Machinery for big ag

MACHINERY FOR BIG AG refers to manufactured equipment used in agriculture. This includes, for example, tractors, haying and harvesting machinery and equipment used for planting, fertilizing, ploughing, cultivating, irrigating and spraying. Today, the world’s largest farm equipment companies are gearing up to control digital ag technologies and farm data as their number one strategy for expanding market share. Digitalised agriculture implies other machinery used down on the farm – drones, sensors and devices that run apps, for example – as well as internet connectivity.

Table 1: Sales of the Leading Farm Equipment Companies, 2020

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company (Headquarters)</th>
<th>Sales 2020, US$ millions</th>
<th>% Market Share 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Deere &amp; Company (USA)</td>
<td>22,325</td>
<td>17.5</td>
</tr>
<tr>
<td>2.</td>
<td>Kubota (Japan)</td>
<td>14,140</td>
<td>11.0</td>
</tr>
<tr>
<td>3.</td>
<td>CNH Industrial (UK/Netherlands)</td>
<td>10,916</td>
<td>8.5</td>
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<tr>
<td>4.</td>
<td>AGCO (USA)</td>
<td>9,150</td>
<td>7.2</td>
</tr>
<tr>
<td>5.</td>
<td>CLAAS (Germany)</td>
<td>4,609</td>
<td>3.6</td>
</tr>
<tr>
<td>6.</td>
<td>Mahindra &amp; Mahindra (India)</td>
<td>2,480</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Total Top 6</td>
<td>63,620</td>
<td>49.8</td>
</tr>
<tr>
<td>7.</td>
<td>Iseki (Japan)</td>
<td>1,399</td>
<td>1.1</td>
</tr>
<tr>
<td>8.</td>
<td>SDF Group (Italy)</td>
<td>1,307</td>
<td>1.0</td>
</tr>
<tr>
<td>9.</td>
<td>Kuhn Group (Switzerland)</td>
<td>1,164</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>10.</td>
<td>YTO Group (China)</td>
<td>984</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td></td>
<td>Total Top 7 - 10</td>
<td>4,854</td>
<td>&lt;4.1</td>
</tr>
<tr>
<td></td>
<td>Total Top 10</td>
<td>68,474</td>
<td>&lt;53.9</td>
</tr>
<tr>
<td></td>
<td>Worldwide Farm Machinery Sales (est.)</td>
<td>127,800</td>
<td></td>
</tr>
</tbody>
</table>

Source: ETC Group, based on company annual reports
According to the Mechanical Engineering Industry Association (VDMA) based in Frankfurt, the worldwide market for agriculture equipment reached US$128 billion in 2020.

- The top 4 companies account for 44% of the global ag machinery market.
- The top 6 companies account for one half of the global ag machinery market.

In some regions and countries, farm machinery markets are even more consolidated.

For example:

- In the United States, just three companies – Deere, CNH and AGCO – account for more than 90% of high-horsepower tractor sales.12
- Mahindra & Mahindra controls more than 40% of India’s farm equipment market.13

Trends: chew on this

ETC finds that the major trends in the industrial ag machinery market include:

- Market Volatility
- A Push to Automate
- Drive to Digitalize Fuelling Ag Machinery Markets
- Continuing Battle over Who Owns and Controls Farm Data
- Drones Take Flight

Market Volatility: A Bumpy Ride

In 2020-21, ag machinery markets experienced pandemic-induced volatility. After the cease fire in the China-U.S. trade dispute resulted in growing demand for corn and soybeans, US tractor sales revved up by double-digit percentages.14 In India, Mahindra & Mahindra saw its June 2021 domestic sales increase by 31% over the previous year,15 and the European Agricultural Machinery Association reported 25% more tractors registered across Europe in the first six months of 2021 compared to the same period in 2020.16

But supply chain challenges caused headaches. Big farm machinery manufacturers scrambled to keep up with new orders in 2021 due to depleted inventory, shortages in labour and raw materials (including semiconductors18) and rising freight costs.19 In May 2021, Deere warned that the chip shortage
posed a significant risk and noted that raw material and freight costs would double for the year. Nevertheless, in August, Deere forecast record net income for 2021, double its 2020 figure. Two months later, 10,000 unionized Deere workers went on strike to protest low wages and inadequate retirement benefits.

**A Push to Automate**

Pandemic-induced lockdowns and restrictions on the cross-border movement of migrant workers led to farm labour shortages, giving the ag equipment sector even more incentive to accelerate a long-promised shift to automation. According to global data platform for intelligence on start-ups, Dealroom, investment in farm robotics/automation start-ups, including vertical and indoor farms, jumped 40% from January to August 2020. In 2020, Kubota unveiled its first completely autonomous tractor – dubbed “the dream tractor” – and is now working with start-ups developing technologies for growing/harvesting crops that require a dextrous handling (fruits such as strawberries, apples, grapes, for example) – an area the company views as especially ripe for automation.

Governments are supporting automation in agriculture, too. In 2020, the U.K. Research and Innovation agency awarded £2.5 million to a consortium of academic and private sector firms developing the world’s first robotic farm, dubbed “Robot Highways.” The project claims that its autonomous tech will enable a 40% reduction in labour and help move the sector toward a carbon zero future. In Thailand, the Ministry of Agriculture and Cooperatives established tech-focused subcommittees on Big Data, Smart Agriculture, E-Commerce and Agribusiness. The government also developed “TraceThai,” a national, digitalized traceability system that will start with tracking organic foods. Industrial agriculture is notorious for exploitation of farm labour and, contrary to companies’ claims, the current push to automate farm equipment threatens to amplify exploitation by increasing worker surveillance, pressures to meet inhumane machine-designated targets and the deskilling of workers.
Table 2: Selected acquisitions/investments related to automation and precision farming by Big Ag Machinery corporations (2019-2021)

<table>
<thead>
<tr>
<th>Farm Machinery Company</th>
<th>Acquisition/Investment</th>
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<tbody>
<tr>
<td>Deere &amp; Company</td>
<td>Acquired Bear Flag Robotics for US$250 million to develop autonomous tractors. Deere is collaborating with tech start-ups: Nori (carbon offset platform based on digital recordkeeping), Nvision Ag (data modelling and aerial imaging for corn farmers to manage nitrogen levels), Scanit (early detection of airborne pathogens), and Teleo (turning existing equipment into remote-controlled robots).</td>
</tr>
<tr>
<td>CNH Industrial</td>
<td>Acquired precision agriculture pioneer Raven Industries for US$2.1 billion; holds minority stake in Augmenta (automates farming operations); minority investment in US-based Monarch Tractors.</td>
</tr>
<tr>
<td>CLAAS</td>
<td>Holds a minority stake in AgXeed (to build field robots).</td>
</tr>
<tr>
<td>AGCO</td>
<td>Precision Planting, LLC (subsidiary of AGCO) acquired Headsight, Inc. (precision agriculture harvesting); acquired Farm Robotics and Automation S.L (“Faromatics”), a precision livestock farming company.</td>
</tr>
<tr>
<td>Kubota</td>
<td>Bought an additional stake in Indian tractor manufacturer Escorts (total 15%); bought stake in Israeli start-up Tevel (flying autonomous fruit-picking robot); collaboration with Aurea Imaging (autonomous orchard and vineyard farming).</td>
</tr>
<tr>
<td>Mahindra &amp; Mahindra</td>
<td>Acquired stake in Resson, a predictive data analytics company (other investors include Monsanto Growth Ventures and McCain Foods); acquired a stake in Swiss agritech firm Gamaya (hyperspectral imaging, AI and machine learning algorithms).</td>
</tr>
</tbody>
</table>

Drive to Digitalize Fuelling Ag Machinery Markets

“We are transforming from a machinery company into a smart technology company.” – Martin Kremmer, director ETIC, John Deere European Technology Center

“…[E]nvironmental narratives are legitimizing a digital transition in the food system that might otherwise raise critical questions about issues such as data sovereignty, increased surveillance and corporate control over farming practices.” – Louisa Prause, Sarah Hackfort and Margit Lindgren writing in Agriculture and Human Value

For all agriculture sectors – from livestock breeding and ranching to industrial farming – data is itself a precious commodity, which some have dubbed “the new soil” and others “the new cash crop.” The farm equipment sector is no exception, and digitalization is driving the growth strategies of all the major companies. (IHS Markit estimates that the global digital farming market was worth US$5-7 billion in 2020 – less than 5% of the total farm equipment market – but is forecast to increase to US$15 billion by 2027.)

With heaps of data on soil quality, weather, input levels – such as seeds, pesticides and fertilizers – farm equipment makers have refashioned themselves into tech companies. Agricultural machinery now also implies drones,
sensors and robots equipped with artificial intelligence (AI) and/or machine learning capabilities to target individual plants or plots, with the promise of “precision” – just the right amount of water or fertilizer or pesticide: good for the crop, good for the environment and good for the farmer’s bottom line, go the claims. Deere & Company now employs more software engineers than mechanical engineers.⁴⁹

In reality, precision ag’s claims to save time, money and labour stand on shaky ground due to unequal digital access, a narrow focus on a few commercial crops, inaccurate GPS systems, sensors and other hardware and software components – especially algorithms – and the inability of these technologies to gauge complex farm realities, practices and micro-climates.⁵⁰

“Precision farming” can imply multiple technologies, including:

- **Robots** for weeding,⁵¹ fruit and vegetable picking, irrigation, and spraying pesticides;
- **Drones** to scan soil fertility, to monitor crop health, to apply pesticides, herbicides and fertilizers, and even to plant seeds;⁵²
- **Sensors** (hyperspectral, multispectral, thermal and LiDAR) that capture information that may not be visible to the naked eye, such as soil moisture, plant stress levels, presence of weeds, or pests;
- **Data analytics** to process the gathered data in order to give recommendations on how, where and when to irrigate, apply pesticides and fertilizers;
- **Satellite imagery** to assess yields, crop damage, growth rates;⁵³
- **GPS (Global Positioning System) and BeiDou Navigation Satellite System (BDS)** for on-farm navigation of machinery;
- **Cloud providers**, making possible storage and processing of massive datasets;
- **Internet connectivity**, which underpins all the other technologies.

Ag machinery companies, together with agrochemical and seed industry firms, have successfully propelled the narrative that precision agriculture is the key to productivity, sustainability and climate resilience. Working hand-in-hand with industry, many national governments, philanthro-capitalists (e.g., the Bill & Melinda Gates Foundation) and the Consultative Group on International Agricultural Research (CGIAR, which has received more than US$1 billion from the Gates Foundation⁵⁴) have embraced the drive to digitalize the global South and peasant agriculture.⁵⁵

Global collaborations, like the Agricultural Innovation Mission for Climate (AIM for Climate) launched at the UN’s 2021 Climate Conference (COP26) by the U.S. and U.A.E., are pushing “climate-smart agriculture,” advocating...
for more investments in ag tech and on-farm data collection, and continuing extractive agriculture.\textsuperscript{56} Even public sector techno-optimists are endorsing digital ag for the global South with scant empirical evidence of how these technologies may impact peasant farming communities.\textsuperscript{57} In her budget speech for the financial year 2022-23, the Finance Minister of India declared that the “use of ‘Kisan Drones’ will be promoted for crop assessment, digitization of land records, spraying of insecticides, and nutrients.”\textsuperscript{58} In the words of researcher Glenn Davis Stone, “there is significant movement towards surveillance-based, decision-appropriating technologies being developed and deployed for peasants in the global South.”\textsuperscript{59}

Some academics warn that the ability to “harvest new data sources” from peasant farmers will amplify the global land grab.\textsuperscript{60} They explain that the extraction of previously-inaccessible, farm-level micro-data will allow better assessments of profit potential, thus accelerating land grabs in the global South.\textsuperscript{61}

\textbf{Table 3: Selected digital agriculture platforms of farm equipment manufacturers and inter-sector collaborations}

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Digital Ag Platform</th>
<th>Some components</th>
<th>Interoperability, Digital Ag collaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deere &amp; Company</td>
<td>Deere Operations Centre (farm management)</td>
<td>JD link (data transfer); John Deere Mobile Weather; Ag Logic (remote work management); Field and Water Management</td>
<td>U.S. Agency for International Development, Corteva, John Deere and Global Communities work on precision ag in Zambia, data integration agreement between E-luminate, Golden Harvest’s (Syngenta’s corn and soybean seeds) digital ag platform and Deere Operations Center.\textsuperscript{62} Deere, CASE, CNH Industrial and 365FarmNet formed a data interface project called DataConnect that will enable farmers operating machinery from different cooperating brands to view and exchange machine data,\textsuperscript{63} partnered with Volocopter to develop an agricultural drone (VoloDrone) for agrochemical spraying</td>
</tr>
<tr>
<td>AGCO</td>
<td>Fuse; FendtONE (operating system) by Fendt (AGCO subsidiary)</td>
<td>AGCO Connect (machine-focused telemetry software, yield monitoring system, AccuBoom (targeted spraying); Climate FieldView app (agronomy decision and visualization)</td>
<td>AGCO partnership with Climate FieldView; AGCO entered into a collaboration with Robert Bosch GmbH, BASF Digital Farming and Raven Industries Inc. to work on targeted spraying technology\textsuperscript{64}</td>
</tr>
<tr>
<td>Kubota</td>
<td>KSAS (Kubota Smart Agri System), cloud-based agricultural management support service</td>
<td>Plans to include fertilizer application, chemical spraying, and business support system\textsuperscript{65}</td>
<td>Partnered with US Chipmaker Nvidia to develop self-driving farm tractors;\textsuperscript{66} partnered with Aurea Imaging for “crop intelligence” for fruit growers;\textsuperscript{67} Japanese subsidiary of Mahindra &amp; Mahindra collaborated with Kubota for joint IoT solutions, OEM supply arrangements;\textsuperscript{68} collaborated with Microsoft to shift to its Azure cloud services; part of AGROS, collaboration between Wageningen University &amp; Research and 26 private partners, including BASF</td>
</tr>
</tbody>
</table>
CLAAS

Digital Ag Platforms
CLAAS Connect, 365FarmNet (CLAAS Subsidiary), CLAAS E-Systems (CLAAS Subsidiary)

Some Components
CLAAS Telematics, BASF AgSolutions Finder (pesticide measures), Agropressure by Michelin (Components of 365FarmNet)

Collaborations
Bayer, CLAAS collaborate to expand Climate FieldView digital farming platform

CNH Industrial

Digital Ag Platforms
AGXTEND

Some components
CropXplorer (uses sensors for nitrogen application and other uses), FarmXtend (provides sensor-based detailed agronomic recommendations), SoilXplorer (soil sensors), NIRXact (Near Infrared sensors providing recommendations for application)

Collaborations
CNH Industrial partnered with AGCO, Bayer, Jacto, Nokia, Solinftec, TIM and Trimble under ConectarAGRO to push precision farming in Brazil; CNH Industrial, Accenture and Microsoft for increasing CNH’s digital capabilities; partnered with DroneDeploy to deliver a packaged deal of a DJI drone/camera and the company’s software for plant health analysis

Mahindra & Mahindra

Digital Ag Platforms
Krish-E (India), DigiSense 4G

Some components
Soil mapping, drone spraying, pest management

Collaborations
Mahindra & Mahindra’s Japanese subsidiary, Mitsubishi Mahindra Agricultural Machinery Company and Kubota announced collaboration for Japanese domestic operations

Continuing Battle over Who Owns and Controls Data

The legal ownership of data collected on-farm is murky at best. Deere, for example, has famously argued that when a farmer buys one of the company’s tractors, they receive a “license to operate the vehicle” but they are not the owner of the equipment, the software embedded in it or the data generated by the equipment. By asserting themselves as the ultimate data-owners, farm equipment manufacturers seek to retain control of a product that itself has enormous value. This is also evident in the partnerships between the big agrochemical/seed companies and farm equipment manufacturers (see Table 3). These collaborations involve the sale or exchange of data, which are analysed to deliver prescriptions to the farmer – for example, which seeds to plant on which plot of land or the application rates of other inputs. The company that controls farm data is positioned to use its farm management platform to link the farmer to preferred products (i.e., its own and those of its partners). The immediate goal is to optimize sales on the company’s platform. In the longer term, the ag machinery-tech firms are positioned to further usurp farmer autonomy and decision-making by creating technology lock-ins. For example, in order to qualify for credit or to meet food safety standards, farmers could be compelled to adopt particular precision ag technologies and products.

Additionally – and relatedly – equipment repair services are a profitable revenue stream for farm machinery manufacturers. Companies like Deere say
it’s illegal for farmers or independent technicians to tinker with embedded software, which is considered proprietary. Equipment repairs are time consuming and costly for farmers, and waiting for a company-approved technician to show up at harvest time can mean tens of thousands of dollars in lost income. The “Right to Repair” movements across the world are fighting against manufacturers like Deere (as well as Apple and Tesla) that want to prevent farmers/consumers from fixing the products they’ve bought. Anti-trust researchers believe that Deere’s aggressive attack on the right to repair demonstrates the company’s attempt to monopolise the market for digital agricultural information.73 In July 2021, the Biden administration took steps to push back on the manufacturers’ anti-competitive repair restrictions in the U.S., but the new rules are still being written.74

Drones Take Flight: Bedrock of Digital Ag is in the Sky

“I am the eye in the sky
Looking at you
I can read your mind…” – from “Eye in the Sky,”
lyrics by Eric Woolfson, Alan Parsons

Cameras and other sensors attached to drones function as the eyes of the digital ag-machine bundle. Sensors can map terrain and capture detailed images of farmland, and drones can shoot seeds in the ground and spray chemicals on crops. In some cases, drones are being used in “precision ranching” to track cattle and monitor health.75 The leading farm equipment manufacturers have become drone devotees, especially through collaborations with other, drone-centred companies: Deere & Company has partnered with Volocopter to develop a drone (VoloDrone) for agrochemical spraying;76 CNH Industrial teamed up with DroneDeploy to deliver a packaged deal of a DJI drone/camera plus DroneDeploy software to assess plant health analysis (with the capability to zoom in to “inches above the plants”);77 and Kubota has recently invested in fruit-picking drone company Tevel.78

Seeds and agrochemical companies, too – Bayer, Corteva AgriScience and BASF, for example – are partnering with (mostly private) drone hardware manufacturing companies like DJI (the largest seller that accounts for about 70% of the drone market),79 XAG® and Delair® (see Table 4). AGCO manufactures its own drones while Mahindra & Mahindra is expected to launch ag-drones soon after getting conditional permission from the Civil Aviation Ministry of India to conduct drone-based agricultural trials and precision spraying on paddy and hot pepper crops in Telangana and Andhra Pradesh, respectively.80

Whose ag-drone software will dominate has not yet become clear: Slantrange,81 Taranis,84 PrecisionHawk,85 FarmLens (owned by AgEagle) and Climate Corporation (owned by Bayer) all sell programs that analyze agricultural data to provide input recommendations to farmers.
Table 4: Partnerships between Drone Manufacturers, Ag Input Companies and other actors

<table>
<thead>
<tr>
<th>Drone company</th>
<th>Partnerships</th>
</tr>
</thead>
<tbody>
<tr>
<td>XAG (China)</td>
<td>XAG partnered with Bayer and Alibaba Rural Taobao to form the “Sustainable Farming Programme” in China focused on digital ag, with Bayer to commercialize digital farming technology in Southeast Asia &amp; Pakistan (SEAP), with Federal University of Paraná (UFPR), Brazil and Timber to plant trees, with The National Centre for Precision Farming, Harper Adams University, U.K. to develop drones and robotics for UK and European farmers.</td>
</tr>
<tr>
<td>AgEagle Aerial Systems (USA)</td>
<td>BASF’s xarvio FIELD MANAGER integrated with AgEagle’s senseFly’s eBee X fixed-wing drone platform; (AgEagle acquired senseFly from Parrot in 2021)</td>
</tr>
<tr>
<td>DJI (China)</td>
<td>With Syngenta Japan to promote ag drones in Japan; CNH Industrial and DroneDeploy sell a packaged deal of a DJI drone/camera plus software for plant health analysis; an agreement with Syngenta Korea to be its sole drone partner, and to promote jointly aerial pesticide application in South Korea; Corteva owns a fleet of 400 DJI drones</td>
</tr>
</tbody>
</table>

Unsurprisingly, Big Tech has already beefed up its involvement in digital agriculture. Gartner, a technology-focused consultancy, calculates that spending on cloud services will reach nearly 10% of all corporate spending on information technology in 2021, while Andreessen Horowitz, a venture-capital firm, estimates that many tech start-ups already spend 80% of their revenues on cloud services. The proliferation of digital ag companies is a gold mine for Big Tech, which will sell cloud services to enable massive volumes of agriculture-related data to be stored and processed. BASF and Bayer use Amazon Web Services (AWS) to process and analyse data on their digital platforms while Syngenta, Corteva Agriscience and BASF use Google Cloud services (via their collaborations with DroneDeploy and Taranis). The cloud services market is tightly consolidated: AWS held 41% of the cloud services market in 2020, and the top five cloud service providers accounted for 80% of the market. More than half of Amazon’s operating income comes from AWS.
Notes
10 YTO Group (China), 2020 Annual Report of the First Tractor Registrations, first 2021 semester confirms recovery despite chain-crunch getting worse-shipping-delta-variant/. “The cost of sending a container from Asia to Europe is about 10 times higher than in May 2020, while the cost from Shanghai to Los Angeles has grown more than sixfold, according to the Drewry World Container Index.”
17 University of Reading (UK) news release, “Reading role in the world’s first robotic farm project,” 17 July 2020: https://archive.reading.ac.uk/news-events/2020/july/pr844759.html.
18 University of Reading (UK) news release, “Reading role in the world’s first robotic farm project,” 17 July 2020: https://archive.reading.ac.uk/news-events/2020/july/pr844759.html.
21 See, for example: ETC Group, “Did you know that the digitalization of agriculture could affect farmers’ rights?” 09 December 2021: https://www.etcgroup.org/content/did-you-know-digitalization-agriculture-could-affect-farmers-rights.
52 See, for example, DroneSeed, a re-forestation start-up: https://droneseed.com/wabot-us.
56 AIM for Climate is supported by 41 countries and more than 100 entities including Big Ag companies, universities, and corporate-linked entities. See AIM for Climate website: https://www.aimforclimate.org/. See also, ETC Group, “As big oil states plan to promote energy-hungry agtech as a ‘climate solution’ at COP26, it’s time to question their AIM,” 28 October 2021: https://www.etcgroup.org/content/big-oil-states-plan-promote-energy-hungry-agtech-climate-solution-cop26-its-time-question.


85 PrecisionHawk, “We’ve closed $75 million of funding—here’s how we’ll use it,” 24 January 2018: https://www.precisionhawk.com/blog/media/topic/weved-closed-75-million-funding-heres-well-use.


Tracy Cozzens, “UAV company AgEagle to acquire senseFly from Parrot,” 19 October 2021: https://www.gpsworld.com/uav-company-ageagle-to-acquire-sensely-from-parrot/.


