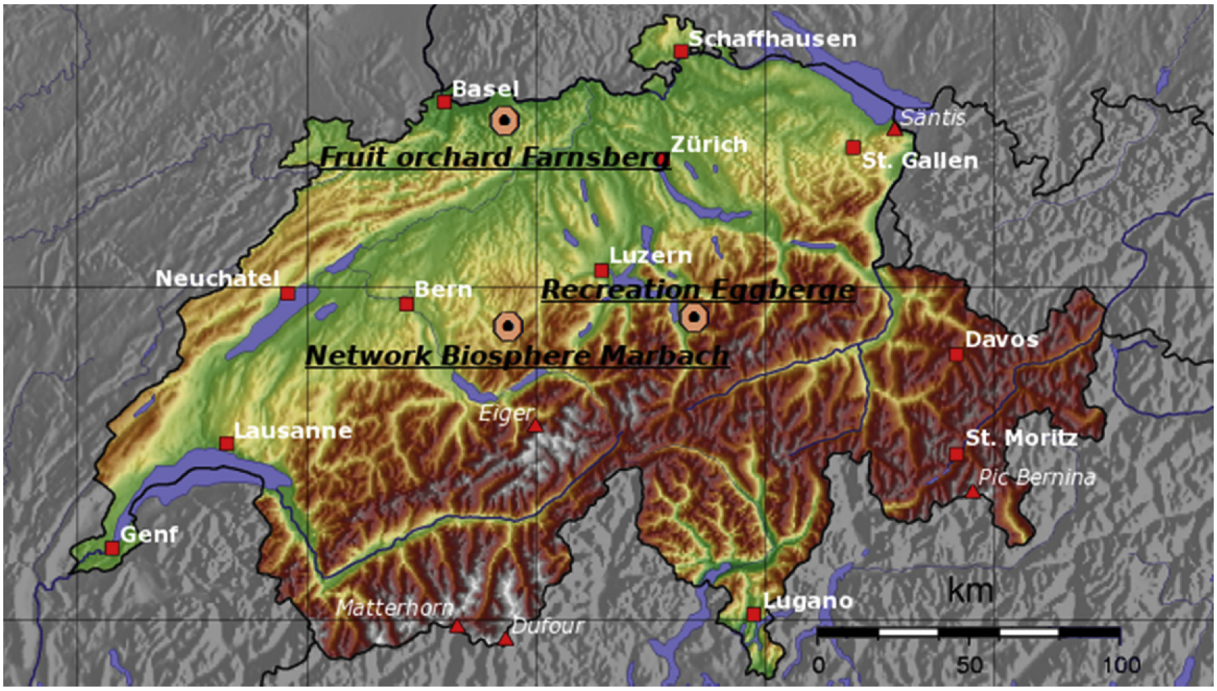

Fig. 1. Topographic map of Switzerland including the location of the three case study projects. Modified map based on "Schweiz topo.png", retrieved from https://commons.wikimedia.org/wiki/File:Schweiz_topo.png.

qualitative approach of an exploratory nature.

The choice of case studies to be investigated was based on three criteria. First, we selected network projects in landscapes with different topographies and with different conservation measures and conservation objectives, as these are likely to face different challenges. Second, we chose projects with different sizes of conserved areas. Third, we selected projects with different types of coordination and different degrees of involvement of conservation NGOs because the problem of coordination plays an important role in the literature on the agglomeration bonus. We carefully screened a list of successful network projects throughout Switzerland (ÖQV-Vernetzungsprojekte erfolgreich umsetzen (BÖA), 2009), and, following our criteria, selected the projects "Fruit orchard Farnsberg", "Networked biosphere Marbach" and "Recreation Eggberge". Fig. 1 shows where they are located in Switzerland, details of the projects are found below.

We gathered information and data for our analysis from grey literature, including project reports. Further information was gathered from problem-centered, semi-structured interviews (Witzel, 2000) which were carried out and transcribed by one of the authors. Interviews were conducted with a total of ten individuals involved in the network projects. Among the persons interviewed were representatives from the farming community, representatives of the cantonal administration, and professionals with ecological expertise in all of the network projects. In the case study description and analysis below, we cite information sources from the literature including unpublished and published project reports. As we promised our interview partners anonymity, information from the interviews is provided in the text without stating a source.

We start by presenting an overview of the legal framework of the Swiss network bonus. Then we explain our framework of analysis. In the following we present the three network projects and evaluate them against the assessment criteria. Finally, we discuss selected results and conclude.

2. Legal framework of the Swiss network bonus

The implementation of the Agricultural Act (Landwirtschaftsgesetz) in 1993 enabled financial support for extensive land use with the introduction of so-called "ecological compensation areas" (Geiger, Göttin, Guignet, Hofmann, & Wild, 2012; Widmer, 1998). Although throughout the 1990s the share of ecological compensation areas was steadily extended, criticism of their ability to effectively conserve biodiversity arose in the late 1990s (Mann, 2010; Widmer, 1998).

As a response to this criticism, the Ordinance of Ecological Quality (Öko-Qualitätsverordnung) was implemented in 2001 (Federal Office for the Environment (FOEN), 2013; Öko-Qualitätsverordnung, 2012); it contains two types of payments that farmers can receive on top of standard payments for ecological compensation areas (Öko-Qualitätsverordnung, 2012). The "quality bonus" for ecological compensation areas of exceptional biological quality, and the "network bonus" for creating the networks of ecological compensation areas on which we focus in this paper. The legal prerequisites for the network bonus are defined by each canton, but have to fulfill the minimum standards set by the Ordinance of Ecological Quality (Öko-Qualitätsverordnung, 2012).

Ecological compensation areas are eligible for the network bonus payment if they fulfill the cantonal requirements for networking and are selected and cultivated according to the requirements of a regional network project. Participating farmers commit themselves contractually to cultivating their ecological compensation areas in compliance with the requirements for the network project over a period of six years (Öko-Qualitätsverordnung, 2012).

Appendix 2 of the Ordinance of Ecological Quality (Öko-Qualitätsverordnung, 2012) contains the following minimum requirements and guidelines for developing a regional network project:

2.1. Documentation of the initial situation

At the beginning of a project, the initial situation has to be documented on a map. This "as-is plan" contains the borders of the planned network project, the agricultural land use, ecological compensation areas and other ecologically relevant information, for example the location of groundwater protection zones.

2.2. Definition of biodiversity conservation objectives

The general objectives of the Ordinance of Ecological Quality have to be adapted to the specific local development potential and their definition has to follow certain requirements.

- Selection of target species (endangered species for which the network project bears particular responsibility) and index species (which are or were characteristic for the project area) and an estimation of their population sizes.
- 2 Definition of conservation goals oriented along the expected effects on target and index species.
- 3 Specification of "quantitative implementation goals", which refer to the types of supported land use and include certain minimum targeted quantities (for example, 12–15% of the agricultural area shall become ecological compensation area). Minimum thresholds for quantitative implementation goals for specific types of ecological compensation areas (for example the minimum number of fruit trees for an orchard to be eligible as compensation area) are set at the cantonal level.
- 4 Formulation of "qualitative implementation goals", which refer to the selection of appropriate conservation measures directed at the target and index species.
- 5 Specified goals have to be measureable and scheduled.

2.3. Documentation of the desired spatial arrangement

A map including a proposal of the desired spatial allocation of ecological compensation areas with conservation measures has to be presented ("target plan").

2.4. Development of an implementation concept

In the implementation concept, roles and responsibilities for the project are assigned. An administrative body, a "trusteeship", has to be nominated; it is responsible for the implementation of the project and for contracts with the farmers. Moreover, a financial plan has to be developed.

Further requirements include an individual consultation of farmers by a qualified person and the submission of a mid-term progress report which documents the achievements of the objectives. At the end of the project, the achievement of objectives has to be assessed. For the continuation of the project, at least 80% of the implementation goals have to be fulfilled. The objectives and measures have to be evaluated and, if necessary, adapted.

The Ordinance of Ecological Quality determines the maximum amount of payments for different land use types in the context of the network bonus (the specific amount is set by the respective canton). Additionally it provides the legal option to implement regionally specific conservation measures.

Payments are differentiated by landscape zones. For example, a maximum payment of 1000CHF (Swiss Franc) is set for extensively used meadows in valleys or up to Mountainous zone II. Maximum payments for extensively used meadows in Mountainous zones III-IV are set to 500CHF.

Areas included in a network project have to be controlled by the canton at least once during the project duration. In case of non-compliance with the legislation, payments may be reduced or refused for up to five years (Öko-Qualitätsverordnung, 2012).

3. Framework of analysis

3.1. Ecological effectiveness

The criterion of ecological effectiveness refers to the ecological success of a policy instrument (Endres, 2011; Engel, 2016; Hanley, Whitby, & Simpson, 1999). Measuring the ecological success of AES targeted at biodiversity conservation is challenging. The rate of participation of farmers in an AES is a potential indicator for assessing its ecological success. However, although it provides information about the uptake of an AES, it does not assess the conservation success of the land-use measures required by an AES (Kleijn & Sutherland, 2003). Monitoring the population size of a species targeted by an AES provides a more suitable indicator. However, this can be costly and the population size is also affected by factors beyond the reach of an AES, such as the situation in the wintering grounds of migratory birds.

Given the data limitations and the exploratory nature of our evaluation, we adopt an indirect approach to assess the ecological effectiveness of the three network projects in question. We examine to which extent experts were involved in the selection of land-use measures to conserve the target and index species, and how the achievement of objectives is monitored in the projects. We also consider subjective assessments of interview partners and, if available, studies about the conservation impacts of the projects. In particular, we address the issue whether the network project generated conservation measures that would not have existed without it. We also provide information on the size of the area designated as ecological compensation areas in the network project and its percentage of the overall agricultural area. If available, we also give some indication of whether the network project leads to additional connectivity in the landscape.

3.2. Monitoring and enforcement

Monitoring and enforcement activities are necessary to ensure that farmers carry out the conservation measures for which they receive payments (Wätzold & Schwerdtner, 2005). Monitoring refers to surveying the implementation of measures farmers agreed upon when they committed themselves to participation in a network project and enforcement refers to procedures and sanctions that are applied in case of non-compliance. For our analysis, we are interested in understanding how monitoring and enforcement takes place in the network projects. Further, we assess whether there is an enforcement deficit and whether costs for ensuring compliance are reasonable based on the literature review and statements from the interview partners.

3.3. Cost-effectiveness

The available financial funds in the context of the network bonus should be spent in a way that achieves the greatest possible benefit for conservation (Petersen, Strange, Anthon, Bjørner, & Rahbek, 2016). Following Wätzold and Schwerdtner (2005) we consider a network project to be cost-effective if the available financial resources are spent in a way that the conservation impact is as high as possible. Given the focus of the discussion in the agglomeration bonus literature (see Introduction) we consider two types of costs, production costs and decision-making costs (Wätzold & Schwerdtner, 2005).

In the context of biodiversity conservation, production costs are the costs of "producing the good biodiversity". This may include, for example, investment costs to build a pond, but also the opportunity costs of using the land for conservation purposes and not for profit-maximising farming activities. Assessing the cost-effectiveness of AES can be a highly complex task requiring spatio-temporally differentiated ecological-economic models (Wätzold et al., 2016).

We use a much simpler approach starting from the assumption that cost-effectiveness requires those conservation measures to be carried out first that have the highest benefit-cost ratio (Duke, Dundas, Johnston, & Messer, 2014). However, a thorough application of such an approach requires a monetary assessment of the benefits and costs of the different conservation measures, which is not feasible in the context of this paper. Therefore, we assume that for given payments for conservation measures farmers select the measures and their location that maximise the farmers' profit (i.e. the difference between payments and

costs). However, these low-cost measures are typically not benefit-cost maximising as they ignore differences in benefits (Duke et al., 2014). We therefore asked interviewees whether in selecting the type and location of conservation measures only cost concerns were considered or whether the conservation impacts were also taken into account. If both costs and benefits were considered we take this as an indicator that cost-effectiveness concerns played a role to some extent.

Decision-making costs arise from the need to make appropriate decisions regarding the implementation of a network project. Here, we focus on the costs of coordinating decision-making. For our analysis, we describe how the coordination and communication activities in the network projects take place, who is responsible for coordination, what challenges occur regarding communication and who finances the communication activities.

3.4. Dynamic incentive effects

A prominent criterion in the economic analysis of environmental policy instruments is the ability of a policy instrument to induce the development and deployment of environmental technological progress to reduce emissions (Endres, 2011). Adopting this criterion in the context of biodiversity conservation, we consider the dynamic incentive effect of a policy instrument as its ability to induce the development and deployment of improved biodiversity conservation measures. Improved means that conservation measures achieve either a higher ecological output at the same cost or the same ecological output at a lower cost.

We assess this criterion in the context of the network projects by identifying possible incentives for involved parties to develop improved conservation measures. We also investigate whether the legal option contained in the Ordinance of Ecological Quality (Öko-Qualitätsverordnung, 2012) to develop and implement regionally specific conservation measures was used in the respective network projects.

4. Case study I: Fruit orchard Farnsberg

4.1. Area and project description

The network project “Fruit orchard Farnsberg” is located in an area of about 1300 ha around the hill Farnsberg in the canton of Basel-Landschaft. The Farnsberg has an altitude of 761 m and the landscape around the Farnsberg is hilly with forest cover (Mohler, Blattner, Hofer, & Landwirtschaftlichen Zentrum Ebenrain, 2015). Small-scale landscape structures shape a particularly diverse vegetation mosaic of open landscapes and forest communities providing habitat for alpine and non-alpine plant species (Mohler et al., 2015). The fauna is as diverse as the flora and a large variety of small mammals, birds and insects can be found. In particular, bird species that benefit from the traditional land use of fruit orchards are characteristic of this region. Among these are some endangered species like the Woodchat Shrike and the Red-backed Shrike. One of their last nesting areas in Switzerland lies within the project region (Mohler et al., 2015).

The endangerment of fruit orchard birds was the main reason for the foundation in 2003 of the “Swiss species recovery programme for birds”. In connection with this programme, the network project “Fruit orchard Farnsberg” started in 2004. The main goal was to maintain the traditional fruit orchards as a habitat for endangered bird species and to improve their ecological quality. In the long run, the fruit orchards are to be managed sustainably from both an economic and an ecological point of view (Projektbericht 2 Obstgarten Farnsberg, 2006).

Since the start of the project, a variety of measures have been implemented. Flower meadows, valuable field and forest margins as well as wildflower strips were created. The food supply for birds was increased with the construction of small structures like piles of rocks and branches, which function as shelter for many invertebrates. Moreover, the conservation and planting of fruit orchard trees was supported (Projektbericht 2 Obstgarten Farnsberg, 2006).

In the beginning, conservation focused especially on the Woodchat Shrike, since one of its last breeding grounds was located within the project area. The network project now considers more bird species (Common Redstart, Red-backed Shrike, Green- and Grey-faced Woodpecker, Wryneck, Cirl Bunting) and is managed according to a comprehensive concept to conserve traditional orchards and improve the living conditions of birds (Projektbericht 9 Obstgarten Farnsberg, 2012). This concept includes the following measures:

- Increase of the density of conservation measures.
- Qualitative improvement of conservation measures.
- Qualitative enhancement of forest margins as a habitat for bird species.
- High-quality care of the fruit trees to improve their long-term survival.
- Improved marketing for local products from the fruit orchards.
- Information to the public about the value of traditional fruit orchards and other ecological improvements in the Farnsberg region.
- Connecting the Farnsberg region with other ecologically valuable regions.

The network project is now in its second project phase. The official trusteeship is represented by the Swiss Association for the Protection of Birds SVS/BirdLife Switzerland (Projektbericht 9 Obstgarten Farnsberg, 2012). However, the project is characterised by a close relationship between bird conservationists and farmers in a rather loose administrative structure.

4.2. Evaluation

4.2.1. Ecological effectiveness

Overall, the network bonus seems crucial for the long-term financing of measures to conserve bird species that benefit from traditional fruit orchards. In combination with the quality bonus (see section Legal framework of the Swiss network bonus), it enabled and encouraged some farmers to convert their whole business towards more ecological cultivation. Since the foundation of the network project, participation has risen from initially six farmers to 21 farmers in 2012 with measures being conducted on an area of about 103 ha. This represents 18% of the 572 ha of the agricultural area of the participating farms (Projektbericht 1 Obstgarten Farnsberg, 2005; Projektbericht 9 Obstgarten Farnsberg, 2012).

Thus, it seems that the network project led to the implementation of conservation measures that would not have happened without the project. Conservation measures have also become increasingly coordinated since the network project started. This coordination is seen as important for the ecological success of the project and was induced by the requirements for the network project. It is an explicit strategy of the network project to involve new farmers whose areas improve the connectivity either between different land parcels within the network or of the network project area with surrounding areas of high ecological value.

Bird conservationists, specialist consultants and representatives from the canton developed the specific conservation measures in the project. How and where these measures were best implemented was discussed in consultation with farmers.

The achievement of objectives is measured in two different ways. First, there is the assessment of the implementation goals. In this regard most objectives were achieved. Today more than 6300 traditional fruit orchard trees are contractually secured. More than 700 of these were planted between 2010 and 2012, which exceeded the goal of the project. Also numerous new conservation areas and small structures like hedges were established (Projektbericht 1 Obstgarten Farnsberg, 2005; Projektbericht 2 Obstgarten Farnsberg, 2006; Projektbericht 8

Obstgarten Farnsberg, 2011; Projektbericht 9 Obstgarten Farnsberg, 2012). However, small structures to provide an increased food supply for birds were only insufficiently created. These measures are labour-intensive, but the financial compensation for farmers is not attractive.

Bird populations were estimated periodically by bird conservationists since the start of the project. A comprehensive faunistic success control conducted by an external nature conservation agency was initiated in 2011 with the aim of assessing the living conditions of locusts, butterflies and birds over a period of five years.

Although all interviewees commended the bird protection efforts, the conservation results have so far been moderate. Most bird populations have remained at the same level. Some have slightly improved, e.g. the Red-backed Shrike, others decreased, e.g. the Woodchat Shrike, which was locally extinct in 2010. However, in hindsight the selection of the Woodchat Shrike as an initial target species was inappropriate since it was foreseeable that the existing small population of only one breeding pair most likely could not be saved.

Moreover, conservation measures have an impact on bird populations only after some time and the population size also depends on factors that cannot be influenced (for example, most birds overwinter in southern countries where the measures in the fruit orchard Farnsberg have no effect). Thus, the ecological effectiveness of the project measures is difficult to assess. Besides the considered bird species, plants and insects also benefited from the measures and their situation has improved substantially.

4.2.2. Monitoring and enforcement

Different parties control whether farmers conduct the conservation measures as contractually agreed upon. In each of the participating municipalities there is one designated auditor (usually a farmer) who is responsible for monitoring the measures. Selecting a local person for monitoring has the advantage that he or she already knows the local people and areas. Additionally the canton conducts random controls, and also farmers control each other closely. For some measures, like mowing on a specific date, non-compliance is easy to detect whereas for other measures, like fertilizer restrictions, non-compliance is almost impossible to detect in retrospect.

A few cases in which measures were not conducted as contractually agreed upon happen every year for different reasons. Sometimes the violations were not committed on purpose, for example a new employee of a farmer did not know about the agreement to leave 10% of the grass uncut. In case of a contract violation a commission decides about the consequences. Depending on the seriousness of the violation, farmers can be forced to return payments and/or get future payments cut.

4.2.3. Cost-effectiveness

The decision regarding which conservation measures to apply and where to conduct them is ultimately made by the farmers, since participation in the network project is voluntary. Consultation plays an important role in this regard. When a farmer is interested in participating in a project, a preliminary map of his land with possible positions of conservation measures is developed by the consultant. This plan is proposed to the farmer, who then usually negotiates with the consultant to find a suitable compromise between ecologic and economic interests. The resulting selection and spatial allocation of conservation measures has to be checked for compliance with the legislative requirements by the cantonal administration before payments are granted.

One beneficial factor for the communication between farmers, consultants and the cantonal administration is the traditionally close relationship between farmers and bird conservationists in the project region. Although the Swiss Association for the Protection of Birds SVS/BirdLife Switzerland represents the official trusteeship (Projektbericht 1 Obstgarten Farnsberg, 2005), farmers are also involved in the management. Farmers are well organised and meet periodically. During these meetings current issues are discussed. If necessary, external experts are consulted about specific problems such as the proper cutting of fruit trees.

Communication among the parties involved has further improved since the network project started. Due to this increased cooperation and communication, participating farmers have gained knowledge about biodiversity conservation. If farmers identify problems they discuss them among each other and with the project management to find suitable solutions. Due to the comprehensive consultation process, knowledge could be transferred, and the commitment of farmers towards the project was increased. As a result, the number of farmers participating in the project has also increased steadily over the years. However, this level of communication, education and consultation is costly; it is funded by, among others, the Swiss Association for the Protection of Birds SVS/BirdLife Switzerland (Projektbericht 1 Obstgarten Farnsberg, 2005; Projektbericht 9 Obstgarten Farnsberg, 2012).

4.2.4. Dynamic incentive effect

Dynamic incentive effects occurred in two ways. First, established conservation measures were optimised due to learning effects. For example, learning makes it possible to maintain extensive meadows at lower costs today than at the beginning of the project. Second, ecological research has contributed to improving the conservation measures. For example, research by the Zurich University of Applied Sciences about the feeding patterns of birds led to the implementation of a regionally specific conservation measure. It turned out that the measure known as “open soils” (meaning that a small part of the pasture is mowed in a certain period in spring) increases the food supply and accessibility for some bird species. Initially the “open soils” measure was conducted on experimental areas for research purposes. Today it is funded through the network bonus as a regionally specific measure. The development of new conservation measures is not undertaken by the researchers alone but in cooperation with farmers, bird conservationists and the cantonal administration.

5. Case study II: Network biosphere Marbach

5.1. Area and project description

The network project “Network biosphere Marbach” is located in the southwest of the canton of Lucerne; it covers the administrative borders of the municipality Marbach, an area of 45.1 km^2. Within the project area the topographical conditions differ and one can distinguish four zones LR1–LR4 (Projektbericht Vernetzte Biosphäre Marbach, 2010).

A strong relief of medium sized hills and gullies characterises the zone LR1 in the northwest of the project area. Dry and wet, shaded and highly sunlit areas create a structured mosaic of small forests and a large variety of meadow types. Meadows and forests are mainly used intensively but have a high potential to be used for ecological improvement measures. The zone LR 2, the valley bottom, is almost exclusively used for intensive, mechanically supported agriculture due to its fertile and flat alluvial soils but some landscape elements such as fruit orchards can function as important networking elements. In zone LR 3 widespread impermeable soils in a strongly structured landscape form a dense network of wetlands and extensively used meadows including a variety of particularly species-rich moors. Difficult topographic conditions (steep slopes, moors and a high amount of small structures like boulders) hamper intensive cultivation. Parts of the zone LR 4 are similar to the zone LR 3 whereas in other parts, fertile soils on wood glades allow intensive agricultural use. At higher altitudes agricultural use is limited to mountain pasture during the summer season. The steep alpine meadows, rubble areas and fissured rock-faces harbour a variety of rare alpine plant and animal species.

The project Network biosphere Marbach was established in 2004 and its goal is to maintain and improve the ecological compensation areas throughout the different landscape zones (Projektbericht

Vernetzte Biosphäre Marbach, 2010). The project is embedded in a UNESCO biosphere reserve, the Entlebuch region. Representatives from the biosphere reserve incentivised municipalities to initiate network projects. The municipality of Marbach represents the official trusteeship of the network project. A project group was created to coordinate activities consisting of the mayor of Marbach, communal representatives of agriculture and forestry, an ecologist and a farmer (Projektbericht Vernetzte Biosphäre Marbach, 2010). Within the project group the agriculture representative bears primary responsibility for the implementation of the network project. He consults the farmers, concludes contracts with them, coordinates conservation measures and is in charge of project reports and information events.

The 25 selected target and index species include small mammals, birds, amphibians, insects and plant species (Projektbericht Vernetzte Biosphäre Marbach, 2010). This diversity is reflected in 24 implementation measures with priority given to extensive meadows, litter meadows and the enhancement of riparian, forest and meadow margins. Characteristic for the project is the lean implementation structure, which is based on only a few engaged individuals. The network project is now in its second phase.

5.2. Evaluation

5.2.1. Ecological effectiveness

As a result of the difficult local topographic conditions, agricultural intensification had been hampered in some parts of the region and many remote areas had been used extensively. However, the time-consuming cultivation of extensively used areas was often no longer economically viable for farmers. Consequently, their cultivation was abandoned and ecologically valuable areas have been lost. As a response ecological compensation areas have been established to a considerable extent. Since the network bonus was implemented the size of compensation areas increased to 327.8 ha which represents 18% of the total of 1821.8 ha of agricultural land in the area of the network project (Projektbericht Vernetzte Biosphäre Marbach, 2010).

In some instances, the spatial allocation of conservation measures has also changed. Some measures that were already conducted before the network project was initiated were moved to another location, because during consultations with the farmers it turned out that the activity could be done more effectively elsewhere. In principle, it is the aim of the network project to create ecological compensation areas in places where they strengthen the connectivity between different land parcels of high ecological value, for example by providing stepping stones for species migration. To what extent this is achieved remains somewhat unclear.

The selection of conservation measures which farmers in the network project can choose from is developed by the trusteeship and the cantonal administration. It is based on the minimum standards defined by the cantonal directive on minimum requirements for network projects (Landwirtschaft und Wald (LAWA) (2014)).

The implementation goals were achieved on average at a rate of 87% after six years of implementation (Projektbericht Vernetzte Biosphäre Marbach, 2010). Some goals were surpassed, for example new litter meadows were created on 5.29 ha but the target area was only 2 ha. Other goals were not achieved such as the enhancement of forest margins (33% of target achieved) and the creation of small structures (63% of target achieved).

When it comes to the achievement of conservation goals, the results are mixed. Some species populations are stable (e.g. the Common Redstart, the Tree Pipit and the Common Cuckoo), but other populations are declining (e.g. the Brown Hare, the Whinchat and the Red-backed Shrike) (Projektbericht Vernetzte Biosphäre Marbach, 2010). However, it seems too early to relate these results to the conservation measures. Some measures need time to take effect such as the transformation of a formerly fertilised area into a valuable low-nutrient meadow. Moreover some species populations are influenced by negative large-scale developments, for example bird species like the Whinchat or the Common Redstart. These highly migratory species rely on intact environmental conditions throughout their widespread habitat. This includes wintering grounds and areas along their migratory routes, which are beyond the reach of the network project's conservation measures. Despite the limited effects of the conservation measures, the overall situation for index and target species within the project area seems to have improved since the network project was initiated.

Although an ecological assessment within each network project is requested by the canton of Lucerne, the scope of this internal assessment is limited and data about species populations are incomplete. The assessment is primarily used in consultations with farmers to increase their awareness and motivation by presenting conservation results.

However, the canton of Lucerne and the UNESCO biosphere Entlebuch are interested in obtaining sound quantitative data about species populations. To use administrative synergies, a concept for a centralised quantitative ecological assessment for the whole area of the UNESCO biosphere (7 municipalities, including different network projects) was developed. Until now the quantitative ecological assessment was conducted once (though results were not yet available at the time of our study) and the plan is to repeat it after six years to investigate how the species populations have developed.

5.2.2. Monitoring and enforcement

A certified monitoring company selected by the farmers conducts the monitoring of legal compliance. Also, the farmers themselves control each other closely. Additionally, random monitoring controls are conducted by the canton. In case of contractual violations, payments have to be returned and future payments can be cut. These financial sanctions can be severe for the farmers. In the early stages of the project contractual violations were frequent. However, over the years the number of such incidents decreased as participants realised that breaking the contract is not a financially viable strategy.

5.2.3. Cost-effectiveness

As part of the initial ecological assessment at the beginning of the project, proposals for suitable locations for specific conservation measures were developed and included in the target plan. As a cantonal requirement, so-called network axes (similar to corridors which enable species to disperse between different habitats) were developed and integrated in the target plan. Conservation activities should preferably be located within these network axes. The target plan is used as a tool in the consultation with farmers to show them where conservation activities are particularly needed. In cooperation with the consultant, farmers can then estimate whether conducting conservation measures as proposed is beneficial to them. Although the consultant can help to identify an economically and ecologically beneficial compromise, the participation decision is ultimately made by the farmer.

To convince as many farmers as possible to participate in the project, the early consultation activities focused on highlighting the economic benefits of participation. It seems that landowners indeed preferably selected those measures that provide the most attractive ratio of costs (in particular labour) to benefits (payments) for them. While some measures, like litter meadows, are particularly attractive for landowners (target goal achieved at more than 250%), other measures, like the enhancement of forest margins, are rather unattractive (33% of target goal achieved) (Projektbericht Vernetzte Biosphäre Marbach, 2010).

The annual plenary meetings and the individual consultations are the main channels of communication between the farmers and the project administration. In the plenum common ideas and problems are discussed. The farmers are also informed about the project progression. On average, each farmer receives two hours of consultation per year. The trusteeship for the project is responsible for financing the coordination activities. Initially, the canton of Lucerne supported the trusteeship with 50% of the costs for the preparation of the project.

Farmers also learn from each other. Non-participating farmers notice when participants conduct conservation measures and they start calculating whether joining the project could be beneficial for them. The farmers' attitudes towards biodiversity conservation play an important role in determining whether they will participate in the project, and their understanding of biodiversity conservation has improved over the years, mainly due to the consultations. Prior to the implementation of the network project farmers regarded ecological elements, like hedges, as an obstacle. Today most of them know that these elements can have both a financial and an ecological value.

5.2.4. Dynamic incentive effect

Regarding the implementation of conservation measures farmers could realise learning effects which facilitated implementation. However, we could not identify any substantial dynamic incentive effects regarding the development of new, regionally adapted measures. Interviewees indicated that the selection of conservation measures in the project is limited by the cantonal directive on minimum requirements for network projects, which lists measures that can be financially supported (Landwirtschaft und Wald (LAWA) (2014)). On the other hand, interviewees positively mention the rather broad content of this cantonal catalogue and commend its ecological opportunities, using the existing set of financially supported measures. Although it is possible to apply for financial support for additional region-specific measures (as has been done successfully in other parts of the canton), the eligibility requirements are considerable (Landwirtschaft und Wald (LAWA) (2014)). Moreover, the standardisation of conservation measures may save administrative costs. In general, the networked biosphere Marbach pursues the strategy of first implementing the given conservation measures to the maximum extent and making qualitative adaptations at a later stage, if necessary.

6. Case study III: Recreation Eggberge

6.1. Area and project description

The network project "Recreation Eggberge" is located in the north of the canton of Uri on the mountainous eastern bank of Lake Lucerne. The project area is located at an altitude of between 1300 m and 1700 m above sea-level and is characterised by difficult topographic conditions. The deeply carved landscape has a high variation of slopes and expositions and includes a diverse set of dry and wet habitats (Projektbericht 1 Eggberge 2, 2010).

Due to the diversity of the landscape the project area was divided into three landscape zones – mire landscapes, landscapes with dry habitats, and poorly networked landscapes – in order to adjust the conservation measures to the respective local conditions. In 2004, the project area covered about 285 ha (Projektbericht 1 Eggberge 2, 2010). In the second phase of the network project (since 2010) the project area was expanded substantially to around 1300 ha, of which about 770 ha are covered with forest. Also, for the characteristic ecologically rich Rigi region with steep, inaccessible montane meadows, a separate landscape zone – wild-hay meadows – was established (Projektbericht 2 Eggberge – Ricki, 2011).

In the beginning, nine index and target species were selected with two more species added in 2010. Among these species are characteristic birds, insects and amphibians (Projektbericht 1 Eggberge 2, 2010; Projektbericht 2 Eggberge – Ricki, 2011). Large parts of the project area (especially since 2010) are located in terrain (high elevation, steep slopes) not accessible with machinery. Thus the form of cultivation is traditionally extensive. Since the ecological quality of these extensively used areas is often very high, a main focus of the network project is their conservation and maintenance.

Initially, the network project "Recreation Eggberge" was founded by the municipality of Altdorf as a pilot project related to the ordinance of ecological quality. In the beginning the municipality of Altdorf also represented the official trusteeship of the network project. After two years, the trusteeship was handed over to local farmers including a responsibility to finance it.

6.2. Evaluation

6.2.1. Ecological effectiveness

Overall, in this project, the network bonus does not require farmers to make substantial changes compared to the base payment for ecological compensation areas in the project region. However, a cultivation of ecologically valuable areas that are difficult to access is only possible at substantial cost and is only financially attractive for the farmers through the network bonus in combination with the quality bonus. Thus, without the network bonus the cultivation of such remote and valuable areas would most likely cease. There are, however, some additional requirements such as the commitment to mow on a certain date that may have some additional ecological impact (Johst, Drechsler, Mewes, Sturm, & Wätzold, 2015). A few additional conservation activities have also been conducted since the network project was initiated. The most important ones are the enhancement of forest margins, the creation and conservation of small structures such as hedges, piles of rocks and branches, and small biotopes such as ponds. The overall size of ecological compensation areas is 57.4 ha. This is 19.7% of the total agricultural area of 291.4 ha in the project area (Projektbericht 2 Eggberge – Ricki, 2011).

There is no indication that the network bonus initiates to a substantial degree additional measures that enhance connectivity. It is rather argued that the network bonus ensures the existing connectivity among valuable and threatened land parcels.

The selection of target and index species was based on an initial ecological inventory by an expert and on their degree of endangerment. According to the needs of these species conservation measures were developed by a consultancy company with ecological expertise and were then reviewed by the cantonal administration and the trusteeship. The consultancy company has since been involved in the project management and today is paid by the farmers themselves. Conservation measures, conservation goals and implementation goals were adapted to the different landscape zones in the project area.

The formulated implementation goals contain rather specific objectives like, for example, the creation of two ponds for amphibians in two specific areas. After the first project period all implementation goals were achieved.

For the project evaluation, a qualitative ecological assessment by an ecological consultant was conducted at the end of the project period (Projektbericht 1 Eggberge 2, 2010; Projektbericht 2 Eggberge – Ricki, 2011). Though quantitative data is not available, indicators such as food availability and breeding options suggest that the overall situation for target and index species has somewhat improved.

6.2.2. Monitoring and enforcement

Whether conservation measures are really conducted as contractually agreed upon is mostly monitored by the consultancy company. But some of the measures are monitored by the trusteeship itself. For example, a representative of the trusteeship can be instructed by the consultancy company to take a picture of a specific area to prove that a certain share of a meadow really remained uncut. Some measures, for example the installation of nesting boxes, were conducted together with the consultancy company and thus do not require additional monitoring. Random controls are also conducted by the canton of Uri. There seem to have been cases of non-compliance in the beginning of the project but this has stopped over the course of the project.

6.2.3. Cost-effectiveness

Which conservation measures are implemented and where is negotiated during consultations with the farmers. The consultancy company presents proposals of possible locations and provides additional

Table 1
Indicative evaluation of the three case studies in terms of ecological effectiveness, monitoring and enforcement, cost-effectiveness and dynamic incentive effect with scoring and key explanations. Scoring system: + + + the criterion is achieved to a high extent, + + the criterion is achieved to a medium extent, + the criterion is achieved to a certain, but minor, extent.

	Fruit orchard Farnsberg	Network biosphere Marbach	Recreation Eggberge
Ecological effectiveness	+ + + - quantitative goals achieved and partly surpassed - increase in connectivity - strong involvement of species experts in measure design and success control	+ + - quantitative goals partly achieved, partly surpassed - connectivity increase envisaged but effect unclear - some involvement of species experts in measure design and success control	+ + + - quantitative goals achieved - maintaining rather than increasing connectivity - involvement of ecological consultants (paid by farmer) in measure design and success control
Monitoring and enforcement	+ + + - different parties involved in monitoring and enforcement, seems to work well	+ + + - different parties involved in monitoring and enforcement, seems to work well	+ + - different parties involved, but key role of ecological consultant paid by farmer
Cost-effectiveness	+ + - measure selection considers costs and ecological benefits - costly consultation but comprehensive and with high informational benefits	+ + - measure selection considers costs and partly ecological benefits - consultation with some informational benefits	+ + - frequently selected low cost measures are also ecologically beneficial - comprehensive consultation with informational benefits
Dynamic incentive effect	+ + + - novel conservation measures developed and learning effects led to lower costs	+ - learning effects facilitated implementation of conservation measures	+ + - coordination and modification of conservation measures due to learning effects

information about the ecological value of specific areas. Usually a compromise between the economic interests of the farmer and ecological requirements is found. However, in this project area the most extensively used areas are also of particularly high ecological value. Since a low labour input and a high ecologic output is in the interest of both farmers and conservationists, negotiations between farmers and the consultancy company are unproblematic.

In the first project period the municipality of Altdorf and the canton of Uri provided financial support for the development of the project, the initial consultation and information events. The municipality of Altdorf also represented the official trusteeship of the project. After the cornerstones of the project were established, the responsibilities were shifted towards the participating farmers, who took over the official trusteeship. Since then they are responsible for the implementation and the financing of the project. Today most of the coordination and communication activities within the project are done by the trusteeship of farmers in close collaboration with the municipal administration and the consultancy company. Tasks include for example the preparation of reports, the ecological assessment and the implementation of more complex conservation measures like the ecological improvement of forest margins.

Farmers benefit from the independent management of their network project. They decide which tasks can be done by themselves and for which tasks an expert has to be commissioned. This way the financial costs for the farmers can be minimised. Moreover, through common objectives the farmers' identification with the community was strengthened and their willingness to help each other was increased. Also the network project had a positive effect on communication between farmers, as they have met more frequently and talked more about biodiversity conservation since the project was started.

A shift in the preferences of farmers towards conservation can be observed. In the early stages of the project farmers wanted to shift their conservation measures to areas that were less visible to the public. They stated that they were afraid their reputation would be damaged when other people see that they did not mow their meadow. However this has changed, probably as a result of the financial incentive in combination with the transfer of knowledge during consultations.

6.2.4. Dynamic incentive effect

Dynamic incentive effects through learning could be observed in terms of coordinating and modifying measures and conservation objectives. For example, farmers began to share machinery and coordinated their use for conservation measures in such a way that the overall costs for the project were minimised. Another example is related to the existence of a certain flower species that became too dominant on meadows. After mowing on these areas failed to solve the problem, experiments with the use of goats were successfully conducted on a small scale. This was made possible due to some degree of flexibility regarding the choice of measures within the network project. However, the development of a regionally specific conservation measure – which would have been possible in principle – was not considered necessary in the network project Eggberge.

7. Summary of results and discussion

We investigated the implementation of the Swiss network bonus employing the criteria of ecological effectiveness, monitoring and enforcement, cost-effectiveness, and dynamic incentive effects for three network projects as case studies. We selected case studies that differ in terms of topographical characteristics as well as conservation objectives and measures, size of conserved areas and coordination mechanisms. By selecting case studies with different characteristics, we get a somewhat differentiated understanding of the implementation of the network bonus. However, given the limited number of three case studies, the diversity of potential conservation measures eligible for the network bonus in Switzerland, regional cultural differences between cantons and differences in agricultural land use, we cannot claim representativeness of our analysis for Switzerland as a whole.

Moreover, given the exploratory nature of our research, the results should be considered as preliminary and indicative rather than precise. Table 1 provides an overview of the evaluation of the three case studies against the four criteria. As we only have qualitative information, the scoring is also qualitative and based on our personal assessment from the interviews and the literature.

In terms of ecological effectiveness, we find that overall the introduction of the network bonus together with the quality bonus led to an increase in the size of the contracted areas. This is primarily due to higher payments to farmers, which make participation more attractive to them. The advantage in comparison to a hypothetical increase in the base payment is that the additional areas are of high ecological quality and integrated in a coherent network of areas to conserve target species.

We also observe that overall the quality of conservation areas that already existed prior to the network bonus has improved and the spatial

coordination of measures has been given more importance. To what extent this had a positive impact on the conservation status of biodiversity in general and the target species in particular remains somewhat unclear. There seems to be a consensus that the conservation situation has at least stabilised with respect to the target species and somewhat improved in general. In order to be able to give a more accurate assessment, better monitoring data would be needed.

The necessity to develop a target plan and select target and index species against which progress can be measured is costly but has several positive effects. The development and selection process together with discussions and consultations between farmers, ecological experts and members of the administration increased the awareness of farmers about the value of biodiversity. It also provided the possibility of a mutual learning process with regard to the selection and improvement of appropriate measures to conserve target and index species. Moreover, farmers are able to gauge the success of their conservation measures against the occurrence of index and target species. This enables farmers to justify their conservation work to third parties and leads to a kind of crowding-in effect of intrinsic motivation (cp. Fischer et al., 2011; Rode, Gómez-Baggethun, & Krause, 2015). It also forced the administration of each network project to think about how conservation measures can be selected and designed effectively and adjusted to local conditions rather than choosing the measures with the lowest administrative cost as is frequently done by administrations across Europe, a point that has been criticised by conservationists (Wätzold et al., 2010).

The establishment of a network project seems to provide the possibility to initiate a process where farmers learn from their neighbours. Farmers who were sceptical about conservation in the beginning later joined the network project after they saw that their neighbours had done so and obviously benefited financially. Learning from neighbours is a process that has also been observed in other circumstances, for example farmers changing from conventional to organic farming (Lewis, Plantinga, Nelson, & Polasky, 2011).

Overall, monitoring and enforcement seem to work reasonably well. Likely reasons for this are the consistent application of sanctions in cases of non-compliance and the fact that farmers also report cases of other farmers' non-compliance. This may be at least partly motivated by the fact that the non-compliance of some farmers endangers the success of the network project as a whole and thus has a negative effect on all participating farmers. However, it seems somewhat questionable that a consultant who is paid by the farmers monitors the compliance of those same farmers. This might lead to a conflict of interest between rigorous reporting of cases of non-compliance and the individual's interest in keeping the job as a consultant.

Regarding cost-effectiveness, the theoretical literature (Drechsler et al., 2010, 2016; Wätzold & Drechsler, 2014) that compares the agglomeration bonus with other payment schemes such as spatially homogeneous payments hypothesises that – for the same budget – spatially homogenous payments lead to a conservation area that is larger but of inferior spatial configuration and agglomeration bonuses lead to a conservation area that is smaller but of superior ecological quality. The latter is because the least cost patches cannot be selected from the landscape as patches need to be spatially connected with other patches.

Our results suggest that the network bonus approach is indeed more costly, but more ecologically valuable areas are included in comparison to a hypothetical situation where the additional money spent on network payments were used for a general increase of payments for ecological compensation areas. However, due to data limitations we are unable to quantify this trade-off between more, but less ecologically valuable conserved areas and less, but more valuable areas.

We observed some dynamic incentive effects that arise mainly from learning effects by farmers and to a lesser extent due to ecological research. Learning effects by farmers occur both in terms of cost reductions for conservation measures but also in terms of improved conservation measures. Improved conservation measures, however, are usually developed in cooperation with ecological consultants or NGOs.

Irrespective of similar observations across the three case studies, we also noticed differences. Network projects seem to benefit from the active involvement of a conservation NGO that nevertheless understands the needs of local farmers and works closely with them, as in the network project "Fruit orchard Farnsberg". This seems to create among participants the will to achieve joint success and, in the case of Farnsberg, also opened up opportunities for further funding from bird conservation NGOs. This is where we also find the strongest dynamic incentive effects, which, however, are achieved with support from a research institution. Overall, the network project "Fruit orchard Farnsberg" seems to be the best performing project in terms of ecological effectiveness whose conservation success is based on personal involvement but also substantial funding from the network bonus and other sources.

Furthermore we found that a strong involvement of farmers in the management of the network project, combined with thorough consultation, seems to have a positive effect. In the example of the network project Recreation Eggberge, participants benefit from gradually assuming more and more responsibility for the project leading to a more effective coordination of their conservation activities, improved communication among each other and common identification with the project. More generally, when farmers are strongly involved they are able to bring in their specific needs and culture, which has been found to be a key success factor of conservation policy instruments (Rode, Wittmer, Emerton, & Schröter-Schlaack, 2016).

We also observed differences in the priorities set during the consultation of farmers regarding the trade-off between cost criteria and ecological effects of potential conservation areas. In comparison to the project Network biosphere Marbach, in the projects Fruit orchard Farnsberg and Recreation Eggberge during the consultations more emphasis is put on including particular areas that are valuable for conservation. In contrast, in the project Network biosphere Marbach, more emphasis is placed on quantitatively increasing the area where conservation measures are implemented, stressing the financial benefits for farmers resulting from participation. The advantage of the approach used in the project Network biosphere Marbach is that the size of conservation area is higher and consultation costs are lower. The disadvantage is that mostly low-cost areas are included and few areas with a good benefit-cost ratio. Moreover, farmers might feel less intrinsically motivated to carry out or further develop the design or spatial arrangement of conservation measures. In this case they might just do what is needed to receive the payments with a limited interest in the overall conservation situation in the project area. This suggests that projects – depending on how they are implemented – may either lead to an increase of intrinsic motivation to conserve biodiversity or not (cp. Rode et al., 2015; Sommerville, Milner-Gulland, Rahajaharison, & Jones, 2010). We leave it to further research to investigate in more detail under which conditions such increases arise.

Furthermore granting each network project the flexibility to pursue a different implementation strategy albeit in a common framework can be seen as a positive feature of the Swiss network bonus. Implementation strategies can be adapted to various local conditions, such as ecological values, topographic properties and cultural characteristics. However, the obligation to periodically update and upgrade the project's conservation goals is likely to deliver a satisfying conservation outcome in the long run, both qualitatively and quantitatively.

Regarding the experimental economics literature on coordination in the context of the agglomeration bonus, Parkhurst et al. (2002) find pre-play communication while Parkhurst and Shogren (2007) find experience to be important for land users when it comes to cooperating to create contiguous habitat. These findings are in line with our finding that communication and learning matters in the three case studies. Banerjee et al. (2014) find that providing more information on the

behaviour of neighbouring land-owners is beneficial for coordination. This result is also in line with our finding from the case studies that farmers observe each other and learn from each other's behaviour.

For future research, we see the need for a quantitative analysis to determine which type of coordination and which other socio-economic factors are beneficial for the conservation success of network projects. This would identify possible options for improving the design of the Swiss network bonus. Moreover, it would stimulate and enrich the debate about other potential schemes similar to the agglomeration bonus (Pe'er et al., 2014) and a comparative assessment of the agglomeration bonus with other policy instruments (Drechsler, 2017). Such research would, however, require better monitoring data about the conservation success of individual network projects.

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