

# Digital Farming in Germany

ISSUE 2023/2024

**Demand for technological advances in agriculture is growing. Digital farming technologies provide solutions to harvest security, natural resource protection and animal welfare. Digitalization in agriculture is seeing developments made in sensor technologies, robotics, automation, artificial intelligence, and big data.**

## Global market digital farming

The global “smart agriculture” market is expected to grow from around USD 12.4 billion in 2020 to around USD 34.1 billion by 2026. The European digital agriculture market was valued at almost USD 1.5 billion in 2020. Worldwide, the most significant technological trends in the agriculture market in 2022 were the Internet of Things (IoT) with 19 percent market share, robotics (17 percent) and artificial intelligence (14 percent).

## Agriculture in Germany

Germany was Europe’s second-biggest agricultural production nation in 2022, with production value of EUR 74.4 billion. Almost half of the country’s land mass – 16.6 million hectares – was used for agricultural purposes in the same year. Arable farming accounts for more than 70 percent of land use, followed by permanent grasslands (28.5 percent) and permanent crops (1.2 percent). In 2022, there were 262,800 farms with an average agricultural land area of 63 hectares per farm.

## Agriculture machinery in Germany

Germany is the world’s third biggest producer of agricultural machinery after the USA and China. In 2022, domestic market volume for agricultural machinery was around EUR 7.5 billion. Data collection and processing and intelligent automation technologies are important focal points in new machinery development. Agricultural businesses tend to source machinery from an array of producers, creating a marked preference for solutions that allow digital connectivity between machines.

## Digital Farming in Numbers

**1 in 6**

German farms plans to invest in digitalization in the near future

**EUR 72 million**

forecast software spending in in the agriculture industry in Germany in 2024

**EUR 7.5 billion**

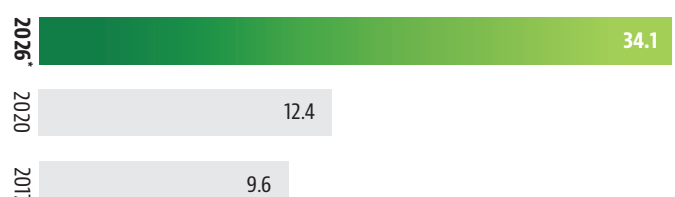
domestic market volume for agricultural machinery in 2022

**Number 3**

producer of agricultural technology in the world

Sources: Bitkom, Statista, BMEL 2022

## Global market size of smart farming 2017-2026 in USD billion



\*forecast  
Source: Statista 2022

## Agricultural Sector in Germany

Germany's agricultural sector has undergone a structural transformation in recent decades. The number of farms and size of the workforce is in decline as agricultural product volume continues to rise. Larger farm sizes, increased efficiencies, digitalization, and the promotion of high-yield crops and livestock are driving these developments.

### Agricultural distribution in Germany

There were around 262,800 farms in the German agricultural sector in 2022. These typically occupy around 63 hectares of agricultural land area per farm, with small farming businesses most often found in southern Germany. Larger farm operations – with 200 hectares or more – are typically located in the east of the country. The three federal states with the greatest agricultural land use are Bavaria, Lower Saxony and North Rhine-Westphalia. Cattle, pig and poultry production represent the focus of livestock husbandry in the country, with animal products generating around EUR 26 billion in turnover in 2021.

### Robotics in agriculture

In 2021, there were 125 agricultural machinery companies in Germany belonging to the leading manufacturers of agricultural machinery and equipment worldwide. Germany ranks second internationally in terms of production of service robots for professional use according to the International Federation of Robotics (IFR).

*Sensor technologies, AI and big data will be the next big thing in digital farming.*

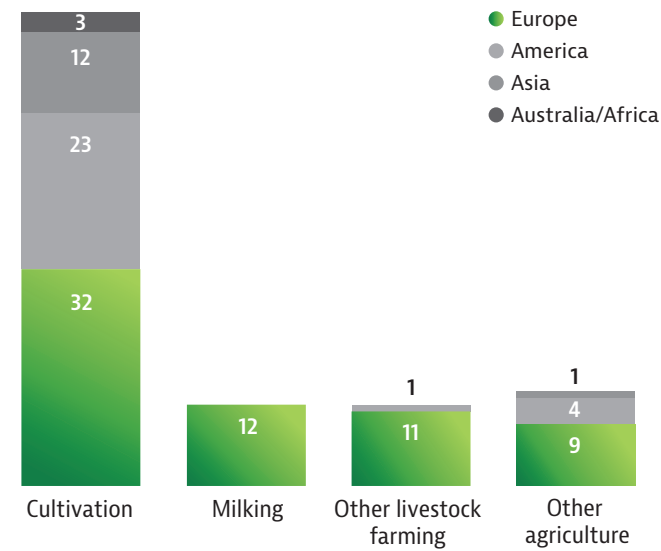
As such, it can be assumed that German suppliers provide most of the agricultural robots currently in use in Europe. The IFR is aware of 97 suppliers of agricultural robotics worldwide. There are 70 suppliers of manufacturing robots for various cultivation tasks. Twelve European companies offer robots for milking purposes, with another 11 companies from Europe and one from North America producing robots for other livestock farming tasks. There are 14 suppliers of robots for other agricultural tasks that do not fit into any of the above classes.

### Digitalization in agriculture

Global market volume of agricultural robots is forecast to grow from the 2020 level of six billion units to almost 36 billion units in 2030. According to digital association bitkom, one in six companies planned investment in digitalization in the near future, with 78 percent of respondents seeing digitalization as an opportunity for their business. At present, just 14 percent of domestic farms use artificial intelligence and big data solutions. However, around 59 percent of respondents plan to implement these technologies.

### Robotics in agriculture

Number of field robot producers per continent



Source: IFR 2021

### Digitalization in agriculture

Investments in digital farming technologies in Germany

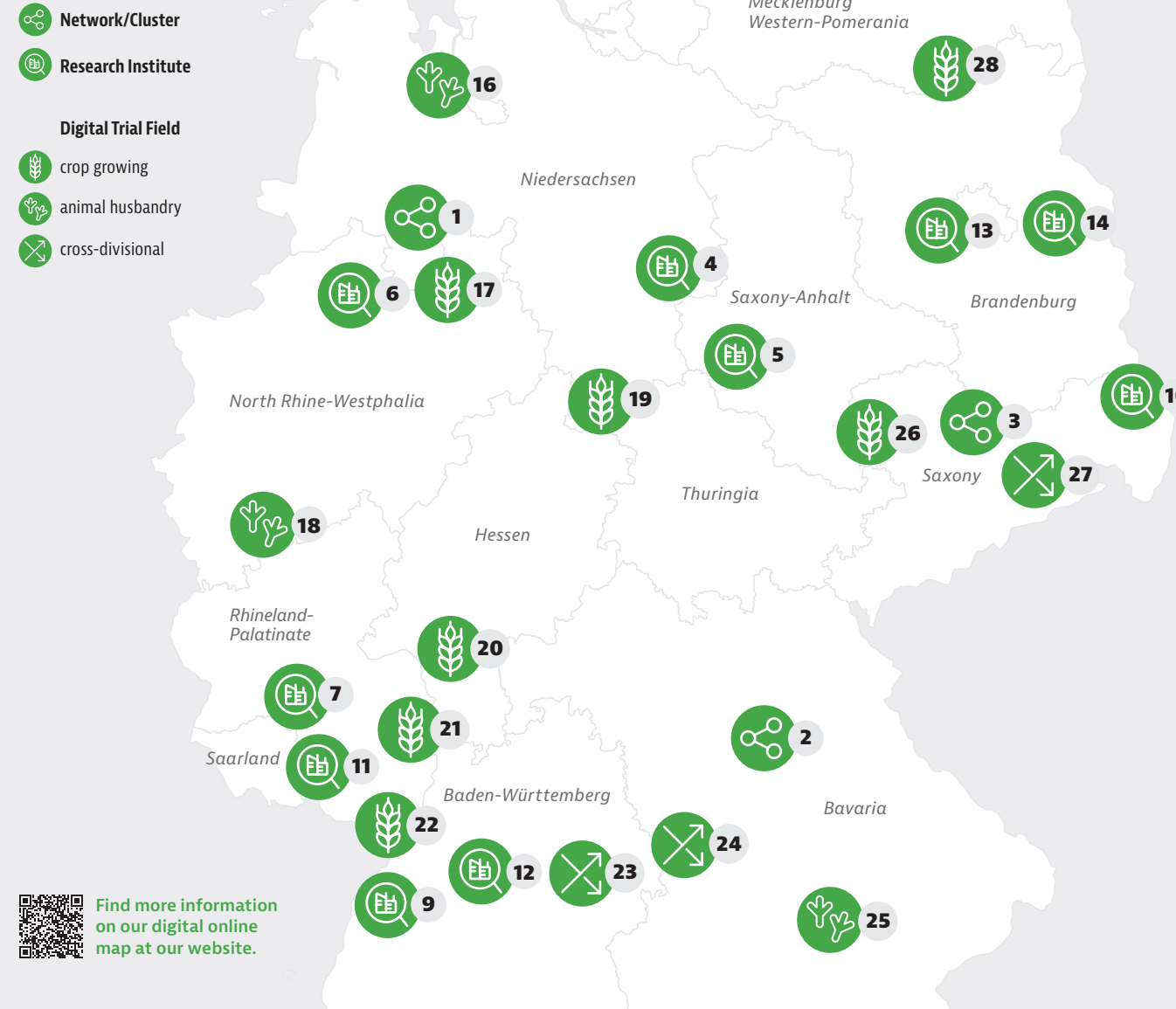
	in use	in planning
GPS-controlled machinery	58%	24%
Apps for mobile devices	39%	34%
Farm and herd management systems	32%	27%
Automated feeding systems	24%	16%
Sensor technologies	22%	42%
Drones	19%	33%
Milking and barn robots	19%	26%
AI/Big Data	14%	59%
Field robots	3%	30%

Source: Bitkom 2022

Sensor technologies are also high on the investment agenda, with 42 percent of respondents planning future investment in this area. Almost 80 percent of respondents currently use a digital technology or process in their daily operations. Thirty percent of bitkom respondents currently use applications for the site-specific deployment of fertilizers, while 23 percent of respondents use applications for the site-specific use of crop protection products.

## World-class Research & Development

Internationally renowned research institutes are present in agricultural industry clusters distributed across the country. Digital trial fields funded by the Federal Ministry of Food and Agriculture are also currently being conducted nationwide.



Find more information on our digital online map at our website.

### LIST OF SELECTED INSTITUTES AND TRIAL FIELDS CORRESPONDS TO NUMBERS ON THE MAP

#### Networks/Clusters

- Agrotech Valley Forum e. V.
- Competence Network Digital Agriculture Bavaria
- Agronym e. V.

#### Research Institutes

- Johann Heinrich von Thünen-Institut - Institute of Agricultural Technology
- Julius Kühn-Institute (JKI)
- DFKI Competence Center Smart Agriculture Technologies (CC SaAT)
- German Research Center for Artificial Intelligence (DFKI)
- Friedrich-Loeffler-Institut (FLI)

- Karlsruher Institute of Technology (KIT)
- Fraunhofer Institute for Transportation and Infrastructure Systems (IVI)
- Fraunhofer Institute for Experimental Software Engineering (IESE)
- Fraunhofer Institute for Manufacturing Engineering and Automation (IPA)
- Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)
- Leibniz Centre for Agricultural Landscape Research (ZALF)

#### Digital Trial Fields

- BeSt-SH
- DigiSchwein
- Agro-Nordwest
- CattleHub
- Farmerspace
- DIWAKOPTER
- EF-Suedwest
- DigiVine
- DiWenLa
- Diabek
- Digimilch
- EXPRESS
- Landnetz
- Agrisens-DEMMIN 4.0

Source: GTAI Research 2023

## Location Advantage Research & Development

Germany's world-class R&D institutes are shaping the future of digital farming. A selection of most important institutes and trial fields for smart farming are described below. The numbers correspond to the numbers on the map.

### Networks and clusters

International companies active in the digital farming sector enjoy ready access to agricultural technology clusters where farmers, machinery manufacturers, agrotech start-ups, universities, and research institutes work together.

1 2 3 Stakeholders are organized in regional networks like the Agrotech Valley in northwestern Germany, Competence Network Digital Agriculture Bavaria in Bavaria and Agronym in Saxony.

### Federal Research Institutes

Germany can count three federal research institutes that conduct research in the field of digital farming. One of their many research areas is the use of digitalization and automation in agriculture.

4 The Thünen Institute conducts research and provides policy advice on rural areas, agriculture, forests, and fisheries.

5 The Julius Kühn-Institut (JKI) is the Federal Research Centre for Cultivated Plants and an autonomous superior federal authority aligned to the Federal Ministry of Food and Agriculture (BMEL).

8 The Friedrich-Löffler-Institut (FLI) focuses on farm animal health and welfare.

### DFKI

In the field of innovative commercial software technology using Artificial Intelligence, DFKI is the leading research center in Germany.

6 The German Research Center for Artificial Intelligence (DFKI) "Smart Agriculture Technologies in Osnabrück" (CC-SaAT) competence center brings the DFKI's different agricultural competences together at one site. Working with industry and other research partners, CC-SaAT develops and applies AI technologies in agricultural contexts.

7 The DFKI has also initiated the Yield Consortium as part of its AI4EO Solution Factory in Kaiserslautern. Established in 2021 in cooperation with the European Space Agency, the Yield Consortium makes use of satellite data and AI to forecast agricultural yield and develops predictive models for selected arable crops.

### Fraunhofer Society

Working closely with industry and the farming community, Fraunhofer society is bringing innovations to market.

11 As part of the COGNAC ("Cognitive Agriculture") flagship project, the Fraunhofer Institute for Experimental Software Engineering (IESE) is leading eight Fraunhofer institutes to conduct joint research on basic principles for the production of agricultural products that are as environmentally and resource friendly as they are efficient. Innovation areas include agricultural data space, sensor technology and autonomous field robotics. Developments are now at such a late stage that the innovations can be integrated into the products, processes and services of interested industry partners.

### Leibniz Association

The Leibniz Association connects 97 independent research institutions that conduct basic and applied research.

13 The Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) is one of the major agricultural engineering research institutes in Europe.

14 The Leibniz Centre for Agricultural Landscape Research (ZALF) conducts research in the area of agriculture and digitalization and is one of the BMBF "Agricultural Systems of the Future" initiative project coordinators.

### Digital trial fields

The BMEL currently supports 14 digital trial fields at agricultural operations all over Germany with EUR 50 million funding. These trial fields focus on crop growing, animal husbandry or are cross-divisional in nature.

15-28 The projects have the option to prolong the funding period for two more years. The aim of the trial fields is to help research digital techniques for crop production and animal husbandry as well as to test their practical suitability. In 2021, the BMEL announced the "Funding Guideline for the establishment of trial fields as future businesses and future regions of the digitalization in agriculture as well as up-and downstream value chains" with funding of EUR 60 million. The future farms and regions should be interlinked closely with the existing digital trial fields.

### Universities

There are 35 universities with a department of agricultural sciences in Germany. The Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU) has even started a "Digital Farming" course of study. More and more universities in Germany focus on aspects of digital farming including computer science and engineering.

# Digital Farming Funding Opportunities in Germany

**Germany supports digitalization in agriculture through diverse initiatives and programs. A number of R&D funding programs have been created to promote the development of digital agriculture technologies. The different funding programs focus on a broad array of innovation themes including artificial intelligence and energy efficiency in agriculture.**

## Research and development funding

The BMEL and the Federal Ministry of Education and Research (BMBF) have established R&D programs to promote innovation in digitization generally and in the field of digital agricultural technologies specifically. Research and development programs provide up to 70 percent of eligible costs subject to company size and research area.

## Supporting investment in agriculture

The BMEL "Investment and Future Program in Agriculture" initiative provides support to SMEs in the agricultural sector that invest in modern technologies to promote climate, nature and resource protection. The program, which runs from 2021 through to 2024, has a budget of EUR 816 million. The federal government's "Energy Efficiency Program" is attractive for companies in the agriculture sector that meet energy-efficiency requirements by investing in digitalization and artificial intelligence solutions.

## Promotion of artificial intelligence in agriculture

The BMEL is providing EUR 44 million in funding to 36 collaborative projects within a research context. Areas promoted include AI in agriculture, the food chain, health nutrition, and rural areas. Of the 28 agricultural projects included, 24 projects are crop production related, with four projects dedicated to animal welfare.

## Agricultural start-up support

Agriculture-related start-ups in the early stage phase can benefit from the BMEL's program to support young, innovative companies through programs implemented by the Rentenbank, the country's development agency for agribusiness and rural areas. The bank offers subordinated direct loans of up to EUR 800,000 in combination with grants for consultancy services to start-up. Rentenbank also provides indirect capital to start-ups as a limited partner of specialized venture funds. Accelerators like Seedhouse and Rootcamp specialize in the needs of tech start-ups from the agriculture and food sector. They not only provide access to a broad network of start-ups, corporations, universities, and research institutes, but also offer finance and coaching programs as well as office space.

## Bank loans and funding programs

As a business development bank, Rentenbank is an important financing partner for enterprises in the agriculture sector. Companies can request public promotional loans, leasing financing and guarantees. Financing can be used for a wide range of purposes including investment in digitalization and automation. Access to the different financing options is via the company's main bank. Rentenbank also handles application processing and funding of the BMEL start-up and agriculture investment program.

## How to Benefit from R&D Funding

To participate in R&D grant programs, companies must define an R&D project with clear objectives and a fixed timeline. Projects should be intended to develop a new product, process or service that substantially surpasses existing products, processes or technical services in terms of their functions, parameters or features. An application for R&D funding also has to set out a commercialization plan, detailing how research results will be transformed into marketable products, processes or services that generate additional turnover and/or employment in the region where the R&D project is located.

## R&D Funding Project Examples

### Bonirob

The BMEL-funded "Bonirob" research project has developed an autonomous robot for plant phenotyping. The prototype is universally applicable. Initial field trials have seen navigation and sensor technology tested under natural conditions. The project is being led by the Competence Center of Applied Agricultural Engineering at the University of Applied Sciences Osnabrück in partnership with a number of companies.

### Agrosystems of the Future

The BMBF-funded "Agrosystems of the Future" initiative has selected eight research consortia that are researching and developing future agricultural production systems. Work began in 2019, with funding recipients receiving funding for up to five years.



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## Imprint

**Publisher:** Germany Trade and Invest  
Gesellschaft für Außenwirtschaft und Standortmarketing mbH  
Friedrichstraße 60, 10117 Berlin, Germany  
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**Executive Board:** Julia Braune, Chairwoman/CEO,  
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**Editor:** William MacDougall, GTAI

**Layout:** Danielle Röbbenack, GTAI

**Print:** Kern GmbH, 66450 Bexbach, [www.kerndruck.de](http://www.kerndruck.de)

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**Order Number:** 21379/1

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Federal Ministry  
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and Climate Action

on the basis of a decision  
by the German Bundestag