Master Thesis

Result-oriented biodiversity measures for agriculture in Swiss mountains

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RESULT-ORIENTED BIODIVERSITY MEASURES FOR AGRICULTURE IN SWISS MOUNTAINS

MASTER THESIS

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Swiss Alps with their mountainous farmlands are a biodiversity hotspot both in terms of wildlife and livestock species. However, lately, the conservation of this farmland biodiversity is threatened by intensification of profitable meadows and pastures and abandonment of unprofitable meadows and pastures. To counteract the negative effects of intensification and land-abandonment on Swiss mountainous farmland biodiversity, effective measures are needed. One of the measures are agri-environmental schemes that give direct payments for environmental-friendly farming. There are two different approaches of agri-environmental schemes: action-oriented approaches (AOA), where farmers are paid for a prescribed management within their land and result-oriented approaches (ROA), where the direct payments are directly bound to ecological results.

This study investigates the farmer’s commitment and willingness to implement various result-oriented biodiversity measures (ROBM) and the farmer’s acceptance regarding the ROA in comparison to the AOA. For this purpose a qualitative study with 21 mountain farmers within the mountain zones in the Canton of Lucerne was used to get context-specific insights of the farmers to the ROBM. A quantitative study with 146 German-speaking mountain farmers within the mountain zones was used to get statistically representative and significant results on the respective research questions.

The results show, that the farmer’s current commitment and willingness for different ROBM and their corresponding rewards are relatively low for most farmers. The production intensity such as high livestock density und cutting frequency clearly shows a negative effect on the farmer’s commitment and willingness to implement biodiversity measures. When asked to choose the measure that farmers are most willing to implement in the future, farmers mostly chose to improve forest edges (23%) and grassland biodiversity (18%). The better a farmer understands the utility of a ROBM, the greater the probability of his or her participation for it. A fourth of the Swiss German-speaking mountain farmers (25%) prefer the ROA over the AOA because they assume that through this approach biodiversity is increased more directly and effectively. Three fourth of the farmers chose the AOA because they believe that less external specialists and controls are needed to analyse the efficiency of the approach. Farmers who prefer the ROA are more willing to invest in further education and closer cooperation with other farms than farmers who prefer the AOA.

Given the results, local information campaigns are recommended to reduce the knowledge gaps about result-oriented approaches and biodiversity measures that were revealed among the Swiss mountain farmers. Such campaigns would inform farmers about the following: the result-oriented approach and its benefits; the target and indicator species and their functions; and specific actions that can be taken to provide financial, social and ecological benefits to the farmers. The specific actions would promote a large scale sustainable biodiversity management by the Swiss mountain farms for the future.

Increasing intensification of agricultural production (i.e. higher livestock density and cutting frequency) has significantly decreased biodiversity and ultimately negatively influenced the commitment and willingness of farmers to implement action- and result-oriented agri-environmental measures. As a strategy against these negative processes, the current Swiss agricultural policy aims at lowering the farming intensity (i.e. livestock density) in the mountain zones. The results of this thesis suggest that this strategy should be pursued or even reinforced in the future by the Swiss government if the commitment and willingness of farmers to increase biodiversity in mountainous systems should be strengthened.
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1. Introduction

1.1 General Introduction

The world’s population is expected to grow to 8.9 billion by 2050 (FAO, 2006). For this purpose, countries around the world have promoted intensification of agriculture since 1950 (FAO, 2011). In Europe, the intensification has been promoted over the last decades (Birrer, Balmer, Graf, & Jenny, 2009) which led to a significant loss of biodiversity in diverse cultural landscapes (Baur et al., 2004). Significant losses in biodiversity in Switzerland related to agriculture have mostly affected fens and dry meadow ecosystems (Federal-Office-of-Agriculture, 2013). This development is in contradiction to the Swiss Federal Council which proposes multifunctional agriculture since 1996 (Federal-Council, 1996).

Multi-functional agriculture, additional to guarantee food supply security, cares for the cultural landscape and maintains decentralized settlements (Birrer et al., 2009).

Swiss Alps and pre-Alps with its mountainous farmland are part of the cultural landscape of Switzerland and a biodiversity hotspot with a genetically divers pool of species (Klaus, 2013). This biodiversity hotspot has a responsibility for the evolutionary capacity of Europe (Klaus, 2013). However, agricultural intensification has reached the Swiss mountainous farmland over the last decades and now threatens its biodiversity (Peter, Gigon, Edwards, & Luscher, 2009). The profitable and well accessible meadows are intensifiﬁed through more fertilization which allows higher cutting frequency and more hay yield (Kampmann et al., 2008). The profitable pastures are intensiﬁed through higher livestock densities since 2008 (Federal-Office-of-Agriculture, 2013; Küttel, 2013). In more remote areas with poorer economic potential, agriculture is often abandoned (Federal-Office-of-Environment, 2009; MacDonald et al., 2000). Additionally to the abandonment, farmers experience land loss due to urban sprawl, also in the alpine regions. (Federal-Office-of-Agriculture, 2013). Thus, proﬁtable meadows and pastures in the mountain areas are threatened by intensification, whereas unproﬁtable ones are menaced by abandonment (Dietschi, Holderegger, Schmidt, & Linder, 2007; Federal-Office-of-Environment, 2009; MacDonald et al., 2000; Tasser & Tappeiner, 2002). Both threats affect biodiversity negative (Federal-Office-of-Agriculture, 2013; Tasser & Tappeiner, 2002): Intensified meadows and pastures show less diversity in their species compositions due to higher nutrient content in the soil and trampling damage, whereas abandoned meadows and pastures are overgrown by shrubs and bushes which suppresses light-demanding species and therefore lowers the overall species diversity (Federal-Office-of-Environment, 2009; Küttel, 2013).

To counteract the negative effects of intensification and land-abandonment on biodiversity in Swiss mountain areas, effective measures are needed to increase or at least stabilize the biodiversity level. One approach that has been taken by different countries to preserve multifunctional agricultural landscapes are agri-environmental schemes that give direct payments for environmental-friendly farming. In Switzerland, the government has implemented different agri-environmental schemes since 1993 attempting to stop the trend of declining farmland biodiversity (Kampmann, Luscher, Konold, & Herzog, 2012). Within the classical schemes, which are called action-oriented approaches (AOA), farmers are paid for a prescribed management form within their land for example for managing a part of their land as ecological compensation area (ECA) (Mann, 2010). The effects of this approach in Switzerland have been mainly evaluated by Birrer (2009), Herzog (2005) and Kampmann (2008). For the Swiss plateau the effects of the AOA were only moderately positive for biodiversity (Herzog, T. Walter, et al., 2005; Walter et al., 2013). Despite partial success for genetic diversity, considerable deﬁcits exist regarding the conservation of species and ecosystem diversity in Switzerland (Lachat et al., 2010). This failure of the action-oriented approach has led to the idea of stronger coupling direct payments to ecological outcomes.
Since 2001 a new approach, called result-oriented approach (ROA), has been implemented by the Swiss government (Mann, 2010). In this approach the direct payments are bound to ecological results. The effects of this approach have been evaluated in Switzerland by Mann (2010) and Walter (2013). Walter (2013) found a general quantitative lack of ECAs in the lower altitude areas and a qualitative deficit of ECAs all over Switzerland. Different weaknesses of the cost-effectiveness of the different ROA have been pointed out by Mann (2010). The direct payments for ECAs with ecological quality are bound to a certain amount of target and indicator species. When a farmer has achieved the expected target and indicator species, there is no further incentive to improve the ecological quality for the farmer. An effective control system for the quality achievements of ECAs, which are within an inter-linkage projects, has not been consistently implemented. The effects of ROA on ecology and on economy are not convincing yet. The effects on society respectively the farmer’s acceptance of the ROA is discussed controversial. Whereas Sabatier (2012) and his colleges are convinced of the advantages of the ROA believing that it will be very well accepted by farmers, Burton (2013) and his colleges are more reluctant saying there is a need for more empirical studies into how likely farmers are to respond to the ROA.

1.2 Research objectives and questions

This thesis tries to find such empirical evidence assessing the acceptance of Swiss farmers regarding the ROA (Research question a). Going into more detail, this study investigates various result-oriented biodiversity measures (ROBM) with a potential to increase biodiversity on Swiss mountain farms (Research questions b, c, d and e). For this purpose a step-wise process was conducted: First, a literature review was conducted to assess the current adoption by farmers and the effectiveness of the agri-environmental schemes promoting biodiversity in Switzerland. Second, factors influencing the farmer’s commitment and willingness to implement ROBM were identified through literature review. Third, farmers were asked qualitatively and quantitatively about their acceptance regarding the ROA in comparison to the AOA and their commitment and willingness to implement ROBM in the German-speaking mountain part of Switzerland. Fourth, the data were analysed for factors influencing the farmer’s commitment and willingness to implement ROBM. Finally, the results were discussed and conclusions are drawn with regard to policy recommendations.

The following research questions will be answered in the thesis:

a. How committed are the farmers currently to implement result-oriented biodiversity measures (ROBM)?

b. Do the farmers prefer the action-oriented approach (AOA) or the result-oriented approach (ROA)?

c. Which result-oriented biodiversity measures (ROBM) are the farmers willing to implement?

d. Which socio-demographic and farm characteristic factors influence the commitment and the willingness to implement result-oriented biodiversity measures (ROBM)?

e. Which support do the different groups of farmers prefer to implement biodiversity measures?
1.3 Associated European project MERIT

The qualitative analysis of the thesis is part of the European project MERIT (Merit based income from sustainable land management in mountain farming). The main goal of the MERIT project is to investigate result-oriented biodiversity measures with a potential to create a higher income and at the same time increase biodiversity in the European Alps. Particularly, public and private biodiversity supporting schemes shall be investigated regarding result-oriented approaches versus action-oriented approaches. Within this project the results of the qualitative analysis of interviews with German, Austrian, French, Italian and Swiss farmers in the Alps are compared (MERIT, 2014). The Swiss participation is financed by the Federal Office of Agriculture.

1.4 Literature review

1.4.1 Development of action-oriented Swiss agri-environmental schemes and measures

The Swiss government has implemented different agri-environmental schemes since 1993 (Dietschi et al., 2007; Kampmann et al., 2012) which grants farmers financial compensation for lower agricultural yields and ecosystem services. These agri-environmental compensation payments as well as all other direct payments for Swiss farmers are bound to several ecological and social conditions called eligibility criteria according to the Swiss agricultural law since 1993 (Federal-Council, 1996). Since 1998 farmers need to fulfil the Ecological Performance Record (EPR) which includes amongst other requirements that farmers must have a reasonable proportion of Ecological Compensation Areas (ECAs) (Kampmann et al., 2012). In 1998, this proportion has been raised from 5% to 7% (Federal-Council, 2014). In 2012, 49'705 farms who manage 1'028'199 hectares of Swiss utilized agricultural area (UAA) received direct payments (Federal-Office-of-Agriculture, 2013). This means that 90 % of Swiss farms which cultivate 98% of the Swiss UUA comply with the eligibility criteria and therefore manage minimally 7% of their land as ECAs (Federal-Office-of-Agriculture, 2013).

In 1993, farmers could choose between three different ECA types to fulfil the eligibility criteria and these were promoted by direct payments (Table 1). In 1998 ten additional ECA types were included. Nine of the thirteen ECA types were promoted by direct payments. Since 2014, farmers are offered 16 different ECA types which are all promoted by direct payments. The direct payments for the different ECA types are understood as action-oriented measures, as the area is paid according to the management measures prescribed to the farmer and independent of the actual species-richness on the area. Direct payments for keeping animals (unless specific animal-welfare friendly systems) are no longer paid to farmers, as these were a factor of intensification with negative impact on biodiversity.
Table 1. Ecosystem elements, biodiversity level and action-oriented approach (AOA) or result-oriented approach (ROA) of existing public agri-environmental measures (Federal-Council, 2014).

<table>
<thead>
<tr>
<th>Agri-environmental measures</th>
<th>Ecosystem elements</th>
<th>Biodiversity level</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological Compensation Area</td>
<td>extensively farmed grassland, low-intensity farmed grassland, standard fruit tree equivalents, litter meadows, hedges, field and bank side groves, extensively farmed pastures, forest pastures, wildflower strips, crop-rotation fallow land, crop margins, herbaceous borders, endemic habitat-appropriate individual trees and avenues and vines of natural biodiversity, meadows along the banks of streams and rivers species-rich grasslands in the alpine area, region-specific biodiversity promotion areas</td>
<td>Plant diversity, habitat diversity</td>
<td>AOA</td>
</tr>
<tr>
<td>Quality-oriented ECA</td>
<td>extensively farmed grassland, low-intensity farmed grassland, standard fruit tree equivalents, litter meadows, hedges, field and bank side groves, extensively farmed pastures, forest pastures, vines of natural biodiversity</td>
<td>Plant diversity, habitat diversity</td>
<td>ROA</td>
</tr>
<tr>
<td>Inter-linked ECA</td>
<td>All ecosystem elements of ECAs and additionally dry stone walls, stone piles, clumps of branches, ponds, moats or lakes, breeding sites for bird species</td>
<td>Plant diversity, animal diversity, habitat diversity</td>
<td>ROA</td>
</tr>
</tbody>
</table>

1.4.2 Development of result-oriented Swiss agri-environmental schemes and measures

In 2001 the Direct Payment Ordinance (DPO) was extended with the Ecological Quality Ordinance (EQO) (Birrer et al., 2009; Federal-Council, 2014; Mann, 2010). The agri-environmental scheme contains two result-oriented approaches: one promoting ecological quality of Ecological Compensation Areas (ECA) and the other promoting inter-linked ECA (Birrer et al., 2009; Mann, 2010). Additional payments are given to the farmers if they meet a minimum ecological quality standard for ECAs and/or if they join a regional project to inter-link habitats (Herzog, Dreier, et al., 2005). In a first approach, the ecological standard was defined through a simple quality criterion: If a minimum of six plant species of a list of 40 plant species, which are typical for biodiversity-rich grasslands, are found within an ECA it holds a high ecological quality (Mann, 2010). The indicator species have been selected by scientists. The Cantonal authorities are allowed to adapt the indicator species list to their regional characteristics (Mann, 2010). An analogous quality criterion for faunlike biodiversity could not be defined, as animals are more mobile than plants and their presence on a certain spot depends on daily and seasonal time changes and are highly stochastic (Mann, 2010). Since 2001 the quality promoting ECA includes five ECA types (Table 1). In 2008, there was a revision of the EQO and three additional ECA types were introduced. Additionally, the quality payments for all the eight ECA types were increased.
The inter-linked ECAs need a community-based and administered “inter-linkage” project where a concept is developed (Mann, 2010). That concept illustrates the initial state of valuable habitats, the desired state through faunist and floristic target and indicator species and an action plan how to achieve the desired state (Mann, 2010). The desired states are periodically evaluated, latest after eight years (Mann, 2010). Implementing these concepts, farmers create additional ECAs acting as small scale habitats between ECAs and will get additional payments per ECA in return.

1.4.3 Development of a private result-oriented scoring system and label organisations to enhance biodiversity

In 2007 the project “Diversity score – Farmers enrich nature” was launched by the Swiss ornithological institute in Sempach and the Research Institute of Organic Agriculture in Frick, later in collaboration the two label organisations first with IP-Suisse and later also with Bio Suisse (Birrer et al., 2009). The two institutes developed a scoring system which assesses the performance of farmers promoting biodiversity. Since biodiversity is not directly measurable, the system evaluates different habitats (Table 2). The result-oriented system is based on the size, quality and location of ecological compensation areas as well as other biodiversity measures (Birrer et al., 2009). The assessment is done by the farmer and thus allows a self-evaluation of the farm from an ecological perspective (Birrer et al., 2009). This benchmarking will be able to show the farmer new biodiversity measures he has not implemented yet (Birrer et al., 2009). Since the ecological potentials of valley and mountain farms differ, a variation was developed for the mountain farms (Birrer et al., 2009). Since 2010, IP-Suisse and its farmers participate in the project “Diversity score – Farmers enrich nature”. Bio Suisse and its farmers introduced the project in 2014 and will start participating officially in 2015.

The label organisation ProSpecieRara was founded in 1982. This non-profit organisation’s goal is to promote the genetic diversity of Swiss livestock breeds and crop varieties (ProSpecieRara, 2014) (Table 2).

<table>
<thead>
<tr>
<th>Private measures</th>
<th>Ecosystem elements</th>
<th>Biodiversity level</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP-Suisse biodiversity scoring system</td>
<td>All Ecosystem Elements of quality-oriented and inter-linked ECAs, additionally quality-oriented forest edges, rare livestock and arable crops, rare wildlife species (target species)</td>
<td>Plant diversity, animal diversity, habitat diversity, genetic diversity of plants and animals</td>
<td>ROA</td>
</tr>
<tr>
<td>Breeding program ProSpecieRara</td>
<td>Rare livestock and arable crops</td>
<td>Genetic diversity of plants and animals</td>
<td>ROA</td>
</tr>
</tbody>
</table>
1.4.4 Farmer's participation in action-oriented biodiversity measures

Since 1993 Ecological Compensation Areas (ECA) have strongly increased in a first phase and stabilized on a relatively high level since 2002 (Fig. 1). Since 2011, the percentage of utilized agricultural area (UAA) managed as ECAs increased again. In 2013, on average 13% of the Swiss UAA was managed as ECAs, with a higher percentage in the mountain areas as compared to the lowlands (Federal-Office-of-Agriculture, 2013).

The currently most applied ECA type are extensively farmed grasslands, in which management prescriptions are late cut (not earlier than mid-June) and no fertilization during six years (Federal-Office-of-Agriculture, 2013). The late mowing ensures that plant seeds reach maturity and animals (e.g. invertebrates, ground-nesting birds and small mammals) have enough time to reproduce (Federal-Office-of-Agriculture, 2013). Since 1993, the extensively farmed grassland weakly increased until 1998 (Fig. 2). From 1999, they steadily increased up to be the dominant ECA type with 51% in 2011. The second dominant ECA type is low-intensity farmed grassland, which must be managed equally as extensively farmed grassland except that a restricted fertilization with manure is allowed (Federal-Office-of-Agriculture, 2013). They show the opposite trend of the extensively farmed grasslands with a steady increase from 1993 until 1998 led by a steady decrease from 1999 down to 18% of all ECA types in 2011.
The ECA type standard fruit tree equivalent is often used. One fruit tree corresponds to one area (100 m²) of land (Agrigate, 2014). Their level stayed constant over time. The ECA types litter meadows and hedges, field and bank side groves weakly increase since 1998. The litter meadows are especially protected through the nature and heritage protection law since 1996. The other eleven ECA types are rarely used by farmers and therefore not shown in the diagram (Biodiversitätsmonitoring, 2014).

1.4.5 Farmer’s participation in result-oriented biodiversity measures

Since 2001, ECAs with special quality have strongly increased in a first phase and decreased again from 2004 on (Fig. 3). After the revision in 2008, ECAs with quality have increased again. ECAs in inter-linkage projects have steadily increased since 2001. In 2012, on average 8 % of the Swiss UAA was managed as ECAs in an inter-linkage project and 5 % with special quality (Federal-Office-of-Agriculture, 2013).
1.4.6 Farmer's participation in the private result-oriented scoring system and label organisations to enhance biodiversity

In 2013, all farmers with IP-Suisse label had to achieve 17 points in the project “Diversity score – Farmers enrich nature” (IP-Suisse, 2012). In 2010 37% of the participating farmers reached 17 points and this number steadily increased up to 86% in 2013 (Fig. 4). The goal set of the IP-Suisse organisation was nearly attained. More points in the scoring system means a stronger promotion of biodiversity (IP-Suisse, 2012).
The people which are voluntarily committed to preserve genetic diversity for the label organisation ProSpecieRara are increasing every year (ProSpecieRara, 2013). In 2013, 1276 persons were voluntarily committed to promote genetic diversity of 26 animal breeds and 2481 persons were voluntarily committed to promote genetic diversity of 3300 plant crops for the label organisation ProSpecieRara (ProSpecieRara, 2013). In 2013, 456 persons owned the seal of approval, which allows those farmers to sell their products with the ProSpecieRara label (ProSpecieRara, 2013).

Fig. 5. Development of persons committed to preserve genetic diversity (ProSpecieRara, 2013)

1.4.7 Effectiveness of action-oriented Swiss agri-environmental schemes and measures

In the Swiss lowlands, a significantly higher species richness of plants and invertebrates such as grasshoppers and wild bees was found on extensively and low-intensity farmed grassland compared to conventionally farmed grassland (Knop, Kleijn, Herzog, & Schmid, 2006). Nevertheless, most hay meadows (80%) and traditional orchards (88%) were of poor ecological quality (Herzog, T. Walter, et al., 2005). Grassland and orchard birds weakly profit from these two Ecological Compensation Area types (Zellweger-Fischer, Kery, & Pasinelli, 2011). The habitat quality of these meadows is insufficient for specialized plants and arthropods which is shown in the fact that there was no positive population trend in endangered species recorded until now (Birrer et al., 2009; Birrer et al., 2007; Knop et al., 2006). Still, most litter meadows (86%) and hedgerows (50%) were of good ecological quality and attracted wetland and hedgerow birds (Herzog, T. Walter, et al., 2005). In the Swiss mountain area, a significantly higher plant species richness was found on extensively and low-intensity farmed grassland compared to conventionally managed meadows (Kampmann et al., 2008). In the Swiss mountain area more hay meadows are of good quality than in the lowlands (Herzog, T. Walter, et al., 2005). The existing high species diversity is maintained by encouraging the traditional management through action-oriented schemes and thus preventing abandonment of economically unattractive and remote sites (Dietschi et al., 2007; Kampmann et al., 2008). At low altitudes action-oriented biodiversity measures protect species richness at a few economically marginal sites important for
maintaining the species pool whereas at higher altitudes, the measures still preserve existing biodiversity more equally distributed at the landscape scale (Kampmann et al., 2012).

1.4.8 Effectiveness of result-oriented Swiss agri-environmental schemes and measures

The result-oriented biodiversity measure which promotes ecological quality shows the predefined amount of target species and therefore exhibits higher plant diversity as Ecological Compensation Areas without ecological quality. The result-oriented biodiversity measure which inter-links different habitats increases the colonisation process of invertebrates like grasshoppers and land snails (Knop et al., 2006). If hedgerows are linked to extensively used meadows for example, the fauna profits more than from isolated habitats (Herzog, T. Walter, et al., 2005). In summary, the result-oriented measures have a high potential to conserve and increase biodiversity (Mann, 2010). Yet, the actual percentage of Ecological Compensation Areas with quality and inter-linkage within the Swiss agri-environmental scheme is still far too low to stop the trend of declining biodiversity especially in the plain region and the mountain zones I and II (Walter et al., 2013).
2. Methods

2.1 Data collection

Through literature review and expert interviews, possible result-oriented biodiversity measures (ROBM) were assessed. All the measures were classified according to their ecosystem elements, biodiversity levels and policy approaches. Some representative biodiversity measures were chosen to investigate further through a qualitative and quantitative survey with Swiss mountain farmers. The qualitative study was used to get context-specific insights of the farmers about ROBM, identify factors influencing the farmer’s decision making and investigate causalities. The quantitative study was used to get statistically representative and significant results on the respective research questions, which can be generalized. In January and February 2014 a preliminary qualitative survey was conducted with 21 not randomly chosen mountain farmers within the mountain zones in the Canton of Lucerne who receive agricultural direct payments. With these results the quantitative survey form was developed (see Appendix). This questionnaire was administered in March to April 2014 to a stratified random sample of 1000 German-speaking Swiss mountain farmers within the mountain zones who receive agricultural direct payments. Strata were the mountain zones and organic vs. non-organic production. The alpine areas as well as the plain area were excluded. The random sampling out of the Swiss Agricultural database latest actualised in 2012 was done by the Federal Office of Agriculture. The overall response rate was 20% which is lower than the generally expected 25% of comparable empirical studies (Personal Communication Schmid, O., 2014). 30 responses were of farmers that have given up farming and 24 responses of farmers who did not fill out the questionnaire in an analysable manner. This led to 146 fully completed questionnaires used for the analysis. The quantitative data was analysed with descriptive statistics and statistical tests with the software SPSS. The qualitative data was used in the discussion to complement qualitatively the results of the quantitative data.

2.2 Survey design

The survey form for the quantitative study consisted of eight pages comprising questions about the farmer’s socio-demographic characteristics (age and education) and farm characteristics (farm size, production emphasis, production system, production intensity and production conditions), farmer’s current commitment for result-oriented biodiversity measures (COM), farmer’s future willingness to implement result-oriented biodiversity measures (WIL), farmer’s preference for biodiversity promoting approaches and finally the farmer’s preference for support for biodiversity implementation.

The production emphasis was identified by asking for the different label livestock breeds. Regarding the production system it was distinguished between organic, integrated and conventional production. As the survey was only sent to farmers who receive direct payments, the eligibility criteria as well as the ecological performance record was met by all surveyed farmers. Producing organically means to follow the directives of the Bio Suisse label organization. Producing integrated means to follow the directives of the IP-Suisse label organization. Both labels support the engagement of farmers to protect nature and to foster biodiversity. Producing conventionally means to follow the ecological performance record (EPR) as a minimum commitment to ecology.
The production intensity was identified with three variables. One variable measures the intensity of livestock farming through the stocking density. For all livestock breeds a livestock manure unit per hectare (LMU) can be calculated. This value gets more meaningful when divided by the fertilizable land in hectares. One LMU corresponds to one cattle of 650 kg (Biodiversitätsmonitoring, 2014). For each animal class a livestock unit factor has been defined to convert the different livestock breeds. Those conversion factors depend on the nitrogen and phosphorous excretions of the different livestock breeds (Biodiversitätsmonitoring, 2014). In the questionnaire the farmers were asked for the amount of their different livestock breeds and explicitly for their LMU per hectare and LMU per fertilizable hectare. With the livestock data the LMU was calculated implicitly using the conversion factors. The calculated LMU was used as a variable to verify the farmer's data. Another variable measures the cutting intensity of intensively managed meadows, less-intensively managed meadows and intensively managed pastures. The third variable is a self-assessed production intensity variable.

The self-assessment was used to compare the self-perception with the calculated farming intensity.

The production conditions were identified with items about the farm's level above sea, the amount of land with 18 to 35% and more than 35% of steepness as well as the farm's mountain zones. The Swiss Federal Council has defined four mountain zones according to the length of vegetation period, the traffic accessibility and the steepness of the UAA (Federal-Council, 1999).

The farmer's current commitment for result-oriented biodiversity measures (COM) was identified with three variables: The items about the farmer's total share of Ecological Compensation Areas (ECAs), the share of quality-oriented ECAs and inter-linked ECAs were added up to a variable representing the farmer's current commitment for action- and result-oriented biodiversity measures directly subsidised by the state (COMDS). The items about the farmer's implementation of single element measures to achieve quality-oriented and inter-linked ECAs were added up to a variable representing the farmer's current commitment for result-oriented biodiversity measures indirectly subsidised by the state (COMIS). The farmer's commitment for genetic diversity measures (COMG) was identified through adding up items about the farmer's participation in a livestock breeding program of the organisation ProSpecieRara.

To identify the farmer's future willingness to implement result-oriented biodiversity measures (WIL), two variables were created using nine representative biodiversity measures (Table 3). The farmer's willingness to implement result-oriented plant, animal and habitat diversity measures (WILB) has been identified through adding up six variables testing the willingness to implement the six measures 1, 2, 3, 4, 5 and 9. The farmer's willingness to implement genetic diversity measures (WILG) has been identified through adding up three variables testing the willingness to implement the three measures 6, 7 and 8. The allocation of the variables into these two groups is based on the results of a principal component analysis.
Table 3. Nine representative measures to promote biodiversity on different biodiversity levels.

1. Farmers improve the plant diversity of their meadow and pasture and make sure that a minimum number of plants and butterflies as well as grasshopper species occur in it.

2. Farmers improve the plant diversity of their hedges and make sure that a minimum number of nesting bird species occur in it.

3. Farmers improve the biodiversity of their forest edges and make sure that a minimum number of nesting bird species occur in it.

4. Farmers put dry-stone walls or rock piles on their land and make sure that a minimum number of reptile species are found therein.

5. Farmers install ponds, moats or lakes and make sure that a minimum number of dragonflies and amphibians occur in it.

6. Farmers keep rare large livestock breeds.

7. Farmers keep light large livestock breeds.

8. Farmers keep rare small livestock breeds.

9. Farmers plant rare arable crops, vegetables, fruit trees or berry varieties.

The items about the reasons for the farmer’s future willingness to implement result-oriented biodiversity measures (WIL) were developed and categorized based on Ajzen’s theory of planned behaviour (1991). According to this theory, farmers take decisions guided by three types of rationales: behavioural beliefs, normative beliefs and control beliefs (Ajzen, 1991). The reasons for the WIL were divided into five subgroups. The three subgroups personal willingness, financial factors and ecological and cultural landscape diversity factors were categorized as behavioural beliefs. The subgroup personal ability was categorized as control beliefs and the subgroup social acceptance was categorized as normative beliefs (Table 4). These subgroups were further analysed with principal component analyses regarding specific biodiversity measures.

Table 4. Five main reasons for biodiversity measure preference

<table>
<thead>
<tr>
<th>Reasons for measure preference</th>
<th>Specific reasons for measure preference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioural beliefs</strong></td>
<td></td>
</tr>
<tr>
<td>Personal willingness</td>
<td>Joy and chance to learn something new</td>
</tr>
<tr>
<td>Financial factors</td>
<td>More income</td>
</tr>
<tr>
<td>Ecological and cultural landscape diversity factors</td>
<td>Increase of biodiversity and preservation of cultural landscape diversity</td>
</tr>
<tr>
<td><strong>Control beliefs</strong></td>
<td></td>
</tr>
<tr>
<td>Personal ability</td>
<td>Easy implementation</td>
</tr>
<tr>
<td><strong>Normative beliefs</strong></td>
<td></td>
</tr>
<tr>
<td>Social acceptance</td>
<td>Social acceptance by family, neighbours, customers and society</td>
</tr>
</tbody>
</table>

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Siebert (2006) emphasizes that additionally to the three factors of Ajzen’s theory of planned behaviour, the policy design and its influence on the three factors has to be investigated. In this study, the farmer’s preference of the two main policy approaches promoting biodiversity in Switzerland and its influence on the three factors was examined statistically. The action-oriented and the result-oriented approach were described in detail using existing examples and then it was asked, which approach the farmers prefer and why. The reasons were formulated based on factors mentioned in literature reviews. Finally, the farmers were asked which support they need to implement the biodiversity measures. To be able to perform statistics, all questions were closed and responses to reasons for the farmer’s decisions were measured across a standard 5-point Likert type scale.

### 2.3 Data analysis

The influence of most predictive variables could be tested with Pearson correlation. The farmer’s education, the production system, the farmer’s current commitment for result-oriented biodiversity measures (COM), the farmer’s future willingness to implement result-oriented biodiversity measures (WIL) and the approach preference are nominal variables. Their influences on each other have to be tested with Chi-square instead of Pearson correlation. To be able to perform the Chi-Square test, respectively the Fisher’s Exact test, it was necessary to transform the variables measuring the farmer’s education, the production system, the COM and the WIL into a binominal variables. Half of the variable values were assigned to one and the other half to two. The data was further analysed with bivariate T-tests and principal component analysis (PCA) using the software SPSS. PCA is an eigenvector-based multivariate analysis and is mostly used as a data reduction method (Statistics, 2014). In the study, PCA was used to reduce the sixteen given reasons why the farmers prefer a certain biodiversity measures to a few principal components. For each component a component score, which is the transformed variable value corresponding to a particular data point, is calculated (Shaw, 2003). The value of the component score, which is the weight by which each standardized original variable should be multiplied to get the component score, is an indication of the correlation (Shaw, 2003). The sum of all the component scores account for the variance the components can explain (Statistics, 2014). The varimax rotation with Kaiser normalization was used as this simplifies the interpretation. The used data set is jointly normally distributed, so the principal components are guaranteed to be independent. According to the advice of Comrey and Lee in (Tabachnick & Fidell, 1991) regarding sample size the used sample size of 146 is between poor and fair. The Kaiser-Meyer-Olkin (KMO) score with 0.6 as a suggested cut-off was used to check whether the data set is adequate for PCA (Statistics, 2014).
3. Results

3.1 Farmer’s socio-demographic and farm’s characteristics

The farmers were on average 48 years old compared to the national average of 52 years (BFS, 2012). More than half of the farmers (51%) have completed an agricultural education. Some farmers have completed a different apprenticeship (18%) or even an agricultural master craftsman certificate (15%). Only very few farmers have completed studies at university (3%). The average mountain farm size was 18.2 ha compared to the national average of 18.6 ha (BFS, 2012). Most farmers (78%) were strict dairy farmers. A few farmers (24%) had cattle with suckler cows, goats, mutton sheep, dairy sheep, pigs or poultry besides dairy cows. Comparing the responses regarding the production system with the initial sample and the national data, organic farmers were overrepresented on all mountain zones (Table 5). The integrated production farmers (36%) sell their products with the IP-Suisse label and the organic farmers (35%) sell their products with the Bio Suisse label. A few farmers (8%) sell their products with a regional or the ProSpecieRara label.

<table>
<thead>
<tr>
<th>Percentage of organic farming in Switzerland [%]</th>
<th>Percentage of organic farming of initial sample [%]</th>
<th>Percentage of organic farming of respondents [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain zone I</td>
<td>11.1</td>
<td>11.7</td>
</tr>
<tr>
<td>Mountain zone II</td>
<td>14.2</td>
<td>15.1</td>
</tr>
<tr>
<td>Mountain zone III</td>
<td>26.0</td>
<td>25.6</td>
</tr>
<tr>
<td>Mountain zone IV</td>
<td>36.0</td>
<td>37.5</td>
</tr>
<tr>
<td>Average</td>
<td>21.8</td>
<td>22.5</td>
</tr>
</tbody>
</table>

The farmers are quite evenly distributed among the mountain zones. More than a third of all farmers are in the mountain zone II (36%), a fourth of all farmers are in the mountain zone III (25%), less than a fourth are in the mountain zone I (22%) and a few farmers are in the mountain zone IV (17%). The farms lay between 430 and 2016 meters above sea-level, with an average level of 910 meters a.s.l. On average, 6 ha or 33% of the land are 18-35% steep and 5 ha or 28% of the land is steeper than 35%. The mountain zone the farmers work in correlates significantly positive with meter a.s.l. and steepness of more than 35% (Appendix A). It correlates significantly negative with the livestock density and meadow cutting frequency.

The explicit and implicit average livestock density of 1.2 LMU per hectare as a measure of the intensity of farming was identical to the national average (Biodiversity monitoring, 2011). The explicit average livestock density per fertilizable hectare was higher than the explicit average livestock density (Table 6). The explicit livestock density per hectare, the implicit livestock density per hectare as well as the livestock density per fertilizable hectare was significantly inter-correlated (Appendix B) indicating that the explicit livestock density per hectare is representing the stocking density well.
Table 6. Explicit and implicit average livestock farming of respondents \((n=146)\) on all mountain zones.

<table>
<thead>
<tr>
<th>Mountain zone</th>
<th>Explicit average livestock density [LMU/ha]</th>
<th>Implicit average livestock density [LMU/ha] calculated by number of animals</th>
<th>Explicit average livestock density [LMU/fertilizable ha]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain zone I</td>
<td>1.5</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Mountain zone II</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Mountain zone III</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Mountain zone IV</td>
<td>0.9</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Average</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The cutting frequency of meadows as a measure of the farming intensity was rather high. The farmers manage most of their hay meadows intensively with four cuts per year (Table 7). Some hay meadows are managed at lower intensity with three cuts per year and the permanent pastures are farmed intensively with four grazing periods per year. The cutting frequency of intensively farmed hay meadows, of low-intensity hay meadows as well as the grazing intensity on permanent pastures was significantly inter-correlated (Appendix C) indicating that the cutting frequency of intensively farmed hay meadows is representing the cutting frequency of meadows well. The farmers were also asked for a self-assessment relating to the intensity of their farming (Appendix D). The self-assessed intensity significantly correlated with the cutting frequency of meadows and the livestock density indicating that the cutting frequency of meadows and the livestock density are representing the intensity of farming well.

Table 7. Average hectares, cuts and grazing, average mineral nitrogen fertilization, average liquid and dry manure application of hay meadows and permanent pastures \((n=146)\).

<table>
<thead>
<tr>
<th>Hay meadows</th>
<th>Average hectares</th>
<th>Average cuts or grazing respectively per year</th>
<th>Average mineral nitrogen fertilization [kg N/ha and year]</th>
<th>Average liquid manure application [m³/ha and year]</th>
<th>Average dry manure application and year [t/ha]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive hay</td>
<td>10</td>
<td>4</td>
<td>37</td>
<td>80</td>
<td>13</td>
</tr>
<tr>
<td>Low-intensity</td>
<td>6</td>
<td>3</td>
<td>21</td>
<td>42</td>
<td>8</td>
</tr>
<tr>
<td>Permanent</td>
<td>3</td>
<td>4</td>
<td>30</td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td>pastures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2 Farmer’s current commitment for result-oriented biodiversity measures

The farmers are variably committed to the different result-oriented biodiversity measures (ROBM) and their corresponding rewards. More than half of the farmers used up to 10% of their land as Ecological Compensation Area (ECA) with ecological quality (58%) and inter-linked ECA’s (59%) (Fig. 6). More
than a quarter of the farmers used between 11% and 20% of their land as ECA with ecological quality (27%) and inter-linked ECA's (26%). One sixth of the farmers (16%) used more than 20% of their land as ECA with ecological quality and inter-linked ECA's. Overall, the farmer’s current commitment for result-oriented biodiversity measures directly subsidised by the state (COMDS) is relatively low.

![Figure 6](image)

**Fig. 6.** Percentage of farmer's Ecological Compensation Areas (ECA) with inter-linkage and quality.

The farmer’s current commitment for result-oriented biodiversity measures indirectly subsidised by the state (COMIS) is relatively high. More than four fifth of the farmers (81%) have taken biodiversity measures on their meadows. Two third of the farmers (66%) have created a pond. More than half of the farmers (53%) installed nesting and breeding sites for birds and less than half of the farmers enhanced the edges of the woodland ecologically (46%) and leave clumps of branches on the land (42%). More than a fifth of the farmers managed dry stone walls (23%). The farmer’s current commitment for genetic diversity measures (COMG) is relatively low. A third of the farmers have endemic standard fruit trees (33%). A few farmers have endemic bees (*Apis mellifera mellifera*) (10%), rare cattle races (8%), small animal races (7%) or are involved in the conservation breeding program of ProSpecieRara (8%). Summarized COMIS is higher than COMDS and this is higher than COMG. Although there are big differences among the three commitment variables, there are significant dependences between them. The COMDS is significantly influenced by the COMIS, but not to the COMG (Appendix E). The COMIS is significantly influenced by the COMG. As these variables are not all independent from each other, they were tested separately in the data analysis.

The COMDS is significantly influenced by several factors. It is positively correlating with the mountain zone, the steepness of the farmer’s land and the farmer’s age and it is negatively correlating with the intensity of farming (Table 8). The COMDS is significantly influenced by the production system. More exactly, the organically producing farmers have a significantly higher COMDS than the farmers producing with an integrated approach to farming. The organically producing farmers have a significantly higher share of quality-oriented ECAs ($X^2(1)=14.714, p<0.001$) than the farmers producing with an integrated approach to farming as well as a significantly higher share of quality-oriented ECAs ($X^2(1)=6.930, p<0.01$) than the conventionally producing farmers. Between the integrated and the conventionally producing farmers, there is no difference concerning the COMDS. The COMDS is not influenced by farm size, meter a.s.l., farmer’s education or approach preference.
Table 8. Factors like age, steepness, mountain zone, livestock density and cutting frequency influencing farmer’s current commitment for result-oriented biodiversity measures directly subsidised by the state (COMDS).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pearson Correlation Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age*</td>
<td>0.239*</td>
<td>0.011</td>
</tr>
<tr>
<td>Share of land with steepness higher than 35 %*</td>
<td>0.193*</td>
<td>0.044</td>
</tr>
<tr>
<td>Mountain zone*</td>
<td>0.339***</td>
<td>0.000</td>
</tr>
<tr>
<td>Organic farmers vs. farmers producing with an integrated approach to farming*</td>
<td>7.513**</td>
<td>0.006</td>
</tr>
<tr>
<td>Livestock density [LMU/ha]*</td>
<td>-0.318**</td>
<td>0.003</td>
</tr>
<tr>
<td>Cutting frequency of intensively farmed meadows*</td>
<td>-0.360***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Pearson Correlation, **Chi-square test, Significance level (2-tailed): * 5%, ** 1% and *** 0.1%.

The COMIS is significantly influenced by the production system. More exactly, the organically producing farmers have a significantly higher COMIS than the conventionally producing farmers ($X^2(1) = 8.818, p<0.001$). COMG is not significantly influenced by any of the tested factors.

### 3.3 Farmer’s preference for biodiversity preserving approaches

Exactly three third of the farmers prefer the action-oriented approach (AOA) over the result-oriented approach (ROA) independent of the farmer’s socio-demographic and the farm’s characteristics (Fig. 7). The two groups of farmers were analysed descriptively: The farmers preferring the AOA are producing slightly more intensive as they have a marginally higher livestock density (1.2 LMU/ha) compared to the farmers preferring the ROA (1.1 LMU/ha). This difference is not significant. The farmers preferring the ROA produce predominantly organic (45%), integrated (35%) and a lower percentage of farmers conventional (20%) whereas the farmers preferring the AOA more equally produce organic (35%), integrated (32%) and conventional (33%). This difference however is not significant either.
Five reasons for the choice of the two approaches differentiated significantly between the two groups of farmers (Table 9). The reason differentiating most is the reason “less specialists and controls are needed to analyse the efficiency of the approach”. Farmers who preferred the ROA, preferred the reason “biodiversity is enlarged more directly and effectively”. Farmers who preferred the AOA preferred the following four reasons: “it is clearer what farmers have to do in order to get direct payments, less specialists and controls are needed to analyse the efficiency of the approach”, “it is surer, that the farmers will get the direct payments”, “it is easier to control and everyone has the same conditions”. Four reasons were not significantly differentiating the choice of the two approaches by the farmers. Farmers did equally prefer the reasons: “having more possibilities to apply their experience and knowledge”, “improvement of their self-empowerment”, “more flexibility in the adoption of the measures and more income” indifferent of their approach preference.
Table 9. The five reasons significantly differing between the preference of the action-oriented approach (AOA) and the result-oriented approach (ROA).

<table>
<thead>
<tr>
<th>Reason</th>
<th>Choice</th>
<th>Mean</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity is enlarged more directly and effectively.</td>
<td>AOA</td>
<td>3.42</td>
<td>3.636***</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>4.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is clearer, what farmers have to do in order to get direct payments.</td>
<td>AOA</td>
<td>4.19</td>
<td>-2.813**</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>3.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less specialists and controls are needed to analyse the efficiency of</td>
<td>AOA</td>
<td>4.10</td>
<td>-4.017***</td>
<td>0.000</td>
</tr>
<tr>
<td>the approach.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>2.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is surer, that the farmers will get the direct payments.</td>
<td>AOA</td>
<td>4.11</td>
<td>-2.970**</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>3.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is easier to control and everyone has the same conditions.</td>
<td>AOA</td>
<td>4.19</td>
<td>-2.967**</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>ROA</td>
<td>3.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

3.4 Farmer's future willingness to implement result-oriented biodiversity measures

The farmers are differing in the willingness to implement diverse result-oriented biodiversity measures (ROBM) currently as well as in the future. The qualitative improvement of meadow and pasture biodiversity is the most appreciated measure (Appendix F). More than a fourth of all farmers have already implemented this measure (27%) and less than a fourth are willing to implement it in future (24%). Less than a fifth of all farmers have already improved the ecological quality of their hedges (19%) and forest edges (19%). In the future, more than a fourth of all farmers are willing to implement forest edges improvements (27%). More than a fifth of all farmers are willing to implement hedge improvements (21%). A fourth of all farmers have put dry-stone walls or rock piles on their land and made sure that a minimum number of reptile species are found therein (25%). A few farmers are willing to implement this measure in the future (13%). Building ponds, keeping rare animal races or planting arable crops was not popular among the farmers.

When asked to choose the one measure that farmers are most willing to implement in the future, farmers mostly chose to improve forest edges (23%) and grassland biodiversity (18%) (Fig. 8). To keep rare animals (14%) and light animals (14%) was chosen from fewer farmers. Build rock piles (7%), lakes (7%), cultivating arable crops (6%) and improving the ecological quality of hedges (4%) was least chosen. When asked to choose the one measure that farmers are least willing to implement in future, most farmers chose to plant rare arable crops (27%) and build ponds (26%). Comparing the measures that farmers are most and least willing to implement in future, there are two measures that have been equivalently chosen: improving the ecological hedges quality and keep rare animal races. Over all, the farmer’s willingness to improve grassland and forest edge biodiversity was higher than the willingness to keep rare races and this was higher than the willingness to improve lake and hedge quality.
The farmer’s willingness to implement result-oriented plant, animal and habitat diversity measures (WILB) and the farmer’s willingness to implement genetic diversity measures (WILG) are independent from each other and are significantly influenced by several factors. The WILB is positively correlated with the farmer’s current commitment for action- and result-oriented biodiversity measures directly subsidised by the state (COMDS) and farmer’s current commitment for result-oriented biodiversity measures indirectly subsidised by the state (COMIS) and negatively correlated with the intensity of farming (Table 10). The WILB is significantly influenced by the production system. More exactly, the organically producing farmers have a significantly higher WILB than the farmers producing with an integrated approach to farming and the conventionally producing farmers. Between the integrated and the conventionally producing farmers, there is no difference concerning the WILB. The WILB is not correlated with the socio-demographic variables, the farm size, the meter a.s.l., the steepness, the mountain zone and the approach preference.
Table 10. Factors influencing Swiss farmers’ willingness to implement result-oriented plant, animal and habitat diversity measures (WILB).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pearson Correlation Coefficient/ Chi-square value</th>
<th>P-value</th>
</tr>
</thead>
</table>
| Farmer’s current commitment for action- and result-oriented biodiversity measures directly subsidised by the state (COMDS)
|                                                                          | 0.234**                                          | 0.009   |
| Farmer’s current commitment for result-oriented biodiversity measures indirectly subsidised by the state (COMIS)
|                                                                          | 18.964***                                        | 0.000   |
| Organic farmers vs. farmers producing with an integrated approach to farming
|                                                                          | 5.413*                                           | 0.020   |
| Organic farmers vs. conventionally producing farmers                      | 8.610**                                          | 0.003   |
| Livestock density [LMU/ha]                                                | -0.264**                                         | 0.009   |
| Cutting frequency of intensive meadows                                   | -0.250**                                         | 0.007   |

*Pearson Correlation, **Chi-square test, Significance level (2-tailed): * 5%, ** 1% and *** 0.1%.

WILG is positively correlated with the steepness and the mountain zone (Table 11). It is negatively correlated with the intensity of farming. The WILG is significantly influenced by the production system. More exactly, the organically producing farmers have a significantly higher WILG than the conventionally producing farmers. The farmers producing with an integrated approach to farming have a significantly higher WILG than the conventionally producing farmers. The WILG is not correlated with the socio-demographic variables, the farm size, meter a.s.l., the COM and the approach preference.

Table 11. Factors influencing Swiss farmers’ willingness to implement genetic diversity measures (WILG).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pearson Correlation Coefficient/ Chi-square value</th>
<th>P-value</th>
</tr>
</thead>
</table>
| Share of land with steepness higher than 35 %
|                                                                          | 0.191*                                           | 0.030   |
| Mountain zone                                                          | 0.169*                                           | 0.045   |
| Organic farmers vs. conventionally producing farmers
|                                                                          | 5.222*                                           | 0.022   |
| Farmers producing with an integrated approach to farming vs.
| conventionally producing farmers                                       | 5.582*                                           | 0.018   |
| Livestock density [LMU/ha]                                               | -0.278**                                         | 0.001   |
| Cutting frequency of intensively farmed meadows                         | -0.183*                                          | 0.031   |

*Pearson Correlation, **Chi-square test, Significance level (2-tailed): * 5%, ** 1% and *** 0.1%.

The reasons for farmers choosing certain measures were analysed with a principle component analysis (PCA). The different reasons were allocated to the five categories personal willingness (PW), social acceptance (SA), financial potentials (FP), ecological and cultural landscape diversity potentials (ECP) and personal ability (PA). First, the reasons for choosing to improve forest edges biodiversity were analysed as this was the most preferred result-oriented measure by the farmers. The factorability of the 16 items of the reasons for choosing to improve forest edges quality was deemed to be suitable for PCA as the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.63, above the commonly recommended value of 0.60, and Bartlett’s test of sphericity was significant (Χ² (120) = 246.29, p<0.05). Initial eigenvalues above one indicated that the first five components explained 23%, 18%, 16%, 10% and 9% of the variance respectively (Table 12). The item “The implementation of the
measure preserves Swiss heritage” was not shown, because it failed to meet a minimum criteria of having a primary factor loading of 0.5 or above and it did not clearly load on one specific component. The found five components explaining 75% of the variance correspond quite well to the five categories PW, SA; PF; ECP and PA. Farmers who preferred to improve forest edges quality, agreed on that they are personally willing and capable and feel socially expected to implement the measure and that it brings marketing as well as ecological and cultural landscape diversity benefits.

Table 12. Rotated component matrix for reasons to improve forest edges biodiversity.

<table>
<thead>
<tr>
<th>Reason categories</th>
<th>FP</th>
<th>SA</th>
<th>PW</th>
<th>PA</th>
<th>ECP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of principal component variance [%]</td>
<td>23</td>
<td>18</td>
<td>16</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Society expects me to implement the measure to contribute to biodiversity in Switzerland.</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure leads to higher agricultural yields.</td>
<td>0.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My customers like the implementation of the measure and it increases my chances for additional income through direct marketing.</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure has advantages in marketing under specific labels.</td>
<td>0.66</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure brings a secure income through long-term contracts.</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My neighbour farmers say that I should implement the measure.</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most people, who are close to me, expect me to implement the measure.</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My customers expect me to implement the measure.</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would enjoy implementing this measure.</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to learn something new during the implementation of the measure.</td>
<td>0.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The measure is easy to implement on my farm.</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can implement this measure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
<tr>
<td>The implementation of the measure preserves a variety of landscapes.</td>
<td></td>
<td></td>
<td></td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure significantly increases the biodiversity.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.65</td>
</tr>
<tr>
<td>The implementation of the measure brings additional income through direct payments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.68</td>
</tr>
</tbody>
</table>

Note: The reasons were allocated to the five categories personal willingness (PW), social acceptance (SA), financial potentials (FP), ecological and cultural landscape diversity potentials (ECP) and personal ability (PA). Factor loadings < 0.5 are suppressed
Further, the reasons for farmer’s choosing to improve grassland biodiversity were analysed as this was the second most preferred result-oriented measure by the farmers. The factorability of the 16 items for the reasons for choosing to improve grassland quality was deemed to be suitable for PCA as the KMO measure of sampling adequacy was 0.60 and Bartlett’s test of sphericity was significant ($X^2_{(120)} = 239.74, p<0.05$). Initial eigenvalues above one indicated that the first four components explained 23%, 22%, 19% and 11% of the variance respectively (Appendix G). The four components found explaining 75% of the variance correspond quite well to four of the five categories PW, SA; PF; ECP and PA. Farmers who preferred to improve grassland biodiversity, agreed on that they are personally capable and feel socially expected to implement the measure and that it brings marketing as well as ecological and cultural landscape diversity benefits. Further analysis to find out the reasons for choosing the other measures was not practicable as the factorability of the 16 items was not suitable because the KMO measure of sampling adequacy was below 0.60.

### 3.5 Relation between farmers preferring the result-oriented approach and their preference for certain measures

To investigate the relation between the farmer’s approach preference (action-oriented or result-oriented approach) and their preference of certain measures different methods were applied. First, a Principle Component Analysis (PCA) was carried out to investigate whether the nine measures load on specific components. The factorability of the 9 measures was deemed to be suitable for PCA as the KMO measure of sampling adequacy was 0.82 and Bartlett’s test of sphericity was significant ($X^2_{(36)} = 347.67, p < 0.05$). Initial eigenvalues above one indicated that the first two components explained 34% and 20% of the variance respectively (Table 13). The nine measures load on two specific components.

<table>
<thead>
<tr>
<th>Percent of principal component variance [%]</th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Farmers improve the biodiversity of their grassland.</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>2. Farmers improve the biodiversity of their hedges.</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>3. Farmers improve the biodiversity of their forest edges.</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>4. Farmers put dry-stone walls or rock piles on their land.</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>5. Farmers install ponds, moats or lakes.</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>6. Farmers keep rare large animal races.</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>7. Farmers keep light large animal races.</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>8. Farmers keep rare small animal races.</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>9. Farmers plant rare arable crops, vegetables, fruit trees or berry varieties.</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

Note: Factor loadings < 0.4 are suppressed

Next, a bivariate T-Test was used to investigate whether the two specific components can be explained by the farmer’s approach preference. A PCA, which would have been the more appropriate method for this investigation, could not be used as the selection criterion did not meet the KMO
criterion. The bivariate T-Test showed that farmers who prefer the measures improving biodiversity of hedges, forest edges, putting dry-stone walls or rock piles on the land, installing ponds, moats or lakes as well as planting rare arable crops, vegetables, fruit trees or berry varieties, which belong to the first component of the PCA (Table 13), significantly correlate with farmers preferring the result-oriented approach (Table 14). The second component could not be explained by the farmer’s approach preference, as no T-Test showed significant differences. There is a relation between the farmer’s preference for the result-oriented approach and their preference for certain measures. No relation was detected between the farmer’s preference for the action-oriented approach and their preference for certain measures.

Table 14. Five measures differing significantly between with the approach preference.

<table>
<thead>
<tr>
<th>Choice</th>
<th>Mean</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Farmers improve the biodiversity of their hedges.</td>
<td>AOA 2.66</td>
<td>3.808***</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>ROA 3.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Farmers improve the biodiversity of their forest edges.</td>
<td>AOA 3.01</td>
<td>2.376*</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>ROA 3.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Farmers put dry-stone walls or rock piles on their land.</td>
<td>AOA 2.66</td>
<td>2.055*</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>ROA 3.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Farmers install ponds, moats or lakes.</td>
<td>AOA 2.01</td>
<td>2.072*</td>
<td>0.045</td>
</tr>
<tr>
<td></td>
<td>ROA 2.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Farmers plant rare arable crops, vegetables, fruit trees or berry varieties.</td>
<td>AOA 1.80</td>
<td>2.183*</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>ROA 2.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

3.6 Different groups of farmers and their preference for support to implement biodiversity measures

In order to promote biodiversity measures, improved planning security within agricultural policies and direct payments are the most important supportive elements for the future for both farmers groups; farmers preferring the action-oriented approach (AOA) (23%) and the farmers preferring the result-oriented approach (ROA) (18%) (Fig. 9). For the farmers preferring the AOA consulting (17%) is more important than for the other group of farmers (12%). For the farmers preferring the ROA, further education (14%) and social recognition (14%) are more important supportive elements than consulting (12%). Additional to further education and social recognition closer cooperation with other farms (8%) is more important for the farmers preferring the ROA than for the other group of farmers (2%).

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All farmers mostly like to get advice to promote biodiversity measures from the cantonal consultancy service (19%), from magazines (18%) and from the communal agricultural representative (16%) (Fig. 10). Farmers’ association (10%) and professional colleagues (9%) are important information sources as well. Private consultancy is least liked by the farmers (4%). Farmers preferring the ROA, prefer to get advice from the label organization Bio Suisse (19%) and the Research Institute of Organic Agriculture (10%) compared to the farmers preferring the AOA, who are less interested to take advice from the label organisation Bio Suisse (9%) and the Research Institute of Organic Agriculture (4%). Advice from the label organisation IP-Suisse is preferred by the farmers preferring the AOA (9%) compared to the other group of farmers (4%).
Fig. 10. Support from institutions and organizations to promote biodiversity measures.
4. Discussion

The overall response rate was 20% which is lower than the generally expected 25% of comparable empirical studies (Personal communication with Schmid, O., 2014). This might be because Swiss farmers seem to be replete with surveys about biodiversity from research and governmental institutes, as some comments in the survey responses indicated. The sensitization and awareness about biodiversity seems to be heterogeneous among Swiss farmers, which might be another reason for the low interest in filling out the questionnaire about biodiversity.

The whole sample has a bias in its-self as the farmers who answered the questionnaire are farmers who are probably more committed towards biodiversity than the farmers who have not responded. This might explain why the organically producing farmers are overrepresented. The farmers who prefer the result-oriented approach (ROA) are found to be predominantly organically producing farmers. Therefore, the farmers who prefer the ROA are probably overrepresented as well.

Despite this bias, all five research questions could be answered and will be discussed in detail in the following discussion sections (Tab. 14). Finally the methods are discussed.

Tab. 14: The five research questions of this thesis and their corresponding answers

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. How committed are the farmers currently to implement result-oriented biodiversity measures?</td>
<td>Two third of the farmer’s current commitment to implement result-oriented biodiversity measures is relatively low.</td>
</tr>
<tr>
<td>b. Do the farmers prefer the action-oriented approach or the result-oriented approach?</td>
<td>Three third of the farmers prefer the action-oriented approach mainly because they think that less external specialists and controls are needed to analyse the efficiency of the approach.</td>
</tr>
<tr>
<td>c. Which result-oriented biodiversity measures are the farmers willing to implement?</td>
<td>The measures which increase the ecological quality of forest edges, grassland and hedges are mostly favoured by the farmers mainly because farmers think that they increase their financial potentials for further income and social acceptance will increase.</td>
</tr>
<tr>
<td>d. Which socio-demographic and farm characteristic factors influence the commitment and the willingness to implement result-oriented biodiversity measures?</td>
<td>The farmer’s age, the organic farmers and the steepness of the farmland showed a positive influence on the commitment and the willingness to implement result-oriented biodiversity measures. The production intensity (i.e., the livestock density and the cutting frequency) as well as the accessibility of the farm showed a negative influence on the commitment and the willingness to implement result-oriented biodiversity measures.</td>
</tr>
<tr>
<td>e. Which support do the different groups of farms prefer to implement biodiversity measures?</td>
<td>All farmers favor a high planning security and financial incentives. They prefer to get the advice from the cantonal consultancy service, the agricultural representative, magazines, farmers’ association and professional colleagues over private research and consultancy institutes.</td>
</tr>
</tbody>
</table>
4.1 Farmer’s current commitment for result-oriented biodiversity measures

The first research question about how committed the farmers are to the different result-oriented biodiversity measures (ROBM) can be answered as follows: More than half of the farmers (59%) show low commitment towards ROBM as they used up to 10% of their land as Ecological Compensation Area (ECA) with ecological quality and inter-linked ECA's. More than a quarter of the farmers (27%) are intermediately committed towards ROBM. One sixth of the farmers (16%) are very committed as they use more than 20% of their land as quality-oriented and inter-linked ECAs. For example the farmer Christian Schnider from Sörenberg in the Canton Lucerne uses half his land (49%) as quality-oriented Ecological Compensation Areas (Fig. 11). Overall, the farmer’s current commitment for ROBM directly subsidised by the state (COMDS) is relatively low. This goes in line with the national averages: 5% of the UUA holds ECA quality and 8% of the UUA are part of an ECA inter-linkage project in 2012 (Federal-Office-of-Agriculture, 2013).

Fig. 11: Christian Schnider from Sörenberg in the Canton Lucerne is a farmer highly committed to preserve biodiversity. He produces according to the IP-Suisse label. Half of his farmland (49%) is used as different quality-oriented Ecological Compensation Areas: extensively farmed meadows and pastures, litter meadows as well as hedges. He scored 34 biodiversity points within the biodiversity scoring system of IP-Suisse. (Foto: O. Schmid)
4.2 Farmer’s preference for biodiversity preserving approaches

The second research question about which biodiversity preserving approach the farmers prefer can be answered as follows: A fourth of the Swiss German-speaking mountain farmers prefer the result-oriented approach (ROA) to the action-oriented approach (AOA). Matzdorf (2010) found that more than one third of Southern German farmers prefer the ROA to the AOA asking only farmers that currently participate or participated in result-oriented biodiversity measures (ROBM), which may be the reason why the share of farmers preferring the ROA was higher in her study. Matzdorf (2010) additionally asked for the preference for the combination of both systems, which is preferred by a little less than two third of the farmers. This is supported by the preliminary qualitative survey of this thesis where many farmers mentioned that they prefer to have both approaches combined. One farmer argued that the AOA is especially suitable for farmers with risk-averse beliefs to start participating within agri-environmental schemes, because it gives a high security to get the payments and therefore has a low barrier to adopt these measures. The farmer outlined that once the farmers get familiar with the AOA and better understand the utility of the measures, they can go one step further and participate in agri-environmental schemes based on the ROA.

A fourth of the farmers chose the ROA because they think that this approach increases biodiversity more directly and effectively. This indicates that those farmers have a high knowledge about biodiversity. To incorporate the expertise about biodiversity of those farmers, they could be involved in panel discussions with the cantonal consultancy service, the communal agriculture commissioner and other farmers as a bottom-up approach that aims at increasing biodiversity in the regional farmlands. Topics could be open questions like which indicator species could be target species to improve the agricultural situation in the region or how a well-kept and carefully maintained farm should look like, etc. That way, farmers could raise and answer their own questions; learn from each other and from experts and put urgent issues for discussion on the table.

Three fourth of the farmers in this study chose the AOA because less external specialists and controls are needed to analyse the efficiency of the approach and it is easier to control. This shows that the farmers who prefer the AOA most probably believe that the controlling costs of the ROA are too high compared to the AOA. Farmers also choose the AOA because it is surer, that they will get the direct payments and it is clearer what they have to do in order to get direct payments. This shows that the farmers who prefer the AOA are quite risk-averse and probably belief that the uncertainties of the ROA are too high compared to the AOA. Matzdorf (2010) supportively found that the more risk-averse the farmers are, the less probable they will implement the ROBM. These farmers might be more responsive to voluntary measures like meadow contests as they work as a bonus incentive without any risk for the farmer.

The reasons “having more flexibility in the adoption of the measures” and “improving the self-empowerment” were not differentiating the choice between the two approaches. In Switzerland the farmers are not allowed to self-report their outcomes of the implementation of ROBM, but are controlled externally. Therefore, there is no big difference between the AOBM and the ROBM regarding the flexibility of implementation and self-empowerment. Matzdorf (2010) in contrary could show that the main reason for the German farmers to prefer the ROA was the flexibility in the implementation of the ROBM. Almost half of the farmers use the given flexibility to adapt management practices given the climatic and temporal conditions and apply the whole range of potential grassland management systems.

To be able to make recommendations to the consultancies, the characteristics of farmers who prefer the ROA were analysed descriptively. The farmers preferring the AOA are producing slightly more intensive as they have a non-significant marginally higher livestock density (1.2 LMU/ha) compared to
the farmers preferring the ROA (1.1 LMU/ha). One way of dealing with this fact would be to further restrict a certain livestock density. The institute Agridea (2008) has made recommendations for the maximal livestock density allowed which are: 1.4 LMU/ha for mountain zone I, 1.1 LMU/ha for mountain zone II, 0.9 LMU/ha for mountain zone III and 0.8 LMU/ha for mountain zone IV. The difference between these recommendations and the real numbers of the study (1.5 LMU/ha for mountain zone I, 1.3 LMU/ha for mountain zone II, 0.9 LMU/ha for mountain zone III and 0.9 LMU/ha for mountain zone IV) and the average number of Switzerland (1.2 LMU/ha) show that a restriction to these numbers would lead to big changes for the farmers with potentially high resulting costs.

The farmers preferring the ROA produce predominantly organic (45%), with an integrated approach (35%) and a lower percentage of farmers conventional (20%) whereas the farmers preferring the AOA more equally produce organic (35%), integrated (32%) and conventional (33%). This difference however is not significant either. This indicates that further promoting organic farming either financially or with consultancy may help to increase the percentage of farmers preferring and implementing result-oriented biodiversity measures.

4.3 Farmer’s preference for specific result-oriented biodiversity measures

The third research question about which result-oriented biodiversity measures (ROBM) are preferred by the farmers can be answered as follows: Among the measures which increase the species and habitat diversity, the measures which increase forest edge, grassland and hedge biodiversity were the most popular ones for the farmers (Fig. 12). The forest edge and the grassland biodiversity was favoured mostly because of its indirect financial potentials as farmers believe that these measures will increase the reputation among their customers and therefore increase their chances for additional income. Another main reason for this preference is that the farmers believe that these measures will increase the social acceptance from the side of the wider family, the neighbours, the customers and the society. One farmer mentioned that he feels rewarded if the customers and tourists give him a good feedback for his carefully cultivated grassland. Another reason for the farmer’s preference for increasing forest edge and grassland biodiversity is that farmers want to learn something new during the implementation of the measure. Farmers are more willing to implement these measures also because they are easily implementable on the farm. The less effort needed, the higher the willingness of the farmer to implement the AOBM (Lambert, Sullivan, Claassen, & Foreman, 2007; Pannell et al., 2006). Furthermore the personal ability to implement the measure and the ecological and cultural landscape benefits are reasons for the preference of increasing forest edge and grassland biodiversity. Farmers believe that the implementation of this measure leads to a significant increase of biodiversity and preserves a variety of landscape assets. This is supported by Matzdorf (2010) who found that a third of the Southern German farmers think that the maintenance of species-rich grassland contributes to nature conservation and a fourth of the farmers think it contributes to the preservation of the cultural landscape.
The measure to increase hedge biodiversity was very controversial among the farmers. In the qualitative interviews the reasons for increasing hedges and their quality was mainly personal joy as well as the benefit for different rare bird species. One farmer proudly reported that he participates in an inter-linkage project since six years and he finally found the red-backed shrike (Lanius collurio) on his land. This is an important target and indicator species in the Canton of Lucerne for the habitat of thorn hedges as the bird kills his prey spearing them on thorns of hedgerows (LU, 2012). The reasons not to increase the ecological quality of hedges were in a broad range: One main reason was that farmers feared to lose their good reputation among neighbouring farmers if they plant hedges in their fields. "It does not look good if my neighbour would plant a hedgerow in the middle of his field" argued one farmer. Vanslembrouck (2002) and Pannell (2006) supportively found that farmer's neighbour's commitment and willingness to implement AOBM and their opinion about the actions of the farmer has a strong influence on the farmer's commitment and willingness to implement AOBM. Many farmers mentioned that they require more time to take care about the hedge because they have to fence the hedges next to pastures against the grazing cattle or laboriously mow around the hedges next to meadows. This is probably the main reason why most farmers (90%) did not register the existing hedges as ECA hedgerows (Herzog, T. Walter, et al., 2005). Some farmers did not understand the benefit of hedges for biodiversity and therefore did not implement this measure. “I would like to promote hedges with indigenous plants like hazel trees (Corylus avellana), but I cannot understand why there is a need of 20 % thorn bushes (hawthorn (Crataegus sp.) and blackthorn (Prunus spinosa)) within the hedges with quality”. This farmer assumes that thorn bushes have never grown in the Canton of Lucerne and therefore are not indigenous, which is wrong. This example shows a lack of knowledge of indigenous plants and understanding of indicator species and their corresponding functions for the preservation of rare bird species. Matzdorf (2010) supportively found that there is a lack of understanding concerning the function of indicator species among the farmers as a great
majority of them was not informed that their activities are not favouring only the respective indicator species but different habitats with a wide range of species.

For measures like increasing the biodiversity of hedges which is heavily disputed among farmers, a local information campaign could help the farmers understanding the utility and benefit of that measure. Furthermore such a campaign could inform farmers about the target and indicator species and their functions. Addressing the farmers personally, this would lead to more implementation of measures, as the better farmers understand the utility of an approach and a measure, the more they are committed and willing to implement that measure (Delavaux (1999) and Dupraz (2000) in Vanslembrouck (2000)). One example of such a campaign is called “Dornröschen wach auf” meaning “Sleeping beauty wake up”. This project in the Canton of Lucerne promotes hedges with thorn bushes.

Among the measures which increase the genetic diversity, the measure to keep light animals was the most popular one for the farmers. Two farmer families reported that they chose the small and robust Galloway cattle for meat and the light Jersey cows for milk production because these breeds are quite well adapted to the mountains and show good meat and milk quality, respectively. They argued that the light bodyweight most probably compact the soil less and might therefore be better suited to preserve pasture biodiversity. This indicates that farmers did not choose to keep light animals to increase the genetic diversity, but to preserve pasture quality and biodiversity. Keeping light animals was preferred to keeping rare animals by the farmers. Only very few farmers took part in the ProSpecieRara breeding program. This might be due to the fact that the rare cattle breeds have a lower milk production yield than the usual cattle breeds. Farmers do not seem to know that genetic diversity is part of biodiversity. One way to promote genetic diversity would be to make an information campaign about the benefits of the breeding program and explain the function of genetic diversity within biodiversity.

4.4.1 Farmer’s socio-demographic characteristics influencing the farmer’s commitment and willingness to implement result-oriented biodiversity measures

The first part of the fourth research question about how the socio-demographic characteristics influence the farmer’s commitment and willingness to implement result-oriented biodiversity measures (ROBM) can be answered as follows: Concerning the farmer’s age, there is a difference between commitment and willingness to implement ROBM. The older the farmers were, the more committed they were to implement ROBM. This pattern is confirmed by findings of Drake (1999) in Vanslembrouck (2002) but contradicts findings of previous studies that showed that the younger the farmers are, the more they are committed to implement action-oriented biodiversity measures (AOBM) (Vanslembrouck et al., 2002; Wilson & Hart, 2000). Older farmers generally have more experience and a longer relationship with their environment, which could lead to more commitment to implement ROBM. Younger farmers are generally more open towards new ideas and want to try out something new, which could lead to more commitment to implement ROBM (Fig. 13). The farmer’s age was not significantly correlated to the farmer’s willingness to implement ROBM in future.
Farmer’s education was not significantly correlated to the farmer's commitment or the willingness to implement ROBM. Other studies however found that with higher education, farmers are more committed to implement AOBM (Vanslembrouck et al., 2002; Wilson & Hart, 2000). The survey design did not give the option “no education”. This might have slightly changed the results as a few old farmers are expected have no farming education at all. It is an open question whether general agricultural education really enforces commitment, as currently, this branch of farming is highly underrepresented in the farming school curricula (Bio-Suisse, 2014). This might eventually change as the agricultural education develops and integrates biodiversity topics. Severin Lischer as a representative of a young farmer reported that he was educated not only about production but also about environmental issues (Fig. 13).

The farmer’s willingness is affected by the commitment. The more the farmers are committed to implement ROBM, the more they are willing to do the same in future. This confirms findings by other studies which found that farmers with previous participation in AOBM are more willing to engage themselves for biodiversity in future (Drake et al. 1999 in Vanslembrouck et al. 2002). Matzdorf (2010) conformingly found that almost four fifth of all farmers will be continuously managing their current ECAs with the ROA in future.
4.4.2 Farm’s characteristics influencing the farmer’s commitment and willingness to implement result-oriented biodiversity measures

The second part of the fourth research question about how the farm’s characteristics influence the farmer’s commitment and willingness to implement result-oriented biodiversity measures (ROBM) can be answered as follows: The production system has a significant influence on the farmer's commitment and the willingness towards implementing ROBM. The organically producing farmers are more committed and willing to implement ROBM than the integrated and conventionally producing farmers. Between the latter two there are no statistical differences detectable. This result has to be taken with caution as the farmers producing organic were overrepresented. Still, Schader (2008) found that Swiss organic farmers have a higher uptake of AOBM which supports the results of this study. However, Matzdorf (2010) could not detect any statistical difference concerning the implementation of ROBM between the German organic and conventional farmers. In her non-random sample there were 51% organic farmers. As in Germany the average organic farmers were only 7% in 2011, the organic farmers were highly overrepresented in her study. Nevertheless the contradicting results might be due to the differences between the directives of the Swiss and the German organic label organisations. Generally European organic farmers produce less environmentally friendly and socially just than Swiss organic farmers as they are allowed to use more fertilizer and there are fewer regulations on crop rotation, greenhouse gases, air transport and minimum social standards of labour employment for European organic farmers (Bio-Suisse, 2014). For those farmers Ecological Compensation Areas (ECA) are not mandatory whereas for Swiss organic farmers at least 7% of their land have to be ECAs (Bio-Suisse, 2014).

The production intensity clearly shows a negative effect on the farmer’s commitment and willingness to implement biodiversity measures. The higher the livestock density as well as the cutting frequency of intensively fertilized meadows, the less the farmers were and will be implementing biodiversity measures in the past and the future. This confirms findings of a previous study finding that the higher the livestock density, the lower the farmer's probability to participate in AOBM (Dupraz, Vermersch, De Frahan, & Delvaux, 2003). Wilson and Hart (2000) found that extensive grassland farms are more likely to participate in AOBM than intensive livestock farms. They explain this pattern by the drastic reduction of stocking rates necessary for the intensive livestock farms to get direct payments from implementing AOBM. However, Matzdorf (2010) could not detect a statistical influence of the livestock density on the commitment to implement ROBM. This might be due to the higher sample of organic farmers and the smaller number of farmer's interviews (n= 90).

Farm size was not significantly correlated to the farmer’s commitment or the willingness towards implementing ROBM. This confirms findings of Mathjis (2003) who found that Belgium farmers implementing AOBM have an average farm size of 29 ha and farmers not implementing AOBM have an average farm size of 34 ha. This difference is statistically not significant. Other studies however found that farmers with larger farms were more committed to implement AOBM (Vanslembrouck et al., 2002; Wilson & Hart, 2000) and ROBM (Matzdorf & Lorenz, 2010). In the study of Vanslembrouck (2002), Belgium farms of more than 75 ha were more likely to implement AOBM and in the study of Matzdorf (2010) German farms with more than 50 ha were more likely to implement ROBM than smaller ones. Wilson and Hart (2000) compared nine European countries and Switzerland. And found that often farmers with a large farm size were more likely to implement AOBM Swiss farms are generally very small with 18 ha on average compared to the size of European farms. Since the variance of farm size was very low in the sample of this study, the effect of farm size could not be shown for the mountain area of the German-speaking part of Switzerland.
Production conditions act differently on the farmer’s commitment and the willingness towards implementation of ROBM and are mountain specific variables. The steepness had a positive influence on the farmer’s commitment and the willingness towards implementing ROBM. The more land with steepness of more than 35% farmers have, the more the farmers are committed and willing to implement ROBM. This is supported by the qualitative study where farmers mentioned that some of their steep slopes cannot be used for production and therefore can be well used for biodiversity enhancement.

The mountain zone had a positive influence on the farmer’s commitment and the willingness towards implementing ROBM as well. The higher the mountain zone of the farm, the more the farmers are committed and willing to implement ROBM. If a farm lies in a high mountain zone, it is more difficult to intensify the production. This is probably due to the lower accessibility of those farms. Therefore those farmers are restricted to extensive farming. Some of the extensively producing farmers are more motivated to preserve the mountain biodiversity. This is supported by the qualitative study where two farmers in the mountain zone III and IV reported that they still have a very high biodiversity on their land. They argued that they have always protected nature and will also do this in future, because they are aware of the high ecological value of biodiversity in the mountains as in the low-lands there is not much biodiversity left.

Strong significant influences of the production system, the production intensity, the steepness and the accessibility of the farmland on the commitment and willingness to implement result-oriented biodiversity measures (ROBM) could be shown. This indicates that these strongly significant relations are right despite the sample bias. To increase the amount of farmers who are committed and willing to implement ROBM on the one hand organic farming could be promoted more. On the other hand if farmers want to increase their production intensity i.e., livestock density through barn extension and their accessibility through road building, these actions could be coupled to environmental eligibility criteria including biodiversity measures.

4.5 Different farmer groups and their preference for support to implement biodiversity measures

The fifth research question about which support different farmer groups favor to implement biodiversity measures can be answered as follows: Generally, farmers favour a high planning security and high financial incentives. Farmers need to take long-term decisions in their management that is probably why they favor a high planning security. The high financial incentives imply that the main motivation for farmers to implement biodiversity measures are the direct payments. Farmers who prefer the result-oriented approach (ROA) are more willing to invest in further education and closer cooperation with other farms than farmers who prefer the action-oriented approach (AOA). Probably, those farmers are more interested in biodiversity and therefore want to invest more time for a deeper understanding of biodiversity. This group of farmers is therefore a suitable target group for educational approaches. Those farmers attribute more importance to social recognition of family members and neighbours as the farmers who prefer the AOA. The farmers preferring the ROA might generally be more aware of their environment.

Over all, farmers prefer the advice from the cantonal consultancy service, the agricultural representative, magazines, farmers’ association and professional colleagues over private research and consultancy institutes. Defined contact persons and trust in those have a strong influence on the adoption rate of biodiversity measures (Lambert et al., 2007; Pannell et al., 2006). Probably it was easier for the farmers to build trust in local contact persons of the cantonal counselling service and the...
communal agricultural representative who often is a farmer himself than to external consultancies. For agricultural research institutes it might be advisable to consult the farmers indirectly by informing the local consultancies, magazines or farmers’ association. For specific agricultural research institutes like the Research Institute of Organic Agriculture it would be favourable to work with the label organization Bio Suisse, which seem to have a higher acceptance by the farmers (Fig. 14). Farmers who prefer the ROA prefer the label organization Bio Suisse and the Research Institute of Organic Agriculture as an advisor compared to the farmers preferring the AOA. This confirms the findings that the farmers preferring the ROA are mainly organically producing farmers.

Fig. 14: Scientists from the Research Institute of Organic Agriculture and from other research institutes from Europe visiting the farm of the highly committed farmer Christian Schnider from Sörenberg in the Canton of Lucerne to get insights for the consultancy of other farmers with lower commitment to implement result-oriented biodiversity measures. (Foto: O. Schmid)

4.6 Method discussion

Organic farmers and farmers producing after the integrated approach to farming are overrepresented in this study. One way of making the study representative regarding the production system would be to add the necessary amount of farmers producing conventionally to the sample. This could not be done in this work as there were temporal restrictions for the completion of the work.

The principle component analysis (PCA) did not fully work as a method to allocate the reasons for the willingness to implement result-oriented biodiversity measures (ROBM) to the three factors of the theory of planned behaviour. For most ROBM the Kaiser-Meyer-Ordinance (KMO) value was too small to make the PCA. This is probably due to the relatively small sample size. There are other methods which are more suitable for this allocation and those might have worked better for the relatively small sample size. Principal factor analysis (PFA) for example is better suited for class separability and the detection of latent factors. More generally instead of testing the explanatory variables one by one with
its corresponding test, a logit model could have been used to analyse the whole data set. Logit models have been widely used to describe farmer’s behaviour (Duesberg, Upton, O’Connor, & Dhubhain, 2014). Furthermore, the farmer’s uptake of agri-environmental measures have been described using a binary logistic regression model by Mettepenningen (2013).
5 Outlook

In the qualitative interviews farmers made interesting observations which could be further tested as hypotheses: One farmer reported that a flexible cutting time (different times every year within the month of July) gave the best results regarding plant diversity on the meadow. Another farmer is convinced that the cutting height has a greater influence on the fauna diversity than the mowing technique. One farmer family is convinced that moderate dry manure fertilization is better than no fertilization at all in the long term. The meadow which they have extensified has completely lost plant diversity after ten years compared to a meadow they had managed more intensively. These examples show that there is a pool of local knowledge that could be used in designing and testing novel result-oriented biodiversity measures (ROBM) and that approaches and measures might be favourable in certain regions while in others they are not. It would be interesting to find general patterns how reasonable and effective ROBM could be defined.

Further agri-environmental research needs to broaden its focus on the three parts of biodiversity: the genetic, species and ecosystem diversity. The effects of breeds with low body weight on the erosion rate, the soil compaction and indirectly on the mountain biodiversity is an interesting research topic addressing all the levels of biodiversity. It could help the mountain farmers, breeding organisations and NGOs like ProSpecieRara to collaborate closer. Within the research of species and ecosystem diversity, evaluation of the different measures regarding fauna and habitat diversity is necessary. The effects of agri-environmental schemes on grassland diversity have been widely investigated but assessing the effects of diversity of other ecosystems and their connectivity on a systematic large-scale base is lacking. The cost-effectiveness of ROBM has to be further investigated to know how to implement those schemes most effectively. Even though much research has been done on characteristics and attitudes of farmers implementing AOBM and ROBM, the influence of the farmer's education, the production system, intensity and conditions on the commitment and willingness to implement ROBM need further confirmation. Further studies will help to close this knowledge gap.
6 Conclusion

Conditions of mountain farming are more difficult than in the lowlands because the growing season for vegetation is shorter, accessibility of farms is limited and the farming terrain is steeper. All these factors found in Swiss mountain zones have a significant positive influence on the farmer’s commitment and willingness to implement result-oriented biodiversity measures in the Swiss mountains. Most farmers in the mountain zones III and IV still have high biodiversity on their land and are willing to preserve their ecologically valuable land which forms the alpine biodiversity “hotspot”. These farmers are aware of its ecological, financial and social value for Switzerland and Europe. Therefore, those farmers would be perfectly suitable to serve as role models for farmers in the mountain zones I and II. Previous commitments by farmers to preserve biodiversity have significant and positive influences on their willingness to implement additional result-oriented biodiversity measures in the future. The co-existence of the action-oriented and result-oriented approach in the mountain zones of Switzerland can serve as an example for European countries. The probability of a farmer to participate in a result-oriented agri-environmental scheme increases when the farmer is enrolled in the process of agri-environmental schemes. To fully benefit from the result-oriented approach, the Swiss government should utilize Germany, Austria and France as role model countries for the self-reporting evaluation systems by their farmers, which could provide Swiss farmers with more flexibility and self-empowerment.

The better a farmer understands the utility of a result-oriented biodiversity measure, the greater the probability of his or her participation. Local information campaigns are recommended in any case to narrow the knowledge gaps about result-oriented approaches and biodiversity measures that were detected among the Swiss mountain farmers. These campaigns would inform farmers about the result-oriented approach and its benefits, the target and indicator species and their functions, and specific actions that can be taken to provide financial, social and ecological benefits to the farmers. These specific actions would promote a large scale sustainable biodiversity management by the Swiss mountain farms for the future.

Increasing intensification of agricultural production (i.e., higher livestock density and cutting frequency) has significantly decreased biodiversity and ultimately negatively influenced the commitment and willingness of farmers to implement action- and result-oriented agri-environmental measures. As a strategy against these negative processes, the current Swiss agricultural policy aims at lowering the farming intensity (i.e., livestock density) in the mountain zones. The results of this thesis suggest that this strategy should be pursued or even reinforced in the future by the Swiss government if the commitment and willingness of farmers to increase biodiversity in mountainous systems should be strengthened.
7 Acknowledgement

I thank my supervisor Florian Knaus from the Institute of Terrestrial Ecosystems (ITES) at the Swiss Federal Institute of Technology (ETH) for his enormous support starting off with helping to find an appropriate topic and research questions for the master thesis, the organization and the financing of the quantitative survey and ending up with the support for the publication of this work. I thank my co-supervisor Otto Schmid from the Research Institute of Organic Agriculture (FiBL) for his huge support with the integration into the MERIT project and organizing and financing the interviews with the 21 farmers. I thank Richard Bircher and Véronique Chevillat from the FiBL for their companionship for the qualitative interviews with the 21 farmers. I thank all the farmers for their cooperation during the interviews and for filling out the questionnaires. I thank the Federal Office of Agriculture (BLW) for the appropriation of the data for the questionnaires. I thank Robert Home from the FiBL and the statistical advisory service of the ETH Zürich for their support with the creation of the quantitative questionnaire and the statistical analysis. I thank Michael Siegrist from the ETH Zürich for the provision of the Remark machines and Jeanette Villanueva for the introduction to the Remark Office. I thank Pius Hofstetter from the Vocational Training Centre of Nature and Nurture (BBZN) for the expert interview. I thank Katja Jud from the BBZN, Michael Stauffacher from the ETH Zürich, Florian Knaus, Otto Schmid and Richard Bircher for their review of my quantitative questionnaire. I thank Sibylle Stöckli from the FiBL for giving me literature. I thank all reviewers of my master thesis: Matthias Gerber, Guillaume Wurlod, Bastien Mesnil, Dominique Jaquemet, Philipp Reibisch, Gary S. Banuelos, Florian Knaus and Otto Schmid.
References


ProSpecieRara. (2014), from http://www.prospecierara.ch/de/home


Appendix

Appendix A. Mountain zone correlated with meter a.s.l., steepness, cutting frequency and stocking intensity.

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation Coefficient</th>
<th>Sig.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain zone vs. meters a.s.l.</td>
<td>0.538</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Mountain zone vs. steepness higher than 35 %</td>
<td>0.206</td>
<td>*</td>
<td>0.017</td>
</tr>
<tr>
<td>Mountain zone vs. livestock density [LMU/ha]</td>
<td>-0.456</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Mountain zone vs. cutting frequency of meadows</td>
<td>-0.502</td>
<td>***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

Appendix B. Inter-correlations between the explicit and implicit livestock density per hectare as well as the livestock density per fertilizable hectare

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation Coefficient</th>
<th>Sig.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit livestock density [LMU/ha] vs. implicit livestock density [LMU/ha]</td>
<td>0.486</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Implicit livestock density [LMU/ha] vs. livestock density [LMU/ fertilizable ha]</td>
<td>0.477</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Livestock density [LMU/ fertilizable ha] vs. explicit livestock density [LMU/ha]</td>
<td>0.860</td>
<td>***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

Appendix C. Inter-correlations between the different cutting frequencies of meadows and grazing intensities on pastures.

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation Coefficient</th>
<th>Sig.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting frequency of intensively farmed meadows vs. cutting frequency of low-intensity meadows</td>
<td>0.632</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Cutting frequency of intensively farmed meadows vs. grazing intensity on permanent pastures</td>
<td>0.393</td>
<td>***</td>
<td>0.000</td>
</tr>
<tr>
<td>Cutting frequency of low-intensity meadows vs. grazing intensity on permanent pastures</td>
<td>0.545</td>
<td>***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%
Appendix D. Self-assessed intensity of farming correlated with the cutting frequency of meadows and the livestock density.

<table>
<thead>
<tr>
<th></th>
<th>Pearson Coefficient</th>
<th>Correlation</th>
<th>Sig.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-assessed intensity vs. cutting frequency of meadows</td>
<td>0.457</td>
<td>***</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Self-assessed intensity vs. livestock density [LMU/ha]</td>
<td>0.513</td>
<td>***</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

Appendix E. Dependence between the different commitment variables.

<table>
<thead>
<tr>
<th></th>
<th>Chi-square value</th>
<th>Sig.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMDS vs. COMIS</td>
<td>7.851</td>
<td>**</td>
<td>0.005</td>
</tr>
<tr>
<td>COMIS vs. COMG</td>
<td>18.284</td>
<td>***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Significance level (2-tailed): * 5%, ** 1% and *** 0.1%

Appendix F. Shares of farmers that implemented measures in the past and are willing to implement measures in the future.

<table>
<thead>
<tr>
<th></th>
<th>Share of farmers who implemented measure [%]</th>
<th>Share of farmers probably implementing measure [%]</th>
<th>Share of farmers very improbably implementing measure [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Farmers improving the plant diversity of their meadows and pastures and make sure that a minimum number of plants and butterflies as well as grasshopper species occur in it.</td>
<td>27</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>2. Farmers improving the plant diversity of their hedges and make sure that a minimum number of nesting bird species occur in it.</td>
<td>19</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>3. Farmers improving the plant diversity of their forest edges and make sure that a minimum number of nesting bird species occur in it.</td>
<td>19</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>4. Farmers putting dry-stone walls or rock piles on their land and make sure that a minimum number of reptile species are found therein.</td>
<td>25</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>5. Farmers building ponds, moats or lakes and make sure that a minimum number of dragonflies and amphibians occur in it.</td>
<td>12</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>6. Farmers keeping rare large animal races.</td>
<td>8</td>
<td>13</td>
<td>48</td>
</tr>
<tr>
<td>7. Farmers keeping light large animal races.</td>
<td>11</td>
<td>16</td>
<td>44</td>
</tr>
</tbody>
</table>
8. Farmers keeping rare small animal races.

9. Farmers planting rare arable crops, vegetables, fruit trees or berry varieties.

Appendix G. Rotated component matrix for reasons to improve grassland biodiversity. The reasons were allocated to the five categories personal willingness (PW), social acceptance (SA), financial potentials (FP), ecological and cultural landscape diversity potentials (ECP) and personal ability (PA). Note: Factor loadings < 0.5 are suppressed.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>SA</th>
<th>FP</th>
<th>ECP</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of principal component variance [%]</td>
<td>23</td>
<td>22</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Most people, who are close to me, expect me to implement the measure.</td>
<td>0.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure leads to higher agricultural yields.</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My neighbour farmers say that I should implement the measure.</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The measure is easy to implement on my farm.</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to learn something new during the implementation of the measure.</td>
<td>0.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure has advantages in marketing under specific labels.</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My customers like the implementation of the measure and it increases my chances for additional income through direct marketing.</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure preserves Swiss heritage.</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My customers expect me to implement the measure.</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Society expects me to implement the measure to contribute to biodiversity in Switzerland.</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure preserves a variety of landscapes.</td>
<td>0.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure significantly increases the biodiversity.</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure brings additional income through direct payments.</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would enjoy implementing this measure.</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can implement this measure.</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The implementation of the measure brings a secure income through long-term contracts.</td>
<td>0.54</td>
<td>0.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix H. Questionnaire used for the quantitative survey

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Allgemeine Betriebsdaten

Wie gross ist die landwirtschaftliche Nutzfläche (LN) Ihres Heimbetriebs? ......................................................... ha

Wie viel Ackerbau betreiben Sie? ............................................................................................................. ha

Wie viele Tiere halten Sie?

<table>
<thead>
<tr>
<th>Tierart</th>
<th>Anzahl</th>
<th>Tierarten</th>
<th>Anzahl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milchkühe</td>
<td></td>
<td>Milchziegen</td>
<td></td>
</tr>
<tr>
<td>Rinder über 2-jährig</td>
<td></td>
<td>Milchsche ine</td>
<td></td>
</tr>
<tr>
<td>Rinder 1-2-jährig</td>
<td></td>
<td>Zuchtschweine</td>
<td></td>
</tr>
<tr>
<td>Kälber bis 1-jährig</td>
<td></td>
<td>Mastschweine</td>
<td></td>
</tr>
<tr>
<td>Mutterkühe</td>
<td></td>
<td>Legehennen</td>
<td></td>
</tr>
<tr>
<td>Mutterkuhkälber zur Mast</td>
<td></td>
<td>Mastpoulets</td>
<td></td>
</tr>
</tbody>
</table>
Betrachten Sie sich über die gesamte landwirtschaftliche Nutzfläche gesehen eher als ein extensiv oder intensiv bewirtschaftender Landwirt bezüglich Tierbesatz und Düngemittelverwendung? 

- extensiv
- eher extensiv
- mittel
- eher intensiv
- intensiv

Mit welchem Produktionssystem ist Ihr Betrieb zertifiziert? (Bitte nur eine Antwort ankreuzen) 

- IP-Suisse (Integrierte Produktion)
- Bio Suisse (Biologisch)
- ÖLN (Ökologischer Leistungsnachweis)
- Anderes

Ökologische und ökonomische Betriebsdaten

In den folgenden Fragen interessieren wir uns dafür, wie stark Sie sich für die Arten- und Naturvielfalt (Biodiversität) auf Ihrem Betrieb engagieren.

Wie gross ist der Anteil der ökologischen Ausgleichsflächen (neu Biodiversitätsförderflächen) der LN? 

- 7-10%
- 12-16%
- 17-21%
- 22-26%
- > 27%

Wie gross ist der Anteil der ökologischen Ausgleichsflächen (neu Biodiversitätsförderflächen (BFF)) der LN mit Ökoqualität gemäss der Ökoqualitätsverordnung (ÖQV) (neu BFF Qualitätsstufe 2)?

- 0-5%
- 6-10%
- 11-15%
- 16-20%
- > 20%

Wie gross ist der Anteil an LN in einem vom Kanton anerkannten Vernetzungsprojekt?

- 0-5%
- 6-10%
- 11-15%
- 16-20%
- > 20%
Wie gross ist der Anteil der Hecken pro LN mit Öko-Qualität gemäss Ökoqualitätsverordnung (ÖQV)?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>0-2%</th>
<th>3-4%</th>
<th>5-6%</th>
<th>7-8%</th>
<th>&gt; 9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Ja  Nein

Haben Sie Massnahmen zur Erhöhung der Arten- und Naturvielfalt auf Ihren Wiesen getroffen (z.B. Einsatz von Balkenmäher/Stehen lassen von Rückzugsstreifen)?

☐  ☐

Haben Sie Trockenmauern angelegt und pflegen sie diese regelmässig?

☐  ☐

Haben Sie Steinhaufen angelegt?

☐  ☐

Haben Sie Asthaufen oder Holzbeigen liegen gelassen?

☐  ☐

Haben Sie einen Tümpel, Wassergraben oder Teich angelegt?

☐  ☐

Haben Sie einen Waldrand aufgewertet?

☐  ☐

Haben Sie Nistplätze für Vögel eingerichtet?

☐  ☐

Halten Sie einheimische Bienenvölker (z.B. Dunkle Biene Apis mellifera mellifera) an?

☐  ☐

Bauen Sie alte Sorten von Hochstammbäumen an (z.B. Scheiderapfel)?

☐  ☐

Halten Sie seltene Rinderrassen (z.B. Rämisches Grauvieh) und/oder nehmen Sie am Erhaltungszuchtprogramm von ProSpecieRara für Rinderrassen teil?

☐  ☐

Halten Sie seltene Kleintierrassen (z.B. Engadinerschaf) und/oder nehmen Sie am Erhaltungszuchtprogramm von ProSpecieRara für Kleintierrassen teil?

☐  ☐

Falls Sie integrierte Produktion (IP-Suisse) betreiben, wie viel Punkte haben Sie im Punktesystem „Mit Vielfalt punkten“ im Jahr 2013 erreicht? 

..............................................................................................................
Falls Sie biologische Produktion (Bio Suisse) betreiben, wie viele Massnahmen haben Sie im Massnahmenkatalog von Bio Suisse im Jahr 2013 erfüllt?

Unter welchen Labels verkaufen Sie Ihre Produkte? (Bitte alles ankreuzen, was zutrifft)

- IP-Suisse
- Bio Suisse
- ProSpecieRara
- SlowFood
- ProMontagna
- Heidi
- Lokales Label
- Keines

Direktzahlungen

Die Schweiz verfolgt bei den Direktzahlungen für Arten- und Naturvielfalt (Biodiversität) gleichzeitig zwei politische Ansätze.

Welche der folgenden zwei politischen Ansätze befürworten Sie stärker? (Bitte nur eine Antwort ankreuzen)

Massnahmen-orientierter Ansatz

Der Massnahmen-orientierte Ansatz gibt Anreize durch Direktzahlungen für Massnahmen, die die Arten- und Naturvielfalt (Biodiversität) erhöhen sollen. Beispiele hierfür sind: Landwirte werden pro m² ökologische Ausgleichswiese, pro m² Teich, pro m² Trockenmauer, pro m² Hecke oder pro m² aufgewerteter Waldrand bezahlt. Dieser Ansatz ist bisher dominierend im Schweizer Direktzahlungssystem.

Resultat-orientierter Ansatz

Der Resultat-orientierte Ansatz gibt Anreize durch Direktzahlungen für höhere Arten- und Naturvielfalt (Biodiversität). Beispiele hierfür sind: Landwirte werden pro m² ökologische Ausgleichswiese mit einer bestimmten Anzahl seltener Pflanzen (gemäss Ökoqualitätsverordnung (ÖQV)), pro m² Teich mit einer bestimmten Anzahl seltener Libellen- und Amphibienarten, pro m² Trockenmauer mit einer bestimmten Anzahl seltener Reptilienarten oder pro m² Hecke bzw. aufgewertetem Waldrand mit Nistplätzen von einer bestimmten Anzahl seltener Vogelarten bezahlt. Dieser Ansatz ist noch praktisch inexistent im Schweizer Direktzahlungssystem.

Wie stark stimmen Sie mit den folgenden Aussagen zu Ihrer Wahl überein?

Ich habe den gewählten politischen Ansatz oben befürwortet, weil dieser Ansatz … (Bitte in jeder Zeile jeweils eine Antwort ankreuzen)

- … die Arten- und Naturvielfalt (Biodiversität) direkter und effektiver fördert.
… klarere Orientierung gibt, was ich für die Direktzahlungen machen muss. □ □ □ □ □ □

… mehr Möglichkeiten gibt, mein Wissen und meine Erfahrung in die Umsetzung der Massnahmen einfliessen zu lassen. □ □ □ □ □ □

… weniger Spezialisten und Kontrollen für die Auswertung der Resultate der Massnahmen braucht. □ □ □ □ □ □

… mehr Sicherheit bringt, dass ich die Direktzahlungen wirklich erhalte. □ □ □ □ □ □

… meine Selbstbestimmung fördert. □ □ □ □ □ □

… mehr Flexibilität gibt, die Massnahmen an meinen Betriebsablauf anzupassen. □ □ □ □ □ □

… einfacher kontrollerbar ist und dadurch für alle die gleichen Bedingungen setzt. □ □ □ □ □ □

… mehr Einkommen bringt. □ □ □ □ □ □

Akzeptanz von Arten- und Naturvielfalts-Massnahmen

Mit der Agrarpolitik für die Jahre 2014 bis 2017 wird die Arten- und Naturvielfalt (Biodiversität) durch Direktzahlungen stärker gefördert. In politischen und wissenschaftlichen Kreisen wird diskutiert, ob die Zahlungen so verändert werden sollen, dass die Resultate der Massnahmen bewertet werden. Das bedeutet, dass für eine bestimmte Anzahl Pflanzenarten oder Tierarten auf ihrer landwirtschaftlichen Nutzfläche Direktzahlungen ausbezahlt würden. Oder wenn Sie seltene Pflanzenarten anbauen, sowie wenn Sie seltene Tierarten halten, würden Sie durch Direktzahlungen belohnt. Stellen Sie sich vor, in der Schweiz würde nur noch dieser Resultat-orientierte Ansatz gefördert:

Wie wahrscheinlich ist es dann, dass Sie die folgenden Massnahmen einführen?

(Bitte in jeder Zeile jeweils eine Antwort ankreuzen)

1. Ich werte Wiesen/Weiden auf und sorge dafür, dass eine Mindestdzahl von Pflanzen und Tagfalter- sowie Heuschreckenarten darin vorkommen. □ □ □ □ □ □

2. Ich lege eine Hecke an und sorge dafür, dass Nistplätze einer Mindestdzahl von Vogelarten darin vorkommen. □ □ □ □ □ □
3. Ich werte meinen Waldrand auf und sorge dafür, dass Nistplätze einer Mindestanzahl von Vogelarten darin vorkommen.


5. Ich lege Tümpel, Wassergraben oder Teiche an und sorge dafür, dass eine Mindestanzahl von Libellen- und Amphibienarten darin vorkommen.


Wählen Sie eine, der 9 nummerierten Massnahmen der vorhergehenden Frage, die Sie am ehesten umsetzen würden? (Bitte nur eine der Massnahmen auswählen und entsprechend ankreuzen)

1 2 3 4 5 6 7 8 9

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Sie haben in der vorherigen Frage eine der Massnahmen ausgewählt, welche Sie am ehesten umsetzen würden. Was waren die Gründe für Ihre Wahl?

(Bitte in jeder Zeile jeweils eine Antwort ankreuzen)

Stimme zu Stimme eher zu neutral Stimme eher nicht zu Stimme nicht zu

Ich hätte Freude daran, diese Massnahme umzusetzen.

☐ ☐ ☐ ☐ ☐

Es liegt hauptsächlich in meiner Hand, ob ich die Massnahme umsetzen kann.

☐ ☐ ☐ ☐ ☐

Die meisten Menschen, die mir nahe stehen, erwarten von mir, dass ich die Massnahme umsetze.

☐ ☐ ☐ ☐ ☐
Die Umsetzung der Massnahme führt zu höheren landwirtschaftlichen Erträgen.

Die Umsetzung der Massnahme erhöht die Arten- und Naturvielfalt (Biodiversität) deutlich.

Ich möchte etwas Neues lernen während der Umsetzung der Massnahme.

Die Massnahme ist gut umsetzbar auf meinem Hof und passt gut in meinen Betriebsablauf.
Meine Nachbarsbauern meinen, ich sollte die Massnahme umsetzen.

Die Umsetzung der Massnahme bringt Zusatzeinkommen durch staatliche Direktzahlungen.

Die Umsetzung der Massnahme erhält Schweizer Kulturgut.

Meine Abnehmer erwarten von mir, dass ich die Massnahme umsetze.

Die Umsetzung der Massnahme kommt bei Konsumenten gut an und erhöht meine Chancen, für zusätzliche Einnahmen durch Direktvermarktung.

Die Umsetzung der Massnahme bringt ein sicheres Einkommen durch langfristige Verträge.

Die Umsetzung der Massnahme erhält vielfältige Landschaften.

Die Umsetzung der Massnahme bringt Vorteile in der Vermarktung unter spezifischen Labels (IP-Suisse, Bio Suisse, ProSpecieRara, lokale Marke, etc.).

Die Bevölkerung erwartet von mir, dass ich die Massnahme umsetze, um einen Beitrag zur höheren Arten- und Naturvielfalt in der Schweiz zu leisten.

Wählen Sie eine, der nummerierten 9 Massnahmen der ersten Frage im Teil D (vgl. vorherige Seite), die Sie eher NICHT umsetzen werden? (Bitte nur eine der Massnahmen auswählen und entsprechend ankreuzen)

1 2 3 4 5 6 7 8 9

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Sie haben in der vorherigen Frage eine der Massnahmen ausgewählt, welche Sie eher nicht umsetzen würden. Was waren die Gründe für Ihre Wahl? (Bitte in jeder Zeile jeweils eine Antwort ankreuzen)
Ich hätte keine Freude daran, die Massnahme umzusetzen.  

<table>
<thead>
<tr>
<th>Stimme zu</th>
<th>Stimme eher zu</th>
<th>neutral</th>
<th>Stimme eher nicht zu</th>
<th>Stimme nicht zu</th>
</tr>
</thead>
</table>

Es liegt hauptsächlich nicht in meiner Hand, ob ich die Massnahme umsetzen kann.  

Die meisten Menschen, die mir nahe stehen, erwarten nicht von mir, dass ich die Massnahme umsetze.  

Die Umsetzung der Massnahme führt zu tieferen landwirtschaftlichen Erträgen.  

Die Umsetzung der Massnahme erhöht die Arten- und Naturvielfalt (Biodiversität) nicht wesentlich.  

Ich möchte nichts Neues beginnen.  

Die Massnahme ist schlecht umsetzbar auf meinem Hof und passt schlecht in meinen Betriebsablauf.  

Meine Nachbarsbauern meinen, ich sollte die Massnahme nicht umsetzen.  

Die Umsetzung der Massnahme bringt keine Zusatzeinkommen durch staatliche Direktzahlungen.  

Die Umsetzung der Massnahme trägt nicht wesentlich zur Erhaltung von Schweizer Kulturgut bei.  

Meine Abnehmer erwarten nicht von mir, dass ich die Massnahme umsetze.  

Die Umsetzung der Massnahme kommt bei den Konsumenten schlecht an und lässt meine Chancen, für zusätzliche Einnahmen durch Direktvermarktung sinken.  

Die Umsetzung der Massnahme bringt kein sicheres Einkommen durch langfristige Verträge.  

Die Umsetzung der Massnahme trägt nicht wesentlich zur Erhaltung von vielfältiger Landschaft bei.  

Die Umsetzung der Massnahme bringt Nachteile in der Vermarktung unter spezifischen Labels (IP-Suisse, Bio Suisse, ProSpecieRara, lokale Marke, etc.).  

Die Bevölkerung erwartet nicht von mir, dass ich die Massnahme umsetze, um einen Beitrag zur höheren Arten- und Naturvielfalt (Biodiversität) in der Schweiz zu leisten.
Allgemeine Betriebsdaten

Wie gross ist Ihr Tierbesatz total in Dünger-Grossvieheinheiten (DGVE) pro Hektar LN?........................DGVE/ha

Wie gross ist Ihr Tierbesatz total in DGVE pro Hektar düngebare Fläche (DF)?.....................................DGVE/ha DF

Falls Sie zusätzlich einen Sömmerungsbetrieb haben, wie gross ist die Sömmerungsfläche Ihres Sömmerungsbetriebs?............................................................ha

Wie viele Normaltössen halten Sie auf dem Sömmerungsbetrieb?..............................................................

Falls Sie Tiere in die Sömmerung geben, wie viele Normaltössen geben Sie in die Sömmerung?......................

Wie viel Gülle führen Sie zusätzlich zu? ......................m³ Rindergülle, ......................m³ Schweinegülle

Wie viel N-Kunstdünger kaufen Sie zusätzlich ein?.................................................................kg N total

Wie bewirtschaften Sie Ihre Mähwiesen und Dauerweiden?

<table>
<thead>
<tr>
<th>Flächen (ha)</th>
<th>Anzahl Schnitte/Jahr bzw. Beweidung (inkl. Herbstweide)</th>
<th>Durchschnittliche N-Düngung (kg N/ha/Jahr)</th>
<th>Durchschnittliche Gülle Anwendung (m³/ha/Jahr)</th>
<th>Durchschnittliche Mist Anwendung (t/ha/Jahr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive Mähwiese</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weniger intensive Mähwiese</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intensive Dauerweide</td>
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</tr>
</tbody>
</table>

Auf welcher Höhe liegt Ihr Betrieb?...........................................................................................................m ü. M

Wie viel Fläche haben Sie mit einer Hangneigung von 18-35%?...............................................................ha
Wie viel Fläche haben Sie mit einer Hangneigung von über 35%?...............................................................ha

In welche Bergzone liegt Ihr Betrieb?

<table>
<thead>
<tr>
<th>Bergzone I</th>
<th>Bergzone II</th>
<th>Bergzone III</th>
<th>Bergzone IV</th>
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</thead>
<tbody>
<tr>
<td>□</td>
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Unterstützung zur Umsetzung von Arten- und Naturvielfalts-Massnahmen

Welche Unterstützung brauchen Sie, um in Zukunft Massnahmen für Arten- und Naturvielfalt (Biodiversität) umzusetzen?

Von wem möchten Sie in Zukunft zum Thema Arten- und Naturvielfalt (Biodiversität) beraten werden?

Bitte alles ankreuzen, was zutrifft:

- □ Beratung
- □ Weiterbildung
- □ Finanzielle Anreize vom Staat
- □ Finanzielle Anreize durch ein Label
- □ Grössere Nachfrage nach meinen Produkten
- □ Soziale Anerkennung im direkten Umfeld
- □ Engere Zusammenarbeit mit anderen Betrieben

- □ Landwirtschaftsbeauftragter
- □ Kantonaler Beratungsdienst
- □ Beratungsdienst Agrofutura
- □ IP-Suisse
- □ Bio Suisse
- □ Agrarinstitution (ART, FiBL)
- □ Berufskollegen
Persönliche Angaben

In welcher Gemeinde ist Ihr Betrieb? PLZ: ........................................................................................................

In welchem Jahr sind Sie geboren? 19...........................................................................................................

Welches ist Ihre höchste abgeschlossene Ausbildung?

<table>
<thead>
<tr>
<th>Agrarpraktiker</th>
<th>Landwirtschaftliche Berufsausbildung</th>
<th>Sonstige Berufsausbildung</th>
<th>Meisterprüfung</th>
<th>Berufsmaturität</th>
<th>Fachhochschule/Hochschule</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
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