ResKuh: development of tools, diagnostics and recommendations for better herd management

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Abstract

Energy transition, limited resources and climate change are setting new priorities for local food security and call for a plan for sustainable food production in particularly affected areas. This is why the Alsace Chamber of Agriculture and the Regional association for performance testing in livestock breeding of Baden-Württemberg have jointly launched a new project in October 2023 to continue the innovative and strong partnership of recent years. As the name “ResKuh” suggests (“Kuh” being the German translation of cow), the project focuses on improving resilience in bovine milk and meat production. The aim of the project is to support farmers in improving the sustainability of their production systems and in optimizing the use of scarce resources in times of climate change. The project area covers the Upper Rhine region with Alsace in France, Baden in Germany and the High Jura in Switzerland. An important topic that is being addressed is the improvement of water management in dairy farming by reducing water consumption and optimizing the use of resources. Another goal is the development of innovative meadow and pasture management to preserve grassland, particularly with regard to dry periods and more efficient use of self-produced feed. Furthermore, experts from the ResKuh project are working on the sustainability of farms, in particular with regard to animal welfare, the greenhouse gas emissions and the energy transition. By bringing together experts from research, training and consultancy fields from the three countries, ResKuh aims to provide suitable tools to support farmers in overcoming the above-mentioned challenges of climate change and to offer technical aids and training for farmers on the topics mentioned. Cooperation across national borders benefits of skills, tools and methods available on both sides of the Rhine and at the same time promotes exchanges between farmers who are affected by the same problems in the three countries involved.

Keywords: herd management, production, dairy cow, dairy farming, MIR, spectral data.
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Introduction

Climate change presents numerous challenges across various sectors of human activity in the present day. The increasing frequency and duration of extreme weather events, such as droughts, coupled with rising global temperatures, elevate the risk for farms in terms of water scarcity and animal well-being (Huber and Gulledge, 2011). Livestock

systems are particularly vulnerable to the impacts of climate change (Kuczynski *et al*., 2011) and contribute significantly to greenhouse gas (GHG) emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (Lesschen *et al*., 2011).

Addressing the effects of climate change on agriculture and animal production, as well as mitigating these sectors' impact on the environment is crucial to ensure a sustainable food supply for a growing global population (Bauer *et al*., 2016). Research initiatives like the project ResKuh aim to provide adaptation options for agricultural farms in the face of future ecological change. ResKuh, officially known as "Resource optimization and development of sustainable livestock systems in the Upper Rhine region," is a European project co-funded through Interreg. Its goal is to enhance the resilience ("Res") of the bovine ("Kuh" in German) sector in the Upper Rhine region concerning resource management and farm sustainability.

The project focuses on five key areas of animal husbandry, each with its unique challenges: pasture and meadow management, energy management, water management, reduction of greenhouse gas emissions, and animal welfare. The project area covers the Upper Rhine region with Alsace in France, Baden in Germany and the High Jura in Switzerland. Five research groups consisting of experts from the three countries and from different institutions are working in the five areas mentioned before. Each group will develop a methodology to perform diagnoses in pilot farms of the three countries, like the monitoring of the grass growth in pastures, a carbon diagnosis of the CO_2 emissions, a diagnosis of the atmosphere in the stables or the monitoring of the heat stress in dairy cows. The collected data will serve as basis to produce various outputs illustrating the challenges of climate change for the bovine sector and the development of relevant solutions to improve the sustainability of the farms. The project ResKuh aims to provide tools and methods to help the farmers in maintaining the resilience of their farms in the face of climate change, as well as in mitigating their own impact on global warming. Sharing skills, knowledge, and methods of experts from research, training and consultancy across the whole Upper Rhin region throughout this project will help to achieve the above-mentioned goals, while also promoting international research and cooperation between regions affected by the same problems.

Material and methods

The aim of the project is to support livestock farms in the Upper Rhine region in switching to a more sustainable way of farming, by using scarce resources more efficiently and preserving the cultural landscape of this area while also achieving climate-neutral food production wherever possible.

The planned measures are divided into two axes:

1. Increasing the resource efficiency of dairy farms as an adaptation to climate change in two packages of measure improved management of water used on meat and milk producing farms (drinking water and water used in production processes), firstly by reducing water consumption, but also by examining water supply options.
   - introducing innovative grassland and pasture management adapted to climate change in practice, both through the selection of suitable resistant grass varieties and adapted fertilization; in both cases taking biodiversity into account. Another point is the planting of hedges and trees to prevent the grassland from drying out quickly due to wind and sunlight, and through more efficient use of local fodder.
2. Increase environmental protection and improve the sustainability of dairy farms. This objective is to be achieved through three packages of measures:

- improving animal welfare and health through better housing conditions (buildings, ventilation) and through innovative data analyses and studies for breeding robust and resilient animals that can better adapt to a more difficult climate;
- supporting livestock farms in improving their carbon footprint by reducing greenhouse gases (GHG) emissions both in production and through the various possibilities of CO_2 storage, as well as by reducing nitrogen in feeding;
- transition to energy self-sufficiency to limit energy consumption and increase energy production on farms, e.g. by utilizing animal excrement or using a photovoltaic (PV) system to generate energy.

The five international research groups are as followed:

Group "Water management"

Extreme heatwaves and the associated water shortages could jeopardise livestock farming (Doreau *et al*., 2012) in the Upper Rhine region. Groundwater levels are falling and the availability of water is becoming increasingly scarce (Brown *et al*., 2019), even though it is an important resource for livestock farming. In mountainous areas, livestock farmers are already facing water supply problems. Therefore, one of the objectives of this working group is to help farms identify and quantify the different consumptions of water in order to develop measures to improve their water management and optimize consumption by carrying out diagnoses and finding common solutions. The diagnoses will be carried out using a common methodology and a common tool for the project area. It is therefore possible to quantify the amount of water used in the commercialized products and to sensitize livestock farmers to consider the issue of water in their production cycles. The issue of water supply will also be analyzed, as this is an important issue for the animals, especially in situations of heat stress, as well as water quality. As part of this working group, literature research on solutions (e.g. use of different water sources) and an inventory of practices already implemented by livestock farmers will be carried out.

Group "Pasture management"

Global warming, with more intense dry spells combined with high temperatures, is affecting pastures by altering grass growth, composition, and yield (Wu *et al*., 2021). It is imperative for farmers to adapt their practices to ensure sustainable management and sufficient forage production for cattle. The aim is to develop recommendations for the management of meadows and pastures regarding drought, biodiversity, and climate protection. This will be achieved through the joint development of a protocol for measuring grass growth, as well as by analysing the quality of the harvest.

Group "Animal welfare"

Global warming has a major impact on animals. For cows, the ideal outside temperature is between -5°C and 18°C. When temperature and humidity become high, cows begin to suffer from heat stress and are no longer able to dissipate their body heat efficiently (Atrian and Shahryar, 2012; Huber and Gulledge, 2011). To ensure the well-being and productivity of the animals and thus the sustainability of the farms, it is important to work on mitigation measures to avoid this heat stress as far as possible and to adapt the herd towards periods of heat in the best possible way. One possibility is to improve the conditions within the stables by adapting them for a better air circulation to reduce

the THI level within the building, thus reducing heat stress for the cows. In particular, the ventilation of the stables is a critical point to monitor to achieve the best possible climate in the buildings (West, 2003).

Another approach will be to analyse the heat stress and resistance of the animals for a selection aid.

Group "Energy management"

The use of energy is essential for the smooth running of livestock farms (Benoit and Mottet, 2023). However, given the current economic, political, and climatic context, it is essential to work on reducing energy consumption to lower it. Whether it is to protect the environment or to ensure the continuity of its business, farms should aim at lowering their energy consumption as energy resources are becoming increasingly scarce, limited, and expensive (Kreps, 2020). For this reason, this project plans to work on the creation or acquisition of an energy diagnostic tool that can be shared across the various project areas. Indeed, there is currently no common energy assessment tool adapted to the diagnosis of farms in France, Germany, and Switzerland. This diagnostic tool will make it possible to identify and quantify the different sources of energy consumption and to work on adjustments and recommendations to reduce energy consumption. Possible alternatives for greener and more autonomous energy production will also be analysed.

Group "Reduction of GHG emissions"

Agriculture and even more specifically livestock farming contribute to the global GHG emissions (Reisinger and Clark, 2018), thus livestock farms should try to reduce their carbon emissions. Therefore, it is necessary to use a carbon diagnosis tool to identify greenhouse gas emission and work on recommendations to reduce them. In Alsace, the Chamber of Agriculture uses the CAP'2ER tool, as does AGRIDEA in Switzerland. As part of a previous project KLIMACO, various carbon diagnosis tools were tested and compared. The results show that the CAP'2ER tool is one of the best, although the translation and utilization for Germany and Switzerland is not yet optimal. However, to obtain comparable data for the project area, the use of the CAP'2ER tool is recommended, which is why this tool will be translated in German and optimized for the German and Swiss regions.

Conclusion

Throughout this international cooperation and the work of the five different groups mentioned, the project ResKuh aims at develop tools, methods and references for farmers to adapt their farm management towards the challenges imposed by climate change upon agriculture and more specifically, upon livestock farming in the Upper Rhine region. As mentioned by the sustainable development goals of the United Nations (UN General Assembly, 2015), the resilience of agriculture will be a key point for the improvement of many goals such as "Food security and nutrition", "Sustainable consumption and production" or "Ecosystems and biodiversity", which is why such development projects are paramount.

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