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Cover Topic

Digital agriculture: Benefits, opportunities, and challenges

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About the DCZ

The Sino-German Agricultural Centre (DCZ) is a joint initiative of the German Federal Ministry of Food and Agriculture (BMEL) and the Ministry of Agriculture and Rural Affairs (MARA) of the People's Republic of China.

The DCZ was established in March 2015 as a central contact and information platform in charge of coordinating the bilateral co-operation between Germany and China in the agriculture and food sector. In April 2022, the project entered its third phase.

China is one of the world's largest food producers and consumers. Therefore, its agricultural development and transformation process is of significant importance for its German partners. By bringing together stakeholders from politics, business, and academia, the DCZ promotes the exchange of experience and knowledge to tackle shared challenges and support the sustainable development of the agriculture and food sector in both countries.

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1 Editorial

Dear partners and friends of the Sino-German Agricultural Centre (DCZ),

A key challenge for the agriculture sector is to increase output while reducing environmental impacts and preserving natural resources. Decades of agricultural intensification have helped feed a growing world population, but they have also taken a heavy toll on the environment – from loss of biodiversity to pollution and degradation of soil, water, and air.

Digital agriculture can help mitigate these negative environmental impacts. If managed well, it offers an opportunity for improved productivity and reduced environmental impact through more efficient use of natural resources. Increased yields with fewer inputs, fewer emissions, better animal welfare, and more attractive rural areas are amongst the key benefits.

Decision-makers in Germany and China are well aware of the potential of digital agriculture technologies. Funding and research in digital innovations are a top priority in both countries, while demonstration sites and trial fields seek to test the practicability of new digital tools and integrate them into on-the-ground crop farming and animal breeding operations. Digitalization of agriculture and rural areas has also been an important topic in the dialogues and exchange activities promoted by the DCZ. Our recent participation at an expert forum at the 2023 World Expo on Digital Agriculture (WEDA) in Shandong province and the launch of a Smart Agriculture website as part of a "virtual study visit" in 2020 are just two examples.

This second issue of Harvest | 丰收 – the biannual Sino-German agricultural magazine of the DCZ – is dedicated to the topic of digital agriculture, assessing the opportunities, benefits, and challenges that come with the application of new digital tools in the agriculture and food sectors of Germany and China. Contributions in this issue present new empirical data on adoption levels of digital technologies in China, share practical insights from the implementation of digital tools on German dairy farms, and assess the use of remote sensing technology in mitigating climate change risks in agriculture. The contributions highlight the possibilities, but also current challenges when it comes to making agriculture more digital, including purchase costs, interoperability of data systems, and digital literacy.

Other topics included in this issue focus on the German pioneers developing new objective standards and tools for measuring farm sustainability and on China's latest research initiative aimed at deciphering crop genetic resources. As always, there are interviews with different stakeholders in Sino-German agricultural cooperation – this time with two Chinese organic entrepreneurs and the new agricultural counsellor at the German embassy in Beijing. Furthermore, this edition includes a book review as well as a photo story on rural cooperatives in China's northeastern black soil regions. Last but not least, we recapitulate the range and breadth of events, outputs, and activities the DCZ team has been involved in over the past six months.

We hope you enjoy this issue of Harvest | 丰收 and look forward to your feedback and suggestions at info-dcz@iakleipzig.de.

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Cover Topic

Digitalization of Chinese agriculture – a step forward?

Lena Kuhn
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Increase food production – input intensity vs. total factor productivity

Amid a peaking population and the increasingly sophisticated consumer demands of a growing middle class, China has become a net importer of food products since 2004. In particular, the rising demand for animal proteins and the subsequent boom of the national hog sector have made China heavily reliant on imports of animal feed, i.e., soy beans, mostly from the Americas. While the international trade system has thus far been able to cater to Chinese demand for agricultural products, climate change and the current geopolitical situation have revived notions of self-sufficiency – sustaining food security without becoming dependent on food imports. A direct consequence is the political drive to once again increase national food production, as most recently postulated by the high-level initiative to turn China into an agricultural powerhouse (农业强国).

However, this strategy is challenged by well-known resource constraints: while China is one of the largest countries worldwide in terms of land area, its stock of arable land per capita is by far the lowest among large agricultural producers. Water is equally scarce, so production gains will have to stem from increased factor productivity and higher input use. Higher input use, particularly the input of fertilizer and pesticides, is typically the fastest way to achieve production gains. Meanwhile, the potential of this strategy has been widely exhausted in China over the past decades, reaching a point at which the country features the highest level of fertilizer input per hectare in the world, leading to serious degradation of soils and pollution of water resources. While short-term productivity increases may seem desirable from a political perspective, unsustainable productivity growth could seriously hamper the future development of Chinese agriculture. Underestimating long-term aspects of food security, such as sustainability and green agriculture, could exacerbate the already serious limitations and depletion of natural resources.

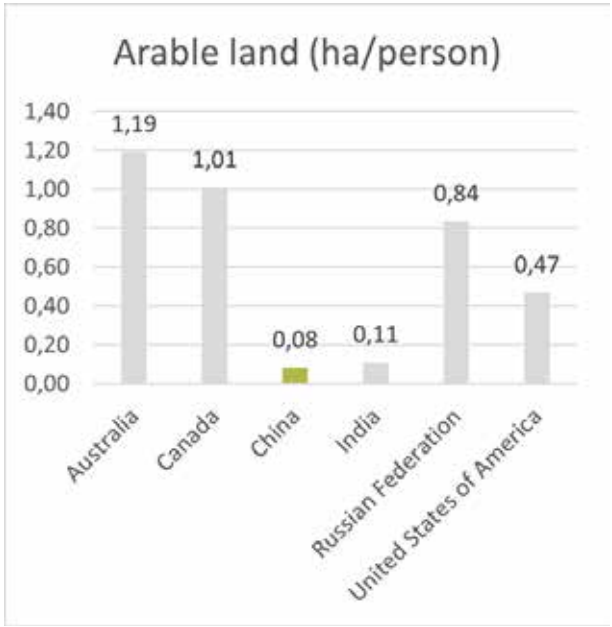

Figure 1: Arable land (ha per person), 2020

Source: FAOStat 2022

China Daily interview with Lena Kuhn on how digitalization is going to shape China's agricultural sector

Another approach to increasing production output is to increase factor productivity, which means increasing the output that can be realized from a set amount of production inputs. In recent years, digitalization has been promoted as one potential solution worldwide to increase factor productivity, e.g., by optimizing the amount, time, and location of input application. While China is well known for its substantial investment in the establishment of a digital infrastructure and a well-developed information and communication infrastructure in urban areas, little was known about the implementation of digital technologies for agricultural production and farm management.

The research project DITAC – digital transformation of China's agriculture

The research project DITAC aims to analyze and assess digitalization processes in China's agrifood sector with regard to their effects on production, use of resources, and trade. The first step is the systematic assessment of the status quo of China's digital agriculture, which forms the basis for econometric and behavioral economic analyses of the adaptation and adoption of selected technologies, as well as the empirical estimation of the economic and environmental consequences. The findings will serve as a basis to consider future development paths and assess the impact of digital transformation processes from a global perspective. For this project, the Leibniz-Institute of Agricultural Development in Transition Economies (IAMO) is partnering up with China Agricultural University (CAU), the Institute of Agricultural Economics and Development at the Chinese Academy of Agricultural Sciences (IAED-CAAS), the Macro Agriculture Research Institute at Huazhong Agricultural University (MARI-HZAU)/International Food Policy Research Institute (IFPRI), as well as the Sino-German Agricultural Centre (DCZ).

Below, we share preliminary findings of a 2022 survey on the state of digitalization of Chinese agriculture. A farm-level survey was conducted in five Chinese provinces (Sichuan, Heilongjiang, Hubei, Hebei, and Hunan) in 2022 among 2,400 randomly selected farms, which also represents China's growing number of large commercial farms. Despite many impressive technical advancements and initiatives in China, actual digitalization levels of its farms were found to be rather low. Only 4.4% of the 2,214 sampled crop farms owned any machinery with a digital component at all. The most frequently owned machinery were agricultural vehicles, planters, rotary cultivators, and UAVs, which were used by 0.5 to 1% of the farms each. For most of the appliances, not even an analog (nondigital) version was being owned. For the livestock and aquatic industry, digitalization levels were higher. Here, the highest level of digital machinery was found in the poultry and pig industry. Among these farms, 16 to 19% of farms had at least one application with digital functions. Overall, 17% of farms engaging in the livestock industry had at least one type of digital equipment.

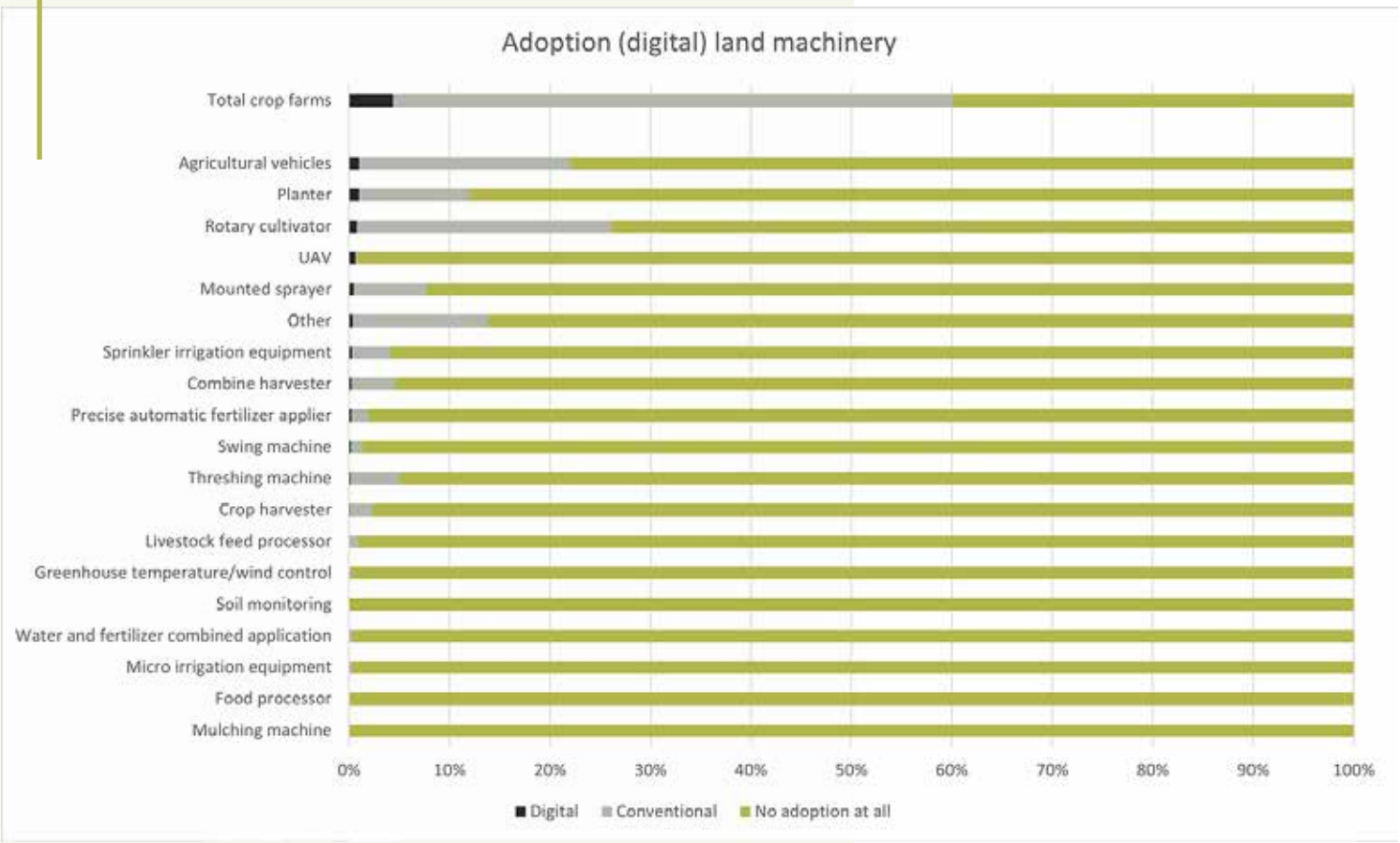

Figure 2: Adoption of (digital) land machinery among crop farms, 2022

Source: Own illustration, data from own survey.

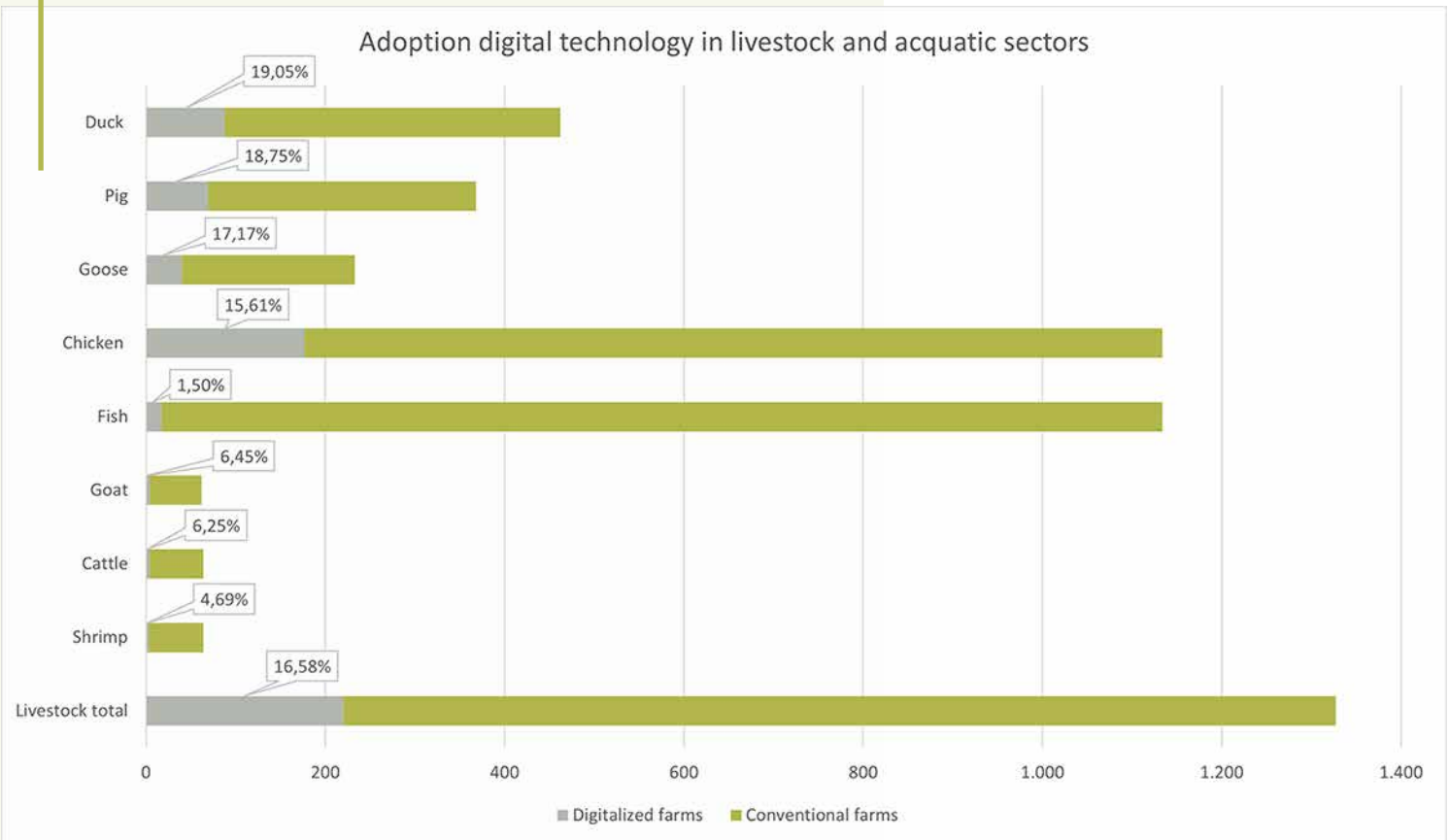

Figure 3: Adoption of digital technology in livestock and aquatic industry, 2022

Source: Own illustration, data from own survey

Equipment for using agricultural software and applications was more readily available. Among 86% of the sample farms, at least some household members were using the internet. While 83% of farms had at least one smartphone in the household, desktop computers or laptops/tablets – which could be used for more sophisticated software – were only available in 27% and 25% of the farms. The lowest availability was agricultural sensing equipment with internet connection, which was only owned by 2% of the farms.

Actual usage of digital applications meanwhile was lower. 43% of the respondents used agricultural mobile phone software to inquire about agricultural production information at least once a month. 43.4% of the respondents shopped online, but only 4% shopped for agricultural inputs like fertilizer or pesticides. Only 6% of the interviewed farmers understood how to sell products online and only 4.3% had already sold products online. Equally low was the use of e-finance: 21% of the farmers, e.g., used the internet to make online transfers, but only 1.9% bought financial products online. 3.1% used mobile banking and other online credit products.

Land fragmentation and small farm sizes hindering digitalization?

Overall, the level of digitalization of China's agriculture thus remains lower than anticipated. One possible explanation for these findings is the small average size of Chinese farms. As can be seen, digitalization levels were highest among farms that would be considered large by international standards (> 150 mu/10 ha).This was in contrast to micro farms and farms between the Chinese and international standard for large-scale farming (30 to 150 mu/2 to 10 ha).

What accounts for the low digitalization levels of small farms? First, small farms have difficulty to accumulate the required capital for investement. Second, high initial investments into digital technology might simply not pay off for small farmers. However, large scale agriculture is not a panacea, as we can see from international experience: After decades of land consolidation in Germany, various negative consequences of large-scale agriculture have been acknowledged, for instance monocultures, loss of biodiversity, and soil erosion.

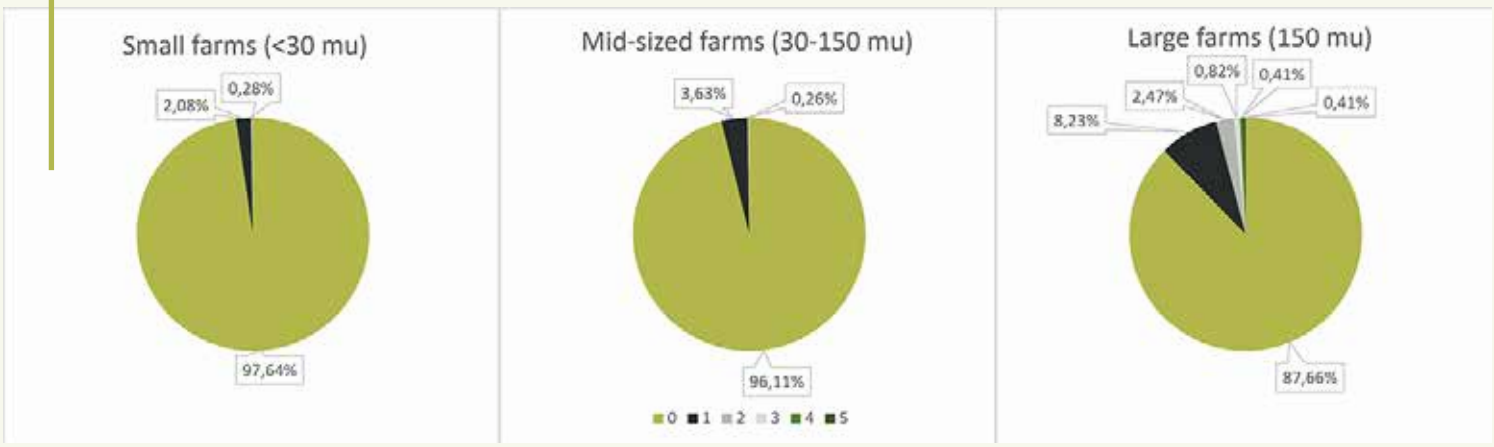

Figure 4: Number of digital hardware by farm size

Source: Own illustration, data from own survey

Government subsidies can help to boost digitalization also in small-scale agriculture, but only if clearly targeted in terms of usage and recipients. For instance, German national and regional government support investment into digital technology, but usually so with a specific focus on technologies enhancing the protection of climate and environmental protection. In addition to general EU subsidies – which are allocated based on agricultural area and thus mostly benefit large farms – national governments also introduce programs targeted at small farms specifically (see info box at the bottom of this article).

A crucial task ahead: improving digital literacy among farm managers

A second, maybe even more important factor is low digital literacy among farmers: In 28% of the cases, interviewed Chinese farmers were not personally using the internet. Even among internet users, 27% could not search for information in a browser, 40% could not download, install or update a mobile app, and more than 50% did not know how to make online purchases.

In Germany, as well as in China, the need for sustainable agricultural production at high productivity levels requires a new type of agricultural labor force. However, hoping for individual initiatives might not be enough, especially if the average age of farm managers is high (e.g., 53 years in Germany, 57 in our Chinese sample). Training tomorrow's farm managers will be the task of the education system. In Germany, about two thirds of farm heads received vocational degrees, either by vocational training, technical school, or some other type of higher agricultural school. Vocational training takes three years, during which students spend half of their time in school and the other half in training farms, to learn about production techniques, marketing and book keeping. 14% of German farmers even hold a university degree, which means additional courses on financial management, plant biology, or soil sciences. However, most vocational and university level programs are still in the process of establishing curricula on digitalization of agriculture and food industry.

Two major differences between China and German are obvious: Germany has by far larger farm sizes on average, which makes the employment of sophisticated high-cost technologies (high-tech tractors, harvesters, etc.) far more profitable. Further, another major driving force of digitalization has been the rising labor wages in Germany, which left farmers in labor-intensive sectors no choice, but to substitute costly labor with digital applications. As a 2022 study on 500 German middle- and large-scale agricultural producers revealed, 79% of German farms are already using at least one digital application in their farming practices. While China certainly is yet at a different stage of demographic transition, digitalization might at some point in future not just be an option, but a necessity.

Further links

Kuhn, L., Jamali Jaghdani, T., Prehn, S., Sun, Z., Glauben, T. (2022). **Keep calm and trade on: China's decisive role in agricultural markets under turmoil**. *IAMO Policy Brief No. 45*, Halle (Saale): Access at: https://www.iamo.de/fileadmin/documents/IAMOPolicyBrief45_en.pdf

Bitkom Research (2022). Digitalisierung in der Landwirtschaft 2022. Access at: https://www.bitkom.org/sites/main/files/2022-05/Bitkom-Charts%20Landwirtschaft.pdf [German]

Examples of national or federal digitalization initiatives in Germany

Research funding – digital trial fields (BMEL)
Digital trial fields are an initiative by the German Ministry of Food and Agriculture (BMEL) that supports research into the practical benefits of digital technologies for arable farming and animal husbandry. With a budget of EUR 50 million, the program supports 14 projects for a three-year period. The project is under the umbrella of the "Programme on the Future of Digital Policy for Agriculture", a program which aims at providing targeted support to further develop digitalization.
Source: https://www.bmel.de/EN/topics/digitalisation/digital-trial-fields.html

Investment program "Digitalization and technology for sustainable forestry" (BMEL)
With a total volume of EUR 800 million, BMEL supports, among others, investments into precision farming and related consultion services. While investments have to be cofounded by a commercial credit, state subsidizes up to 40% of the investments at a maximum of EUR 1 million per applicants.
Source: https://www.bmel.de/DE/themen/landwirtschaft/klimaschutz/investitionsprogramm-landwirtschaft.html

Investment program "Promoting digitalization in agriculture" in German province Hesse
Under the guideline of Hesse province for support of innovation and cooperation in agriculture and rural areas, the program "Promoting digitalization in agriculture", the regional government supports the purchase of agricultural software, sensor technology, harvest machinery, digtal monitoring units as well as consulting services towards digitalization of farm management. This line supports projects between EUR 1,500 and 80,000 with direct subsidies, thus dedicately supporting also smaller projects and enterprises. Similar funding lines are available in many other provinces, e.g., Bavaria.
Source: https://hessen.de/presse/land-unterstuetzt-digitalisierung-in-der-landwirtschaft

European Recovery Program (ERP) – digitalization and innovation credit

Below-market rate investment credit line for volumes of EUR 25,000 to 25 million for investment into innovation and digitalization measures by KfW targeted mostly at middle-sized enterprises, not restricted to agriculture.

Source: https://www.kfw.de/inlandsfoerderung/Unternehmen/Innovation/F%C3%B6rderprodukte/ERP-Digitalisierungs-und-Innovationskredit-(380-390-391)/

Digitalization of farm management – AgrarBüromanagerIn/Agrarbüro digital by Agricultural Chamber Lower Saxony

Series of free webinars and trainings on digitalization of agricultural management and office managements by the agricultural chamber.

Source: https://www.lwk-niedersachsen.de

Dr. Lena Kuhn
Leibniz Institute of Agricultural Development in Transition Economies, Germany

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Remote sensing data for climate risk management in agriculture: Comparing practical implementation of index insurance in Central Asia, Mongolia, and China

Ihtiyor Bobojonov and Lena Kuhn
Leibniz Institute of Agricultural Development in Transition Economies (IAMO)

Summary

This study presents practical insights from the project KlimALEZ on usage of remote sensing data for establishing index insurance markets. We discuss several opportunities and challenges in terms of identifying a suitable index for the above-mentioned countries and farmers' acceptance of the new risk management tool. For once, usage of satellite-based, freely accessible indices can increase transparency and reduce basis risk in farming systems with small-scale, highly fragmented plots. Second, we show how important it is to involve local farmers in the early stages of product design, e.g., via farmer extension meetings and field experiments. For remote regions, especially in area states like China and Mongolia, digital extension services are of particular value. Third, we argue that only after several years of piloting, farmers will fully acknowledge the concept and related products. Furthermore, moderate-scale projects may enable cost-effective and flexible adjustment to subjective preference of farmers as well as identify the best dissemination and extension strategies at lower costs. To develop a true contribution to farmers' climate resilience, pilots should be planned on moderate scale, but for a longer time period, in contrast to immediate out-scaling with only a few years of program support, as has been witnessed in many previous piloting activities worldwide.

Introduction

Weather extremes of increasing severity and frequency associated with climate change are challenging agricultural producers worldwide (IPCC, 2022). High production risks associated with climate variability often limit agricultural producers' access to credit markets and thus the investment into productive technologies especially in developing countries (Miranda and Farrin, 2012). Thus, strengthening financial stability is of utmost importance to achieve resilient production systems (World Bank, 2017). Agricultural insurance provides an opportunity to offset harvest losses associated with climate and market uncertainties and thus smoothens farm incomes. Risk sharing and more stable incomes both facilitate the access to formal credits (from banks and microcredit institutions), which in turn raises investment into new technologies and thus increases overall agricultural productivity and resilience.

Until recently, agricultural insurance markets have been mainly successful in high-income countries (Jensen and Barrett, 2017). There are many reasons for underdeveloped agricultural insurance markets in low and middle-income countries, including lack of trust between farmers and insurance companies and high transaction costs associated with monitoring farming activities and settlement.

Figure 1: Surveyed index-based agricultural insurance projects worldwide

After the occurrence of yield defaults, insurance companies assign agronomists with assessing the part of the loss associated with the insured peril and separating it from losses due to farmers' poor farm practices. This process is very complex and typically drives insurance premiums beyond farmers' willingness to pay. Furthermore, subjective and less transparent loss evaluation processes can lead to conflicts between farmers and insurance companies.

Index insurance, first introduced more than two decades ago, was proposed to solve several of the problems of agricultural insurance markers in developing countries (Hazell and Hess, 2010; Miranda and Farrin, 2012; Miranda and Glauber, 1997). For this type of product, yield losses are not evaluated at site, but estimated based on an index that is highly correlated with local yields, e.g., weather station data. This procedure not only avoids expensive and time-consuming site inspections, but is also supposed to increase the transparency and trust of customers as well as international reinsurance companies.

Despite these attributes, several practical challenges remain, making index-based insurance often not sustainable under market conditions. The project KlimALEZ ("Increasing climate resilience via agricultural insurance – Innovation transfer for sustainable rural development in Central Asia") is led by the Leibniz Institute of Agricultural Development in Transition Economies (IAMO) and aimed at contributing solutions that solve the issues related to lack of data and making the index insurance more attractive and affordable to farmers. This study provides lessons learned during implementation of piloting activities in Central Asia and Mongolia in the scope of KlimALEZ and other projects of IAMO and discusses their relevance for China.

A review of 92 insurance pilots or programs in 44 countries in Europe, the Americas, Asia, and Africa by the KlimALEZ team provides first insights into practical implementation processes and challenges. Among those insurance pilots, five case studies from China were analyzed in more detail in the scope of this study where more complete data in English language is available. In the following, we discuss two main challenges, which may be solved by proceeding digitalization.

Finding the best satellite-based index

First, weather data from ground-based stations in the past did not allow to reduce basis risk (local deviation of index values from reported yields), as stations in many mid- and low-income countries are sparsely distributed and often do not provide reliable historical records. The availability of medium- and high-resolution satellite weather data is now easing this problem (Eltazarov et al., 2021). The first main challenges for the outscaling of previous pilots was the lack of reliable data for index design and operation. Therefore, the project dedicated strong efforts towards the identification of those data sources and indices that are freely available and have higher correlation with local yields in Central Asia. One of the two most important criteria for satellite data for index design are their availability for a sufficiently long period of time (at least ten years) and high correlation with local yields. We obtained regional and district level yields for the last 20 years to test the correlation with climate data from CHIRPS, GSMaP, and GLDAS products (Eltazarov et al., 2021). Another issue is the type of index used for yield predictions. In our case, we tested satellite-based vegetation products like the Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), the Enhanced Vegetation Index (EVI), the Green Chlorophyll Index (GCI), and the Leaf Area Index (LAI). These indices were calculated for wheat-growing districts, followed by an analysis of their correlation with average yields (Eltazarov, 2023). Furthermore, the products underwent practical assessment by insurance partners, government organization and farmers. Farmers, e.g., demanded to consider also other risks (temperature, dry wind, etc.) in the index design beyond rainfalls, since those are also important determinants of drought in rainfed farming systems of Uzbekistan. Among existing options, satellite-based precipitation data (Eltazarov, 2021) and an NDVI index were identified as most suitable index for highest risk-reduction potential (Eltazarov, 2023). Figure 2 and Figure 3 demonstrate the suitability of an NDVI-based index for wheat production in the case of Uzbekistan.

These developed indices were then passed on to national insurance and German reinsurance companies for pricing and the organization of sales activities in scope of our piloting activities. IAMO also served as a settlement agent, meaning that its scientists provided index values and indicated due indemnity payments.

Farmers' understanding and take-up of satellite-based index insurance

The second main challenge identified in the study on index insurance pilots worldwide was the lack of understanding and trust in the index-based product. Mobile applications and other data solutions can help to raise trust of farmers with regards to settlement and the underlying climate data, one of the crucial impediments against outscaling of previous pilots. Several KlimALEZ project activities aimed to determine farmers' assessment of the presented project and explore their understanding of the index developed on remote sensing.

The first approach were behavioral experiments in Kyrgyzstan and Uzbekistan involving 344 farmers in total. These experiments simulated the decision making of farmers to understand general demand to index insurance and explore participants' general understanding of the concept. Experiments in Kyrgyzstan confirmed lack of trust into insurance

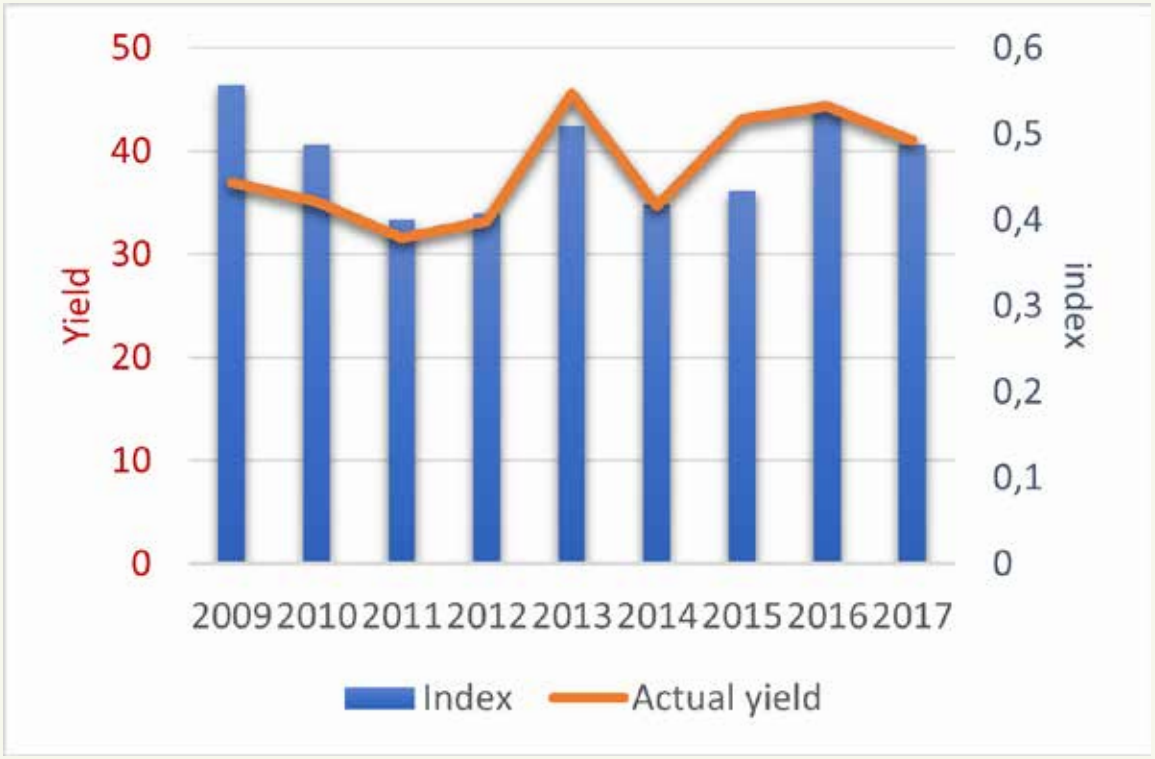
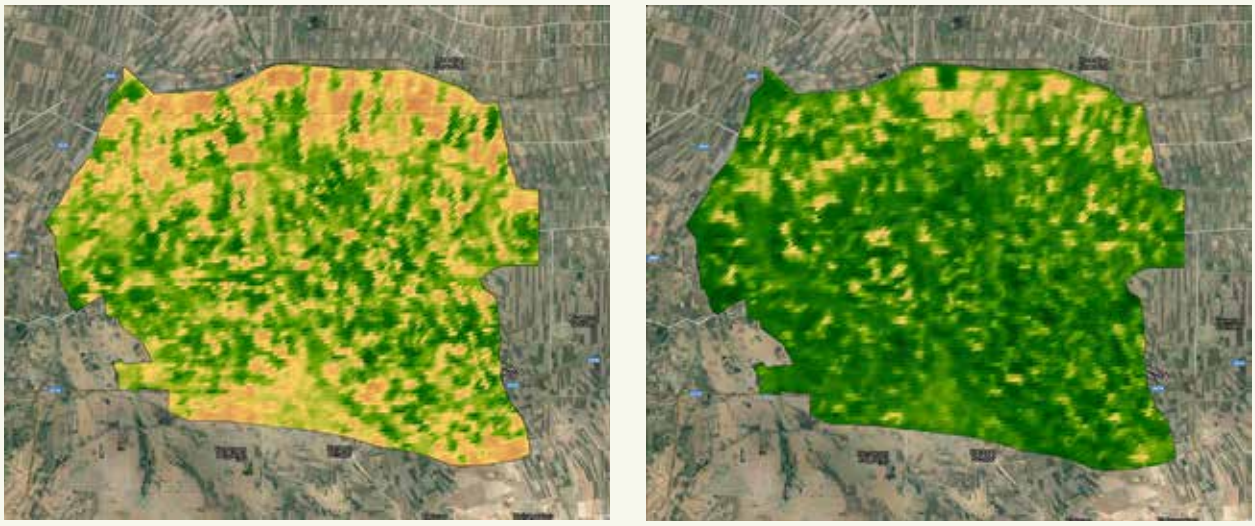


Figure 2: Example of yield and NDVI index in Zarbdar district of Djizzah province, Uzbekistan



2011, drought year

2016, normal year

High vegetation

Low vegetation

Figure 3: Comparison of NDVI values for a drought and a normal year in Zarbdar district of Djizzah province, Uzbekistan

companies as important determinant of insurance adoption, indicating strong need for community-based extension services (Moritz et al., 2023). Moreover, the experiments and subsequent debriefing with participants indicated strong need for more transparency in terms of climate and vegetation data. This finding motivated the development of an Android App, "FarmPulse", which is targeted at farmers in the region. This app offers free monitoring of plot-level vegetation development along satellite information, as well as information on present and historical NDVI values, to make insurance triggers and payouts more transparent to farmers.

While digitalization helped to solve two major issues – the reduction of basis risk and increasing transparency of settlement – it is, however, no panacea. Most importantly, the issue of affordability remains. Most of the commercial projects worldwide rely on heavy subsidization, which often turns out to be the Achilles' heel of projects in countries that are exhibiting large fluctuations in state budgets. The project KlimALEZ therefore implemented two waves of piloting in Uzbekistan and in Mongolia, where marketable index-based insurance was sold under market conditions. First, a satellite-based rainfall insurance was implemented in Uzbekistan in 2019 in cooperation with the local insurance company GROSS Insurance. Only a small number of contracts were sold, since premiums were unsubsidized, and the product was not coupled with any other services like credit, procurement, or input prizes. Farmers found the market-based price very expensive and specifically asked for coupling insurance with credit. This information was also confirmed in the results of the behavioral experiments conducted at the same time in the same region.

The second wave of implementation was conducted in 2020, due to Covid-19 restrictions in Mongolia, which was at that time less affected by local lockdowns than other countries in the region. Following experience from the pilot in Uzbekistan, this product relied on an NDVI index, which was developed by scientists of IAMO and implemented by Mongolian insurance companies under the coordination of the reinsurance company MonRe. Furthermore, insurance was now coupled with credit, as suggested by farmers in field experiments and piloting activities in the previous years. The insured productions served as a partial collateral for subsidized credits for investment into summer wheat production in 2020. However, the premium rate for index insurance was not subsidized. Credit applicants were required to insure 30% of their production value. The dissemination of credit and index insurance was implemented by local banks as well as the National Agricultural Fund and were sold by local insurance companies under supervision of Mongolian Re. The credit line and thus the insurance product was offered to all summer wheat producers in Mongolia. The Agricultural Fund was responsible to allocate the credits, which was granted to any farmer who agreed to purchase the index insurance. The credit is used to purchase fertilizer, minerals, and machinery from state organizations at preferential conditions. 30% of the insurance premium was due upon taking out the insurance. The remaining 70% of the premiums were to be paid after harvesting the wheat, as liquidity of farmers in the region is typically lower than in industrialized countries. Overall, 387 farmers purchased the offered index insurance for wheat and obtained a subsidized credit.

To explore farmers' opinions, measure the impact of the program and explore existing problems, the project team conducted an ex-post data collection among farmers who participated in the program (i.e. treatment) as well as similar farmers who did not participate (control). Overall, we collected data on 232 farms who purchased index-insurance and 310 farms who did not participated in the program, resulting in an overall sample size of 542 farms.

Analysis of the data could not identify an immediate increase in yields of insured crop in the first year of insurance purchase and credit access. Similarly, farmers did not change their farm management strategies in terms of input use because of insurance coverage or credit access. However, we found total production of wheat to be significantly higher among insured farm, possibly explained by using more land due to credit access. For assessing mid- and long-term effect on farming practices, we rely on future waves of data collection among participants.

Comparison between China, Central Asia, and Mongolia

Among the other countries analyzed in the study, China has also many years of experience with pilot projects. In 2004, the Document No. 1 of the Central Committee of the Communist Party of China postulated to "[Accelerate] the development of a policy-oriented agricultural insurance system, providing certain premium subsidies to farmers participating in planting and breeding insurance". Earliest implementation of index insurance started in 2007 by Anxin Insurance company (Agroinsurance, 2017; FAO, 2011). In 2012, The State Council issued the Agricultural Insurance Regulations, the first law about agricultural insurance in China. By now, China's agricultural insurance premium revenue is the second largest in the world and the largest in Asia. Currently, there are already nearly 200 small and regional index insurance products active, however, little is known of the overall participation rate in these programs.

One of the main differences between the KlimALEZ pilots and index insurance in China is the high level of subsidies – nearly 80% of the premiums are covered by the Chinese governments. As has been shown by Ye et al. (2020), this high level of subsidization results in a situation where the price advantage of index insurance does not offset the basis risk introduced by (in this case area yield) indices. While little is known about this effect in other, potentially satellite-based products, similar effects are likely. While high subsidization is certainly effective in quickly increasing coverage of conventional insurance, it seems to increase the requirements for product design and basis risk reduction for index insurance.
A common issue of index insurance implementation across all study countries seems to be the lack of understanding of the products by farmers and other stakeholders, which may create difficulties in outscaling (IFAD and WFP, 2010; Sirimanne and Srivastava, 2015). In China, apparently extension efforts were reduced by dealing with local representatives rather than farmers, leading to a reduction in premiums, but also lower trust and understanding among the insured farmers (Ye and Mu 2020). A solution to this trade-off between extension efforts and administrative premiums/prices could be digital extension services and weather data. Once again, this notion is supported by our practical findings in Central Asia and particular Mongolia, where problems of remoteness hinder physical extension and marketing visits.

Conclusions

This study has shown that previous technical barriers related to the availability of climate data can be overcome by using satellite data (Eltazarov et al., 2021, 2023). This kind of data is often freely available and could make it possible to create a farm-level index, as is often recommended (e.g., Bucheli et al., 2020). This could be also relevant in case of China, where meteorological stations might not always cover more remote areas of northern and western China (Cao et al., 2016). Lacking coverage of meteorological stations is particularly a problem for small, highly fragmented plots, which is the case for most of Chinese crop producers. Moreover, we determine a strong need for designing index with participation of farmers to investigate their needs and determinants of their demand (Moritz et al., 2023). Our experience further shows that not all farmers understand the principles of index insurance immediately and they may still have negative associations with their experience with traditional insurance products. Therefore, piloting activities should be implemented only when considerable efforts are dedicated towards extension activities. A longer piloting stage is required to gain enough experience on subjective preferences of farmers and adjust information and extension campaigns accordingly over the years. Therefore, we recommend planning pilot activities on a smaller scale, but over a longer period of time in order to make sustainable use of government funding as well as research and development funds.

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3

Window on German agriculture | 德国农业之窗

Sustainable forage production through digitalization

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Agriculture is one of the many fields increasingly influenced by digitalization. In addition to saving work time, operating resources, and inputs, modern digital tools are an important factor for sustainable agriculture. The DigiMilch project (see info box below) analyses different aspects of digitalization along the milk production process chain. In the following section, we will present aspects of digitalization in the fields of farm manure management, sensor-based yield determination, and feeding management.

Farm manure management

Farm manure, such as cattle or pig slurry, is a valuable and farm-specific compound fertilizer that must be used as efficiently as possible. Modern application techniques already enable a significantly improved utilization of nitrogen in slurry, which can be applied in a targeted and geo-referenced manner with the aid of GPS and driver assistance systems (see Figure 1).

These digital technologies also allow the use of application maps and improved data handling with farm management information systems (FMIS). Currently, either standard table values or laboratory analyses are used to determine the nutrient content of manure. However, these can be subject to considerable fluctuations due to changes in feeding, bedding, or the amount of water used on the farm. In addition to seasonal fluctuations, layers with different nutrient contents can also occur within a slurry pit, making accurate recording difficult. Tabular values always represent only an approximation of the actual content, and even laboratory analyses can only provide a snapshot of the results, which are usually only available with significant delay.

Online sensors, such as near-infrared spectroscopy (NIRS) sensors, promise a continuous estimate of content during application, allowing application rates to be adjusted to fluctuating compositions (see Figure 2). As NIRS is an indirect estimation method, it is always dependent on the quality and up-to-datedness of the stored calibrations. Nevertheless, good estimation results can usually be achieved with standard manure. In some cases, such as manures with very low or very high dry matter (DM) content, manure additives, and changes in ration design, estimations can be inaccurate. The results of analyses in the DigiMilch project showed high deviations of sensor measurements from the laboratories for these types of slurries.

Figure 1: Modern slurry tanker with frame for near-ground spreading and NIRS sensor (Photo: S. Wehry)

Hence, a reliable way to detect these implausible values estimated by the NIRS sensors is still missing. Provided that the sensor estimates agree well with the laboratory values, the use of this type of digital technology in the management of agricultural fertilizer can optimize the distribution of nutrients depending on plant needs and avoid a nutrient oversupply, which can lead to soil eutrophication. These sensors can also be used in forage harvesters for roughage forage harvesting, thus enabling multiple use of the technology. As a result, the high purchase costs can be amortized more quickly.

Figure 2: Mobile NIRS station for measuring nutrient content in slurry while pumping (Photo: LfL)

Sensor-based yield determination

Yields in grassland and forage production are currently the biggest unknown factor in the farm nutrient cycle. Yield sensors on self-propelled forage harvesters can record the volume flow, dry matter content and ingredients of the crop (see Figure 3, Figure 5 and Figure 6). These yield data and parameters can be monitored in real time during harvesting and provide the farmer with initial information on the quantity and quality of the harvested material, thus enabling the farmer to positively influence the ensiling process during the harvesting process. The harvested material can, e.g., be ensiled in the ideal order according to dry matter content (DM) enabling good compaction in the silo and helping reduce the resulting losses. The stored yield data provides the farmer with a decision-making basis for optimizing roughage feed management after harvest. For example, mineral and farm fertilizers can be applied according to yield maps (see Figure 4), allowing nutrients to be used more efficiently. Grassland management can also be adapted to area-specific yield potential, thus reducing costs for operating resources and increasing roughage forage quality. High-quality roughage forage can also improve feed efficiency, resulting in saving protein feed cost during feed formulation. Digital technology can also be used to identify silage losses by offsetting the yield data from the forage harvester against the feeding data from the feed mixer, which can be limited by optimized roughage feed management.

For a holistic view of the roughage cycle within the farm, it is necessary to record the yields throughout the year and over several years. The aim of yield recording is always to estimate the annual dry matter yield, which is the basis for optimizations in the operational process. This can become a challenge for farmers if, e.g., some areas are used for hay production instead of silage production and the yields can therefore not be recorded with the forage harvester. Alternatively, yield estimation using satellite imagery in conjunction with growth forecast models can be used to estimate yields on a multi-year basis. These two options for yield estimation can be combined to make it easier for the farmer to record annual dry matter yield. The biggest challenge is the lack of proper interfaces between the various manufacturers' systems. Companies in the agricultural sector have already made several things possible in terms of data exchange and networking, but there is still great need for action, often involving only minimal adjustments.

Yield determination through digital technologies such as sensors in forage harvesters or satellite imagery can help farmers to harvest forage and grassland based on actual data. This practice contributes not only to a more efficient use of resources, but also allows farmers to manage their areas more sustainably and economically through adapted cut utilization.

Figure 6: NIRS sensor for determining the DM content and ingredients on the ejection manifold of the self-propelled forage harvester (Photo: F. Worek)

Figure 3: Terminal on a self-propelled forage harvester (SFH) to display yield values from volume flow, moisture, and ingredient determination (Photo: S. Wehry)

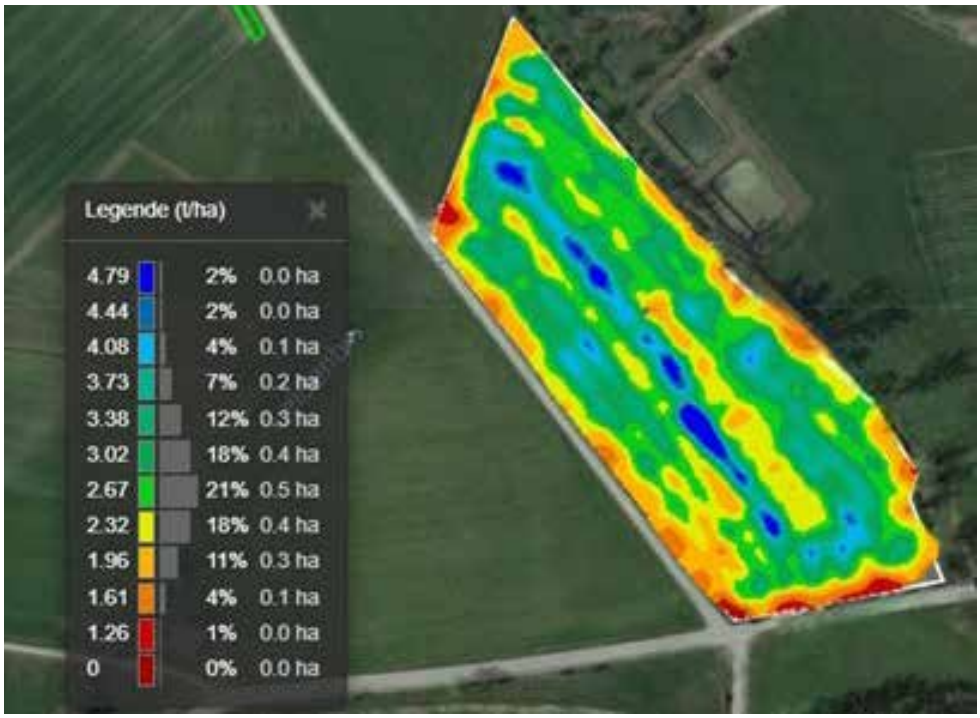

Figure 4: Yield map by yield potential of a practice farm, created in an FMIS

Figure 5: Self-propelled forage harvester with sensor-based yield recording during grassland harvesting (Photo: S. Wehry)

Feeding management

Digitalization on dairy farms greatly facilitates the accurate recording of the nutrient flow in the feeding process. As shown in Figure 7, feeding is the largest source of nutrient input in the nutrient cycle. To map the nutrient flow, seen as input/output in the nutrient cycle, accurate knowledge of feeding rates is essential. Feeding mixers with programmable scales are key because they record the exact quantities of components during the loading process.

Figure 8 shows the data flow in the project. Together with different feeding technology and software manufacturers, it was possible to connect the technology and software on project farms. In this way, the feeding data are available for further analysis, e.g., to calculate feed costs per animal per day, feed, and nutrient efficiency on farms.

Table 1 gives an overview of the nutrient input/kg milk yield on the project farms. The wide variation of nitrogen and phosphorus effort/kg ECM (energy corrected milk) clearly illustrates the potential for increasing efficiency and reducing nutrient consumption through adapted feeding. The only way to optimize the feeding process on dairy farms is to feed in line with dairy cows' needs, which requires an analysis of the nutrient content in the farm's own roughage. Therefore, it is important to adjust the feed ration to the herd performance even when feeding the same components to avoid oversupply.

In conclusion, it remains to be said that the digitization of the individual subsectors already offers important potential for improvement in terms of resource efficiency. This, combined with a holistic view of the dairy farm system and its nutrient flows, makes a decisive contribution to increasing sustainability in agriculture.

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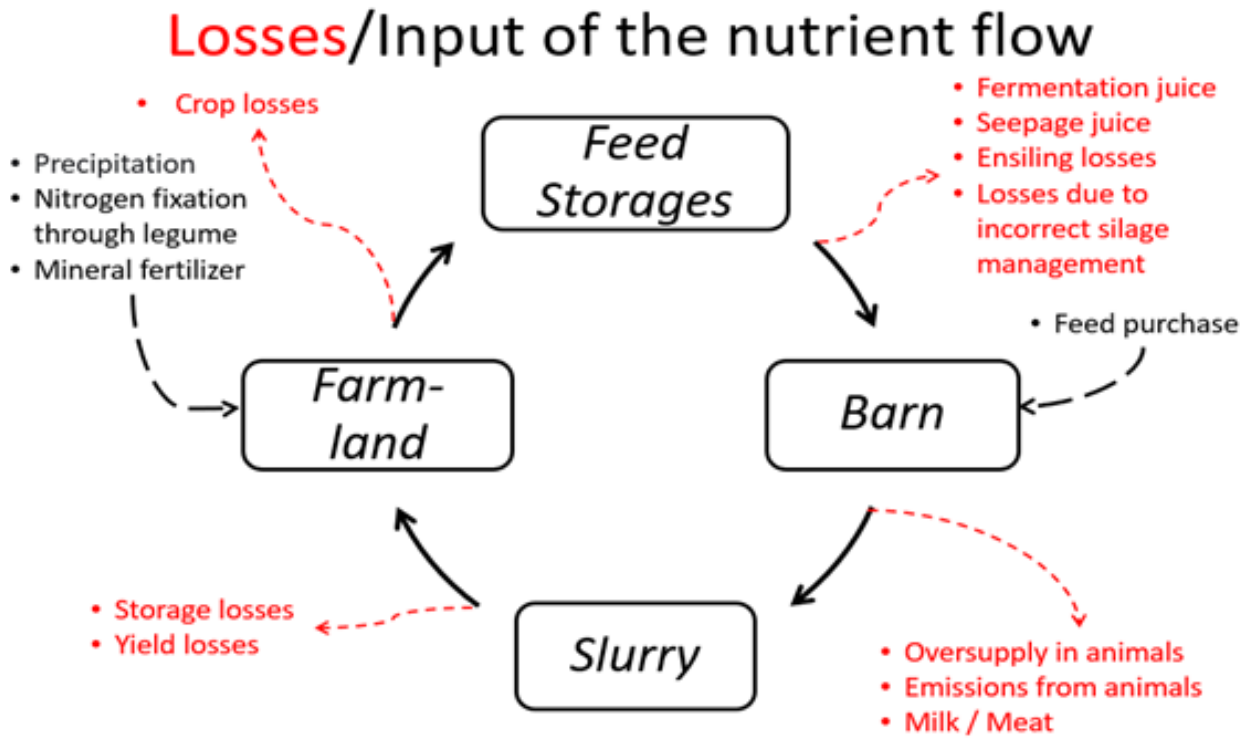

Figure 7: Schematic representation of the nutrient cycle

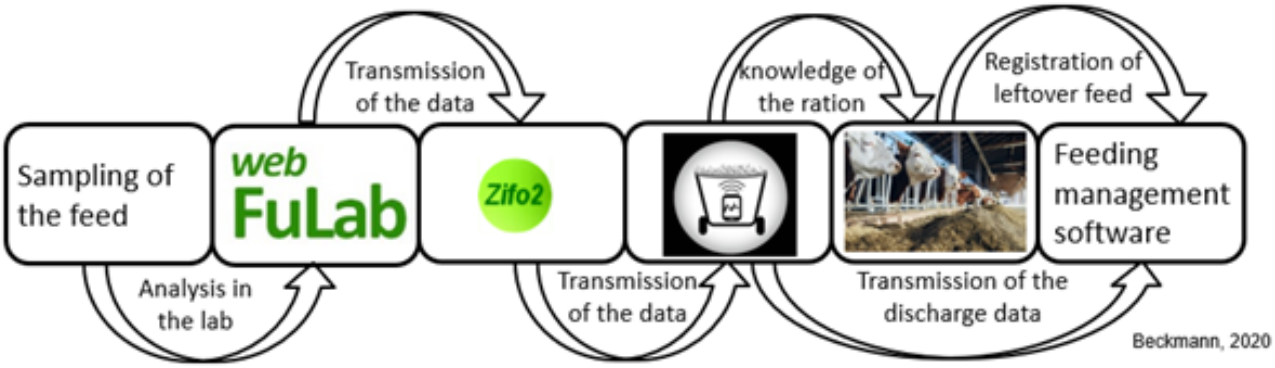

Figure 8: Data flow from the silo to the trough in demonstration project 3

Parameter	Minimum	Mean	Maximum
N effort/kg ECM	9,5	**15,8**	24,5
P effort/kg ECM	2,3	**3,4**	4,6
XP/kg DM, g	111	**144**	186
P/kg DM, g	3,1	**4,3**	5,2

Table 1: Key figures of the nutrient effort/kg energy corrected milk (ECM) on DigiMilch project farms

DigiMilch is funded by the Federal Ministry of Food and Agriculture (BMEL) based on a resolution of the German Bundestag. Located at the Bavarian State Research Centre for Agriculture in Grub near Munich, the project comprises five demonstration projects, which collect data on 20 commercial and four research dairy farms in Bavaria. DigiMilch is sponsored by the Federal Agency for Agriculture and Food (BLE) within the program "Experimental Fields in Agriculture", which aims to investigate digital technologies for crop production and animal husbandry and test their suitability for practical use in farming. To find out more about DigiMilch, scan the code below and watch a short film on YouTube.

通过数字化实现可持续饲料生产

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农业是越来越受到数字化影响的众多领域之一。除了节省工作时间、运作资源和投入外，现代数字工具也是可持续农业的一个重要因素。DigiMilch（数字牛奶）项目（见下面的信息框）分析了牛奶生产过程链中数字化的不同方面。在下文中，我们将介绍数字化在农场粪肥管理、基于传感器的产量测定和饲喂管理方面的应用。

农场粪肥管理

农场粪肥，如牛和猪的粪便，是一种宝贵的、农场特有的复合肥料，必须尽可能有效地利用。现代施用技术已经能够显著提高粪肥浆料中氮的利用率，在GPS和驾驶辅助系统的帮助下，可以有针对性地以地理参照的方式施用（见图1）。

这些数字技术还允许使用应用地图并改进农场管理信息系统（FMIS）的数据处理。目前，通过标准表格数值或实验室分析来确定粪肥的营养成分。然而，由于饲料、垫料或农场用水量的变化，这些指标可能会出现相当大的波动。除了季节性波动外，粪浆池内还可能出现不同营养成分的分层，使准确记录变得困难。表格中的数值通常只能代表实际成分的近似值，而且即使是实验室分析也只能提供一个结果的快照，而结果的获得往往会有显著延迟。

在线传感器，如近红外光谱（NIRS）传感器，承诺在应用过程中对营养成分进行连续估计，允许根据波动的成分调整施用速率（见图2）。由于近红外光谱是一种间接估计方法，它总是依赖于存储校准的质量和最新状态。尽管如此，对于标准粪肥，通常可以取得良好的估算结果。在某些情况下，如干物质（DM）含量很低或很高的粪肥、粪肥添加剂和饲料设计的变化，估计结果可能不准确。DigiMilch项目的分析结果显示，对于这些类型的粪浆，传感器测量结果与实验室数据偏差很大。因此，仍然缺少一种可靠的方法来检测这些由近红外光谱传感器估计的不可靠的数值。如果传感器的估计值与实验室数值一致，那么在农业肥料管理中使用这种类型的数字技术就可以根据植物的需要优化养分的分配，避免养分供应过剩而导致土壤富营养化。这些传感器还可用于青贮收割机上，用来收割粗饲料，从而实现该技术的多种用途。因此，高额的采购成本可以更快地被摊销。

基于传感器的产量测定

草地和青贮产量是目前农场养分循环中最大的未知因素。自走式青贮收割机上的产量传

图1: 装配近地喷洒框架和近红外光谱传感器的现代粪肥罐车 (图片: S. Wehry)

感器可以记录作物的体积流量、干物质含量和成分 (见图3、图5和图6) 。这些产量数据和参数可以在收割过程中被实时监测, 为农民提供收获物的数量和质量的初步信息, 从而使农民能够在收割过程中主动影响青贮过程。例如, 收获的草料可以根据干物质含量以理想的顺序青贮, 使其在青贮窖中实现良好的压实, 并有助于减少由此产生的损失。

图2: 移动近红外光谱站在泵送时测量粪肥浆液中的营养成分 (图片: LfL)

图 6: 自走式青贮收割机喷筒上用于测量干物质含量和成分的近红外光谱传感器 (图片: F. Worek)

存储的产量数据为农民在收获后优化粗饲料管理提供了决策依据。例如, 可以根据产量图施用矿物肥料和农场肥料 (见图4), 使养分得到更有效的利用。草场管理也可以根据特定地区的产量潜力进行调整, 从而降低运营资源的成本并提高粗饲料质量。优质的粗饲料还可以提高饲料效率, 从而在饲料配方中节省蛋白质饲料成本。数字技术还可以通过将青贮收割机的产量数据与饲料搅拌机的进料数据相抵消来识别青贮损失, 这可能受到优化的粗饲料管理的限制。

为了全面了解农场内的粗饲料循环, 有必要记录全年和几年的产量。记录产量的目的始终是估算干物质年产量, 这是优化操作流程的基础。这对农民来说可能是一个挑战, 例如, 如果一些土地用于生产干草而不是青贮饲料, 因此无法用青贮收割机记录产量。另外, 使用卫星图像结合增长预测模型估算产量也可以用于估算多年的产量。这两种估算产量的方法可以结合使用, 使农民更容易记录每年的干物质产量。最大的挑战是不同制造商的系统之间缺乏适当的接口。农业部门的公司已经在数据交换和联网方面实现了一些可能, 但仍然非常需要采取行动, 通常只涉及微小的调整。

通过青贮收割机中的传感器或卫星图像等数字技术来确定产量, 可以帮助农民根据实际数据收割牧草和草场。这种做法不仅有助于更有效地利用资源, 而且还能使农民通过调整采伐利用, 更可持续、更经济地管理他们的土地。

图3: 自走式青贮收割机 (SFH) 上的终端，通过体积流量、湿度和成分测定显示产量值 (图片: S. Wehry)

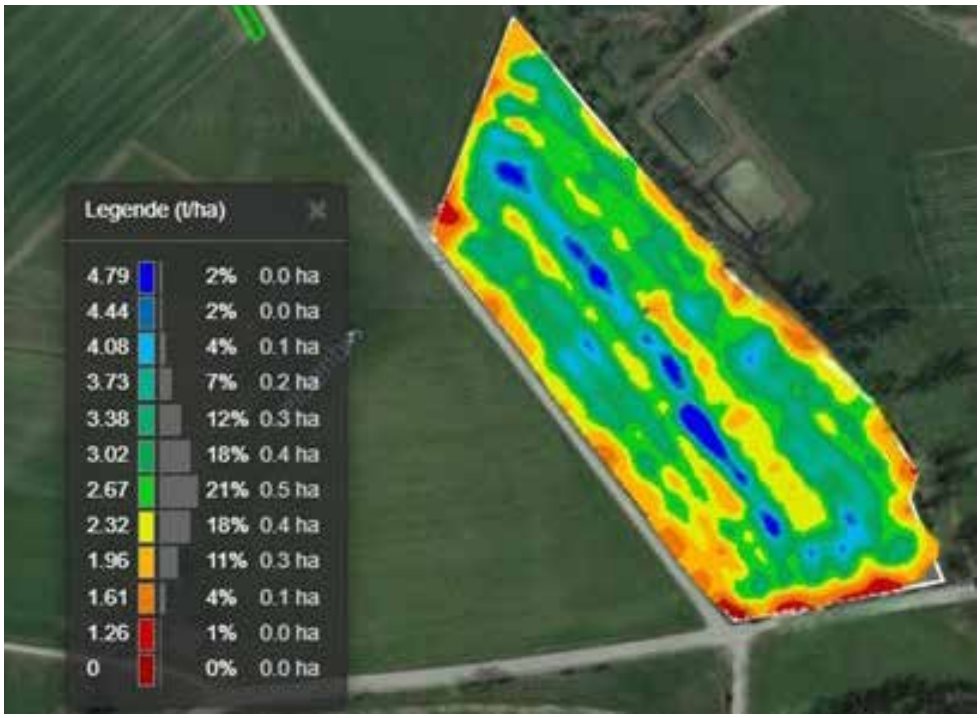

图4: 在农场管理信息系统 (FMIS) 中创建的一个实践农场的产量潜力图

图5: 在农场管理信息系统 (FMIS) 中创建的一个实践农场的产量潜力图

饲喂管理

奶牛场的数字化大大方便了准确记录饲养过程中的养分流动。如图7所示，饲料是养分循环中最大的养分输入来源。要绘制养分流动图，如养分循环中的输入/输出，准确了解饲喂率至关重要。带有可编程称重的饲料搅拌机是关键，因为它们会在装载过程中记录各成分的准确数量。 图 8 显示了项目中的数据流。与不同的饲养技术和软件制造商一起，可以将项目农场的技术和软件连接起来。通过这种方式，饲养数据可用于进一步分析，例如计算每只动物每天的饲料成本、农场的饲料和营养效率。表 1 总结了项目农场每千克养分投入的奶产量。每千克氮和磷消耗能量校正乳 (ECM) 的巨大差异，清楚地说明了通过调整饲喂来提高效率和减少营养消耗的潜力。优化奶牛场饲喂过程的唯一方法是根据奶牛的需要进行饲喂，这需要对奶牛场自身粗饲料中的营养成分进行分析。因此，即使饲喂相同的成分，也要根据牛群的表现来调整日粮配给，以避免过度供应。

总之，需要指出的是，各个分部门的数字化已经为提高资源效率提供了重要潜力。这一点，再加上对奶牛场系统及其养分流动的整体看法，对提高农业的可持续性做出了决定性的贡献。

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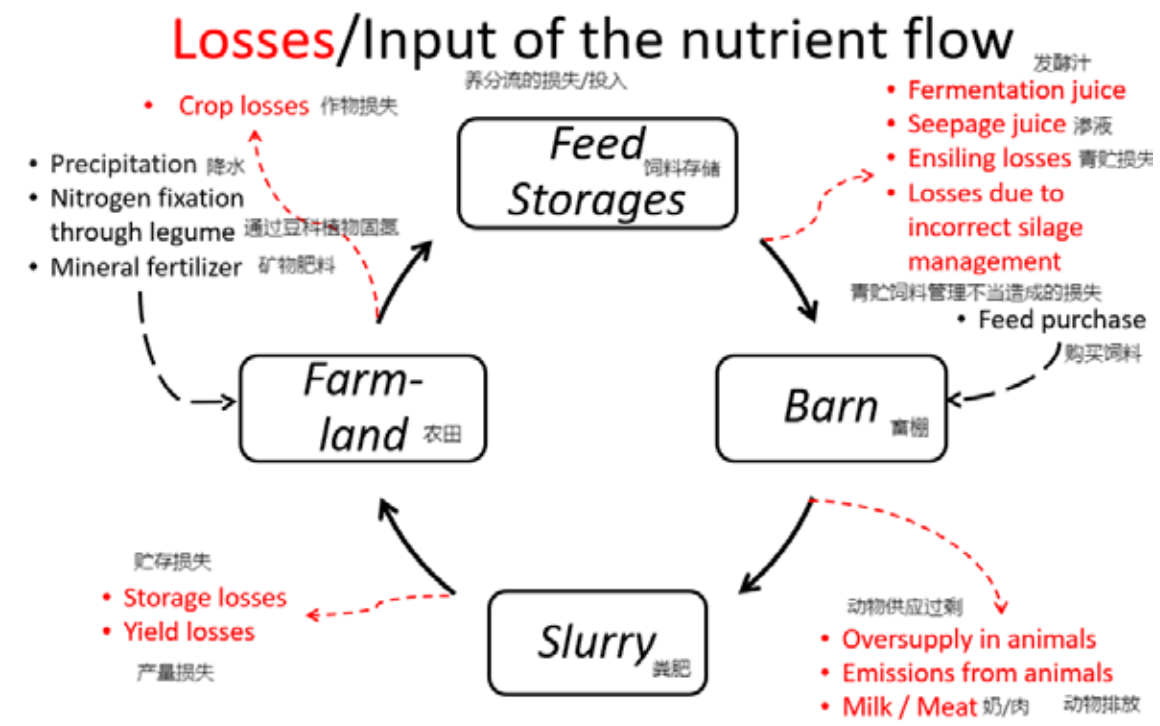

图7: 养分循环示意图

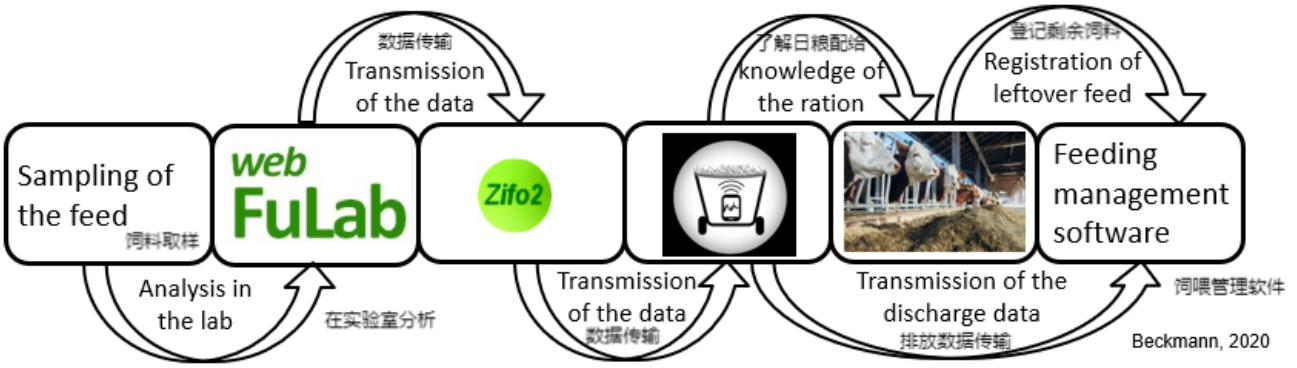

图 8: 示范项目 3 中从料仓到料槽的数据流

参数	最小	平均	最大
N effort/kg ECM	9,5	**15,8**	24,5
P effort/kg ECM	2,3	**3,4**	4,6
XP/kg DM, g	111	**144**	186
P/kg DM, g	3,1	**4,3**	5,2

表 1: DigiMilch项目农场的营养消耗 /千克能量校正乳 （ECM） 的关键数据

DigiMilch由联邦食品和农业部 (BMEL) 根据德国联邦议院的一项决议资助。该项目位于慕尼黑附近Grub的巴伐利亚州农业研究中心，包括五个示范项目，收集巴伐利亚州20个商业奶牛场和4个研究奶牛场的数据。DigiMilch由联邦农业和食品局 (BLE) “农业实验场”项目赞助，该项目旨在研究作物生产和畜牧业的数字技术，并测试它们是否适合在农业中实际应用。如需了解更多信息，请在YouTube上观看关于DigiMilch的短片。

Introducing DINAK – a tool for assessing the sustainability of farms

Martin Schneider
IAK Agrar Consulting

Sustainable agriculture at the heart of the United Nations 2030 Agenda

In 2015, the United Nations committed to 17 global goals for a better future with its 2030 Agenda for Sustainable Development. These goals aim to enable a dignified life worldwide while preserving natural foundations for the long-term. All industries must adhere to it and optimize accordingly. At EU level, the Green Deal has been established as a priority, which includes developing a resource-efficient economy and becoming a climate-neutral continent by 2050. Sustainability refers in this context to the ability to use and protect natural resources and ecosystems in a way that ensures their conservation and regeneration, to meet the needs and requirements of both present and future generations. It involves balancing economic, social, and environmental aspects and taking a long-term perspective to enable positive development and quality of life.

As the world needs to become more sustainable, tools are necessary to measure the degree of sustainability in all sectors, including agriculture. Based on the results of such assessments, farmers can target their agricultural practices to increase the level of sustainability.

Assessing the sustainability of farms with DINAK

DINAK, short for "Deutsches Institut für Nachhaltige Agrarkultur" (German Institute for Sustainable Agricultural Culture), offers a range of tools for measuring the degree of sustainability at farm level. It was established by the two German companies IAK Agrar Consulting GmbH and INL – Privates Institut für Nachhaltige Landbewirtschaftung GmbH.

DINAK provides a criteria and indicator model for diverse and objective assessments of sustainability in agriculture. Three pillars of sustainability are considered: ecology, economy, and social aspects. Moreover, the assessment of animal welfare plays a role. Each pillar comprises a number of individual indicators (see Figure 1).

Ecological sustainability considers, e.g., the nitrogen, phosphorus, and humus balance as well as plant protection intensity. This pillar also takes into account the carbon footprint for the entire farm, but also for individual products, fields, or animal barns. To calculate the degree of ecological sustainability of the farm, information on agricultural inputs, machinery, and equipment used in the farm management process is considered.

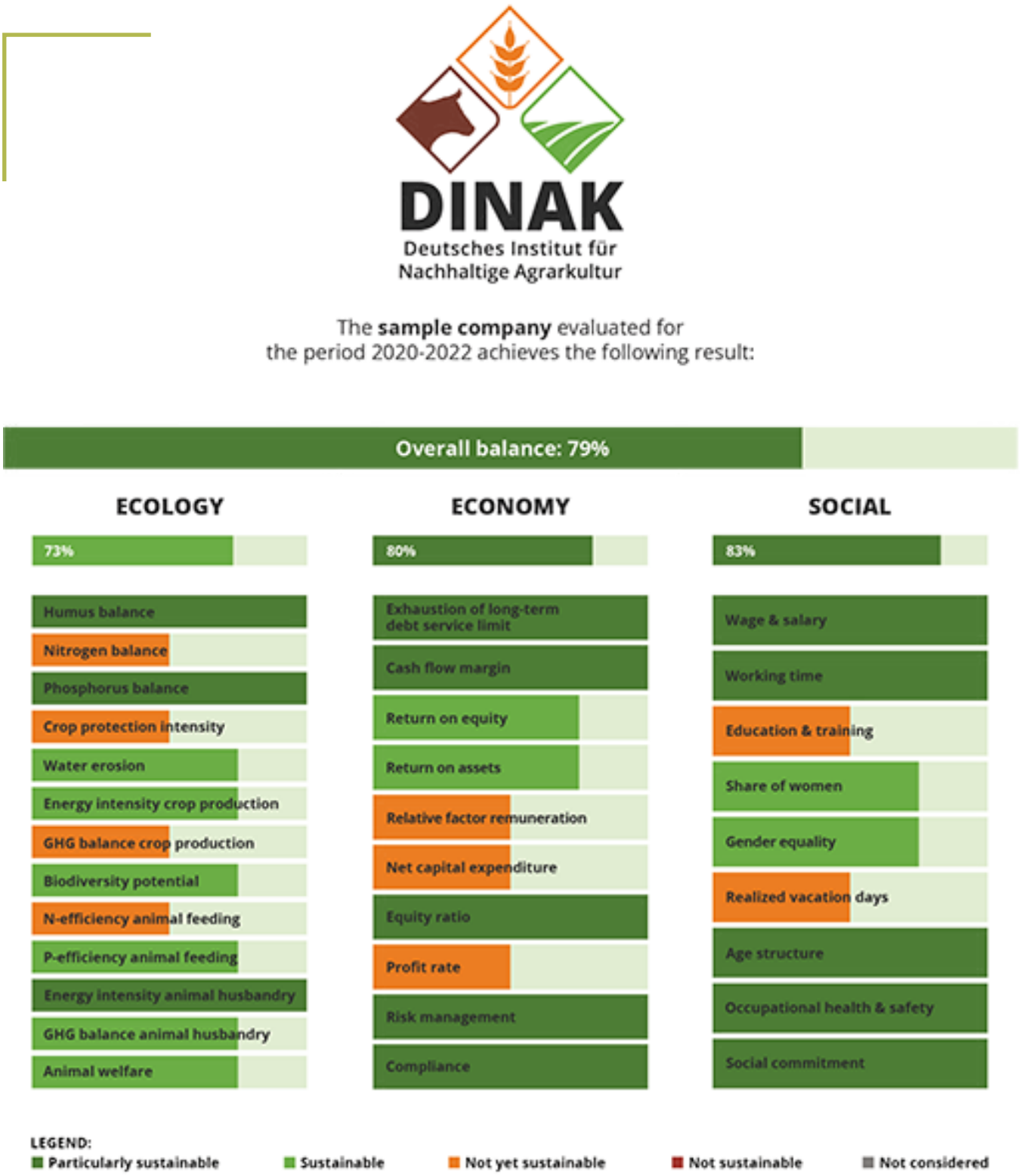

Figure 1: Sample result of a sustainability assessment – the evaluated farm has achieved a sustainability score in the class of 75 to 100%.

When assessing the **economic sustainability** of a farm, indicators such as cash flow margin, return on equity, profit rate, or utilization of long-term capital service limit are considered. Moreover, consideration is given to which risk management instruments are available and used. The data required to calculate the indicators are largely taken from the annual financial statements of the farms.

Social sustainability includes, among other things, the evaluation of wage levels, further training for all employees, occupational health and safety, and the age structure of all farm workers. The company's contribution to the region and the way in which it operates are also taken into account.

Future role of farm sustainability assessment in Germany

DINAK is one of several systems for assessing the sustainability of farms in Germany. In this system, the focus is on the comprehensive and objective recording of the actual production process on the farm. By taking into account ecological, economic, and social aspects, it also covers all aspects of sustainability. Other systems focus more on individual aspects.

In Germany, there are various systems that calculate the carbon footprint of production, e.g., "HUNTER" and "TEKLa". Individual processors of agricultural raw materials have started to offer their own systems. For example, dairy farmers who supply the dairy company ARLA can document their production process in a system from which their greenhouse gas footprint is calculated. Other sustainability assessment systems are based on questionnaires where an auditor interviews the farmer or where the farmer enters the required information herself/himself. Such systems do not include full documentation of the actual production process. Compared to DINAK, they are faster to use, but their results are influenced more by subjective factors.

The DINAK system has existed in its current form for two years. However, some aspects of it have been in use for longer and have proven their practicality for more than ten years. This is particularly true of the algorithms for assessing ecological sustainability. Accordingly, a wide range of experience is already available. The DINAK system has so far been used to assess farms with an area of 100 to 3,000 ha, with or without animal husbandry. After the assessment, the results are evaluated in a personal conversation with the farmer.

It is seen time and again that the results of a sustainability assessment can be used to look at the farm from different perspectives. Areas that are running well become visible, but weak points where optimization is still needed are also identified. The farmer takes time outside of her/his daily production routine to reflect on her/his performance and review how she/he is doing. Moreover, the results can be communicated to various stakeholders. European banks are required by regulations to consider the level of sustainability of the farms they finance in the future. In some cases, more favorable financing terms are already granted if the farm can provide its bank with a good result of a sustainability assessment. In addition, the degree of sustainability will also play a role in the future allocation of leased land. In Germany, it is becoming apparent that lessors will consider this information when deciding to whom they lease land.

Sustainability assessment of farms and digitalization go hand in hand

Since the DINAK system requires numerous data about the production process over a long period of time, data collection can be quite time-consuming. The necessary data and information are often spread across various systems that do not always provide digital interfaces for data transfer. Furthermore, it has been shown that additional plausibility checks must be carried out after the data are transferred to correct existing data gaps or implausible values. To keep transaction costs low for conducting these assessments, further and more comprehensive digitization of data management on farms is necessary. In other words, if comprehensive sustainability assessments for farms become mandatory in the future, this will increase or accelerate the degree of digitalization of the production process.

Find out more about DINAK:

What's in it for farmers?

Toolboxes for sustainability assessments are necessary to show the farmer and other stakeholders the current situation. Sustainability assessments conducted on a regular basis (e.g., every three years) provide a good knowledge base to guide the farm on sustainable paths. When information on the level of sustainability is shared with consumers of farm products, it can provide opportunities for product differentiation, which can be linked to price premiums.

Martin Schneider
IAK Agrar Consulting GmbH

Martin Schneider holds a PHD in Agricultural Economics from Martin-Luther-University of Halle-Wittenberg. As managing director of IAK Agrar Consulting GmbH, he currently leads the domestic farm advisory service.

DINAK — 一个评估农场可持续性的工具

Martin Schneider
德国IAK农业咨询有限公司

可持续农业是2030年议程的核心

联合国2015年在《2030年可持续发展议程》中承诺实现17项全球目标，以创造更美好的未来。这些目标旨在全世界实现有尊严的生活，同时长期保护自然基础。所有行业都必须遵守并进行相应的优化。在欧盟层面，《绿色协议》已被确立为优先事项，其中包括发展资源节约型经济，到2050年成为气候中和型大陆。可持续性在这里指的是，以一种确保自然资源和生态系统保护和再生的方式使用和保护它们的能力，以满足今世和后代的需要和要求。它涉及到平衡经济、社会和环境，并从长远的角度来实现积极的发展和高质量生活。

随着世界必须变得更加可持续，需要有工具来衡量包括农业在内的所有部门的可持续性程度。根据这些评估的结果，农民可以有针对性地调整他们的耕作方式，以提高可持续性程度。

用DINAK评估农场的可持续性

DINAK是"Deutsches Institut für Nachhaltige Agrarkultur - 德国可持续农业文化研究所"的缩写，它提供了一个工具箱，用于衡量农场层面的可持续性程度。它由两家德国公司IAK Agrar Consulting GmbH（IAK农业咨询有限公司）和Institut für Nachhaltige Landbewirtschaftung GmbH（可持续农业管理研究所有限公司）共同成立。

DINAK为农业可持续性的多重和客观评价提供了一套标准和指标模型。可持续发展的三大支柱 — 生态、经济和社会方面被考虑在内。此外，动物福利的评估也很重要。每个支柱包括一组单独的指标（见图1）。

例如，在生态可持续性方面，考虑了氮、磷和腐殖质的平衡，以及植物保护强度。在这一支柱中，整个农场以及单个产品、田地或畜棚的碳足迹也被考虑在内。为了计算农场的生态可持续性程度，还考虑了农场管理过程中使用的农业投入、机械和设备的信息。

在评估农场业务的经济可持续性时，会考虑现金流边际、股本回报率、利润率或长期资本服务限额的利用率等指标。 此外，还要考虑哪些风险管理工具是可用的和正在使用的。计算指标所必需的大部分数据取自农场企业的财务报表。

社会可持续性包括工资水平评价、所有员工的继续教育、职业健康和安全，以及所有农场工人的年龄结构等。还要考虑公司如何为地区做出贡献以及以何种方式运营。

通常考虑三年的平均值，特别是在农业方面，由于不同的天气条件，不同年份的结果可能会有很大差异。

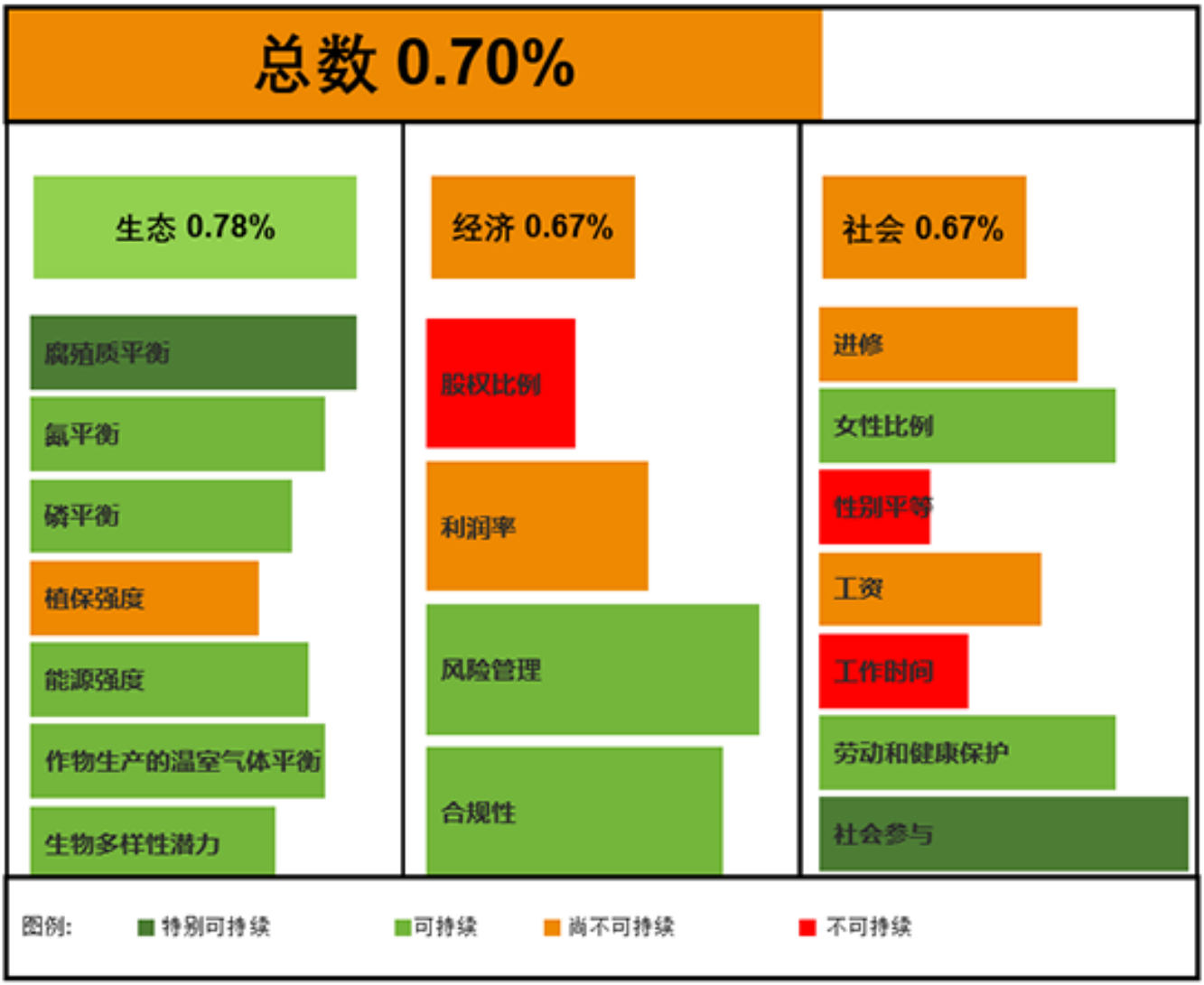

图1: 可持续性评估的样本结果。被评估的农场的可持续性得分从73到100%不等。

从现有的软件系统中获取数据后，将检查数据的合理性，并使用可持续性评估的算法进行计算。计算结果汇总在审计报告中，并与农业企业一起进行评估。

德国农场可持续性评估的未来作用

DINAK 是德国用于评估农场可持续性的几个系统之一。在这个系统中，重点是对农场的实际生产过程进行全面和客观的数据采集。此外，通过考量生态、经济和社会方面，可持续性的所有方面都被涵盖。其他系统则更侧重于个别方面。

在德国有不同的系统可以计算生产的碳足迹，如 “HUNTER”、“TEKLA” …… 个别农业原料加工商已经开始提供自己的系统。例如，供应乳品公司 ARLA 的奶农可以在一个系统中记录他们的生产过程，从中计算出他们的温室气体足迹。其他的可持续性评估系统基于问卷调查，由一名评估员对农民进行访谈，或由农民自己填写必要的信息。这种系统不包括对实际生产过程的完整记录。与 DINAK 相比，它们应用起来更快，但对结果有更多的主观影响。

DINAK系统以目前的形式存在了两年。然而，它的某些方面已经应用了更长的时间，并且已经证明了它们的实用性超过10年。用于评估

生态可持续性的算法尤其如此。因此，各种经验已经存在。迄今为止，DINAK 系统已被用于评估土地面积从 100 到 3000 公顷不等的农业经营，无论是否有畜牧业。评估之后，将与农民进行个人对话来评价结果。

人们一次又一次地清楚，可持续性评估的结果可以用来从不同的角度审视农业经营。表现良好的区域变得可见，但同时也能发现需要优化的薄弱环节。农民在日常生产活动之外抽出时间来反思他们的表现和他们是如何做的。此外，评估结果可以传达给不同的利益相关者。法规要求欧洲的银行考虑他们未来资助的农业经营的可持续性程度。在某些情况下，如果农业经营能够向其银行提供良好的可持续性评估结果，那么今天就已经授予了更有利的融资条件。此外，可持续性程度将对未来租赁土地的分配发挥作用。在德国，出租人在决定将土地出租给谁时，很显然会考虑这一信息。

了解更多关于DINAK的信息

农场可持续性评估和数字化齐头并进

由于 DINAK 系统需要大量的长期生产过程的数据，因此数据收集可能非常耗时。农业经营的必要数据和信息通常可以在各种系统中获得，而这些系统还未提供所有数字接口用于数据传输。此外，已经表明，在数据传输后必须进行额外的可信度检查，以纠正现有的数据差距或不可信的数值。为了保持进行这些评估的低交易成本，有必要对农业经营的数据管理进行进一步和更全面的数字化。换句话说，如果未来对农业经营进行全面的可持续性评估成为强制性的，这将提升或加速生产过程的数字化程度。

对农民有什么好处

可持续性评估的工具箱对于向农民和其他利益相关者展示当前的情况是必要的。这是引导农场管理走上可持续发展道路所必需的。定期（例如，每三年一次）进行的可持续性评估为指导农场管理走上可持续发展道路提供了良好的知识基础。如果有关可持续性程度的信息被传达给农场产品的消费者，它可以为产品的差异化提供可能性，这可以与价格溢价联系起来。

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4

Science dialogue

From genome to phenome (G2P): Deciphering crop genetic resources. A new science initiative contributing to a new green revolution

Jianmin WAN and Luxiang LIU
Chinese Academy of Agricultural Sciences

The State of Food Security and Nutrition in the World 2021 released by the UN reports that in 2020, the global population suffering from starvation reached 768 million, increased by 118 million year on year. The goal of zero starvation by 2030 is becoming more and more challenging with the global climate change, continued population growth, and regional conflicts. Increased availability of access to food remains to be the foundation for achieving the UN Sustainable Development Goals. In response, international organizations, governments, the science community, industries as well as civil societies around the world have developed various initiatives to restrategize and reinforce the role of science and innovation as a driver in the transformation of the global food and agriculture systems. As a result, innovations, broadened partnerships, and collaboration in plant science and crop improvement technologies are expected to play a central role in meeting the global challenge.

History has proven that no major crop production improvement can be achieved without discovering and utilizing novel genetic resources. The extensive use of rice dwarf gene sd1 and wheat dwarf gene Rht1/Rht2 triggered the first green revolution. In the current context of the global food crises as well as the vision for sustainable development of the United Nations, it is imperative to have concerted global efforts in discovering and making available novel genetic resources with high yield potential, elite quality and nutrition, and resistance to biotic and abiotic stresses that would lead to breakthroughs in global crop production.

However, free access to and the ability to understand and use broad genetic resources, per the relevant global conventions and treaties, remain a key constraint for plant breeders, especially for agricultural research organizations of developing countries.

The recently held FAO Science and Innovation Forum (Rome 17-21 October 2022) emphasized the importance of public goods as a key driver for achieving the UN Sustainable Development Goals. We need more **global public goods** that can be openly accessible to enable plant breeders in both public and private sectors, from the North and the South, to take advantage of cutting-edge science, such as molecular marker assisted breeding and genome editing technologies. To achieve this, an equitable mechanism for the access and benefit

sharing of genetic materials, aligned with the international conventions and treaties, would be a prerequisite. In April 2022, the authors together with a team of leading scientists from China and international research centers and universities initiated an international mega science project: From Genome to Phenome – Deciphering Crop Genetic Resources (G2P). The project was funded by the Ministry of Science and Technology of the People's Republic of China. One of the major outputs of the project was the conceptualization of a new phase of G2P, to be a much broader, more inclusive as well as more in-depth international collaborative research initiative.

The **vision of G2P** is to decipher genetic resources contributing to a new green revolution and global food and nutrition security. **The initiative aims to** intensify international scientific and technological cooperation in crops research, to establish a new paradigm and a platform for collaborative research and global sharing of genetic resources, carry out precision phenotyping on germplasm across diverse environments, unveil the molecular basis of important traits to generate accessible global public goods that would catalyze a new green revolution towards global food and nutrition security. It is envisaged that the G2P will be a long-term international collaboration with a duration of nine to ten years with secured and consistent funding.

The main **research agenda** of G2P under discussion include:

1. Characterization and evaluation of global crop germplasm resources using large scale, high throughput, high efficiency and low-cost platforms of genotyping and phenotyping to develop an atlas of global crop germplasm evolution and diversity.
2. Investigation and understanding of fundamental questions in crop genetic resources such as evolution and domestication of important crop species and land races, genetic basis and regulatory gene networks for important traits, and genetic and molecular mechanisms for crop-environment interactions.
3. Development of novel crop gene resources to enable breakthroughs in new variety development of important crops, coupled with and supported by innovations in key technologies for global crop genetic resources, such as "biotechnology+ artificial intelligence + big data", genome design breeding, and synthetic biology.
4. Construction of a global, integrated, and open-access database platform for crop germplasm resources, covering the full biological cycle of the crop genetic resources from DNA/RNA to downstream metabolites and the whole spectrum of traits. There will be innovative algorithms and data mining technologies to further facilitate the access, sharing, and use of germplasm resources and data to empower plant breeders on a global scale.

The expected results and outputs of the G2P project include:

1. A network for global cooperation in crop genetic resources and a new paradigm of international cooperation for sharing and deciphering crop genetic resources.
2. A batch of novel genes of significant breeding value available for plant breeders globally especially for those from the developing countries. It will also include comprehensive characterization of at least 20,000 accessions of germplasm resources with pan-genome maps and novel genes for important traits such as yield, quality, nutrition, and stress resistance.

3. A high-efficiency genotyping and phenotyping system with commonly agreed protocols, standards, and locally adapted procedures that can enhance the application of new technologies such as precise gene editing and intelligent crop design.
4. A global platform for sharing and studying crop genetic resources that is comprehensive, easily accessible, and user-friendly.
5. An international coalition of scientists from both public and private sectors established to promote, convene, and carry out cooperation in genetic resources research, with special efforts to nurture a cadre of young scientists, both men and women, especially from developing countries, trained and networked to become a part of the future drivers for transforming the world's food and agriculture.

One of the reasons for the ambition and the confidence for success of the G2P is the availability of important facilities and platforms in crop germplasm conservation and research in China and globally. The Chinese Academy of Agricultural Sciences (CAAS) hosts the China National Crop Gene Bank with 530,000 accessions of germplasm resources, ranking the second in the world. Two state-of-the-art crop phenotyping platforms will soon be built in Sanya, Hainan Province, and Wuhan, Hubei Province, respectively. These platforms will be the key facilities for high throughput phenomics research in germplasm resources, which will be open to international partners for collaborative research. In July 2022, CAAS, International Rice Research Institute (IRRI) and the International Maize and Wheat Improvement Center (CIMMYT) signed a Letter of Intent to jointly establish the "Sanya International Crop Breeding Center" in Hainan Province. The center will undertake joint research on germplasm discovery and utilization, new variety development, and international training on crop breeding.

The G2P project concept has been enthusiastically received by the international agricultural science community. Leading research institutions such as the Leibniz Institute of Plant Genetics and Crop Plant Research, Germany, The Wageningen University & Research of the Netherlands, the Norwegian Institute of Bio-economy Research, the International Maize and Wheat Improvement Center (CIMMYT), the International Rice Research Institute (IRRI), the International Food Policy Research Institute, the International Potato Center (CIP), the Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO), the African Orphan Crops Consortium, the Pakistan Agricultural Research Council, the National Institute of Agricultural Research of Uruguay, to name a few, have expressed their interest in jointly launching the G2P International Mega Science Project.

The G2P initiative is still at the preparation stage. Next, the more than 30 participating institutions from China and abroad will focus on an inventory of existing research, databases, and facilities relevant to the G2P agenda while building consensus through inclusive consultation about such issues as, inter alia, the list of focused crops, the detailed research agenda, the governance and management structure, mechanisms for genetic resources sharing and IP management, estimated budget and financial contributions from the partners and, very importantly, developing a common vision for success.

We are excited about the vision, the mission, the research agenda, and the potential global impact of the G2P initiative. We have been overwhelmed by the enthusiastic support of the Chinese and international partners. It is our firm belief that the success of this international science initiative will depend upon the dedicated participation and support of all project scientists, institutions, and governments, as well as a truly international, inclusive, transparent, and equitable consultation and consensus building process. The G2P International Mega Science Project welcomes international partners to take part in the project and jointly contribute technical solutions to global food and nutrition security.

Acknowledgement: The authors are grateful for the helpful comments from Dr. Wang Ren, Senior Advisor on International Cooperation, CAAS.

Dr. Jianmin WAN

Dr. Jianmin WAN is an Academician of the Chinese Academy of Engineering, Professor in rice gene mining and molecular breeding, Institute of Crop Science, Chinese Academy of Agricultural Sciences. His research team has made significant progress in the utilization of heterosis between indica and iaponica rice, mining of new genes for disease- and pest-resistance and as well as improved grain quality. He has developed and widely disseminated 18 new japonica rice varieties with fine quality, high yield, and multi-resistance.

Dr. Luxiang LIU

Dr. Luxiang LIU is a research professor, Deputy Director General of Institute of Crop Sciences, Chinese Academy of Agricultural Sciences and Chief Scientist of the China Wheat Research System. He has a long track record of research on development of new irradiation mutagenesis, space breeding, and use of biotechnology for crop improvement. His team has developed and officially released thirty mutant varieties with improved yield and stress tolerance in wheat, maize, groundnut, and vegetables.

5

Experts in dialogue

Quo vadis, organic? Where China's organic farming sector is headed

An interview with Tingting ZHANG and Youting ZHANG
by Eva Sternfeld and Michaela Boehme

This interview was conducted at Biofach 2023 in Nuremberg, Germany. As representatives of Chinese entrepreneur Organic and Beyond Corporation (OABC), Tingting ZHANG and Youting ZHANG regularly present the latest development trends of China's organic sector to international audiences at Biofach Germany. Tingting Zhang is also on the board of IFOAM Asia – the regional umbrella organization for organic movements in Asia. Youting Zhang is an expert at the Working Group on Organic Product Certification of the Certification and Accreditation Administration of China.

Biofach Germany is the world's largest trade fair for organic food. Since when have you participated in the event and what is the main purpose of your visits?

Tingting Zhang: We have come to Biofach Germany every year since 2009, apart from the past three years when large-scale events and cross-border travel were restricted due to the Covid-19 pandemic. There are three reasons for us to come here. First, we are a global sourcing company. Most of the organic suppliers we work with are also present at Biofach. So, we use the event to build relationships and enlarge our supplier network. Secondly, each year we present the English translation of an annually published book detailing the development of the organic industry and product certification in China. For this, we collaborate closely with government bodies such as the Certification and Accreditation Administration of China (CNCA) and China Agricultural University (CAU). We think China is a very important organic country, so we want to share information about China's organic development with the world. And lastly, Biofach has an exciting conference program, so we and our colleagues are here to learn more about the latest trends in organic farming.

Organic and Beyond Corporation (OABC) is a global sourcing company. Can you tell us more about your business model and how your company works?

Youting Zhang: OABC was founded in 2007 in Beijing. After 16 years of development, OABC has established long-term cooperation with more than 30 organic farms in 14 countries worldwide. For example, we source olive oil from Greece, cheese from Denmark, beef from Australia, and coffee from Colombia. All our products are produced using organic farming methods, but we don't always certify them in China due to the prohibitive costs that entail in certain cases. But even though our products are not always labelled as organic in China, we market them as high-quality, green, and sustainable products.

Who are your consumers? Do you market your products to supermarkets, or do you sell directly to end customers?

Tingting Zhang: We have a unique business model. We don't sell our products directly to the customer, but we sell gift cards to big companies like Alibaba, Tencent, or Baidu. We have some 20,000 big companies in China that buy our gift cards to give to their important customers or employees. The gift card recipients choose which products on the card they like, and we deliver the products to their homes. This is not only a good business model for us, but also an efficient way to promote knowledge about organic products and make the benefits of organic agriculture known more widely.

You just touched on the fact that consumer knowledge is an important driver to promote the development of the organic sector. So, what do Chinese people know about organic agriculture? What are the main reasons for people in China to buy organic?

Tingting Zhang: Consumer awareness about organic agriculture is still lower in China than in developed countries, but consumers are slowly beginning to think about these issues. I can see it very clearly, consumer demand is upgrading, with people looking to buy more sustainable and green products. This is also related to a shift towards healthier lifestyles. More and more young people choose healthy foods, especially young women. I used to eat out all the time, now I mostly cook organic food at home. Although organic food is more expensive than conventional food, it doesn't have such a big impact on your monthly budget if you change your habits towards eating more home-cooked food. But there are still many challenges related to a lack of knowledge and trust amongst consumers.

How would you assess the policy support framework for organic agriculture in China? And, being here at Biofach, where could China learn from Germany?

Youting Zhang: China places quite some emphasis on the development of the organic industry. By the end of 2021, close to three million hectares of cropland were certified as organic. We now have 75 certification bodies and sound organic laws and standards, but we lack the national top-level design. For example, Germany has a policy goal to reach 30% organic production by 2030. China doesn't have such a comparable goal. China's organic certification regulations and standards are quite advanced, but support measures for the organic industry are dependent on the initiative of local governments. So, we need more policy support on the national level to raise consumer awareness, boost market demand, and thereby lift up the whole sector.

Tingting Zhang: I think it depends. Take Xichong county in Sichuan as an example. Over the past 20 years, the local government there spent a lot of money to promote the development of an entire organic industry. Why did they do this? I think they realized the importance of organic agriculture for farmers, local communities, and rural development. But not everyone thinks this way. I think there are at best 20 organic demonstration counties like Xichong in the whole of China. But we are still at an early stage. Examples like Xichong are important because they offer a different model of development for others to adopt.

Finally, where do you see the biggest potential for China's organic sector in the future?

Youting Zhang: There are many organizations now that do a good job in educating consumers

At Biofach Nuremberg, Germany: Youting Zhang, Michaela Boehme, Eva Sternfeld, and Tingting Zhang (from left to right)

and building networks of trust. Take Beijing Farmers' Market as an example. They play an important role in connecting small-scale, organic producers and consumers, showing people where their food comes from and how it is produced.

Tingting Zhang: Also, we shouldn't underestimate the importance of new technologies such as livestreaming. There is a growing number of online influencers in China who promote organic and green agricultural products by explaining to people how these products are made and what their benefits are. Some of these accounts have millions of followers. They do an incredibly important job in communicating with the public and really have the ability to change people's lifestyle choices towards more sustainability.

Xichong 西充: China's number one county of organic agriculture

Located in the northeastern part of Sichuan, Xichong has been at the forefront of organic agriculture development in China. By the end of 2020, organic produce was grown on more than 15,000 ha of farmland, accounting for 18.5% of the county's arable land. Over 100 products had received organic certification, including cereals and oils, fruits and vegetables, bamboo shoots, mushrooms, poultry, and aquatic products. Local authorities have also worked to strengthen local value chains. Today, the county is home to multiple organic food processing enterprises and a sought-after destination for rural tourism. Geographical indications and trademarks have helped to further enhance the reputation and value of local agricultural products and food businesses.

6

Who’s who in Sino-German agricultural collaboration

The Agriculture Team at the German embassy in Beijing

Friederike Dörfle
German embassy in Beijing

Interview with agricultural counsellor Friederike Dörfler
conducted by Michaela Boehme, DCZ

Can you give us a glimpse into your day-to-day work as agricultural counsellor at the German embassy in Beijing?

Actually, every day is different – and that is what I like most about this job: We deal with market access issues for food and agricultural products, we observe the developments in the agricultural and food sector, including forestry and also climate change issues in the People's Republic of China, evaluate and report them, we prepare delegation trips to and within China, we are the point of contact for authorities, associations, and companies.
To put it in a nutshell: My team and I act as an interface for Sino-German cooperation in food and agriculture.

What have been the highlights of your work so far?

We had the opportunity to create new formats on how to strengthen cooperation in the agricultural sector. For example, I led an agribusiness delegation trip to Ningxia province to learn more about agriculture in China and to give the companies traveling with me the opportunity to expand investments and collaboration.
This year's highlight will be the first agricultural week in three years that is held offline. It will be a great chance to meet in person and to revive and strengthen the Sino-German relations in the field of agriculture and food.

Since you have taken up your post in Beijing, you've visited many farms and agricultural projects across China. What has surprised you the most about the agricultural sector in China?

I was surprised how diverse agriculture in China is: from the small farmer who keeps a few chickens in the yard to ultra-modern facilities with thousands of animals. Some farmers still work with pickaxes, others rely on satellite and drone technology. You can see how this sector is changing – in China speed. What also surprised me was the openness to make changes towards more climate and resource protection. This is a key element for our further cooperation and a good opportunity for German technology and know-how.

From left to right: Reiner Witzel, Yingying Li, Friederike Dörfler, Li Li

Germany and China have a long-standing cooperation in the agriculture and food sector. Going forward, where do you see the biggest potential for mutual learning and exchange?

First, working together on a climate-friendly and resource-protection agriculture. The People's Republic of China and Germany are strong countries – both with a lot of knowledge on smart agriculture and technology. Therefore, we share responsibility for how our food is produced, how our resources are used and to protect our global climate. With China being one of the largest countries in the world with the second biggest population, every small change here can make a big difference everywhere. Second, our relations have matured, and China

is very innovative. Our cooperation should reflect even more than in the past that this is a cooperation for mutual benefit and based on reciprocity. Third, Germany has high-quality products like pork, where export to China is completely halted. I think that this year, with the opening of China, should be a good opportunity to discuss market access.

The Agricultural Team of the German Embassy in Beijing introduces itself

The Agriculture Team is a specialist group in the Economics Department of the German Embassy.

It works in day-to-day operations as an interface between German and Chinese authorities in the areas of export, agricultural policy, and food safety as well as associated reporting and goods-specific reporting obligations. We prepare video audits between Chinese and German control authorities. We observe developments in agriculture, food, and forestry as well as marine protection, biodiversity, and climate protection. We connect organizations and create discussion platforms to improve cooperation between Germany and the People's Republic of China.

Agricultural counsellor Friederike Dörfler has headed the Agriculture Team since September 2022. Ms. Dörfler studied communication sciences, political science, and philosophy in Tübingen, Germany. From 2018 to 2022, she worked as press officer and deputy head of the press office for the then Federal Minister of Food and Agriculture Julia Klöckner and for the current Minister Cem Özdemir.

Agricultural attaché Reiner Witzel, as a master craftsman and specialist in occupational safety and business administration, has in-depth experience in the meat and dairy industry as well as in manufacturing infant formula and organic controls. Mr. Witzel has been working in the administration of the Federal Office for Agriculture and Food (BLE) in Bonn since 2001. He joined the Agricultural Team of the German Embassy in Beijing in 2021.

As local employees, Ms. Yingying LI and Ms. Li LI support the Agricultural Team with their many years of experience, their well-founded specialist knowledge and their good contacts to Chinese authorities and institutions. Wolfgang Lahr, an experienced German diplomat, who has been deployed to various countries around the world, supports the team on climate issues in agriculture.

Ms. Yingying Li studied, among other majors, forestry in Freiburg, Germany. After her Master graduation, she worked for the German Chamber of Commerce Abroad in Beijing and as Project Manager of the Central Marketing Agency of German Agricultural Industries Ltd. (CMA) Greater China Shanghai Representative Office. She has been working at the German Embassy since 2007, making her the first local employee on the Agricultural Team.

Ms. Li Li is a Germanist. She worked in Germany for a photovoltaic technology company. In China, she worked at the Society for International Cooperation (GIZ) in Beijing in the Climate and Environment department before starting her job at the German Embassy in 2013.

7

View from rural China

Bayan County: farmer cooperatives in China's black soil region

Pictures and text by Yolanda vom Hagen

Bayan County is located in Harbin, Heilongjiang Province. The name comes from the Manchurian word "bayan susu", which means wealthy village. The county is part of one of only three black soil areas worldwide. Located in northeastern China, black soil plains are a boon of nature. Under natural conditions, it takes around 400 years to form one centimeter of black soil. In this area, farmers produce mainly soybeans, rice, and corn. They say one out of ten bowls of rice comes from the black soil areas in Heilongjiang, making it the number one region in terms of grain yield and food security in China.

Heilongjiang is also a major grower of soybeans, accounting for around 60% of China's total planting area for that crop. In 2022, Heilongjiang planted an extra 6,600 km2 of soybeans compared with the previous year. When the shell is yellow and dry, they are ready to be harvested as feed for China's large livestock industry or processed into edible oil. When they are still fresh and green, we find them as Edamame beans on our tables.

Despite the advantageous natural conditions and high agricultural outputs, counties like Bayan are facing many structural challenges. An aging farming population and small farm sizes make it difficult to roll out new technologies and scale up production. To address these issues, the national government has been encouraging farmers to join rural cooperatives to help them farm their fields.

Liu Hui is the founder of Bayan County Liu Hui Farmers' Planting Professional Cooperative (巴彦县刘辉农民种植专业合作社) and comes from a farming family in Shanhou township. Initially, he was selling grain seeds to farmers. In 2015, witnessing the number of elderly farmers steadily rising, he came up with the idea to help farmers plant their land in exchange for purchasing his seeds. With only rudimentary knowledge of farming and an elementary school education to begin with, he managed to grow his business steadily. In just a few years, the area he oversees has grown from 13 to 1,700 ha. The crops are mostly corn (2/3) and soybean (1/3).

Picture:
Road running through the countryside in Bayan County

Soybeans awaiting harvest in Bayan County

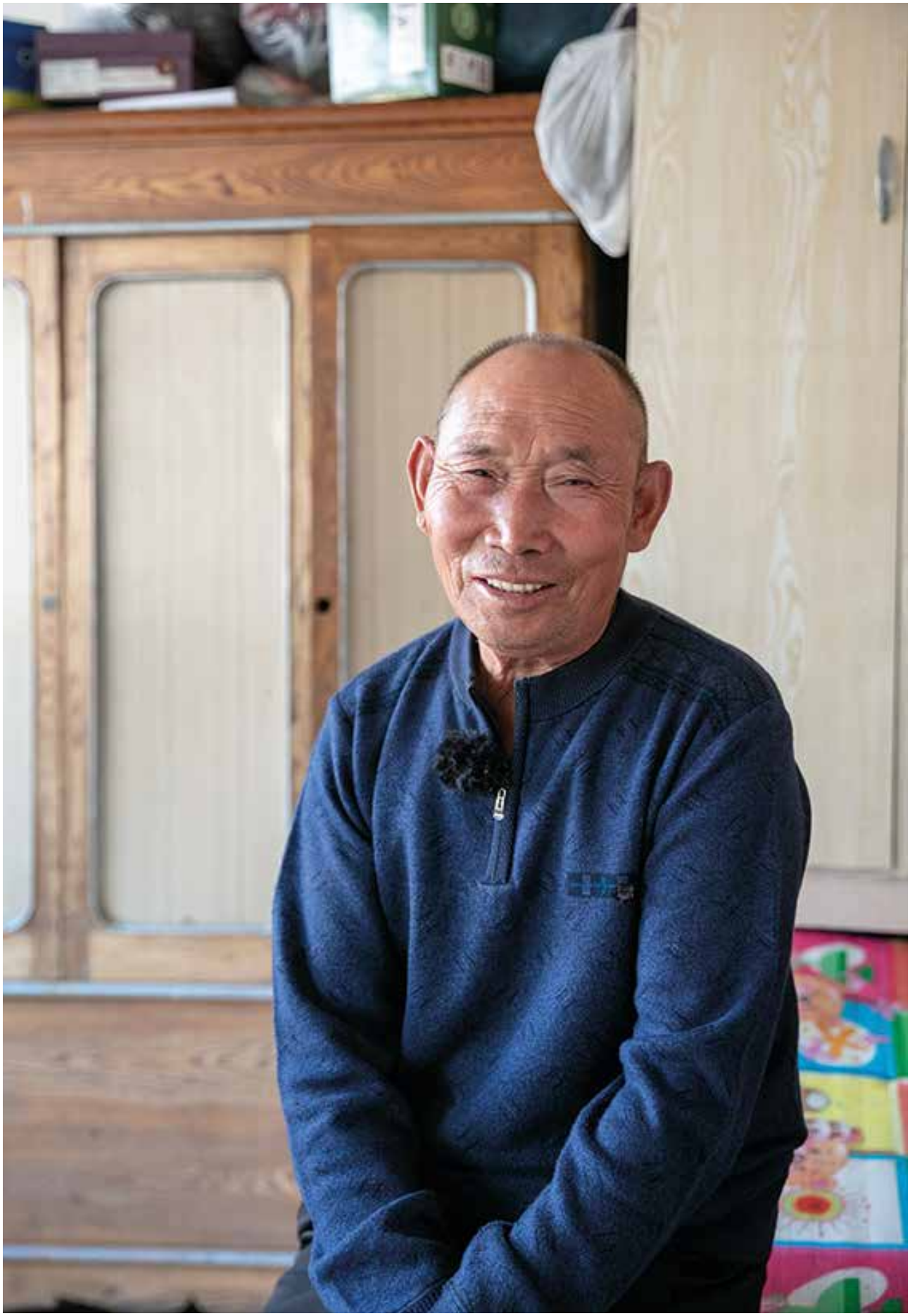
Photographer Yolanda vom Hagen in conversation with cooperative founder Liu Hui

The cooperative's 42 area managers oversee 1,700 ha belonging to 5,700 farmers, which in turn are managed by over 400 operators. They are all chosen from the ranks of the best farmers in each region. Every year, they evaluate the actual conditions of each piece of land before deciding on issues like crop rotation, seeding density, and what fertilizer to use.

A cooperative manager teaching members about new crop varieties

Who are the farmers who join these cooperatives? He Yaxin is 75 years old and one of the aging farmers that lease their fields to Liu He. He comes from Shuangshan Village, Waxing Town in Bayan County. Farming is in his blood. He has three children, which led to an allocation of around 8 mu (traditional unit, equaling 0.5 ha) of land to his family by the government in 1983. After the implementation of the land transfer policy, he started leasing extra land from relatives and neighbors, giving him the opportunity to cultivate over 32 mu (2.1 ha) of farmland. Around 20 mu (1.3 ha) of land is all planted with soybeans.

As he and his wife grew older, He Yaxin was less and less able to cope with the heavy farm work himself. Yet, he and his family still feel a strong connection to the land. To solve this conundrum, they started to hand over the handling and management of their land to Liu Hui's cooperative. From planting to fertilizing to harvesting, the cooperative takes care of everything since they joined with their own land and the leased hectares in 2020.



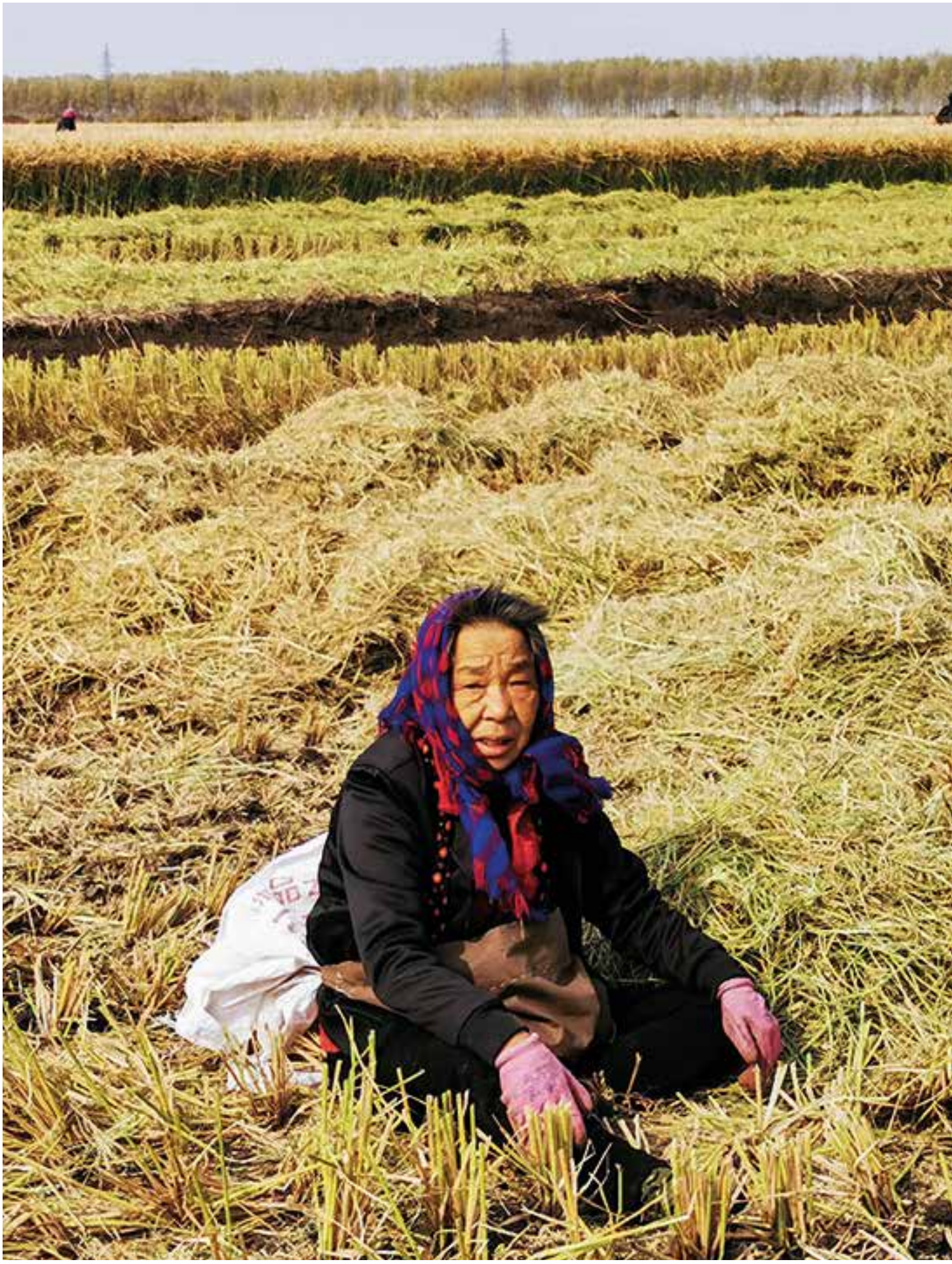
He Yaxin in his home in Shuangshan Village

He Yaxin's only son is watching the harvester of the cooperative working on his family's fields. For him, the cooperative is a blessing. He can rest assured that the family's land is taken care of while he is outside to gain extra money working for Liu Hui´s cooperative or as construction worker.

He Yaxin's wife is using a bamboo tool to thresh the dried soybeans harvested from their small private plot of land in the back of their house.

The cooperative's harvester completed the harvest of He Yaxin's field in less than a day. The big machine picks up the whole crop, separates the seeds from theirs shelfs, and spits them out nearly completely free of waste and fully intact within a couple of seconds.

Nowadays, modern machines harvest eight mu (0.5 ha) of soybeans in around 1.5 hours. Before the modernization, everything had to be done by hand. Back then, half a mu took a day of work, 8 mu took about two weeks to harvest. Workers would first reap the crops, bind them into bundles, and bring them home to thresh the beans out of their shells. Sometimes they used horses and threshing stones, later some bigger wheel rollers. After that, stalks, chaff, and dirt had to be removed by winnowing the crops. For that, wind was necessary.



Elderly woman from the village collecting crops that were not picked up by the harvester.

The manual labor of the villagers helps reduce food waste at the harvesting stage.

He Yaxin and his neighbor driving from field to field to check on the work of the cooperative they joined in 2020

Soybean harvest stored in the cooperative's grain silo

The advantage of the modern machines is that the rests of the crops stay on the fields and can be ploughed back into the black soil, using the crop waste as natural fertilizer – a technique that is not feasible without mechanization. No-till and strip-till systems allow the soil to rest, while still planting crops. Cooperatives and land-transfer systems answer the challenges of an aging farming population in China. Their larger scale makes it possible for them to access and use new technologies to not only preserve the soil, but also to ensure food production.

The harvest of the more than 1,900 soybean-growing farmers belonging to the cooperative is first measured in weight and quality before it is stored in the cooperative's grain silo. The quality of the harvest is assessed based on size, shape, moisture, and color. Impurities and bug bites are also taken into account. The farmers can choose themselves if they want to collectively sell their harvest or take it to markets themselves. Selling grain via the cooperative has several advantages: Farmers with lower-quality harvests can reach higher prices due to the mix with higher-quality beans of other fields. Bigger batches have the advantage of being able to be sold to bigger industries, fetching better prices in the market.

The story behind the story:
This photo story was created in 2022 during the making of a TV documentary for Phoenix TV, showcasing how China's agriculture is entering a new age of land transfers and large-scale rural cooperatives. You can watch the documentary on YouTube: https://youtu.be/J2dq87taE94

Yolanda vom Hagen

Yolanda vom Hagen is a professional photographer, curator, key opinion collector, and life coach living and working in Shanghai since 2010. Professionally, she works in the fields of interior, industrial, portraiture, and documentary photography with her own company in China since 2019.

8

Book review

China and Global Food Security by Shaohua Zhan

Reviewed by
Michaela Boehme

In little more than four decades, China has transformed itself from a country struggling to feed its population to a major player in the global agri-food system. Massive increases in domestic agricultural output, growing flows of trade and investment, and the global expansion of Chinese agribusinesses all bear witness to this remarkable transformation. China's growing importance as a hub of agri-food production, trade, and investment has raised hopes, but also fears in the international community. How will China's rise impact the international food order? Does China's investment in overseas agricultural resources present a development opportunity or a risk to other countries, particularly in the Global South? Will rising agricultural imports to China affect global food security?

In *China and Global Food Security*, Shaohua ZHAN from Nanyang Technological University, Singapore, presents a nuanced analysis of China's evolving food strategy and the ways in which it is reshaping agri-food relations both at home and abroad. Published with Cambridge Elements' Global China series, this succinct work is more of an extended essay in character than a monograph. On a mere 85 pages, Zhan traces the origins and developments of China's domestic food security policies and examines their global implications along three dimensions: agri-food trade, overseas agricultural investment, and the expansion of Chinese agribusiness cooperations. The book ends by discussing alternative visions for China's food system transformation.

Unlike others, Zhan examines the topic from the perspective of critical agrarian studies. Rooted in intellectual traditions such as political economy and political ecology, Zhan's analysis finds fault with both the domestic modernization narratives informing the country's transition to what he calls "agrarian capitalism" and the alarmist "who will feed China?" discourses surrounding China's rise in Western policy and media circles. For Zhan, much of the international criticism of China's transformation into a powerful agri-food player is misplaced because it fails to address the logics of profit and corporate power shaping China's integration into the global agri-food system. By focusing his critique on the expansion of capitalist dynamics both within and outside of China, Zhan's account lays bare the contradictions and paradoxes that riddle the country's food security strategy as China integrates more deeply into a global food system driven by corporate profits.

Zhan starts his account by laying out what emerges to be a two-pronged food security strategy: While China seeks to actively utilize overseas resources, it

simultaneously emphasizes the need to maintain high levels of domestic food production. In contrast to much current analysis, Zhan does not conceive of China's strategy as a zero-sum game, whereby China must compensate resource shortages at home by increasing imports. Rather, he argues that the two are mutually dependent. By ensuring high domestic production levels, China can gain a strong bargaining position in agri-food deals, giving it greater leverage to adjust import categories and amounts. Thus, for Zhan, China's success abroad hinges on more, not less, domestic food production.

Zhan then goes on to examine the impacts of this strategy on global food security and the international food order. In doing so, he challenges many of the common assumptions around China's emergence as a major agri-food player. Let us take China's growing grain imports as an example: critical commentary has often voiced concerns about such imports affecting food security in low-income countries, particularly in Africa. Zhan's account makes clear that this debate misses the point. Africa is neither a major food exporter to China nor are its grain imports predominantly used to feed human populations. Instead, Zhan points to the growing demand for animal feed as the driving force for China's imports. With 60% of the global soybean trade exported to China to be used as animal feed, it is animal agriculture, not a hungry Chinese population, that is driving the expansion of crop production around the world, with its attendant detrimental effects on the environment as rain forests make way for soybean plantations and farming expands to ever more marginal land.

Zhan is equally critical of the environmental determinism – encapsulated in the well-rehearsed trope of China feeding 20% of the world's population on 9% of global farmland – that permeates much of the mainstream commentary on China's agri-food trade. Zhan contends that resource constraints have an important role to play, but the liberalization of food trade following China's accession to the World Trade Organization (WTO) in 2001 is often overlooked as a conditioning factor. Tracing China's integration into the global food market, the book shows how low tariffs under the WTO have opened up China as a lucrative market for food exporting countries with a comparative advantage in crop production. It is indeed worth noting that China's integration into the WTO is a double-edged sword for China's two-pronged food security strategy: while cheap imports are a boon for the food and livestock industry, they risk squeezing out uncompetitive Chinese farmers, thus undermining domestic grain production goals.

Beyond agri-food imports, China's food security strategy has been in the spotlight for its purported role in the global "land grab". Drawing on empirical studies of Chinese overseas farm investments from several continents, Zhan shows that investment projects tend to be much smaller in size than reported and that they focused on producing food for sale in the local market rather than for export to China. With Chinese companies having produced a mere 1.8 million tons of grain overseas in 2018 compared to domestic production levels above 650 million tons, Zhan concludes that overseas investment in crop production has played a negligible role in China's food security. Rather than linking China's overseas agricultural engagement to the pursuit of food security, the book highlights control over global prices and agri-food value chains as the main drivers for Chinese overseas investments in times of growing US-China rivalry.

Rising imports and overseas investments are accompanied by an expansion of Chinese agribusiness corporations. Supported by

preferential policies and loans, state-owned as well as private companies such as COFCO, WH Group, or New Hope Group, to name just a few, are driving the transformation of China's agricultural sector at home and the growing power of its corporations abroad. Zhan agrees that China's agribusiness expansion has the potential to undermine the dominance of western agribusinesses such as the ABCDs (Archer Daniel Midlands, Bunge, Cargill, and Louis Dreyfus), which together control 70% of the global market for agricultural commodities. In contrast to conventional wisdom, however, Zhan insists that Chinese agribusinesses are working from *within* the profit-driven, neoliberal food order, not outside of it.

And this is precisely where Zhan inserts his own critique: the state's marshalling of agrarian capital in the name of agricultural development and food security. For Zhan, growing corporate control within China's agriculture and food sector will not only deepen environmental pressure and marginalize small-scale farmers in China and around the world, but also lead to growing contradictions as food security goals clash with food-for-profit logics. Rather than the pursuit of large-scale, corporate, and ostensibly "modern" agriculture, Zhan advocates for a food security policy based on strengthening rural cooperatives, secure land rights, direct links between farmers and consumers, and principles of food sovereignty.

The book should be read as a response to the "who will feed China?" discourse that has been shaping geopolitical and media perceptions of China's agricultural rise since the 1990's. Zhan counters the discourse's inherent anxieties by providing a nuanced and, as I would argue, more realistic view on the ways in which China's rise is transforming the global agri-food order. His critique of the growing role of capital in China's food system will sound familiar to those sympathetic to the theory and practice of critical agrarian studies. Other readers may find that the book covers a lot of ground on very limited space. Yet, even as each chapter allows only for a cursory overview, they all offer useful entry points into thinking critically about different aspects of our current food system and China's role within it.

Zhan, Shaohua (2022). *China and Global Food Security* (Elements in Global China). Cambridge: Cambridge University Press. doi:10.1017/9781108914680

Dr. Michaela Boehme

Dr. Michaela Boehme is an expert in agri-food studies with a focus on China. She works as an analyst at the DCZ, where she focuses on Chinese agricultural and rural policies.

9

News from the DCZ

Activities

Field trip to rural revitalization project by Hanns Seidel Foundation in Qingzhou, Shandong province

APR 2023

At the mayor's office in Nanzhanglou village

On 29 April 2023, the DCZ team and Agricultural Counsellor Reiner Witzel from the German embassy in Beijing followed an invitation from Dr. Michael Klaus at Hanns Seidel Foundation Shandong to visit Nanzhanglou village near the city of Qingzhou, Shandong province. Nanzhanglou village is a pioneer of rural revitalization and a success model for the region. In cooperation with the German federal state of Bavaria and Hanns Seidel Foundation, it was amongst the first villages in China to implement a land consolidation project, allowing for more efficient land use and higher productivity while regarding social and ecological goals. Since the late 1980s, the creation of local farming cooperatives and several other businesses along the agricultural and industrial value chain have ensured the steady increase of rural incomes while generating revenue for the infrastructural as well as cultural renewal of the village. On our visit, we met with local village representatives, took a tour around the restructured farmland plots, and visited local agricultural businesses, including a seedling nursery and a fruit production cooperative.

World Expo on Digital Agriculture (WEDA) and field trip to demonstration projects in Shandong province

Field visit to grain demonstration zone in Shanghe county, Shandong province

The final week of April was dedicated to a study tour focused on the topic of digitalization. We started our tour with a visit to China's first World Expo on Digital Agriculture (WEDA), organized by our partner FECC in the city of Weifang, Shandong province. At the expo, we did not only get to see the latest developments in digital agriculture in China, but also contributed to the Sino-German Entrepreneurs Forum on Smart Agriculture with speeches by the German managing director of the DCZ, Juergen Ritter, and DCZ policy expert, Michaela Boehme. This was followed by a visit to a factory by German agricultural machinery manufacturer CLAAS in Gaomi, Weifang city. Together with a delegation of EU agricultural counsellors and representatives of Chinese cropping companies from the provinces of Heilongjiang, Inner Mongolia, and Jilin, we explored how digital tools and smart technology are reshaping the ways in which farmers make use of modern agricultural machinery. We ended our trip with a two-day visit to Shanghe county, Shandong province, where we joined the Sino-German Agricultural Cooperation Field Days. In Shanghe, we visited, amongst others, a crop variety trials center as well as a grain demonstration zone and gained some first-hand insights into the ways in which farmers use sensors, drones, and automated irrigation and fertilization systems to boost yields and increase resource efficiency.

Read more

Agricultural Outlook Conference

On 20 April 2023, the DCZ joined the China Agricultural Outlook Conference (AOC). Hosted by our partner CAAS (Chinese Academy of Agricultural Sciences) in Beijing, the annual event presented projections on the development of agricultural supply, demand, prices, and trade flows, with a focus on key agricultural commodities such as oilseeds, staple crops, cash crops, as well as animal products. China's food security strategy and latest policy vision to become an "agricultural superpower" (农业强国) were also discussed at the conference.

Read more

New webinar series DCZ TALKS: first event on urban agriculture

MAR 2023

On 23 March 2023, we held the first event of our new webinar series DCZ TALKS. Building on previous dialogues at the 4th Exchange Forum back in December 2022, the event focused on the role of urban and peri-urban agriculture for the development of city food systems and climate-resilient food production in urban environments. Invited speakers at the event were Katrin Bohn from the University of Brighton, Shulang Fei from the CAAS, and IURC cluster manager and agricultural consultant Rita Merkle. As a regular webinar series open to the wider public, DCZ TALKS will bring together policymakers, scientists, business leaders, and practitioners to discuss key issues of interest to Sino-German agricultural cooperation – from food security to digital farming, climate-resilient agriculture, biodiversity, and rural development.

Read more

FEB 2023

EU-China Conference on Agricultural Research

The EU-China Conference on Agricultural Research was held on 28 February 2023 in Beijing under the motto "Setting the tone for a renewed partnership and future cooperation". Taking place in hybrid format, the event was organized by the EU Working Group on scientific cooperation in agriculture with China with support from the EU Delegation to China. DCZ expert for China agriculture policy monitoring, Ahmatjan Rouzi, attended the event on site and participated as a panelist in a discussion on smart agriculture to promote climate neutral and green agriculture.

Read more

Biofach 2023

From 14-17 February 2023, after three years of interruption due to the Covid-19 pandemic, Biofach, the world's largest trade fair for organic food, took place again on the usual date in Nuremberg. For the first time since 2019, Chinese companies and visitors were also able to present themselves among the 2,765 exhibitors and over 36,000 professional visitors. The fair was accompanied by an extensive conference program. DCZ experts Eva Sternfeld and Michaela Boehme attended the event to speak to Chinese exhibitors and communicate information about Germany's organic sector development and strategy to stakeholders in China.

Read more

DEC 2022

4th Exchange Forum on Sino-German Collaboration in Agricultural Science

On 13 December, the 4th Exchange Forum on Sino-German Collaboration in Agricultural Sciences brought together an interdisciplinary group of Chinese and German researchers to discuss opportunities for collaboration and joint research in the field of urban agriculture. Topics included optimizing plants for growth in urban and indoor environments, vertical farming, and plant factory systems, as well as the integration of food production into urban design and food policy planning. Held as an online event, the forum was hosted by the Institute of Urban Agriculture (IUA) of CAAS, with organizational support from the S&T Platform of the Sino-German Agricultural Centre (DCZ) and the Department for International Cooperation of CAAS. The workshop was attended by 19 participants from IUA and a number of German research institutes and higher education institutions.

Read more

8th Sino-German Agricultural Week

NOV 2022

At the 8th Sino-German Agricultural Week in Beijing. Due to Covid-19 restrictions, invited speakers and guests attended the event online.

The 8th Sino-German Agricultural Week (SGAW) was held from 21-25 November 2022 in Beijing. The five-day event focused on tackling current and future challenges to domestic and global food security. A high-level forum offered expert perspectives on the current global food crisis and highlighted the contributions Sino-German agricultural cooperation can make to bolster food security and create a fair, stable, and sustainable agri-food system that works for all. Three thematic forums took a closer look at how digital technologies, seed development, and strategies to reduce food loss and waste can be leveraged to strengthen food security at the domestic and global level. The conference ended with an event showcasing the role of agribusiness and the closing session of the Sino-German Crop Production and Agrotechnology Demonstration Park (DCALDP) project.

Ma Youxiang, China's vice-minister of agriculture, addressed the conference participants in a recorded welcome speech. Parliamentary state secretary of the German Ministry of Food and Agriculture, Ophelia Nick, gave an opening speech via video link. The conference was broadcast online, reaching well over 1,000 viewers on Chinese livestreaming platforms and around 250 participants on Zoom.

Find interviews, recordings, and presentations from the event on our website.

Publications

Policy brief: China's 2023 "Two Sessions"

The annual "Two Sessions" are a major event on China's political calendar. This policy brief by DCZ expert Michaela Boehme analyzes key themes related to agriculture and rural development discussed at the 2023 gathering and how they will inform Beijing's policy agenda in the months to come.

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Policy brief: China's 2023 No. 1 Document

An annual blueprint for agricultural policy, this year's No. 1 Document focused on building an "agriculture superpower", food security, rural revitalization, preventing a large-scale return to poverty, building affordable housing, and creating more employment opportunities in rural areas. In this policy brief, DCZ expert Ahmatjan Rouzi goes through the key issues of agriculture, food, and rural development in the document and discusses the implications for the various sub-sectors and stakeholders.

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Study: Agriculture-related greenhouse gas emissions in China and Germany

The agricultural sector is one of the largest contributors to climate change and at the same time one of the sectors most vulnerable to it. Greenhouse gases (GHG) from livestock production, agricultural land use, and the conversion of forests into agricultural land account for a significant share of total emissions caused by human activities. Yet, measuring and accounting for emissions throughout the entire food value chain remains a challenge. In this study, policy expert Lea Siebert (APFNet) presents the development and status quo of agri-food system GHG emissions in China and Germany alongside both countries' endeavors to tackle these emissions through policies.

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Study: Urban agriculture approaches in Europe and China

The world is rapidly urbanizing. According to UN estimates, more than two thirds of all people may be living in urban areas in 2050. At the same time, only 15 to 20% of the world's food is produced in urban areas, making food security for urban populations a major challenge that will only intensify in the future. This study by agricultural consultant Rita Merkle (IURC) introduces the concept and definition(s) of urban agriculture, describes the state of knowledge in German and Chinese research, as well as the political support for research of relevant technologies and practices in both countries. It then presents examples and best practices to show the diversity of urban farming practices in Germany, Europe, and China.

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Terminology paper: 双循环战略 dual circulation

Billed as a new development paradigm, China's dual circulation strategy (DCS) has received much attention in recent years. This contribution by Yonggong Liu and Michaela Boehme to our "Making sense of …" series looks behind the buzzword to understand the policy context in which the concept emerged and what its implementation will mean for China's agricultural production and trade.

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In Chinese /中文版

The Chinese-language section of our website has new contributions on two highlights of the annual agricultural conference calendar in Germany – the 2023 Global Forum for Food and Agriculture (GFFA) and the Future Forum on Rural Development. In addition, you can find our report on the world's largest organic trade fair and conference, Biofach, as well as interviews with our experts Sino-German Agricultural Week.

Read more

DCZ YouTube channel

DCZ TALKS | Urban agriculture

Germany's Digital Experimental Fields:

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If you are a regular follower of our DCZ activities and events, you may have noticed that we have been working to expand our public outreach on social media and via our website. In this issue of Harvest | 丰收, we are proud to present our new DCZ YouTube channel, where we regularly post videos from our events and field trips. View interviews with experts from last year's Sino-German Agricultural Week, see what stakeholders from politics, science, and farming have to say about smart agriculture in Germany, and, in case you have missed it, re-watch webinars from our DCZ TALKS series.

DCZ in the media

VIEWS

Liu Dongchao

Institutions reform vital for modernization

According to the reform plan of China's State Council institutions submitted to the first session of the 14th National People's Congress for deliberation on Tuesday, China plans to deepen reforms in different sectors including restructuring its Ministry of Science and Technology, setting up a national financial regulatory administration, and establishing a national data bureau.

These moves, aimed at improving governance capabilities, can help inspire the Chinese people to make technological breakthroughs, and better ensure financial security and data regulation.

The State Council institutions reform plan is in line with the plan of the reform of the Party and State institutions which was approved at the Second Plenary Session of the 20th Communist Party of China Central Committee.

The reform of the Party and State institutions is the first major systemic transformation on the way to achieving the "second centenary goal" of developing "China into a great modern socialist country that is prosperous, strong, democratic, culturally advanced, harmonious, and beautiful" by the middle of this century. It is also a guarantee for institutional stability and progress for the next five years and beyond.

First, the reform of the State institutions is necessary to implement the spirit of the 20th National Congress of the CPC, which made clear the designs and arrangements for the reform. The report of the 20th CPC National Congress says that we must resolutely uphold the authority of the CPC Central Committee and its centralized and unified leadership, and make the Party the backbone of the people.

The 20th Party Congress report also

The world is undergoing unprecedented changes and faces continued regional turmoil and conflict, which are increasing economic and sociopolitical uncertainties.

calls, among other things, for deepening the reform of the financial system, building a modern central bank system, and improving the system of unified leadership of the CPC Central Committee.

The next five years will be critical for the comprehensive construction of a modern socialist country. And since more than four months have already passed since the 20th Party Congress, the institutional reforms should be quickly and efficiently implemented, in order to lay a solid foundation for socialist modernization construction.

Second, the reform of the Party and State institutions is necessary for the improvement of the socialist system with Chinese characteristics, which is a scientific system developed by the Party and the people. Given the fast-changing times and increasing uncertainties, this system needs to be continuously adjusted and optimized so as to better meet the complex and arduous requirements.

The most important aspect of this reform is the implementation of the principle of "strengthening the centralized and unified leadership of the Party", because the CPC leadership is key to socialism with Chinese characteristics and the greatest advantage of the socialist system with Chinese characteristics.

Another important principle of the reform is to "coordinate the central organizations of the Party, the National People's Congress, the State Council, and the National Committee of the Chinese People's Political Consultative Conference, and to coordinate the central and local governments". In essence, it is aimed at arranging the institutions on a "national chessboard", which reflects systemic thinking and manifests the key features of the socialist system with Chinese characteristics.

Third, the Party and State institutions' reform is a necessary step toward promoting the modernization of the national governance system and governance capacity. This is evident from the fact that the 2018 reform of the Party and State institutions helped improve China's governance system.

However, China faces some problems on the road to the reforms, such as the lack of a unified management system for scientific and technological work, inadequate financial risk prevention capability, and slow pace of high-quality development. Formalism and bureaucracy, too, are obstructing the reform.

To promote the modernization of the national governance system and governance capacity and solve the reform-related problems, implementing institutional reform is necessary. The goal is to achieve "more scientific leadership of the Party in socialist modernization construction in institutional settings, more optimized functional allocation, more perfect system and mechanism, and more efficient operation and management".

Fourth, the reform of the Party and State institutions is aimed at addressing the complex domestic and international and other problems facing China. The world is undergoing unprecedented changes and faces continued regional turmoil and conflict, which are increasing economic and sociopolitical uncertainties.

The rise of anti-globalization sentiments, unilateralism and protectionism is becoming more and more apparent. For instance, the negative impacts of the Russia-Ukraine conflict, which has entered the second year, are seemingly growing, while the West is continuing to strengthen its containment policy against China. In fact, the West's encirclement of China could potentially escalate into a major conflict.

As China faces increasing uncertainty and unfavorable factors, it should be prepared to withstand major challenges, for which strong institutions and outstanding institutional advantages are needed.

As the 20th Party Congress report says, the problem of imbalanced and insufficient development remains prominent, and there are still many bottlenecks in promoting high-quality development. Solving these problems requires not only top-level design but also strengthened organizational leadership, and an institutional set-up.

The formation of new Party and State institutions in 2023 is expected to enhance the Party's governance capacity and leadership level, mobilize the initiative and creativity of all sectors of society, effectively handle domestic and foreign issues, elevate the cause of the Party and the country to a new level, and facilitate the smooth development of socialism with Chinese characteristics in the new era.

The author is a professor in the department of literature and history research at the Party School of the CPC Central Committee. The views don't necessarily reflect those of China Daily.

Michaela Boehme and Jürgen Ritter

Sino-German agri-cooperation for mutual benefit

Agri-food systems worldwide are facing enormous challenges. And after steadily declining for a decade, world hunger is on the rise again, affecting nearly 10 percent of people globally.

At the same time, prices of farm inputs and food products are rising, exacerbating poverty and food insecurity among the world's most vulnerable populations. As a result, creating a world free of hunger as set out in the 2030 Agenda for Sustainable Development of the United Nations appears to be an ever-more distant prospect.

There is no single reason behind the current challenges. Rather, we are facing multiple, interconnected crises — from climate change to loss of biodiversity and healthy soil, global pandemics, and wars and conflicts in many parts of the world.

In light of these challenges, the German Commission on the Future of Agriculture has developed pathways for a sustainable transformation of the country's agricultural sector. The proposed solutions range from creating more environmentally friendly livestock production systems to the promotion of organic agriculture, and the reduction of fertilizers and pesticides. Efforts at the level of the European Union, such as the EU's Green Deal or its Farm-to-Fork strategy, also aim to make food systems healthy and environmentally friendly, while ensuring productivity and fair returns to farmers.

In China, agricultural production has benefited from the fast rollout of modern agricultural machinery, digital tools, and innovations in biotechnology, thereby helping the country to raise agricultural productivity and grain output levels. With an annual output of more than 650 million tons, China has basically been self-sufficient in the production of staple grains for many years — achievement that has helped ease pressure on food supplies globally.

Yet neither Germany nor China is immune to the crises facing our food systems today. In fact, there are many shared challenges that risk undermining agricultural production in both countries in the medium term. For example, extreme weather events linked to climate change are becoming more frequent and severe. Regions in China and Germany were hit by major droughts in 2022. Protecting biodiversity and soil health is another issue of common concern. China's "zero-growth" action plan regulating the excessive use of fertilizers and pesticides is a step in the right direction, but more needs to be done.

In Germany, where fertilizer use is substantially lower than in China, farmers are now experimenting with new technologies to further improve efficacy and

JIN DING / CHINA DAILY

Balancing food production goals with the need to protect our global public goods, including our ecosystems and climate, is one of the biggest challenges facing both Germany and China in the near future.

reduce environmental impacts.

Moreover, both countries are exploring the use of digital tools to tackle rural challenges such as a declining farming population and rural development. As two major agricultural powers, Germany and China have the joint responsibility to drive the transformation toward a more sustainable, climate-friendly, and fair food system that can ensure food security for all while at the same time protecting our common global goods.

A constructive exchange and dialogue across national borders is indispensable to address the challenges we are facing, as parliamentary state secretary of the Federal Ministry of Food and Agriculture, Ophelia Nick, reiterated at the 8th Sino-German Agricultural Week, held from Nov 21-25, 2022, in Beijing.

How do we best organize these exchanges? The Sino-German Agricultural Centre (DCZ), established in 2015 as a joint initiative of the agricultural ministries of both countries, plays a key role in facilitating necessary cooperation.

Designed to be a central contact and information platform, its multi-stakeholder approach has helped bring together actors from politics, science, and business from both countries to address common challenges and support the sustainable development of the agriculture and food industry.

Over the past few years, agricultural cooperation via the platform of the DCZ has addressed a wide range of issues. In 2019, a Sino-German cooperation project on agriculture and climate change was launched. Within the framework of the project, experts from the Chinese Academy of Agricultural Sciences, the Ministry of Agriculture and Rural Affairs, as well as German researchers were invited to study tours in each other's country.

Furthermore, a set of best practices and policy recommendations on how to reduce emissions from agriculture and mitigate the effects of climate change were developed. German and Chinese agri-food stakeholders have also partnered in the field of agricultural digitalization, with a smart agriculture working group set up in 2020 and the successful launch of a smart agriculture website, presenting insights from Germany's "Digital Experimental Fields".

Other cooperation activities have included in-depth professional exchanges on environmentally friendly management practices of animal manure, plant breeding and digital villages.

However, more can be done. Balancing food production goals with the need to protect our global public goods, including our ecosystems and climate, is one of the biggest challenges facing both Germany and China in the near future. Addressing this challenge will require a wide range of responses, from innovation in digital agriculture to the repositioning of subsidies, the promotion of regenerative farming practices, and the creation of a fair and stable trade environment.

By drawing on their respective experiences, Germany and China can and should develop solutions for jointly overcoming the multiple crises and contribute to building a fair, healthy and sustainable food system for all.

The authors are from the German team of the Sino-German Agricultural Centre. The views don't necessarily reflect those of China Daily.

Mario Cavolo

China's diplomacy seeks peace, development

It is difficult for many to comprehend the rather complex juxtaposition of China and the United States in today's world.

What we do know is: China wants development and peace. Just as Chinese Foreign Minister Qin Gang reiterated on Tuesday at a press conference that Sino-US ties are vital for the whole world, adding that decoupling doesn't serve interests of either country.

Therefore it's time for some countries to abandon their Cold War mindset.

Unfortunately, many Western voices continue to project China as "a threat" to the world while continuing to interfere in other countries' internal affairs and launching or triggering wars. China, on the other hand, has not started any war or attacked any country in the past half a century.

China's firm anti-war stance is once again proved in the Russia-Ukraine conflict. China's message to other governments has always been to help end the conflict through diplomacy. Just as Qin reiterated on Tuesday, China always chooses peace and dialogue.

It is for this reason that German Chancellor Olaf Scholz's remark on Sunday that there would be "consequences" if China supplied weapons to Russia to strengthen the latter's position in the conflict was uncalled for, even though he said he was fairly optimistic that Beijing would refrain from doing so.

Yet the Western media seldom mention such facts or tell their readers and viewers how committed China is to promoting peace and development.

And Qin Gang reiterated that China doesn't send arms to any country in the conflict.

What many Western political leaders and people fail to understand is that China's safe, stable domestic environment — as any expat living in China like me can testify — is a reflection of the values at the core of its policies, which are also embodied in the Global Development Initiative and Global Security Initiative, because they are common values of humanity.

While China proposed the GDI, it was focused on supplying global public goods to help achieve the United Nations' 2030 Sustainable Development Goals, reverse the damage done by the COVID-19 pandemic and facilitate global economic recovery.

As the international community came to realize during the three years of the pandemic, stable and smooth-running industry and supply chains are essential to ensuring sustainable global development, and it is to stabilize the global supply and industry chains that China held the Belt and Road Forum for International Cooperation in 2017, following it up with the second forum in 2019, and will hold the third forum later this year. The forum is also aimed at promoting global cooperation and helping reform global governance.

And economic cooperation with China under the Belt and Road Initiative framework has made it possible for Africa to make remarkable achievements, indicating the values of peace and stability, said Dennis Munene, executive director of the China Africa Center at Nairobi-based Africa Policy Institute. Munene's message speaks to the much broader values of Chinese civilization, and the deeply held values of its people and government.

Yet the Western media seldom mention such facts or tell their readers and viewers how committed China is to promoting peace and development. Instead, quite a few Western countries are obsessed with the military industrial complex because it earns fat revenues for the government — and that's why many Western politicians and profiteers trigger wars and conflicts even if they mean sacrificing lives and resources.

Many military and political experts say that war hawks and profiteers engineered the Russia-Ukraine conflict and are not leaving any stone unturned to keep it alive in total disregard for the human and material costs.

In stark contrast to the Western powers, China has matched the core objectives of the GDI and GSI with its core objectives of peace and development. China proposed the GDI in April last year. And more than 100 countries and regional organizations have supported the two initiatives.

China wants to set global examples for development and peace in the 21st century now that it has risen to the level of a "world superpower" in peace. The world has seen enough provocations, violence and war. And to see development, prosperity and peace, it needs to learn from China's development philosophy and development programs.

The author is an American writer living in China and a non-resident senior fellow at the Center for China and Globalization. The views don't necessarily reflect those of China Daily.

The DCZ is regularly featured in Chinese and German print media. The 8th Sino-German Agricultural Week in November 2022 drew a huge media response, with articles published in *Farmers' Daily, Economic Daily,* and many other outlets. An opinion piece on the future of Sino-German agricultural cooperation by DCZ expert Michaela Boehme and managing director Juergen Ritter came out in *China Daily* in March 2023. We have also been active in academic publications such as the journal East Asian Science, Technology and Society, where DCZ head of scientific dialogue Eva Sternfeld appeared with a book review of Cong Cao's *GMO China: How global debates transformed China's biotechnology policies.*

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