DITAC Policy Brief

The digitalization of China's agriculture: Status quo and economic implications

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Status quo of China's digitalization

China is one of the leading countries in developing digital technologies, especially telecommunications technologies. According to the *International Telecommunication Union* (ITU), China's investment in telecommunications, at around USD 60 billion in 2020, will only be surpassed by the USA. However, in terms of per capita investment, at 35 USD, the country is well behind other industrialized nations such as Germany (130 USD). Regarding Internet use, China has a rather moderate level of 70.4 % compared with high- and middle-income countries, mainly due to significant regional differences in development. Also within rural areas, regional differences are pronounced. The much more densely populated and economically developed regions in the coastal regions and in central China have a high level of rural digitalization, while the rural areas in the northeast and west of China still lack behind.

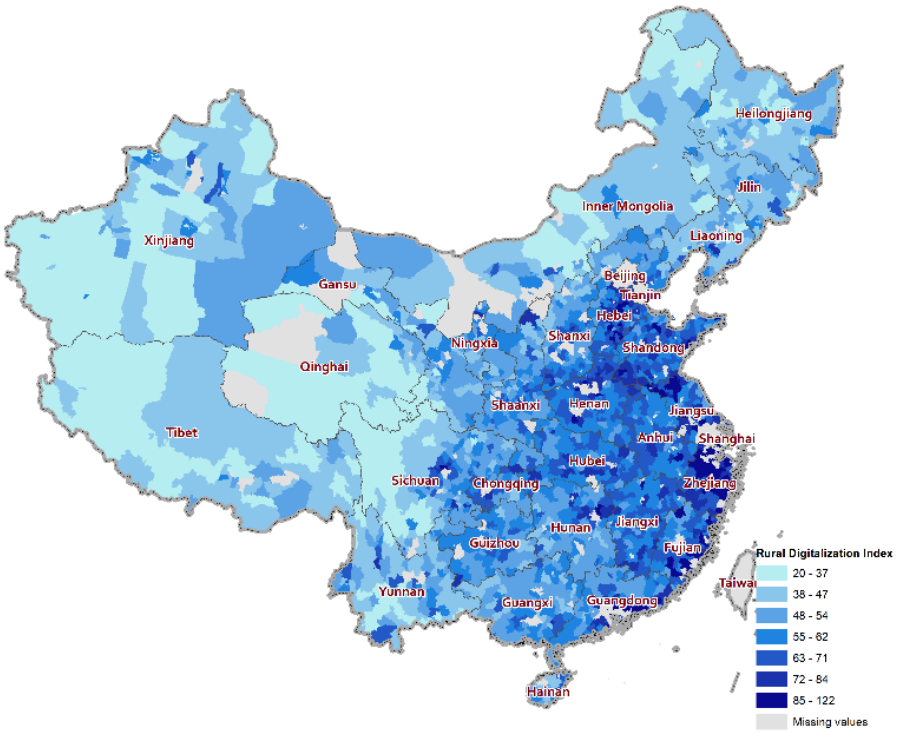

Figure 1: Rural Digitalization Index 2020

Source: Own illustration, data from Alibaba & Peking University 2021.

The DITAC project

The central objective of the DITAC project is to analyze and evaluate digitalization processes in the Chinese agricultural and food industry.

The findings obtained will serve as a basis for a discussion of future development paths and impact assessments of digital transformation processes from a global perspective. At the same time, they provide important indications regarding the impact on international trade relations.

Project partners are the Leibniz Institute of Agricultural Development in Transition Economies (IAMO), China Agricultural University, Huazhong Agricultural University, the Institute of Agricultural Economics and Development of the Chinese Academy of Agricultural Sciences (IAED-CAAS), and the German-Chinese Agricultural Center (DCZ).

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Similarly uneven development can also be found among China's economic sectors. While the service and industrial sectors in China are already highly digitized, the development of digitalization in agriculture has only been decisively driven forward politically since 2015. One factor here may have been the stagnant productivity growth in agriculture since the 2000s. In spring 2023, the Chinese leadership, mainly in response to increasingly evident geopolitical tensions and supply chain disruptions, called for a significant increase in agricultural production under the catchphrase *Agricultural Powerhouse*. The digitalization of agriculture was cited as one of the key pathways to achieving this goal.

At the start of our project in late 2021, very little data was available on actual digitalization on farms, apart from very basic information on Internet use. The state of knowledge at that time was dominated by exemplary reports on demonstration and lighthouse projects. In this report, we present preliminary results mainly based on a farm survey on the digitalization status of Chinese agriculture conducted by IAMO in the summer of 2022 in collaboration with local research partners of the DITAC project. The farm-level survey covered 2404 randomly selected farms in five Chinese provinces: Sichuan, Heilongjiang, Hubei, Hebei, and Hunan.

Among the 2404 interviewed farms, there were 921 pure crop farms, 1193 mixed farms (i.e. farms with arable crops and livestock), and 88 pure husbandry farms (farms using their land exclusively for livestock). Among the pure crop and mixed farms, there were 1506 small farms (less than 2 ha of arable land), 395 medium farms (2-10 ha of arable land), and 213 larger farms (more than 10 ha of arable land). This sample largely assembles China's farm structure—in terms of farm sizes.

The actual level of digitalization in crop production was still very low, if ownership of digital agricultural technology is taken as a yardstick. Only 4.4% of the 2114 surveyed crop and mixed farms owned any machinery with digital components. The most common applications were agricultural vehicles (e.g., tractors), seed drills, tillage machines, and civilian drones, each of which was present in 0.5-1% of the farms. It should be noted that the level of mechanization in our sample was also low, and many farms did not own any of the aforementioned agricultural technology at all.

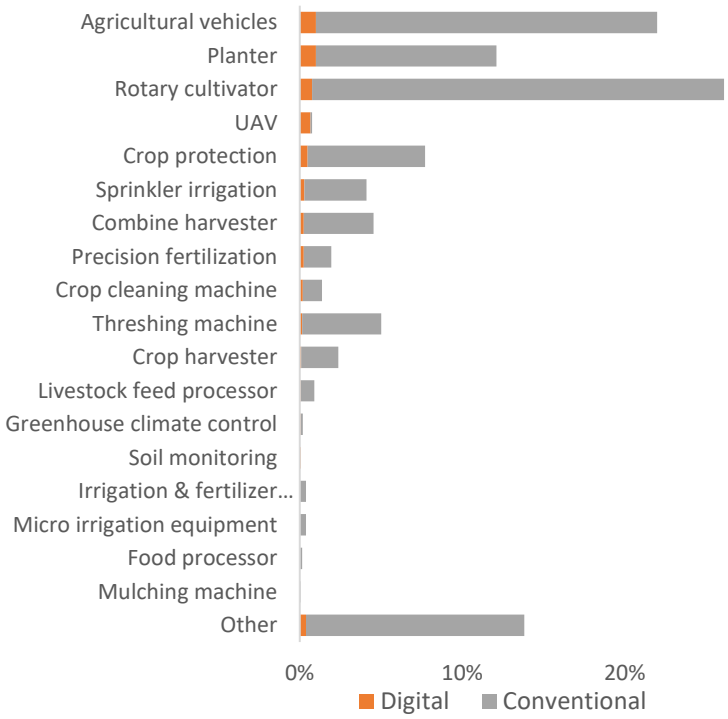

Figure 2: Ownership of digital technologies in crop production, 2022

Source: Own illustration, data from own survey

More widespread, on the other hand, was the use of rented (or borrowed) agricultural machinery, which is mostly required on seasonal basis in crop farming. In total, 107 of the 2114 arable and mixed farms used rented/borrowed agricultural technology, in particular seed drills, technology for soil cultivation and crop protection sprayers. Thus, in total, about 9% of the crop farms used their own and borrowed digital agricultural equipment. One reason for the high reliance on borrowed agricultural machinery is certainly the extremely small average farm size, which make the purchase of agricultural machinery unprofitable.

Among the 1281 farms engaged in husbandry and fishery, on the other hand, the level of digitalization was higher, especially in poultry and pig production, which are fundamentally capital- and technology-intensive. Of these farms, 16 % to 19 % had at least one device with digital functions for automating processes. Overall, 17% of livestock farms used at least one type of digital technology. Lower rates of digitalization were seen in cattle farming, which in China is predominantly carried out in the less densely populated provinces in the West or North; only one-third of production was in more densely populated provinces in central China or the coastal and metropolitan regions, where feedlot farming prevails.

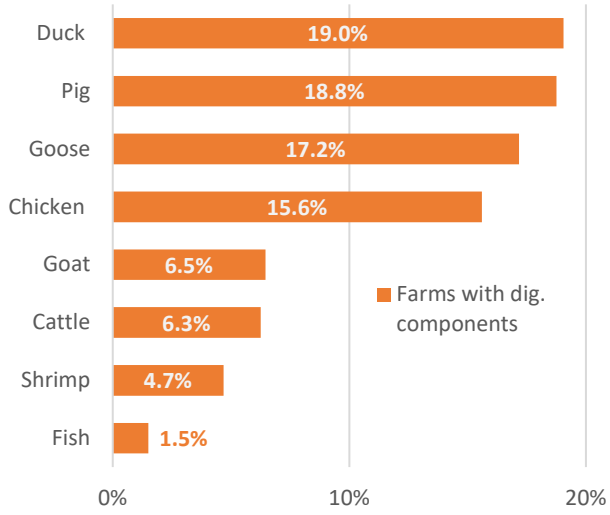

Figure 3: Use of digital technologies in animal production or fish farming, 2022

Source: Own illustration, data from own survey

Software applications are much more pervasive, even among small businesses. Among 86 % of the farms surveyed, at least one household member regularly used the Internet. While 83 % of the farms had at least one smartphone in the household, desktop PCs or laptops/tablets (which could be used for more sophisticated software) were only present in 27 % and 25 % of the farm households, respectively.

The actual use of digital applications, measured by the technical availability of corresponding devices and Internet connection, still remained somewhat below potential. Approximately 58.5 % of respondents with the necessary technical requirements used mobile applications to access information on agricultural production. 43.4% of respondents made purchases online, but only 4% purchased agricultural supplies such as fertilizers or pesticides online. Only 6% of farmers surveyed were aware of online marketing and only 4.3% had sold produce online. Although 21% of farmers used the Internet for online banking and payment, only 3.1% used other options of mobile banking or mobile credit offers.

Small-scale agriculture inhibits investment in digital technologies

Overall, the level of digitalization in Chinese agriculture, measured by the use of digital agricultural technology, remains lower than expected or portrayed in the media, especially in crop farming. One plausible explanation is the dominating small-scale farming in China: The degree of digitalization was highest among larger farms (>10 ha area) in crop and vegetable farming. Digitalization rates were significantly lower for micro and small farms (see Figure 4). This assumption was also confirmed during expert interviews. Firstly, small farms have difficulties raising the capital required for investments. Secondly, small farms are not able to realize economies of scale, which means that the purchase of particularly cost-intensive agricultural technology can hardly be amortized.

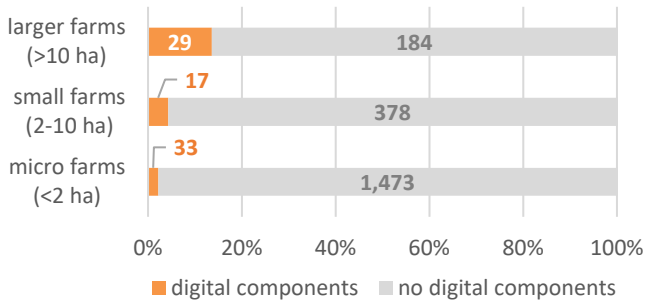

Figure 4: Use of digital agricultural technology by farm size

Source: Own illustration, data from own survey

Low digital literacy among farmers

A second, perhaps more important, factor is the low level of digital literacy among farmers: in 28%

of cases, the Chinese farmers surveyed did not personally use 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% were unable to make online purchases. This apparent lack of digital literacy is directly related to perceived barriers to digitalization in the population as a whole, as measured by the International Telecommunication Union: among those individuals who have not used the Internet to date, only 3.5% cited doubts about its usefulness as a barrier. In 50% of the cases, the main obstacle was reported to be the lack of know-how and experience (ITU 2021).

Economic implications

Our research to date shows that the level of general digitalization in Chinese agriculture is still low. Even the basic mechanization of agricultural production is not at the level of large agricultural producers such as the USA, the EU, Canada, Australia, Russia, Ukraine or Brazil, partly due to the dominance of smallholder farming structures. Implications, therefore, arise in the following areas:

At first glance, the still low digitalization rates in China offer great opportunities for potential German technology exports to China. However, market entry will not be promising in all sectors: Civilian drones have various potential applications even for small-scale agriculture, for example, in the spraying of pesticides. However, China itself is the world leader in producing civil unmanned aerial vehicles (UAVs). The market opportunities for German companies are also rather low in the area of telecommunications technology. In contrast, the market potential is opening up in the area of agricultural machinery technology, an industry with an export volume of just under EUR 9 billion at the last count.[1] The still low use of digital agricultural technology, even by larger Chinese companies, indicates considerable market potential. However, the prerequisite for this would be that the German agricultural technology industry additionally places a stronger focus on technologies for small farms. It will be crucial to develop tailored technological solutions that take into account aspects such as land fragmentation, small acreage sizes, and low digital literacy among farmers, as well as compatibility with other technologies and software that are scarce on the farm level. German manufacturers such as CLAAS have been particularly focused on large agricultural equipment in the premium segment. In contrast, other manufacturers dominate in the field of field robotics and smaller agricultural machinery. There is further market potential in livestock farming, where the level of digitalization has so far been low. With milking and other barn robots, for which there are leading German suppliers, significant efficiency gains could also be realized in China. These capital-intensive production sectors with high added value hold the highest potential and demand for digitalization overall.

Impact on agricultural trade

Other implications relate to China's role in global agricultural trade. The present level of digitalization does not appear sufficient to bring about imminent crop yield gains. Fundamental obstacles to innovation are to be found in the area of land consolidation and human capital development. Both are longer-term challenges that are hard to overcome in the short term. In addition, digitalization is rather to be seen as a means of saving production factors while maintaining the agricultural yield.

As a result, China is likely to continue to demand large quantities of corn, soybeans, and dairy products in the world markets in the coming years. Of particular importance for German exporters is the demand for milk and milk powder, the most important export group in Germany's food trade with China, accounting for 48% of the total export value in 2021. As digitalization and mechanization rates were particularly low in China's rather extensive cattle and dairy production, digitalization effects are hardly to be expected in the short term. China's demand for fertilizers is also relevant to Germany.

[1] https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/Agrarexporte-verstehen.pdf?__blob=publicationFile&v=9

Although China is one of the largest producers of many fertilizer components such as phosphates, urea or sulfur, it purchases potash and sulfur fertilizers in large quantities on the world markets, especially from the Arabian Peninsula, Belarus, Russia, and Canada (ICIS 2022). Here, too, a reduction in China's demand in the short term, for example through more demand-oriented application, is not currently foreseeable.

Even given low levels of digitalization and mechanization in agricultural production, as well as the general benefits of the global division of labor, world agricultural markets are not expected to become less important for China's food security in the foreseeable future.

At present, it is difficult to predict the impact of the *Agricultural Powerhouse* initiative, which aims to increase productivity and efficiency while minimizing environmental impact. The success of the initiative will depend not least on whether it succeeds in unleashing the hoped-for potential of agricultural digitalization.

Related links

Kuhn, Lena; Jamali Jaghdani, Tinoush; Prehn, Sören; Sun, Zhanli; Glauben, Thomas (2022) Keep calm and trade on: China's decisive role in agricultural markets under turmoil. *IAMO Policy Brief No. 45*, Halle (Saale): Online at: https://www.iamo.de/fileadmin/documents/IAMOPolicyBrief45_en.pdf.

Bitkom Research (2022): Digitalization in Agriculture 2022. Online at: https://www.bitkom.org/sites/main/files/2022-05/Bitkom-Charts%20Landwirtschaft.pdf

International Telecommunication Union [ITU] (2021). World telecommunication/ICT indicators database online. Online at: http://handle.itu.int/11.1002/pub/81733fd9-en.

Independent Commodity Intelligence Services [ICIS] (2022): Global Fertilizer Trade Map. Online at: www.icis.com/fertilizers.

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