

Research Programme

Innovative technologies for climate resilience in agriculture and forestry

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1 Preamble

The partly extreme weather conditions in recent years, with long periods of drought, but also regionally heavy rainfall events, have led to enormous forest damage and lower agricultural productivity. Globally, the consequences of such events are rising food and commodity prices and greater food insecurity. Climate modelling indicates that extreme events are likely to become more frequent and larger in scale.

In order to be able to feed the growing world population in the future and to combat the increasing famines and malnutrition in some regions of the world, there is a need to significantly increase agricultural production and at the same time make it more sustainable. As the second major land use sector, the forestry sector, as an essential supplier of raw materials, plays an outstanding role in the realisation of a modern, competitive, and climate-neutral economy by 2050. Against this backdrop, there is a great need for research into new concepts and technologies that will help to prepare agriculture and forestry for the evolving challenges of climate change and at the same time act in a much more sustainable way. The goal must be to make both sectors as robust as possible to climate-related impacts and extreme events, especially through the management of agricultural and forestry land and at the same time to strengthen their own resilience through a sustainable approach.

The state of Baden-Württemberg and the Baden-Württemberg Foundation recognised the importance of climate change and the challenges it poses at an early stage and have taken them up in an initial funding of research projects. Strengthened by the broad-based research landscape of academic and non-academic institutions in Baden-Württemberg, there is thus considerable potential to make a sustainable contribution to developing new approaches for climate-resilient agriculture and forestry through innovative projects.

Agriculture and forestry are already highly mechanised. In the past, this development was predominantly driven by the goal of increasing economic efficiency. Therefore, mechanisation and automation were in the foreground. Building on the so-called Agriculture and Forestry 4.0, the Baden-Württemberg Foundation now wants to use the research programme to further advance the development of digital applications that are suitable for enabling the management of agricultural and forestry areas to contribute to an increased resilience to climate change.

The programme is intended to specifically fund projects whose findings lead to agricultural and forestry applications. For this reason, in addition to researchers from various disciplines, it is also necessary to involve practitioners from the respective sectors. The programme should also contribute to this and enable stronger interdisciplinary networking of research groups and users from Baden-Württemberg.

2 Aim and Subject of the Call

The aim of the research programme "Innovative Technologies for Climate Resilience in Agriculture and Forestry" is to develop internationally competitive, excellent projects with an application-oriented focus, whose research results have a concrete perspective for subsequent transferability into practice.

Climate change requires technological innovations in all areas of the value chain, from management to production and trade. The **management of agricultural and forestry areas** plays a key role in this. It has a decisive influence on which plant and tree species are used and the extent to which inputs, especially fertilisers and pesticides, are applied. Management is thus not only subject to the impacts of climate change including increasing occurrence of weather extremes, but also has a considerable impact itself on the environment and climate. **The present research programme is therefore limited to project ideas that make a concrete contribution to a more efficient and sustainable management of agricultural and forestry land in relation to climate resilience.**

Targeted management that takes equal account of resilience, climate protection and environmental protection is extremely demanding however. Upstream and downstream areas of the value chains must be considered in the decision-making process. The result is a highly complex interplay of diverse factors that influence the targeted control of management.

Digital innovations play a special role here. They offer considerable potential for a **holistic view** of management and contribute to recording, integrating, and analysing spatial-temporal aspects, scientific findings from different sources and data levels, but also economic demands. Against this background, the focus of the call for proposals is on **digital data-centred technologies** that address the following thematic aspects:

Programme module I: Data collection/control - Efficient, cross-level use of sensor technology and cultivation techniques

Data collection through appropriate sensor technology plays a decisive role in the quality of data analysis and the forecasts and measures for land management that can be derived from them. However, it is not uncommon that data resolution is still too low, also against the background of widely differing time scales in agriculture and forestry. Data collection with the help of the corresponding sensor technology and the actual management practices is always an intervention that may impact the ecosystem. Therefore, an important goal of research is not to burden the agricultural or forest ecosystems more than necessary during these processes.

Building on this, the following exemplified research aspects play a role:

- ✓ Innovations from the field of artificial intelligence that, in combination with corresponding sensor technology, enable more autonomous and automated data collection.
- ✓ Digital innovations for data collection by means of "swarm sensor technology", which can be efficiently controlled by the farmer or forester together with the management processes as efficiently as possible in real time.
- ✓ Developments that combine cross-scale sensor technology and thus the simultaneous collection of as many different relevant data as possible and data streams from different sensor platforms
- ✓ Connection of sensor technology with information and communication systems to establish suitable risk warning systems (e.g. before fire, bark beetle infestation, etc.) or to efficiently guarantee the chain of custody.

Programme Module II: Data integration and analysis - Dealing with Big Data, application of AI and prediction

Targeted environmental monitoring, linked to forecasts of regional climate change effects, is an important prerequisite for making the management of agricultural and forest land climate-resilient. Data from breeding and provenance trials, variety tests and official statistical data can also be used profitably. On the one hand, the increase in data from different sources acts as a catalyst. On the other hand, however, the increasing integration of diverse data sources in agriculture and forestry is accompanied by the problem that the data consists of a wide variety of data formats and metadata. Linking these in a targeted manner is hampered by many hurdles.

Against this background, the following research aspects have significance, for example:

- ✓ Research into tools that homogenise data from a wide range of data formats and metadata (integrative data semantics).
- ✓ Development of more precise cross-level and cross-scale mathematical computer-based modelling.
- ✓ Develop new methods of Big Data analysis, including self-learning algorithms, to make the large variety of data accessible for large-scale modelling.
- ✓ The efficient linking of different digital technology levels (modelling and artificial intelligence, digital twins, machine learning).
- ✓ The appropriate integration of data and decision-relevant signals and trends along the respective sectoral value chains (e.g. food vs. renewable raw materials; needs of the timber industry).

Programme Module III: Data preparation and data presentation - User-friendly tools for end-users and Decision Support Systems

The steadily increasing amount of data relevant to agriculture and forestry is still mainly used by scientists alone. This is due in particular to the fact that the data are not prepared in a user-friendly way so that they can be integrated for decisions in the everyday

working lives of farmers and foresters. A functional aspect in this context is also to actively support the end user in the decision for resilient management of the agricultural or forestry area.

There is an enormous need for development, which concerns the following aspects, for example:

- ✓ Web-based, platform-independent and also intuitively operable tools.
- ✓ Handy and mobile use of the tools, for example when used on a portable tablet or directly in the machines or systems used.
- ✓ Clear and descriptive presentation of as much relevant data from different sources as needed for the farmer and forester.
- ✓ User-friendly "decision support systems", which are based on sound scientific data on the one hand and on the other hand report back data on the management measures carried out for scientific analysis and forecast improvements via feedback loops.

Project ideas are sought for new and further digital developments for **each individual module**. However, **it is also possible to work on several modules in one project**. This can also be done as part of an **iterative approach**.

The developments are to be validated in an application-oriented case study in the context of climate resilience for agriculture and forestry. Consequently, cooperation with a practice partner is desired.

The developments can be targeted at agriculture or forestry separately as well as for a mixed system (silvoarable, silvopastoral, agrosilvopastoral) application. The digital tools should, where possible, be developed based on existing data. Projects that aim to specifically re-evaluate existing data sets, for example from long-term trial areas, are also explicitly desired. The collection of new data is permissible as part of the validation of digital developments, or if existing data has significant gaps that stand in the way of the practical application of the tool.

Finding innovative solutions is a multidimensional task that requires considerable **interdisciplinary cooperation and integration of different expertise in a collaborative manner**. This is how important synergies can be created.

3 Eligibility criteria

All universities located in Baden-Württemberg and all non-profit non-university research institutions based in Baden-Württemberg are eligible to participate.

4 Terms and Conditions

The research is conducted on behalf of Baden-Württemberg Stiftung gGmbH on the basis of a contract with the research institution (contract research). All rights to the results are reserved by Baden-Württemberg Stiftung gGmbH.

The starting point of each research project should be a particular research issue that fits the objectives of the call. In addition, the research objectives should have concrete exploitation potential that could result to an application in the medium term.

Financing will be provided for personnel and material costs, travel expenses, and – in duly justified cases – investment costs in the form of depreciation throughout the project.

Applications can be submitted by individual working groups/research institutions or by consortia of different research institutions. Required by the research issue, an interdisciplinary approach is obligatory. Applications must always specify to what extent the competences required to conduct the research project are already in place.

If several research institutions are involved, then a jointly appointed project leader must be named as a contact person for Baden-Württemberg Stiftung who will act as coordinator for the research institutions and will be responsible for the overall execution of the project.

A one-stage application procedure is envisaged. Applications must be submitted by the date specified below and will be evaluated by an independent panel of experts that will provide Baden-Württemberg Stiftung with recommendations for a decision.

The evaluation criteria are:

- Relevance of the topic with regard to the objectives of the call for proposals
- Scientific quality and level of innovation of the proposal
- Differentiation from the international state of the art
- Application relevance and economic added value for the state of Baden-Württemberg
- Quality of the work plan
- Qualification of the working group/research institution/network
- Adequacy of the budget

Projects within the scope of this call for applications can be rejected without giving reasons. There is no entitlement to funding. By submitting a project description, applicants agree to these terms and conditions.

The project duration should not exceed 3 years. The Baden-Württemberg Stiftung gGmbH provides up to 5 million euros (plus VAT) for this research programme.

5 Application Process

All applications from universities must be submitted by their rectorates. Applications from non-university research institutions must be submitted by their management.

6 Deadlines

Applications in German or English must be received by the project management organization **by ~~30th June 2023~~ 1st August 2023, 4 pm** (cut-off deadline).

Applications must be submitted electronically via Project Management Jülich's Internet portal <https://bws-klimaresilienz.ptj.de/>. The PDF document „Approval of legally binding“ signed by the rectorate of the university or the management of the research institutions must be uploaded to the portal. The signature in the PDF is sufficient. The signed document must not be submitted by post or fax.

7 Scope and Content of Applications

The outline of the project application is specified in the online submission tool <https://bws-klimaresilienz.ptj.de/> and includes the following points:

- 1) General information (coordinator, partner, institution, title and acronym of project, legally valid signature)
- 2) Summary: brief, generally comprehensible description of the project in German
- 3) Objectives of the project
- 4) Innovation and relevance of the project compared to the current state of the art
- 5) Scientific background (own project-related preliminary work, publications and existing infrastructure)
- 6) Patent situation
- 7) Detailed presentation of the work plan
- 8) Milestone Plan: verifiable Milestones every six months for each project partners involved
- 9) Exploitation plan
- 10) Financial plan: Breakdown of net costs, indicating VAT separately (if no VAT is specified, Baden-Württemberg Stiftung will assume costs to be gross amounts incl. VAT):
 - Personnel costs incl. person months and pay groups (financing is available for a maximum of € 80,100 /a for postdocs, € 74,100 /a for doctoral researchers, and € 54,300 /a for technical employees – each plus VAT)
 - Itemized material costs (small instruments up to € 5,000, consumables, travel expenses)

- Investment costs in justified exceptional cases (applicable to new investments of € 5,000 or more, depreciation period according to official depreciation table, billable depreciation only for the period of use during project)
- Overview of total costs
- For cooperation projects, a clearly differentiated financial plan must be provided that logically presents the items and resources planned for each partner.

The requirements for applications are outlined in the guidelines (see <https://bws-klimaresilienz.ptj.de/>). The guideline contains the planned structure of the application as a template as well as the maximum number of characters for each of the above application fields in the submission tool. This ensures that an application does not exceed the maximum number of 20 pages.

8 Project Management

Baden-Württemberg Stiftung gGmbH has commissioned Project Management Jülich (PtJ) with the implementation and monitoring of the research program. Project Management Jülich is responsible for the organizational aspects of the program and is the key contact for all applicants.

Contact details for PtJ:

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