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Swiss farmers don't adopt agroforestry because they fear for their reputation

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Abstract Agricultural policy in Europe is moving towards greater support of multifunctional agriculture, such as agroforestry systems. However, modern farmers appear to be resisting this change. Trees in agricultural landscapes have been declining, despite increasing direct payments for their ecosystem services. To understand the drivers of farmer behaviour in Switzerland with regard to practicing agroforestry, we interviewed 50 farmers using a semi-quantitative and open ended questionnaire. In terms of potential motivations for adoption of agroforestry, most farmers gave highest scores to habitat ecosystem services, both for livestock and wildlife. Low scores were given to productivity, profitability and ecological direct payments. Farmers resisting adoption concluded that practising agroforestry would not have a positive impact on their reputation. They also attributed significantly lower scores to perceived behavioural control. We conclude that payments for ecosystem services will be unlikely to change farmers' behaviour, as long as their expectations and knowledge are not appropriately addressed. Transdisciplinary co-production of agro-ecological knowledge could help to change their attitude.

Keywords Agriculture · Ecosystem service · Farmer attitude · Farmer behaviour · Participatory research · Temperate agroforestry

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Introduction

Multifunctional agroforestry systems, some of them ancient, were a common feature in landscapes throughout the world (Nair 1993; Gibbons et al. 2008). These systems were managed to mimic natural ecosystems (Lefroy et al. 1999). In temperate regions fruit and timber trees as well as hedgerows were combined with arable intercrops (silvoarable systems) or with pastures (silvopastoral systems) in an ecologically complex arrangement (Herzog 1998; Eichhorn et al. 2006).

The integrated management of trees, crops and animals contributed to the creation of diverse landscapes and synergistic advantages. Asbjornsen et al. (2013) reviewed the role of perennial vegetation in agricultural landscapes for enhancing ecosystem services. Agroforestry in particular can combine high levels of productivity for food security with environmental services (Palma et al. 2007a). This can include ecosystem services, such as habitat services (Burgess 1999; McAdam et al. 2007; Reeg et al. 2009), climate regulation through CO_2 sequestration (Montagnini and Nair 2004; Palma, et al. 2007b) and soil and groundwater protection (Lehmann et al. 1999; Palma et al. 2007b). Trees in agricultural landscapes also provide highly attractive cultural landscapes (Junge et al. 2011).

However, agricultural policy and research in Europe in the second half of the 20th century encouraged large scale monocultures (Eichhorn et al. 2006). Subsidies were paid to farmers to shift towards ecologically simplified agro-ecosystems. Hedgerows and trees were removed to make way for larger farm machinery. In Switzerland, agroforestry had been popular and widespread until the 1950s (Ewald and Klaus 2010). Policy interventions in the following decades led to an 80 per cent decline from approximately 14 million trees in 1951 to less than 3 million trees in 2001 (BFS 2014). Only recently has the number of trees stabilized at 2.2 million trees (BLW 2013). Agricultural policy gradually refocused, as the problematic environmental impacts of large scale monocultures became apparent. In Switzerland a national vote in 1996 revealed, that the vast majority of the public (78 per cent) welcomed a change towards multifunctional agriculture (Herzog et al. 2005).

One way to restore multifunctional agricultural landscapes is through revitalizing traditional farming systems such as agroforestry. European policymakers are therefore increasingly supportive of the restoration of agroforestry practices but so far, this appears not to have halted their decline throughout Europe (Smith 2010).

This leads to the question of how farmers might be motivated to adopt agroforestry systems and what the obstacles are. To encourage farmers to manage complex agro-ecosystems that are fundamentally different from their current simplified systems is challenging (Pannell 1999). While recent bio-economic research indicates that temperate agroforestry may actually be profitable (Graves et al. 2007), relatively little is known about the socio-cultural driving forces behind farmer behaviour. Most research has been conducted in tropical regions where agroforestry is still widespread (Franzel 1999; Mahapatra and Mitchell 2001). Graves et al. (2009) interviewed 264 farmers across Europe. About half of them showed interest in agroforestry adoption. Whether this attitude leads to actual agroforestry planting is, however, uncertain and we don't observe a massive uptake of agroforestry across Europe. The literature suggests that farmers often tend to be risk averse and are reluctant to change (Pluske and Fraser 1996).

Hence, we set out to better understand the farmers' expectations and resources, in terms of practicing agroforestry. "Resources", in this context, comprises not only land, labour and capital but also technical know how and the farmers' latitude to make decisions in a given socio-cultural context. The ecosystem services concept (Daily 1997; Zhang et al. 2007) as an integrating framework can help to capture this broad approach to farmers' expectations and resources.

This paper explores how farmers perceive ecosystem services provided by agroforestry systems with special emphasis on the ongoing efforts to rehabilitate multifunctional landscapes. In Switzerland, for example, payments related to farmland trees have tripled since the 1990s (BFS 2014). The main objective of this research is, therefore, to determine potential factors which may explain Swiss farmers' resistance to maintain or even to recreate tree-rich agro-ecosystems and to identify the factors which may motivate them to engage in agroforestry.

Methods

In an exploratory phase preceding the main survey (2009–2010), expert and stakeholder workshops were conducted to gain an overview of local knowledge and expectations regarding agroforestry in Switzerland. A total of 21 preliminary interviews in various parts of Switzerland were conducted with farmers experimenting with various types of agroforestry systems (Sereke et al. 2015). This information, together with the findings from the workshops, was used to frame the main survey.

In contrast to the exploratory phase, the main survey addressed "average" farmers, who were not

specifically interested in agroforestry. We aimed at assessing the four psychological variables proposed by the Theory of Planned Behaviour (Ajzen 1985, 1991). We adopted the guidelines proposed by Aizen (2010) for developing a questionnaire to investigate and measure behaviour change. The theory suggests that a person's behaviour depends on the: (i) intention towards the behaviour, which we framed in the question: "Do you plan to maintain or to engage in agroforestry in the foreseeable future?"; (ii) attitude ("What is your opinion about tree products, agroforestry practices and productivity?"); (iii) subjective norms ("What do you expect the reaction of important stakeholders to be?") and (iv) perceived behavioural control of engaging in agroforestry ("Are you confident in your abilities and in framework conditions?"). Another three variables were added to frame those four issues. At the beginning of the interview, qualitative information about the farmer's socio-economic characteristics were recorded. The ecological motivations for adoption were categorized into ecosystem services as reported for agroforestry by McAdam et al. (2009): production (trees, crops, livestock), habitat (shelter, biodiversity), regulation (soil, water, climate) and culture and participants were asked to rank their importance. Economic motivations were assessed including profitability of agroforestry systems and payments for ecosystem services; participants were asked to indicate their respective expectations. Figure 1 illustrates the resulting seven proposed variables influencing the potential uptake of agroforstry.

The actual interview was preceded by a short information about traditional agroforestry systems (such as fruit orchards, which Swiss farmers are familiar with) and modern systems such as alley cropping (which were new to most farmers). The interview then comprised two parts, first the main closed format questions for quantitative analysis, followed by open format questions to record individual views. For all variables except socio-economic characteristics, the response options were based on a 6-point Likert-type item (1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = slightly agree; 5 = agree; 6 = strongly agree). Scores below 4 indicate obstacles for adoption. Multiple choice questions were used only in variable 2 (socio-economic characteristics), for the scoring range of 0–1 (yes/no) and 1–4 (e.g. age classes).

Images were used to discuss the different agroforestry practices. The questionnaire was translated into French and German, in order to meet the language preferences of the surveyed farmers. The survey was limited to the lowlands (Swiss Plateau) which is the main agricultural production region of Switzerland. Amongst the municipalities of the Swiss Plateau, 50 were randomly sampled, followed by the random identification of a farmer per municipality from the

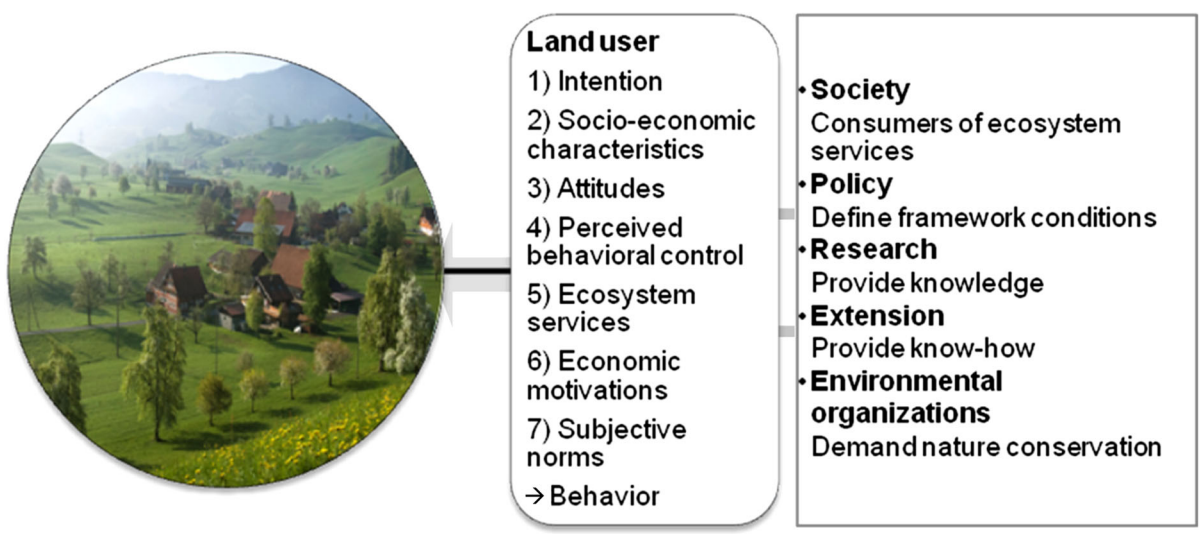

Fig. 1 The shape of agricultural landscapes depends on the decisions made by the local land users, who act under particular framework conditions. We propose seven explanatory variables to investigate and measure behaviour change

local telephone directory. Individual face to face interviews were undertaken on the farm, and lasted approximately 60 min. The comparison of sample means was achieved using a two-tailed T test. Statistics were computed using Excel 2007 for Windows and the statistical software R.

Results

In all, 50 interviews were conducted and evaluated. The results are presented according to the seven explanatory variables (Fig. 1) by which we aim at understanding the farmers' behaviour. On most farms, arable crop production was practiced on the flat fields, whereas remnants of former agroforestry practices and forests were maintained on the marginal slopes of the farm.

Intention: adopters and non-adopters

26 of the 50 interviewed farmers expressed their intention to maintain or adopt agroforestry ("adopters", mean intention score of 4.9), whereas 24 farmers showed no interest ("non-adopters", mean intention score of 2.0). The intentions of the "adopters" and the "non-adopters" differed significantly ($p < 0.001$, Table 1). In the following assessment, adopters and non-adopters were studied separately, to identify differences which rather motivate or discourage adoption of agroforestry.

Socio-economic characteristics: business as usual

The interviewed farmers cultivated on average 10–20 ha, which corresponds to the average of 16 ha farming area per farm in Switzerland (BFS 2014). They owned about half of the land they farmed, the other half was rented. Farmers classified as adopters tended to have more (remaining) trees on their farms (11–20) than non-adopters (5–10). All non-adopters practiced conventional agriculture, whereas three of the adopters were organic farmers. Nearly all interviewed farmers were specialized in arable farming, fodder production or animal husbandry (Table 1). Fodder production and livestock were significantly more important on the adopters' farms, with $p < 0.05$ and $p < 0.01$ respectively.

Trees (forestry or fruit production) played a minor role in the farm businesses of both, adopters and non-adopters. No significant differences were found in the socio-economic variables. However, the low availability of successors is a potential obstacle for planting trees that would be beneficial rather for the next than for the present generation. Almost all farmers had practiced agroforestry in the past and most of them still maintain remnants.

Pessimistic attitudes and popular fruit orchards

Most interviewed farmers were specialised in crop or livestock production, whereas trees were of minor importance in their farming system (Table 1). Similarly, farmers were only interested in silvopastoral practices but not in systems where trees or hedges interfere with arable fields (Table 2). Farmers would plant trees for fruit production rather than for high value timber or biomass production. Non-adopters were generally less interested in tree products ($p < 0.05$). Orchard silvopastoralism remained the most popular agroforestry system, in particular for adopters, whose farm enterprises were geared towards fodder and livestock production. The farmers' second choice was forest grazing. Farmers often mentioned that they would like their animals to graze in the forest, but that this is not allowed anymore. Windbreaks/hedgerows and boundary planting, which would occupy only little space on the field edges, were not popular. Remarkably, farmers were generally convinced that agroforestry is not productive compared to monoculture, non-adopters having a significantly more negative attitude ($p < 0.001$).

Low perceived behavioural control

Most interviewed farmers felt quite free to decide whether to practise agroforestry or not (Table 3). They were not very confident in framework conditions, though (scores <4). Furthermore, both farmer groups were not confident in managing agroforestry practices, while non-adopters felt even significantly less confident ($p < 0.001$). Still, the standard deviations (>1.2) indicate that a number of farmers ranked their confidence as 4 ("sufficient") or higher.

Ecological motivations

Farmers were asked about potential ecosystem services which would motivate them to practice agroforestry (Table 4). The primary motivations were

Table 1 Intention and socio-economic characteristics of the interviewed farmers and their farming system

Variables 1 and 2	Score	Adopters		Non-adopters		All Farmers	
Intention & socio-economics		M	SD	M	SD	M	SD
1) Intention[a]	1_6	4.9	0.7	2.0***	0.7	3.5	1.6
2) Socio-economic characteristics							
Economic importance[b]							
Arable cropping	1_4	3.3	0.9	3.2	1.1	3.2	1.0
Fodder production	1_4	3.7	0.7	2.9*	1.4	3.3	1.0
Livestock	1_4	3.8	0.6	2.8**	1.5	3.3	1.0
Forestry	1_4	1.6	1.1	1.3	0.6	1.4	0.9
Fruit production	1_4	1.4	0.9	1.3	0.9	1.4	0.9
Age[c]	1_4	3.0	0.7	3.3	0.7	3.1	0.7
Sex[d] (female_male)	0_1	0.96	0.2	0.96	0.2	0.96	0.2
Availability of successor[d]	0_1	0.38	0.5	0.42	0.5	0.40	0.5
History[d]							
AF practiced in the past	0_1	1.0	0.0	0.96	0.2	0.98	0.1
AF remnants today	0_1	1.0	0.0	0.88	0.3	0.94	0.2

Mean scores and standard deviations across samples (for "Intention" and "Economic importance" only): Farmers all (n = 50), adopters (n = 26), non-adopters (n = 24). Mean comparisons were made for all data, only statistical significances are indicated (2 sample *T* test)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] Scores between 1 (I totally disagree/very low) and 6 (I totally agree/very high)

[b] Semi-quantitative evaluation: 1 (very low), 2 (low), 3 (high), 4 (very high)

[c] Age classes: 1 (<20 years), 2 (20–40 years), 3 (41–60 years), 4 (>60 years)

[d] Categorical scale: (yes/no) or (male/female)

Table 2 Attitudes towards practicing agroforestry

Farmers were asked to rank the variables with respect to opportunities/strengths or weaknesses of agroforestry practices. Mean scores and standard deviations across samples: Farmers all (n = 50), adopters (n = 26) and non-adopters (n = 24). Mean comparisons were made for all data, only statistical significances are indicated (2 sample *T* test). The scoring range is from 1 (I totally disagree/very low) to 6 (I totally agree/very high)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Variable 3	Adopters		Non-adopters		All Farmers	
Attitudes	M	SD	M	SD	M	SD
Agroforestry products and practices						
Tree products						
Biomass	2.1	1.4	2.3	1.4	2.2	1.4
Timber	2.7	1.5	1.8*	1.0	2.3	1.3
Fruits	4.1	1.1	3.4*	1.5	3.8	1.3
Agroforestry practices						
Silvoarable	2.3	1.3	1.9	1.2	2.1	1.2
Windbreak	3.9	1.7	3.0	1.7	3.5	1.7
Boundary planting	3.9	1.6	3.3	1.5	3.6	1.6
Forest grazing	4.0	1.9	3.4	1.9	3.7	1.9
Silvopastoral	4.9	1.0	3.7**	1.7	4.3	1.5
Productivity and management						
Productivity	3.0	0.7	2.0***	0.7	2.5	1.0
Riskiness	3.2	0.9	2.7	1.1	3.0	1.4
Intercrop competition	3.1	0.8	2.8	1.3	2.9	1.4
Mechanization	3.1	0.8	2.6	1.2	2.9	1.5

Table 3 Perceived behavioral control of practicing agroforestry

Variable 4	Adopters		Non-adopters		All farmers	
Perceived behavioral control	M	SD	M	SD	M	SD
(i) Control over decisions	4.5	1.4	3.9	1.4	4.2	1.4
(ii) Confidence in framework conditions	3.6	1.3	2.9	1.4	3.3	1.4
(iii) Confidence to manage	3.8	1.2	2.4***	1.3	3.2	1.3

The questions in this item refer to whether: (i) farmers feel free to decide for adopting agroforestry; (ii) framework conditions allow them to practise agroforestry and (iii) they feel confident to manage agroforestry practices. Mean scores and standard deviations across samples: Farmers all (n = 50), adopters (n = 26) and non-adopters (n = 24). Mean comparisons were made for all data, only statistical significances are indicated (2 sample *T* test). The scoring range is from 1 (I totally disagree/very low) to 6 (I totally agree/very high)

*** $p < 0.001$

Table 4 Ecological and economic motivations for adoption

Variables 5 & 6	Adopters		Non-adopters		All Farmers	
Motivations for adoption	M	SD	M	SD	M	SD
(5) Ecosystem services						
Production (subsistence)	4.5	1.2	3.9	1.5	4.2	1.4
Regulation						
Soil	3.7	1.4	3.4	1.2	3.6	1.3
Water	3.3	1.3	3.2	1.2	3.3	1.2
Climate	3.1	1.5	3.0	1.3	3.1	1.4
Habitat						
Shelter	5.0	1.0	4.5	1.3	4.8	1.2
Biodiversity	5.0	0.8	4.5	1.2	4.8	1.0
Cultural landscape	4.7	0.8	3.8**	1.4	4.3	1.2
(6) Economic motivations						
Profitability of tree products	3.0	1.2	2.3*	1.3	2.6	1.3
Payments for ecosystem services	3.6	1.4	3.2	1.2	3.4	1.3

Farmers were asked whether the listed ecosystem services and economic variables represent potential motivations to practice agroforestry. Mean scores and standard deviations across samples: Farmers all (n = 50), adopters (n = 26) and non-adopters (n = 24). Mean comparisons were made for all data, only statistical significances are indicated (2 sample *T* test). The scoring range is from 1 (I totally disagree/very low) to 6 (I totally agree/very high)

* $p < 0.05$, ** $p < 0.01$

habitat function, both for biodiversity conservation and shade for livestock. Non-adopters scored the conservation of cultural landscapes through agroforestry significantly lower ($p < 0.01$) than adpoters. Environmental regulation was not a motivation for both farmer groups.

Economic de-motivations

Only few farmers viewed economic benefits from marketing tree products as a motivation to practice agroforestry (Table 4), with non-adopters being more pessimistic ($p < 0.05$). The existing payments for ecosystem services were rated higher than profitability from tree products, but on average the score remained <4.

Subjective norms: reputational risks

In terms of subjective norms about practicing agroforestry, farmers were asked whom they expect to approve the adoption of agroforestry. Most farmers expected that their fellow farmers would not approve

Table 5 Subjective norms about practicing agroforestry

Variable 7	Adopters		Non-adopters		All farmers	
Subjective norms	M	SD	M	SD	M	SD
(7a) Agroforestry would be approved by:						
Fellow farmers	3.0	1.0	2.3*	0.9	2.7	1.0
Extension officers	3.8	0.8	3.1*	1.0	3.5	1.0
Scientists	4.2	1.0	3.5*	1.0	3.9	1.1
Policymakers	4.7	1.0	4.3	1.1	4.5	1.1
Swiss public	4.9	0.8	4.9	0.7	4.9	0.8
Environmentalists	5.6	0.7	5.6	0.8	5.6	0.8
(7b) Effect on reputation	4.4	1.1	3.5**	1.2	3.9	1.2

(a) Which stakeholder do you expect to approve adoption? (b) Would adoption have a positive effect on your reputation? Mean scores and standard deviations across samples: Farmers all (n = 50), adopters (n = 26) and non-adopters (n = 24). Mean comparisons were made for all data, only statistical significances are indicated (2 sample *T* test). The scoring range is from 1 (I totally disagree/very low) to 6 (I totally agree/very high)

* $p < 0.05$, ** $p < 0.01$

agroforestry practices, in contrast to the Swiss public and environmentalists, who were expected to highly welcome agroforestry (Table 5). Non-adopters generally expected lower approval levels. Remarkably, only adopters concluded that adopting agroforestry would have a positive impact on their reputation ($p < 0.01$).

Discussion

With only 50 farmers interviewed, our sample is too small to justify a more elaborated statistical analysis. Still, the farmers were randomly selected and the results allow for an exploration of potential opportunities and barriers with regard to maintaining or adopting agroforestry on the Swiss Plateau.

Many farmers criticized the frequent changes in agricultural policies over the last decades, such as this farmer: "In the past we were asked to uproot our trees to facilitate mechanization, and now the demands are to plant trees". In the second half of the twentieth century, Swiss authorities ran a program for uprooting standard fruit trees to make way for large scale monocultures. In 1975, after increasing complaints by the Swiss public and by fruit juice processing factories, the felling actions were stopped (Ewald and Klaus 2010). Today, public grants are paid to maintain and to re-plant trees in the context of ecological focus areas and landscape conservation (Bundesrat 2013).

Opposing intentions and knowledge systems

Two farmer groups were identified, indicated by the significant differences in the intention levels to maintain or adopt agroforestry practices (Table 1). Almost half of the farmers were very clear in their intention not to engage in agroforestry. Their priority is crop production, as illustrated by the following quote: "If it is dry, trees are a competition to the intercrop". The other half of the farmers perceived opportunities in agroforestry. Those contrasting perceptions of the two groups are clearly visible in the subsequent analysis (Tables 2, 3, 4, 5).

Opportunity costs: barrier for change?

For decades the grant systems of many European countries, including Switzerland, aimed at increasing agricultural production and efficiency (Eichhorn et al. 2006). In spite of the gradually increasing support for ecosystem services since the 1990s, the subsidy system is still such that many farmers are comfortably specialized in monocropping and livestock production (Table 1, Bosshard et al. 2010). The actual development of the grant system can render agroforestry economically competitive (Sereke et al. 2015). Home et al. (2014) found that Swiss lowland farmers are more inclined to adopt ecological practices if these

actually provide the desired outcome. Agroforestry grants are motivated by ecosystem services provided from trees on farms (biodiversity, landscape scenery); those outcomes are quite obvious and can easily be evaluated (e.g. Birrer et al. 2007).

Scientific versus farmers knowledge

Considerable differences between the attitudes of farmers and the findings of recent agroforestry research were found. The integration of high value timber (Graves et al. 2007) or biomass producing trees (Wagner et al. 2009) into arable fields is described as a promising business for farmers in temperate Europe. However, most interviewed farmers were neither interested in high-value timber and biomass production nor in re-integrating trees into arable fields. Those interested in trees opted for fruit production combined with grassland (Table 2). This corresponds to the traditional fruit orchards which they are used to and which are supported by ecological direct payments. Also, farmers see agroforestry as less productive and efficient than monocropping. Recent scientific evidence from Switzerland (Sereke et al. 2015) and other temperate regions of Europe (Graves et al. 2007) suggesting that agroforestry can be even more productive and profitable is not yet available to most farmers. Moreover, Swiss farmers do not share the view that agroforestry can provide key ecological regulation services (Table 4) for example in terms of climate regulation, soil and groundwater protection (Lehmann et al. 1999; Montagnini and Nair 2004; Palma, et al. 2007b). These findings have not been made available to the majority of farmers.

These examples indicate that there is a lack of communication between science and real world practice. Farmer-led joint research can support collaborative development of locally adapted technologies (Waters-Bayer et al. 2015). Observable field trials or farmer field schools can address uncertainties, in terms of managing modern agroforestry practices. It is also noteworthy that there is a high variability amongst the farmers. Although on average they lack confidence in framework conditions and in their own know how (Table 3), the high standard deviations suggest that this evaluation is not unanimous. This observation is corroborated by the existence of "pioneer farmers", who invest in traditional or in modern agroforestry systems (Sereke et al. 2015).

Towards ecological and economic synergies

The primary motivations of adopters and non-adopters to engage in agroforestry were biodiversity conservation and shade for livestock (Table 4). The most significant difference with regard to ecosystem services was that for non-adopters, restoring cultural landscapes was not a motivation. Hence, the two groups seem to have different perceptions of agricultural landscapes. This may be one reason why non-adopters did not perceive agroforestry as good for their reputation.

Most farmers did not expect agroforestry to be a profitable activity. The low score for the profitability of (high-stem) tree products can be explained by low fruit prices combined with high production costs in Switzerland (Alder 2007). Most farmers did not view payments for ecosystem services as a motivation for adoption (Table 4) but rather as a kind of income which is not justified by labour: grants for "lazy" farmers. A recent study confirms that Swiss lowland farmers feel torn between a societal expectation to conserve nature and the wish to appear productive to their peers (Home et al. 2014). The social resistance by the non-adopters can be partly explained by the traditional primary goal of farmers to produce food. Our findings indicate that restoring the market for fruits (from standard trees) would rather motivate farmers to plant trees, than increasing direct-payments.

Co-producing shared visions and solutions

Non-adopters, in contrast to adopters, concluded that engaging in agroforestry would have a negative effect on their reputation. In fact, reputation can be a critical explanatory variable in farmers' non-adoption of agroforestry. Non-adopters' behavior seems to be more oriented towards the opinion of their colleagues, than towards the opinion of society and environmentalists. A lack of sympathy against environmentalists was often mentioned by non-adopters, for example: "I fear environmentalists like a sword", refering to the increasing environmental restrictions.

Exchange, for example in multi-stakeholder platforms (Critchley et al. 2006; Burkhardt-Holm 2008), could reduce the gap between different interest groups and facilitate collaborative landscape improvements. The reputation of ecological innovations can be

improved through a fair coverage of ecosystem services provided by agro-ecosystems in farmer education and relevant media. The rise of organic farming in Europe is an example of successful transdisciplinary collaboration (Aeberhard and Rist 2009). Similarly, a transition towards multifunctional landscapes requires a shift towards transdisciplinary collaboration.

Facilitation of legal conditions is also crucial as the current segregation of forestry and agriculture is an obstacle in restoring multifunctional landscapes (Rigueiro-Rodríguez et al. 2009). Pragmatic solutions are needed, which make sense to farmers and foresters and which can be easily implemented by administrators.

Conclusion

The survey identified social, economic and technical barriers towards maintaining or adopting agroforestry practices by Swiss farmers. Although the interviewed farmers were randomly selected, the sample was small. Also, the scores are rather variable amongst farmers, depending on their personal situation and preferences. The results nevertheless indicate that even high levels of payments for ecosystem services may not be sufficient to change farmers' behaviour. Reputational risk, for example, was one of the key non-monetary obstacles identified. There is also lack of information amongst farmers, in particular with respect to novel agroforestry systems which can be managed with modern machinery and which can be highly productive and profitable.

Involving the perspectives of local stakeholders is critical in any research and policy making process. Both, fundamental and applied research, are needed to increase agro-ecological knowledge and to empower farmers to change. One small step has been taken by this project with the establishment of a multistakeholder platform (www.agroforst.ch/www.agroforesterie.ch). Whilst it is important that formal research results must be made available to farmers, progress and uptake of innovation can be significantly accelerated by farmer-to-farmer learning. Farmers will engage in agroforestry only if they develop an active interest for working with trees and perceive a benefit (economic or ecosystem service) for themselves and/or for the next generation.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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