

Profitability of perennial wildflower fields: Cost estimates and farmers' views at different market price levels

Wirtschaftlichkeit von mehrjährigen Blühflächen: Kostenschätzungen und Sichtweisen von LandwirtInnen bei unterschiedlichen Marktpreisniveaus

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Summary

Agri-environment-climate measures (AECMs) aim to promote environmental goods in agricultural landscapes. Farmers' participation in AECMs strongly depends on their profitability, which is determined by process costs and opportunity costs. Using data from farms in Lower Saxony, Germany, we analysed the effects of recent price developments on the profitability of perennial wildflower fields by calculating process and opportunity costs. We additionally analysed corresponding interviews to explore how profitability, costs, and market changes are reflected in farmers' views and decision-making regarding participation. We found that opportunity costs had a comparatively greater impact on the profitability. However, despite their limited impact, process costs were perceived as important by farmers. Thus, our results shed light on differences in the relevance of actual and perceived costs for farmers and give insights into how the consideration of cost perceptions can support policymaking.

Keywords: agri-environment-climate measures, gross margins, interview, cost perceptions, Common Agricultural Policy

Zusammenfassung

Agrarumwelt- und Klimamaßnahmen (AUKM) können Umweltgüter in der Agrarlandschaft fördern. Ein zentraler Entscheidungsgrund für die Teilnahme von LandwirtInnen ist die Rentabilität von AUKM, die durch Verfahrenskosten und Opportunitätskosten bestimmt wird. Anhand von Daten südniedersächsischer Landwirtschaftsbetriebe haben wir die Auswirkungen der jüngeren Preisentwicklungen auf die Rentabilität von mehrjährigen Blühflächen analysiert, indem wir Prozess- und Opportunitätskosten berechneten. Zusätzlich analysierten wir Interviewdaten, um abzubilden, wie sich Rentabilität, Kosten und Marktveränderungen in den Ansichten und Entscheidungen der LandwirtInnen bezüglich der Teilnahme widerspiegeln. Wir zeigen, dass die Opportunitätskosten einen größeren Einfluss auf die Rentabilität haben. Trotz ihres begrenzten Umfangs werden die Verfahrenskosten von den LandwirtInnen jedoch als wichtig wahrgenommen. Unsere Ergebnisse verdeutlichen demnach die unterschiedliche Bedeutung von tatsächlichen und wahrgenommenen Kosten für LandwirtInnen und geben Einblicke, wie die Berücksichtigung von Kostenwahrnehmungen die Politikgestaltung unterstützen kann.

Schlagworte: Agrarumwelt- und Klimamaßnahmen, Deckungsbeitragsrechnung, Interview, Kostenwahrnehmung, Gemeinsame Agrarpolitik

1 Introduction

Agri-environment-climate measures (AECMs) can be an effective policy tool of the European Union's Common Agricultural Policy (CAP) for nature conservation in agricultural landscapes (Boetzl et al., 2021). These include voluntary management commitments implemented by farmers in return for payments whose level is usually based on income foregone and the additional effort required to implement the measure (Regulation (EU) 2021/2115, Article 70(4)). Alternative implementation models that link payments to the achievement of environmental objectives or that facilitate spatial coordination of AECMs and cooperation between actors are discussed and implemented (Kelemen et al., 2023).

For many farmers, the financial profitability of AECMs is an important factor in their decision to participate (Schaub et al., 2023, Dessart et al., 2019). Profitability is determined by two cost components: process costs and opportunity costs. Process costs include the costs of establishing, maintaining and removing the actual measure, for example, seeds for wildflower fields or the costs of machinery. Many AECMs, such as wildflower fields or fallow land, take place on agricultural land that could instead be used for food, fodder or energy production. Opportunity costs represent the income foregone from such alternative uses (Hampicke, 2013, pp. 85-87).

In the recent past, market prices for agricultural inputs and outputs have changed substantially. Between 2014 and 2020, input and output prices were relatively stable. From 2020, prices rose to exceptionally high levels, peaking with the beginning of Russia's war against Ukraine in spring 2022. Although prices fell in late 2022, they remained at relatively high levels compared to earlier periods (Statistisches Bundesamt, 2024a, 2024b). These developments may affect both the process and opportunity costs of AECMs.

Current work has thematised effects of the invasion of Ukraine on environmental targets and programmes at large, discussing both the possibility of a reduction in funding for biodiversity as well as the risk of changing market dynamics leading to a decline in interest in biodiversity programmes (Strange et al., 2022; Gallo-Caijao et al., 2023). Market risks, such as price spikes, which are associated with the invasion of Ukraine, are perceived as particularly relevant by farmers and are often situated within multiple crises (Komarek et al., 2020). However, participation in environmentally friendly practices might reduce farmers' risk by reducing reliance on input factors that are dependent on market changes (Schaub and El Benni, 2024). Furthermore, associated market changes can influence opportunity costs and thereby affect farmers' perception of environmental measures (Schaub et al., 2023). However, the effect of the changing market conditions in the recent years on the profitability of AECMs and farmers' decisions to participate remains unknown. It is also unclear how farmers perceived the role of the different cost components in these times. Based on that, we aim to answer the following research questions:

1. How do different price levels affect the process and opportunity costs of AECMs and, hence, their profitability?
2. How are profitability and cost components reflected in farmers' views and decision-making regarding participation in AECMs?

2 Data and methodology

2.1 Data and study area

To answer the research questions, we analysed five-year perennial wildflower fields on arable land using cost and gross margin calculations and qualitative interviews. Flower fields can be implemented in a variety of sizes and temporal continuity (i.e. annual or perennial) and are an example of effective AECMs, particularly with increasing age (Boetzl et al., 2021; Pe'er et al., 2022). Compared to other AECMs, a relatively large number of farmers implement flower fields, with a focus on annual measures: For instance, in Lower Saxony, Germany, 30.6% of all AECM applications in 2022 were for annual flower fields and 3.2% were for perennial flower fields (ML Niedersachsen, 2023).

Our study is based on data from 36 farms in the district of Northeim in southern Lower Saxony, Germany. The predominant land use in the study area is arable farming, with cereals, maize, rape and sugar beet as the main crops. In addition to arable farms, there are some mixed farms and some that focus on fodder production (Dahl, 2017). While 23 of the 36 farms established perennial wildflower fields in autumn 2022 and spring 2023, 13 did not. For the cost and gross margin calculations (see Section 2.2), we only used data from 19 of the 23 farms that had established perennial wildflower fields due to unavailability of data. For the qualitative content analysis (see Section 2.3), we interviewed all 36 farmers to capture a variety of perceptions relating to our research topic. While 32 of the interviewed farmers were involved in perennial wildflower fields at the time of the interviews or had prior experience with AECMs, four farmers had not implemented perennial wildflower fields or had prior experience. However, all farmers have previously implemented other conservation measures, such as ecological focus areas. We used purposive sampling to select the 36 farmers in the study area to cover different farm sizes, business models, and farmer characteristics.

The 36 farms included in this study are mainly arable farms and some mixed farms with dairy production and cattle or pig fattening. The average farm size is around 237.7 ha (SD 269.6). Two-thirds of the farms are run as full-time farms, and only a quarter of the farmers are younger than 40 years. Looking at the 19 farms used for the cost and gross margin calculations, the average farm size is higher (314.6 ha, SD 335.1), but almost half of the farms are less than 150 ha. These 19 farms had an average of 8.4 ha (SD 9.3) of perennial wildflower fields, representing an average of 5.3% of their arable land.

Data collection took place within a research project on cooperative AECMs (Schüler et al., 2025), i.e. the coordinated implementation of measures at the landscape level involving farmers and other local actors. The implementation model in the research project focused on local interaction and collaboration and was implemented as a top-up to individual AECMs within the framework set by the CAP. Therefore, the technical implementation and management of the measure itself, and thus the costs, are similar to individual participation in AECMs. In addition, as data collection was carried out at an early stage of a cooperative AECM, we expect farmers’ views to be driven by past experiences of and attitudes towards individual participation in AECMs.

2.2 Cost and gross margin calculations

We collected farm-specific economic data for the crop years 2017/18 to 2022/23 to calculate costs and gross margins (KTBL, 2024c), assessing process and opportunity costs of wildflower fields (Hampicke, 2013, pp. 82-85) and analysing price change impacts on the measures’ profitability. Data was collected through on-farm interviews between December 2022 and February 2023. Yield data for the crop year 2022/23 was collected via e-mail in June 2024.

The farm-specific data included information on general farm characteristics (e.g. average farm-field-distance, average field size), typical crop rotations, and for each crop separately, the fertiliser and pesticide use, and contractor and machinery use. Yields were captured for the crop years examined. We also asked about the actions taken and planned for implementing wildflower fields and the machinery used. Except for yields, these data were used as constants over time within a farm, but varied between farms. Crop-specific yield data varied over time both within and between farms. We complemented the farm-specific data with year-

specific regional statistical data for each crop year on input prices (i.e. seed costs, fertiliser costs, pesticide costs, interest costs), output prices (i.e. selling prices of products, e.g. cereals or sugar beet), contractor costs, and machinery costs (i.e. fuel costs, repair costs) (KTBL, 2018-2022, 2024a, 2024b; Landwirtschaftskammer Niedersachsen, 2019-2024; Statistisches Bundesamt, 2024b). Regional statistical data varied over time, but not between farms.

To determine *process costs*, we calculated the sum of direct costs (e.g. seed costs) and contractor and variable machinery costs (fuel and repair costs) for establishing, maintaining and removing wildflower fields (see Fig. 1). To assess *opportunity costs*, we calculated the gross margin for each crop in alternative crop rotations that would otherwise have been implemented on the specific fields. Gross margins are calculated by subtracting variable costs (i.e. direct costs and variable labour costs) from the revenue of a product (KTBL 2024c). We then averaged these values to determine the overall opportunity costs. Finally, we added the process and opportunity costs to obtain the total costs of the wildflower fields per year (see Fig. 1).

Generally, this follows the basic calculation of payments for environmental, climate-related and other management commitments established in the CAP, by which the “payments [are] to be made on the basis of the additional costs incurred and income foregone resulting from the commitments made” (Regulation (EU) 2021/2115 Article 70(4)).

2.3 Qualitative interviews and content analysis

We conducted semi-structured interviews and subsequent qualitative content analysis to gain insights into how profitability, costs, and market changes are reflected in farmers’ views and decision-making regarding participation. After obtaining written consent to participate, the interviews were

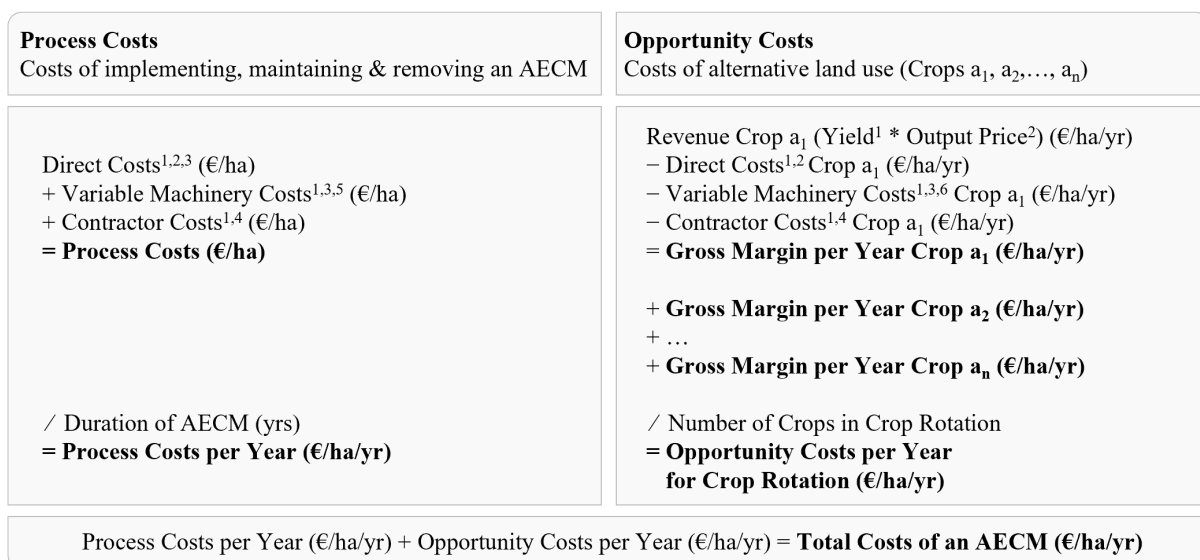


Figure 1. Calculation steps for process and opportunity costs of agri-environment-climate measures.

Source: Own presentation; Data sources: ¹farm-specific data; ²Landwirtschaftskammer Niedersachsen, 2019-2024; ³Statistisches Bundesamt, 2024b; ⁴KTBL, 2018-2022; ⁵KTBL, 2024a; ⁶KTBL, 2024b.

conducted face-to-face in German between July and November 2022. The interviews lasted between 17 and 61 minutes, with a mean of 35 minutes. They were audio recorded and then transcribed and analysed in MAXQDA 2022 (VERBI Software, 2021).

We used a guide to structure the interviews. First, a hypothetical decision situation regarding participation in AECMs was introduced, followed by questions about farmers' attitudes towards AECMs and their reasons for and against participation. We then asked specifically about factors that may affect farmers' participation decisions. Due to the scope of our research, we analysed a subset of questions and included one question each on farmers' attitudes towards AECMs and reasons for and against participation, one question specifically focusing on the role of financial and economic aspects in farmers' participation decisions, and one question on farmers' perceptions of current developments in agriculture to capture their views on recent market changes. Questions on other factors (e.g. environmental attitudes, social influences) not relevant to our research question were not included in the analysis. We carried out two pre-tests and subsequently adapted the guide slightly. Given the minor changes, we included these interviews in our analysis.

Based on the research questions, we deductively created a code system and applied four main codes (*Farmers' views on recent market changes*, *Profitability of AECMs*, *Process costs*, *Opportunity costs*; see Table 1) to the interview transcripts to perform a qualitative content analysis (Mayring, 2014, p. 64). After initial coding by the first author, the co-authors reviewed the coded interview segments to ensure intersubjective comprehensibility. We then analysed the coded segments for each code to filter out farmers' views. To illustrate the results, we provide quotations from the interview transcripts in Section 3.2. The quotations have been translated into English by analogy, not verbatim.

3 Results

3.1 Changes in process and opportunity costs

Process costs for establishing, maintaining and removing wildflower fields averaged 154 €/ha/yr (SD 22) across farms for the crop years 2017/18 to 2022/23. Direct costs and contractor and variable machinery costs each account for about half of the process costs in the years analysed. While

the costs were relatively constant from 2017/18 to 2020/21, they increased sharply by 21.6% in 2021/22 compared to the mean of previous years. In 2022/23, the costs increased again by 11.6% compared to the year before (see Fig. 2a).

The average opportunity cost of the alternative land use from 2017/18 to 2022/23 was 862 €/ha/yr (SD 430) across farms. Opportunity costs increased incrementally over time until 2019/20 (see Fig. 2a). In 2020/21, there was an increase of 33.2% compared to the previous year. The year after, there was another sharp increase of 74.2%, while the opportunity costs decreased by 61.1% in 2022/23. The opportunity costs in this year are again comparable to those of 2017/18 to 2019/20. If 2021/22 is excluded, the average opportunity cost is substantially lower at 705 €/ha/yr (SD 248) across farms. A comparison of opportunity costs and price indices shows a delayed development: While opportunity costs peaked in 2021/22, price indices peaked one year later. This lag reflects the timing of input purchases, usually at an early stage, and output sales at or after the crop year's end.

Breaking down opportunity costs, direct costs and contractor and variable machinery costs remained stable between 2017/18 and 2019/20, while revenues increased slightly over time (see Fig. 3). In 2020/21, costs still remained relatively stable, but revenues increased by 18.4% compared to the year before. The year after, both costs and revenues increased substantially. However, while costs increased by 38.5%, revenues grew even more by 58.7%. In 2022/23, costs increased again by 6.2%, but revenues fell sharply by 35.6% to the same level as in 2020/21.

Process and opportunity costs together determine the farms' costs for implementing wildflower fields. On average, these amounted to 1,016 €/ha/yr (SD 437) across farms for the crop years 2017/18 to 2022/23. If 2021/22 is excluded, the average costs across farms are lower (856 €/ha/yr, SD 247) (see Fig. 2a, 2b).

The CAP provides monetary compensation for AECMs. In Lower Saxony, the payment for perennial wildflower fields was 875 €/ha/yr for the period 2014-22 (Richtlinie NiB-AUM, 2015) and is 910 €/ha/yr for 2023-27 (Richtlinie AUKM, 2023). Comparing costs and payments showed that, on average, the costs would have been covered in the first three years analysed (2017/18 to 2019/20) (see Fig. 2a). Looking at the analysed farms, in 2017/18, only four of the 19 farms had costs that were higher than the AECM payment. In 2018/19 and 2019/20, this was the case for eight

Table 1. Description of main codes used in the qualitative analysis

Main code	Description
Farmers' views on recent market changes	Statements on the general perception of recent market changes in input and output markets
Profitability of AECMs	Statements on the profitability of AECMs that do not consider the individual cost components of process and opportunity costs
Process costs	Statements on process costs of AECMs
Opportunity costs	Statements on opportunity costs of AECMs

Source: Own presentation.

and ten farms, respectively. By 2020/21, however, the payment would no longer have been sufficient to cover the average costs incurred, and only two of the 19 farms would have had costs below the payment level. Participation in 2021/22 would have been even less cost-covering, with no farm having costs below the payment level. In the following year (2022/23), however, average costs would again have been below the payment level, and six of the 19 farms would not have had their costs covered.

3.2 Farmers' views on recent market changes, profitability of AECMs, and cost components

When asked to assess current developments in agriculture, more than half of the farmers interviewed referred to changes in input and output markets, highlighting the importance of this aspect in farmers' perceptions. Most of them associated increased cost pressure due to higher input prices (see Fig. 4, Q1.1) and fears of falling output prices, leading to

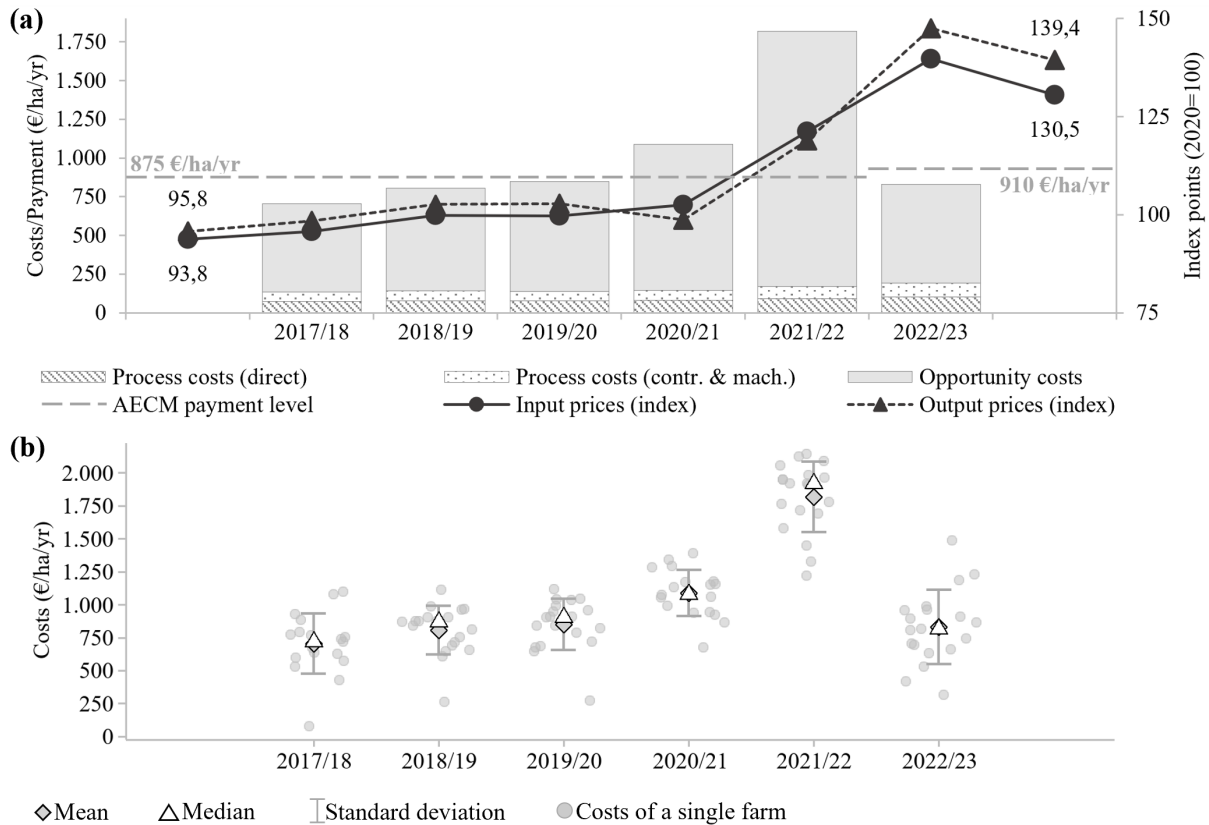


Figure 2. Process costs, opportunity costs, and AECM payments of perennial wildflower fields and input and output price levels (a); and visualisation of the mean, median and standard deviation of the costs for perennial wildflower fields per farm for the years 2017/18-2022/23 (b), (n=19).

Source: Own presentation with data from Statistisches Bundesamt, 2024a, 2024b.

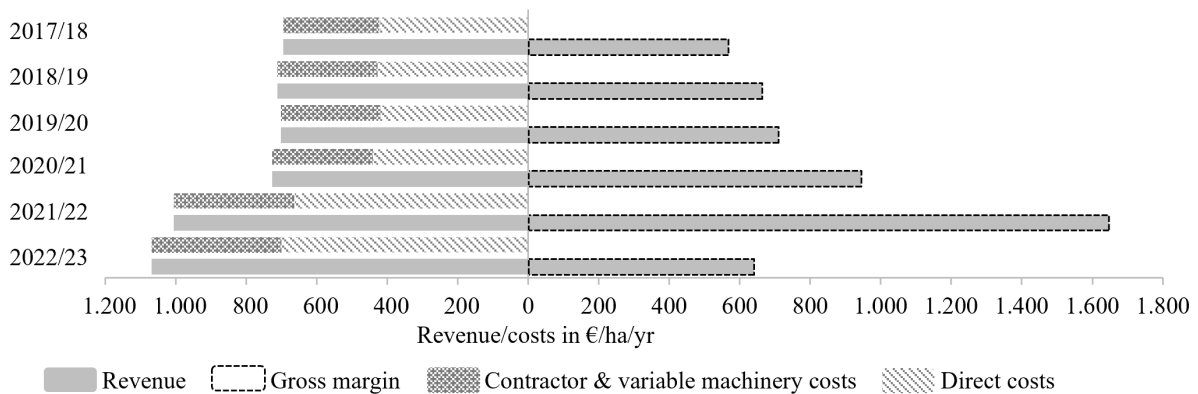


Figure 3. Comparison of components of opportunity costs 2017/18-2022/23 (n=19).

Source: Own presentation.

greater planning uncertainty and risks (Q1.2, Q1.3). However, a quarter of the farmers interviewed also pointed to positive short-term economic effects of the market situation, particularly for arable farming (Q1.4).

Regarding AECMs, more than three-quarters of the farmers interviewed indicated that economic aspects are generally an important factor in their decision to participate or that the profitability of AECMs is even a prerequisite for participation (Q2.1). In contrast, one-sixth of farmers stated that profitability is a side aspect in their decision to participate, with other factors prevailing (Q2.2); some others, however, shared this view but also mentioned the general importance of financial aspects separately. Few farmers referred to the recent market changes and pointed out that long contract periods would make it difficult to react quickly to such changes (Q2.3). Some others, however, stated that AECMs would increase planning certainty by providing predictable revenues over time, assuming that the period of high output prices would not last long (Q2.4).

Looking at the cost components, again, almost three-quarters of the farmers interviewed made statements about process costs. Some referred to practical problems that might require the measure to be re-established, causing additional costs, e.g., for seeds. One-sixth of farmers each reported perceived reduced or additional effort when participating in AECMs. The more extensive management was perceived as reducing the time required, labour peaks and the use of other inputs (Q3.1). In contrast, participation was perceived as increasing the workload due to the often fragmented implementation of AECMs and the small area share compared to other crops (Q3.2). It was noted that this additional effort should be taken into account in the compensation payment (Q3.3). Many farmers commented on perceived follow-up costs, making this a driving issue for process costs. Farmers feared weed pressure after the end of the measure when resuming crop production, resulting in higher costs and, thus, mentioned the need for higher compensation payments (Q3.4).

Farmers' views on recent market changes	Profitability of AECMs
<p>Q1.1: Despite the hard work on the farm, the financial situation is not so good, costs are rising, so it is a heavy burden. <i>Farmer30</i></p> <p>Q1.2: The high prices and the high costs, these are huge challenges that we are facing. [...] The risks are increasing significantly. <i>Farmer25</i></p> <p>Q1.3: The market situation has become very uncertain and volatile. We lack planning certainty. We always have to plan at least a year ahead, but that's no longer possible. <i>Farmer26</i></p> <p>Q1.4: Agriculture also has the advantage of being on both sides of the table. So you are affected, but of course, you also benefit from the situation, for example, in Ukraine or the reduced availability of wheat. Or sugar, the same thing. <i>Farmer31</i></p>	<p>Q2.1: So only if it's economically viable. Because at the end of the day I run a business, not a zoo. [...] Because I have to make a living out of it. <i>Farmer36</i></p> <p>Q2.2: And maybe the financial aspect at the very end. But that's actually very secondary. <i>Farmer18</i></p> <p>Q2.3: But we can also see that volatile markets require us to act quickly. And if I've made a five-year commitment, I can't grow wheat or other cash crops on that land. <i>Farmer27</i></p> <p>Q2.4: But I think you have to take a long-term view. Even these high producer prices won't last. And that's why I always try to spread the risk a little bit. <i>Farmer11</i></p>
Code system	
Process costs	Opportunity costs
<p>Q3.1: You also have less work, basically just sowing once and mulching once. So two, or really just one run per year. <i>Farmer8</i></p> <p>Q3.2: But when I see the farm, a flower field is always something I do as a side job. So you don't really want to worry about it. <i>Farmer31</i></p> <p>Q3.3: But of course, you also have to take into account the extra work that you have to do and things like that. <i>Farmer29</i></p> <p>Q3.4: [...] If I want to cultivate the area again and everything has spread seeds, I need more money than the average contribution margin would be, because I have much higher crop protection costs in the following years. <i>Farmer34</i></p>	<p>Q4.1: There is a potential loss of income, especially now that the price of wheat is high. <i>Farmer3</i></p> <p>Q4.2: [...] It does not necessarily have to be more in times of high prices. But there has to be a basic attractiveness [...]. <i>Farmer14</i></p> <p>Q4.3: I have my arable land and I get average yields every year. And it should at least be balanced, even better, because the effort is a bit higher, so that there is an economic incentive for it. <i>Farmer30</i></p> <p>Q4.4: Farm-specific gross margins should be used. If you have harvested 9 to 10 tonnes of winter barley, that was really, really good. Then you can't use average yields from Lower Saxony, because there are others who have only harvested 6 tonnes with less effort. <i>Farmer1</i></p>

Figure 4. Code system for the qualitative content analysis and characterising quotations from the interview transcripts.

Source: Own presentation.

Almost two-thirds of the farmers interviewed made statements regarding opportunity costs. Most of them stated that monetary compensation should at least be based on the lost income from alternative land use. In this context, many cited the current high gross margins in arable farming as a potential main barrier to participation (Q4.1). In contrast, it was also stated that financial attractiveness should be given, but that it is not necessary to compensate for every period of high prices (Q4.2). Other farmers demanded higher payments as an incentive and to compensate for the increased workload associated with participation (Q4.3). However, some farmers pointed to recent high increases in the price of inputs needed for arable farming, such as fertiliser, which could be saved by participating in AECMs.

In addition to market prices, another factor influencing opportunity costs was the yield capacity of AECM sites. Many farmers indicated that they would locate AECMs on less attractive sites for arable farming to reduce personal opportunity costs. However, some of them stated that compensation payments should recognise the local yield capacity and could, therefore, be lower than the farm average. In this regard, the calculation method used to determine the compensation payment was criticised, which is primarily based on average yields in Lower Saxony, without taking into account regional and temporal differences (Q4.4).

4 Discussion and conclusions

In this study, we analysed how market changes affect cost components and the profitability of AECMs, based on the example of perennial wildflower fields, and how these aspects are reflected in farmers' views and decision-making regarding participation in such AECMs. Our results indicate that changing input and output prices can have a strong impact, resulting in substantial changes in both opportunity and process costs for perennial wildflower fields. In line with other studies (e.g. Schaub et al., 2023), the analysis revealed that financial aspects are important for farmers in their decision-making and that, in most cases, financial compensation should at least cover the process costs and the loss of income from alternative land use. However, other factors, such as differences in yield capacity, increased effort, and follow-up costs, should also be considered in AECM payment calculations, which is not usually the case yet.

Most farmers highlighted the general importance of profitable AECMs. This is not surprising given the high earning potential of alternative land use at the time of the interviews, as reflected in the opportunity cost calculations for 2020/21 and 2021/22, and also noted by Ellßel et al. (2022). However, many farmers also emphasised that recent changes in market conditions bear higher risks in the future. Conversely, we found only a very limited number of farmers referring to the possibility of participating in AECMs to avoid market (or other) risks, which has been shown to be a relevant factor in farmers' decision-making in other cases (Wąs et al., 2021; Schaub et al., 2023; Dessart et al., 2019).

The few farmers interviewed who mentioned AECM participation as a risk management strategy might have had more pessimistic medium-term expectations on output prices and farm profitability than the others. In contrast, one possible explanation for why the farmers did not emphasise this point could be a tendency towards loss aversion (Thaler, 2016). This behavioural bias suggests that losses are perceived more intensely than equivalent gains. In this context, farmers might be reluctant to miss out on the potential for high profits in the current market by tying up their farmland in AECMs with fixed payments, even though the potential market profits are uncertain. Focusing on avoiding a perceived short-term loss of potential market profits could cause farmers to overlook the risk management potential of AECMs in the medium and long term. However, implementation of environmentally friendly practices based on reduced inputs has been shown to partially reduce risks by market changes and to be economically effective in the long term, specifically for arable practices (Schaub and El Benni, 2024). Therefore, a special focus on the possibility of AECMs serving as a risk management instrument in general communication could further foster AECM uptake also in times of changing market conditions.

Although both opportunity and process costs changed over time, considerably larger shifts were seen in opportunity costs. As these account for a significant proportion of total costs, a large increase can put pressure on the profitability of AECMs. Furthermore, while process costs are only influenced by input markets, opportunity costs depend on both input and output markets and yield, indicating a stronger market dependency. Other research has also indicated that opportunity costs can prevent farmers from participating in AECMs (e.g. Russi et al., 2016). Interestingly, despite opportunity costs representing a larger share of the calculated costs, farmers discussed process and opportunity costs to a similar extent. This suggests that farmers' perception of the costs may not align with their proportional contribution. One possible explanation for this is that farmers' perceptions of costs in the context of AECM participation are more directly influenced by process costs. Unlike opportunity costs, which may be perceived as a theoretical concept and are more determined by external market factors, the labour and machinery use that translates into process costs may be more tangible. Thus, farmers may perceive process costs as the only aspect that they can actively manage and reduce through their own efforts and operational adjustments.

The relatively strong focus on process costs was mainly driven by statements about practical issues such as perceived high effort and expected follow-up costs. While implementing and maintaining AECMs was highlighted in the literature as an important concern of farmers (see e.g. Sander et al., 2024 for an overview), their focus on expected costs after termination of the AECM adds a novel dimension. In this context, considering such aspects when designing AECMs could enhance their attractiveness. As another example, outsourcing administrative tasks can reduce farmers' perceived workload (Mack et al., 2019). Providing more targeted farm

advisory support could also be beneficial in assisting farmers with management issues (Tyllianakis & Martin-Ortega, 2021). Furthermore, such issues can be seen as transaction costs, i.e. additional costs associated with participating in AECMs. However, despite the legal framework enabling compensation for transaction costs (Regulation (EU) 2021/2115 Article 70(4)), this is not common in practice. Other studies (e.g. Del Rossi et al., 2021) also highlighted the importance of transaction costs in farmers' decision to participate in AECMs.

For AECMs implemented over several years, compensation payments are originally calculated using average prices from past years, considering income foregone and additional effort (Regulation (EU) 2021/2115 Article 70(4)). Adjustments are subject to the approval of amendment requests and are, therefore, rarely possible at short notice. Additionally, regulatory budget planning requires relatively fixed payment heights in the long term. Therefore, this original approach leaves little room for considering changing prices and addressing related uncertainty of farmers. However, alternative models for determining compensation payments, which incorporate variable conditions and make use of the possibility to take into account targets set for certain measures, are being discussed but have not yet been implemented on a large scale (Röder et al., 2023).

While this study provides valuable insights into the costs and profitability of AECMs and farmers' perceptions, some limitations should be acknowledged. Although the sample size for qualitative interviews is comparatively large, our cost calculations rely only on a limited number of farms for such an analysis. Furthermore, as we included farmers in the qualitative analysis who did not implement AECMs at the time of the interviews, their views on cost components and profitability were more theoretical in nature. Although they were not affected by market changes in the same way as the farmers who had implemented AECMs, their views were based on experience with conservation measures in the past.

In addition, we chose to calculate average costs at farm level, whereas AECM payment calculation is usually based on average costs at federal state level. However, this allowed us to better compare the interview data with our cost calculations, as the spatial scales were compatible. Moreover, our calculations are limited to process and opportunity costs, in line with the basic AECM payment calculation set out in the CAP. Including other cost categories, such as transaction costs, would provide a more comprehensive view of the profitability of AECMs. However, these may be difficult to assess (Splinter and Dries, 2024).

As this study focused on one rather uniform region, we analysed farms with similar production intensities. However, as farming intensity matters regarding AECM participation, it would also be beneficial to analyse diverging farms in different regions. This would allow to further elaborate on the relevance of production intensity in acceptance of, and preference for, AECM participation (Canessa et al., 2024).

Our findings highlight the importance of financially attractive AECMs, especially in times of high market prices.

Although the calculations demonstrate a comparatively minor impact on process costs in monetary terms, farmers emphasised their relevance when deciding to implement a measure. This suggests that policy designs should include not only the costs already addressed by AECM payments (i.e. process and opportunity costs), but also other costs such as transaction costs or costs for future recultivation, and farmers' perceptions of different costs.

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