Geek Farmer

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Creating Change

The Next Decade of Digital Agriculture

ADVANCING AGRICULTURE

We are young before we grow old.
—— Hedgehog Band

Tens of millions of people died of the global flu pandemic around 1920. One hundred year later, a similar virus once again crushed the defense system of modern society, posing great challenges to world economy. Fortunately, life losses have been significantly reduced this time, thanks to the combined strength of all parties. In this course, Digital Technologies (DT) has played a critical part in many ways: health code and cloud consultation help to improve the efficiency of pandemic control efforts; online entertainment and social network effectively reduce stresses; and online office and video conference minimize the impacts to normal operations. The contactless nature of DT has made them powerful weapons against societal problems.

Meanwhile, digitalization has begun to show its power in another life-critical field. In the future, it might be "digital persons" - instead of "natural persons" - who help to solve food security and aging population challenges. ⓧ

Justin Gong

January 2021, Guangzhou

14 | FEATURE

Aspiring Millennial Step up for Australia's Fertile Soils

Jamin Fleming, a fledgling drone entrepreneur based in Australia, has been working flat out between farms since 2020, to provide aerial treatment on pests, weeds, and crop diseases. He is among the tech-savvy, keen millennial generation who passionately embrace a fulfilling career in agriculture.

Creating Change | The Next Decade of Digital Agriculture

34 | COVER STORY

With the rapid development of 5G, cloud computing, and artificial intelligence technology, the power of digital people will become even stronger. The next decade will see the emergence of digital agriculture around the world, and there are many issues in need of our in-depth study and consideration.

CONTENTS

28 PROSPECTS

### The Future of Agriculture: Harnessing the Power of Digital and Unmanned Technologies

At the moment, the power of the pandemic and capital is accelerating the arrival of an unmanned and digital society. In the future, there will be hundreds of millions of robots deployed in farmlands to solve the problems of food production. There will still be people in the countryside in the future, but instead of being engaged in farming, the fields will be planted by robots and people will watch over the robots.

44 | PROJECT X

Bold Innovation for Something Unique

Given the pervasive involution in the drone industry, it is no wonder that V40 was hailed as a game-changer on site, even social media trolls were struck dumb by the extraordinary premiere.
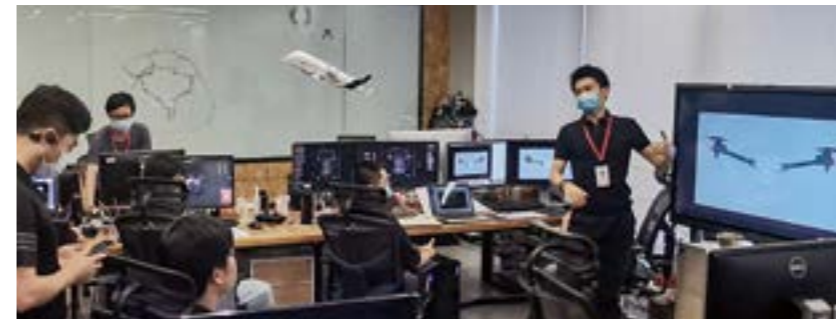
#Technology Lights up Spring Cultivation in China

Technology will influence the future generation, XAG drone pollinates pear trees in Xinjiang.

XAG APC1 AutoPilot Console enables traditional agricultural equipment to be unmanned and automated.

Under the Covid-19, XAG made a concentrated effort to restore the production line to ensure spring cultivation.

Intelligent agricultural drones have become essential tools for spring cultivation in China.

During the rice seeding, drones greatly saved labor costs and improved accuracy and efficiency.

#Advanced Tool Empowers Global Farming

People are watching the drone sprays pesticide on corn fields, technology bring new expectations to Zambia farmers. (Zambia, Africa)

Drones could help control the locust outbreak, the farmer is preparing to spray for cornfileds protection. (Zambia, Africa)

Drone conducts bioagents spraying on organic paddy fields, its continuous efforts to improve agricultural productivity. (Geumodo Island, South Korea)

XAG agricultural drone is capable of flying accurately in the darkness, it helps farmers solve the problem of pest outbreaks at night. (Queensland, Australia)

Agtech Power | to Restore Australia

>> Seed Burned Land for Post-Fire Recovery

After three years of intense drought and months of bushfire devastation that had badly battered the continent, Australia speeded up its recovery gazing into a long-awaited bumper harvest from the resurgent winter cropping season. Among the various technologies tending the expanded size of sown areas, drones designed by XAG are on track to take the pressure off chemical use and water scarcity. They get into the difficult-to-access cropping areas which used to be left in ruin, while spreading seeds to restore the overgrazed pasture.

In a collective effort to restore Australia from wildfire devastation, XAG has joined the first-ever post-fire drone seeding operation on Lake Cobrico, Victoria. This project was funded by Department of Environment, Land, Water and Planning (DELWP) and managed by Heytesbury District Landcare Network (HDLN). It is the first time that agricultural drones are used to re-establish native vegetation within a fire-ravaged peat swamp in Australia.

Due to the increasingly frequent, large-scale bushfire, Australia has been facing an unprecedented decline in biodiversity as well as substantial increase in greenhouse gas emission. Particularly, as one of the world's largest terrestrial carbon reserve, peatlands have been experiencing drainage and fires, which contributes to 5% of global carbon emission. Immediate actions should be taken based on partnership to restore the country's damaged ecosystem.

In April 2020, XAG sent 3 sets of its P Series drones, equipped with JetSeed granule spreading system, to distribute native seeds directly on Lake Cobrico. Within only two days, approximately 40 hectares of burned land was replenished with future new plants, using a blend of 12 different seeds. Since then, XAG and HDLN have been closely monitoring the result of drone seeding, which would be compared with that of the other area where plants are expected to be natural regrowth. It is likely that the project would be replicated across the region and state, especially within the areas where traditional techniques are inapplicable.

> ❝
> **A well-designed and sustainable option for environmental restoration works.**
> ❞

Lake Cobrico is a swamp wildlife reserve located near Warrnambool in Southwest Victoria. Part of the peatland was severely damaged during the 2018 St Patrick's Day Fire, with the vegetation and deeper soil layers left in ru-ins. In areas of high burn severity, the ecosystem itself might be unable to regenerate naturally and requires human intervention, such as direct seeding, for fire recovery. Re-establishment of native vegetation can slow down erosion and sedimentation, and suppress invasive weeds after a wildfire.

XAG drones allow seeding to be done on Lake Cobrico, where landowners and managers used to find it difficult to restore the wet, inaccessible fire-impacted areas. During the operation, the drones accurately followed the pre-set flight route, while harnessing high-speed airflows to project seeds from 2-3 metres above the ground.

Also, seeding rates could be precisely controlled and adjusted in real time to ensure that the proper number of seeds were distributed evenly into the targeted bare land. This has not only limited the exposure of staffs and ground vehicle to rugged terrain, but also avoided using either too much or too little seeds.

HDLN co-ordinator Geoff Rollinson said in an interview with Cobden Timboon Coast Times that, drone technology provides access to all areas despite the complex landforms. "This project wouldn't be able to go ahead in the normal manner because some areas of Lake Cobrico are unstable," he said.

XAG is the first business in Australia to obtain swarm flight approval from Civil Aviation Safety Authority (CASA), therefore operation of up to five drones by one pilot is made possible to increase efficiency.

By innovatively using drones for direct seeding, XAG has transformed the way ecosystem restoration works are conducted. Seeding by hand or ground equipment is inapplicable to Lake Cobrico where part of the peat swamp is difficult to access; this approach might also disturb the vulnerable post-fire vegetation and soil.

Aerial seeding by plane or helicopter can cover a larger area, but besides costly, it might result in seed drift and uneven distribution that might adversely affect a successful outcome.

The trial project in Lake Cobrico demonstrates the best practice of drones to regenerate fire-impact peat swamps in a safe, cost-effective manner, without human or mechanical trampling on vegetation cover. XAG's drone seeding solution is now recommended by DELWP and HDLN as a 'well-designed and sustainable option for environmental restoration works.'

Bushfires are a natural part of Australia's ecosystem, in which many plant species develop to become fire-resistant. However, the 2019-20 Australian bushfires, as one of the most severe, has brought devastating, long-lasting impact on the world's biodiversity. Over 17 million hectares of land was burned across the nation, with an estimated one billion animals killed in the raging fires.

Facing great environmental challenges caused by the fire disaster, Australia has been going through a bumpy pathway to long-term recovery. New technologies can empower government and land managers to restore the fire affected regions under safer operating conditions. Ⓧ

Aspiring
Millennial
Step up
for
Australia's
Fertile Soils

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) has forecast the winter crop yield to be 44.5 million tonnes in 2020–21, which is 11 percent above the average annual level of the past ten years. This is owing to the favourable weather conditions, as rain began falling steadily and soil developed a good moisture profile after a long-standing drought.

Despite the COVID-19 pandemics remains a challenge, agriculture has shown strong resilience, becoming one of the few bright spots of Australia's economic activities. Sales of agricultural machinery is booming, as well as farmers' demand for crop protection services.

» Heed the Call of Countryside

Jamin Fleming, a fledgling drone entrepreneur based in Bundaberg, south-east Queensland, has been working flat out between farms since 2020, to provide aerial treatment on pests, weeds, and crop diseases. He is among the tech-savvy, keen millennial generation who passionately embrace a fulfilling career in agriculture.

Unlike other parts of the world with an ageing farming population, Australia has seen a return of young talents into the countryside, either inheriting the land to be the next generation of

farmers, working for farm businesses as farmhands, managers, and agronomists, or starting their own companies as service providers. An insight snapshot from ABARES has highlighted that more people are now entering into the agricultural workforce, with the proportion of those under 35 years old is on the rise.

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Innovations are desperately needed from new faces to help manage the enormous risks of climate change.

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"Australia's agricultural workforce is

getting a lot younger now, because I think a lot of young people don't want to be in an office or doing the same thing every day. Agriculture has a great range and the technology is getting better every day," said by Fleming. Since Australia's agriculture is a significantly volatile industry plagued by harsh, unpredictable weather conditions, innovations are desperately needed from these new faces to help manage the enormous risks of climate change.

Growing up in a large cattle farm, Fleming upholds the history and culture of Australia's agriculture, but also breathes new life into the social, environmental side of its sustainability. With a whole set of XAG's agricultural drone gear, he founded his own agribusiness Oztech Drones to exploit the huge untapped potential of drone technology, specific to Australia's vulnerable farmland. Fleming has been closely working with XAG to dismiss farmers' suspicions and scale up drone applications across the state of Queensland.

"The biggest challenge I find is people find it hard to believe that our drones can do what we say they will do. Hence why I often drive and take time out of my day to visit potential clients to show them what we can do, and then they are always blown away with what we are able to achieve," he said.

» The Sustainable Macadamia Nuts

Until recent weeks, Jamin Fleming has been working with Queensland's local growers, such as Redrock and Suncoast Gold Macadamias, on a series of trials

to apply fungicides and fertilisers with XAG's drones on macadamia trees. The Australian macadamia industry, with a farm-gate output value of AUD 267 million in 2019, has been leading the world in its adoption of sustainable farming practices and climate-resilient productivity.

Macadamia trees have the natural ability to optimise water consumption, adapt to dry condition, and absorb substantially higher amount of carbon, suggesting in-built sustainability unmatched by many other crops. According to the Australian Macadamia Society, each year 70% of its macadamia crops, as confectionary and healthy snacks, are exported to over 40 countries, while this constitutes 30% of the global production.

However, tractor-mounted spray cannons are still widely used as the spray tool for pest and disease management in macadamia orchards. As the industry is committed to minimising its carbon output.

The use of heavy diesel machinery should be further limited, and this creates an untapped area where drone-based solutions from XAG can reduce 30% chemical use and conserve up to 90% water.

Fleming shed light on how drones facilitate precision agriculture. "We first mapped an area of the farm out using the XMission survey drone and found the trees that were lacking in health. Then, we sent the crop protection drone just to spray those specific trees rather than the entire crops as normal spray rigs would do."

With this fully autonomous drone, farmers can even target at individual plants and skip the spacing between

trees. "We found the spraying drone can spiral over larger trees with better coverage of the whole canopy. Also, you can pre-program the drone to conduct hover spray over the smaller trees, which is more efficient," he said.

Results from the trial phase also showed that droplets were broken down into tiny particles of different sizes that could reach the lower foliar of the macadamia trees. The big picture here is trying to help macadamia growers prioritise the protection of water, minimise pesticide usage from traditional techniques, and eliminate possible chemical drifts.

Given that water shortage has been a persistent issue in Australia, such benefits of drone applications should be seen across the entire agriculture industry which accounts for three quarters of total water use.

» Fly Over the Toughest Places

Though as an industry newcomer, Fleming's drone business has really taken off to accumulate field experience on a wide variety of crops, including grains, fruits, nuts, and vegetables. Fleming said drones can flex their muscles over complicated terrains, where large manned machinery such as tractors or helicopters find it difficult to handle the operation. He has just contracted to one of the largest sweet potato growers in Australia, managing invasive weeds with XAG drones in all their channels, hard-to-reach areas and around the dams.

"We also help them with controlling weeds around water hydrants in the

middle of fields. In one field, there could be 50 hydrants which a tractor used to drive through damaging the crop to get to these hydrants. Now using the XMission drone we can survey the entire field, find the hydrants, and send the spray drone out to only target the hydrant," he said. Thanks to this nimble, flexible technology, crop damage is avoided to help farmers close their yield gaps.

With a good drop of rain and mild temperature, many farmers in Australia are very thrilled to have one of their best cropping seasons in lifetime. Yet, a long-unseen wet winter also brings another big problem to disease management on waterlogged areas after rain. Eyes on the issue, Fleming has also started working with fruit growers on strawberries.

"Some of their fields have low area in them which after rain or excess watering are inaccessible by tractor. And therefore, pesticides and fungicides cannot be applied leaving the strawberry plants prone to diseases and pests. We come in and identify the low areas and then spray them all with applications recommended by the agronomist."

While looking to create a pest suppressive landscape, drones can be of great use in Australia's 332 million hectares of livestock farms which is 10 times the size of land used for crops. As overgrazing, drought, and the warmer climate have been turning pasture into degraded land, demand for pasture seeding is growing, now added onto Fleming's long list of pilot jobs. The modular design of spray drone allows

it switch to a "flying spreader" within minutes when embarked on a custom spreading attachment.

"Depending on application rate, we can seed up to 15 hectares an hour. Now hopefully we get some more rain at the end of the week to help it sprout," he said. It is hoped that the more precise, safer method of distributing grass seeds would be scaled up to rehabilitate the fertile land of Australia. X

XAG Drones Tested, Breathe New Life to South Africa's Sugar Industry

Drones, with specialty spraying technology, was deployed to ripen a sugarcane farm in South Africa, showing an evident increase in the amount of sugar extracted from these canes. This might signal a potential improvement in profit margin for the cane growers, who have been incurring loss from the country's ailing sugar industry.

Primarily grown in tropical and subtropical regions, sugarcane is the type of perennial, high-value cash crop that serves as juicy fruit as well as the major feedstock for sugar production. South Africa ranks the world's top 15 sugar producing countries that provide cost-effective, high-quality sugar products.

However, due to a series of interweaving threats, mainly the influx of cheap imports and the imposition of sugar tax, South Africa's $833 million sugar industry has been struggling to stay competitive in the global market. Crop-spraying drones, meanwhile, gently tap in and get prepared to give a new lease of life to this industry.

» Outperform to Reap Recoverable Value

June 2020, in Seafield Farm, located at the Midlands South region of KwaZulu-Natal, a new round of sugarcane harvest arrived. What made this harvest season special was that a commercial ripening trial was conducted for the first time to compare the efficacy of drone and helicopter. Ripening refers to the process of applying chemical ripener to enhance the content of sucrose in the sugarcane plants, usually six to nine weeks before harvest. The ripening application has been widely adopted as a routine management that proves to effectively improve cane quality and sugar yield.

In this trial, different fields of the Seafield Farm were selected, each of which divided into two areas between 1 to 5 hectares assigned to different ripener applications. The drone used was XAG P20, which carried a custom spraying attachment and 12-litre smart liquid tank designed in a modular fashion. It followed the pre-set flight route, operated at a fixed height 2 to 3 metres above the crops, and sprayed accurately into the target fields. Results show that the traditional manned helicopter was considerably outperformed by XAG drone in both cane yield and quality of the harvested crops.

The areas ripened with drones had a small, yet significant one percent point increase in recoverable value (RV), compared to those ripened with helicopter. In South Africa, RV is the accepted measure of the amount of sugar recovered from every ton of cane crushed in the mills.

"This means a lot to us. With higher sugar extracted from every tons of sugarcane, we get paid higher and my farms become more profitable," said Kim Hein, the licensed operator of XAG drone as well as cane grower who has been testing the feasibility of drone spraying solution in sugarcane cultivation.

Under the RV Cane Payment System since 2000, the South African farmers are remunerated for their harvested sugarcane based on recoverable value. As RV% generally falls within 9% to 14%, the more than a one percent point increase is a relatively satisfactory progress for sugarcane growers to obtain a greater return on investment. This smallest breakthrough could mean a great deal to individual farmers facing an ailing sugar industry.

■ Seafield Farm trial: The left fields showed stripes of uneven ripening caused by helicopter overspray

» Small-scale Growers Being the Early Adopters

Despite the market chaos of the sugar industry, South Africa has granted the legal take-off of agricultural drones last year which could innovatively transform the labour-intensive farming ecosystem. Kim Hein, the man behind the Seafield Farm ripening trial, has purchased agricultural drones from XAG to tend its self-owned 200ha sugarcane field as well as those of his farmer counterparts.

"Drone, imagery, and smart agriculture system can help us solve many environmental and labour problems," Hein said. Drones with precision spraying ability can address the increasing pressure to use less chemical, while reducing labour usage to tackle the rising labour cost that is disproportionate to the quality of work done. As the advantages of drone technology start to shine through, there has been a growing acceptance of drone-based treatment by cane farmers, who has been dealing with difficulties to manage this specialty crop.

Sugarcane plants can reach 3 to 7 metres high, that ground equipment such as tractors are inapplicable. Manual option with knapsack sprayer can expose field workers directly to the chemicals. This leaves manned aerial approaches, such as helicopter and airplane, to be used for sugarcane ripening over the past 20 years.

According to Heim, helicopter spraying can only be subject to blanket spray, but the downside of it was that most sugarcane fields are quite small in size. According to South Africa Sugar Association (SASA), small-scale farmers constitute 90% of the nation's 22,949 registered sugarcane growers, predominantly located in two provinces namely Mpumalanga and KwaZulu-Natal. They form the backbone of the sugar industry value chain.

» Get ready for the Sugar Master Plan

The introduction of precision drones into farming complements government's determination to rejuvenate the sugar industry. The Department of Trade, Industry and Competition has announced the Sugar Masterplan in 2020 that marks a major milestone in efforts to ensure the health and longevity of the industry.

The sugar industry makes important contributions to South Africa's economic activities and rural employment. Its direct and indirect employment is estimated at 435,000 jobs, as well as representing over 11% of the total agricultural workforce. However, based on the SASA statistics, the annual sugar production has declined by 25% over the past 20 years, while the number of sugarcane farmers experienced a decline by 60% along with a reduction by 45% in sugar industry-related jobs.

The Sugar Masterplan aims to reverse this industry downtrend and protect tens of thousands of livelihoods in rural areas. As SA Cane Growers' Association chairperson Rex Talmage introduced, the warmly welcomed plan includes the actions to enhance import protection, diversify sugar by-product production (i.e. biofuel) and support small-scale cane farmers.

Amid the industry reconstruction, smart agriculture technology such as drones could play a new role in the upstream part of the sugar value chain. Through generating higher recoverable value, reducing labour costs, and minimising the use of chemicals, drones could help to guarantee sustainable supply of sugarcane and improve the profitability of small-scale growers.

When talking about his future plan, Kim Hein expressed positive attitudes towards the scale-up of smart agtech. "The number of tasks that can be done with drones have growing. We are now testing new applications to treat sugarcane crops at different stages in ways we could never image in the past, such as field mapping, fertilisation, controlling diseases, weeds, and pests, etc." X

Unmanned Cotton Farming

One Step Further

Unmanned Agriculture Achieved Throughout Cultivation, Management and Harvest. With the advancement of XAG's annual drone harvesting operation "Take Off for Harvest Time", more and more farmers in Xinjiang have adopted a smart agricultural system to plant and manage their cotton. Through data collected and analyzed by the XAG smart agricultural system, a scientific planting model can be established to provide comprehensive farming guidance and decision assistance to growers throughout cultivation,

planting, management and harvesting, so that even people without farming experience can easily achieve a yield of over 6 tons per hectare.

Wide use of XAG smart agricultural system and unmanned smart agricultural equipment in Xinjiang has revolutionized the region's cotton cultivation, which greatly reduced human labor from cotton cultivation, management and harvesting, cut down farmers' input, improved yields and quality, enhanced the international competitiveness of Chinese cotton, and helped the whole world feel the warmth of Chinese agricultural technology.

» New Farmers

You can hardly find someone with similar figure as Li's among all cotton fields in Xinjiang - he looks more like a lean city commuter despite his tanned skin, and he did used to be. As a Beihang University graduate, Li's former occupation was air traffic controller at the airport tower in Shanghai. A visit to his hometown earlier this year made him consider returning to this familiar yet increasingly strange land.

A Beihang University graduate and

former air traffic controller, Li surely knows the nuts and bolts of flying. From the start of training to the completion of the examination, Li set the fastest local record. Even expertise in directing large planes above the busy skies of Shanghai, Li found it was difficult to fly agricultural drones.

After two weeks of research and learning, Li solved all the initial problems. He began to think about ways to improve the operational efficiency. After calculating input-output ratio, Li bought his second set of XP 2020 agricultural drone without hiring more workers. Now, on suitable plots, Li can control two drones simultaneously. By such means, he always complete the work faster than others. His profession skill has won him trust from many cotton farmers. As a result, Li receive increasing orders from customers which make him hardly rest before 3 A.M during the autumn harvest.

The post-90s and post-00s have not yet make up the bulk of the cotton-growing force in Xinjiang, but more and more of them are returning to

farmland. Technology is becoming their best choice to find new paths in cotton fields.

Unlike Li, Han from Yuli County, Xinjiang, is a new farmer with "eccentric" characteristic. He gave up his stable job and started his own business this year. Now he is the manager from a drone spraying services company. As many traditional spraying companies believe, the market for agricultural spraying is getting tougher. But as a new player in the industry, Han has different ideas.

Han noticed that due to a deficiency in agricultural spraying knowledge, most farmers aren't using pesticides scientifically. Base on this acknowledge, he started his business on providing professional services, but it wasn't easy at first. Farmers concerned more about the price of the spraying rather than whether using suitable pesticides or not.

Han therefore explained to farmers patiently how to use pesticides properly, meanwhile organized

professional training for his drone pilots teams, to improve their skill on both knowledge and drone operation. During the cotton harvest season, Han launched the one-stop professional service which covers defoliation, harvesting and selling. His principle tasks has became dispatching his teams and cotton picking drones to conduct spray orders or answering farmers' inquiries from phone call. The autumn harvest season has also been his busy season every year.

Han also has strong competitors in business, but as he said, he won't care that much. He focused himself in improving the service to farmers, he believes that's the root of his foothold and livelihood.

To many new farmers, their competitors often possess more experience and capital. But these new entrants are digging the value of agriculture from brand new angles. One of Li's predecessor said, in a few years, he will have to learn from Li. The potential shared by Li and other new farmers will profoundly shift the farming landscape and agriculture.

» Smart Agricultural System

Mr. Yang is a technical manager who workd for the largest cotton enterprise in Yuli County, Bayingoleng Mongol Autonomous Prefecture, Xinjiang. This year, he has been in charge of 5% of the total 13,333 hectares cotton fields that owned by his company, this 666 hectares land has brought him 600 kg more yield per hectare than last year.

But that's not the best part of Yang's story. Actually, he only spent one-third of his time in his cotton field, the rest of time was spent on breeding work, and planning ahead for next year.

The magic weapon for the increased yield and high efficiency is XAG's smart agricultural system. Yang's strategy can be concluded in one word "early": early sowing can let cotton fully grow and allow measurement for unavoidable mistakes. But seedlings will be frozen if sown too early, farmers need more than experience to help them determine the effect of time and temperature on seeds.

The XAG agricultural system helped Yang solve this problem. It can collect real-time soil temperature, humidity and weather data from XAG agricultural IoT devices, which provide Yang with key information needed for early sowing. After sowing, the XAG remote sensing drone "Xmission" can monitor the seedling rate and let Yang know immediately whether the cotton

has survived the first trial of life, which gives a solid foundation for this year's production.

A mature smart agricultural system must be able to collect information, make decisions and execute in the field. Yang's examples have shown the highlights of the XAG smart agriculture in "sensing", but as the core of smart agriculture, can XAG smart agricultural system "make decisions"? A 0.3 hectare test field may give us the answer.

» Empower Farmers with Zero Experience

According to the Chinese National

Bureau of Statistics, in 2019, the yield per hectare of cotton in Xinjiang was 1961.9 kilograms. In 2020, XAG gathered a group of people without any farming experience to try growing cotton for the first time. In autumn, these amateur farmers harvested 1,847 kilograms of cotton bolls from merely 0.3 hectare of land. The average cotton production reached 6,247 kg per hectare, 2 times higher than the national level.

The small test field achieved a very encouraging result, not only because it was managed by zero-experienced farmers, but because these people were guided by the XAG smart agricultural system.

In this test field, the cotton plants all have strong and healthy roots. The

average length of the cotton root in the test field reached 30 cm, which is a good indication of high yields. What's the secret behind such achievement? The decision making process of XAG smart agricultural system played the key role: how much water needed, what time to water, which areas of soil needed more moisture, which fertilizers to use? All answers to these questions are calculated by the XAG smart agricultural system based on the crop growth model.

By the medium term of cotton growth, the XAG smart agricultural system can analyze the growth of cotton, pests and diseases in the test field through the data obtained by XAG remote sensing drones and deploy agricultural drones when necessary, while most of the time, the growers

basically won't need to stay in the field themselves.

Although the gap between the XAG smart agriculture system and the ideal of unmanned farming still existing, it proved the capability to guarantee good harvests even for amateur growers and allowed experienced farmers to improve the yield with less labour. That reveals the potential of unmanned farming is faster than our imagination, the future is NOW. XAG smart agriculture covers and connects the full cycle throughout aricultural production, included cultivation, seeding, management and harvesting, which is making more farmer in Xinjiang to believe that technology will certainly further improve cotton production and bring them better life from now. X

Behind China's World Heritage: Flying Over the Hani Rice Terraces

A set of drones in red and white fashion first appeared over the linked pieces of rice terraces in Southern Yunnan of China, waking up the sleepy villages where elderly people form the backbone of rice production. Li Zhenglin, a Hani rice grower in his 60s, gazed down into the hillsides from distance and watched the 'flying spreader' release the seeds of hope for the rice planting season.

As a product of thousand years of agricultural civilisation, the Honghe Hani Rice Terraces cover an immense area of over 16,600 hectares. It was carved out of a wilderness over the past 1300 years by the Hani people, who have developed an integrated four-essential farming system of forests, water supply, mushroom houses, and terraces, cascading down the slopes of the towering Ailao Mountains. In 2013, it was inscribed as the prestigious UNESCO World Heritage Site.

Red rice is the main crop of this area, sown in spring for autumn bounty once a year and grown in the irrigated terraces bred by buffalos, cattle, ducks, fish, and eels. Though facing the harsh environment of high mountains, the Hani people for centuries have been dedicated to cultivating red rice with heavy manual labour. But as the decreasing workforce poses both challenges and opportunities, the Hani Rice Terraces is now witnessing a change in the way red rice is farmed.

> *Innovations are desperately needed from new faces to help manage the enormous risks of climate change.*

» Crisis: Lack of Successor to Farm

From the first day it was created, the Honghe Hani rice terraces had to be managed with much more efforts due to the complex terrains. The steepest slopes could reach up to 75 degree, while in some places there are as many as 3000 terraced fields along the hillsides, which at its narrowest point is less than one metre wide.

Li Zhenglin, who lives in Jingkou village of Yuanyang County, the core area of Hani rice terraces, started to grow red rice since he was 12 years old. Just like most Hani people, he has safeguarded these terraced fields using primitive farming tools, solely devoted his entire life to the provision of food.

Without the help of modern agricultural machines, Li can only rely on manpower to seed, spread fertilisers, and spray pesticides, which is laborious, tedious, and lacked efficiency. As he grew older in his 60s, he felt physically losing his grip on farm, and a lack of caution might ruin the yield.

The inscription on the World Heritage List has boosted the local tourism economy, driving a rapidly increasing number of tourists to the Hani terraces. However, in the meantime, more and more Hani young people have turned away from the gruelling farm works and chose to abandon the terraces that nourished them. While they seek better jobs for higher income in the city, those left behind in the village to farm were already aged 50 to 70.

The Hani rice terraces is one of China's many rural areas which suffer from an ageing population. The long-standing rice cultivation system might be threatened if no one to inherit, risking the loss of both the cultural heritage and the livelihood of the Hani people.

» Solution: Conquer the Sculptured Hillsides

Since March 2020, XAG breathed a new lease of life to wake up the "hollow villages" around the Hani terraces. A group of tech-savvy young people has brought a set of XAG drones to help farmers like Li Zhenglin improve their agricultural productivity.

Simply through several clicks on the phone, the drone automatically took off and navigated itself above the terraces, dropping rice seeds precisely into the target areas. This was the first-ever drone seeding operation in Yunnan's rice terraces, where drones could ride over the steep slopes to grow red rice amid labour shortage.

According to Honghe Agricultural Machinery Research Institute, traditional rice seeding involves a series of procedures, in which the paddy seeds are first sown in nurseries and raised into young seedlings before manually transplanted to the levelled fields. The use of drones in direct seeding of rice requires less labour and time to produce high-quality crops, which can help farmers grow more with less to improve their profits. One drone is estimated to be 10 times more effective than manual seeding.

Other applications of drone also include spraying pesticides and fertilisation. These farm essentials were once conducted by farmers painstakingly climbing up and down with a knapsack sprayer or bucket of fertilisers. "In the past, it took up to one day for us to manually sprinkle organic fertilisers on only 0.3 hectare of rice terrace. But now the same amount of work could be completed by one drone in 5 minutes. What a huge transformation that we are tapping into," Li said.

When drones and robots take over the repetitive, exhausting fieldworks, staying on the land would longer be a tough mission for farmers. The Hani people can free from the constraints of the traditional farming pattern which is labour-intensive and time-consuming. "Most rural young people have left their hometown. If it had not been the help of our new friend XAG, the red rice would be slashed this year," Li said. ◪

The Future of Agriculture:

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Harnessing the Power of Digital and Unmanned Technologies

Author / Peng Bin

A year full of ups and downs, 2020 has flown by. It took us by surprise, but also brought many opportunities. The pandemic and the power of capital are accelerating the advent of a digitalized and automated society. As we fight our way through this trend, we ought to envision the future of agriculture, comprehend its underlying logic, and work together to realize its potential.

The ancient trade of agriculture is undergoing irreversible change due to aging worldwide populations, urbanization, and reduced agricultural labor forces. The already worsening problem of farm labor shortage has been exacerbated by the pandemic. However, the pandemic has also prompted more people to pay attention to the development of the industry and understand that digitalization, artificial intelligence, and automated agriculture are the best solutions to the problem of "undermanned farming."

▋▋ XAG's Mission in the Digital World

We exist in a digital world and our lives can change with every new development in it. We grow accustomed to this digital and ever-changing world because it makes our lives better and more convenient. The cameras and phones we use in our lives have long been digitalized, making it easier to capture and share content, revolutionizing our societies and creating new artists, industries, and subcultures.

Cars are the most recent entrant into this miraculous process of digitalization. The transition from fuel cars to electric cars is digital in nature, and we are now just at the beginning of the process. Over the past year, we have seen a convergence of digitalization with trends of automation. The emergence of Tesla, for example, marks more than just a new electric car manufacturer and new phenwomenon in transportation. The accomplishments of Tesla are not most valuable according to the standards of the automotive industry, but rather according to the logic of internet businesses. The new world Tesla built is different. It is essentially a digital world superimposed by and designed for automation, which allows whole new possibilities for the development of society.

Ever wonder why agriculture seems more complex when compared with industry? Which sector requires a higher quality of talent, agriculture or industry? Usually, it is industry that demands people of higher quality, but this is where the logic breaks down. Why does the seemingly complex field of agriculture require a lower quality of workers?

The answer is simple: agriculture looks complex because too many people with different agricultural methods are involved in it. The diversity of these people leads to differences in growing processes, which then leads to varied efficiency and quality. However, industry is different production is standardized and automation is very common. Because people's influence

on industry is negligible, industrial efficiency will be significantly increased by merely increasing the number of jobs. In other words, if agriculture follows the pattern of industry with standardized processes that can be scaled up and executed automatically, then conducting agricultural production will be much simpler, and production efficiency will also be significantly increased.

Based on this logic, what will the future built by XAG's mission and vision look like? Macroscopically speaking, XAG's mission is to build an intelligent, unmanned agricultural ecosystem, so that agriculture can enter the era of automation, precision, and efficiency, thereby improving agricultural production efficiency. In the essence of

agriculture, we must find which section can most improve efficiency.

In agriculture, the number of factors that can improve efficiency are fairly few. Industry cultivation, seed management, and harvesting data indicate that plowing, planting, and harvesting mechanization rates are relatively high. However, real mechanization rates are quite low, due to low efficiency in the "management" section, so the rate is basically in the single digits. The management of farmland occupies 70% of labor time and more than 65% of planting costs. Therefore, if we improve the efficiency of farm management, we can greatly improve the efficiency of agricultural production. The goal of XAG is to use our technology to improve the

efficiency of agricultural production from a management perspective.

▌ The Future Form of Farmland

The future of agriculture should be intelligent and automated. In order to realize automated agriculture, replace the influence humans have on the variability of farmland, and reduce reliance on experienced labor, these five aspects must be considered: standardized planting, crop models, growth perceptions, agronomic decision-making, and farming execution. If all the above steps can be completed by unmanned means, a closed loop of agricultural automation can be formed.

Normative planting is the starting point of agricultural standardization.

Inconsistent crop seedling spacing and planting time will lead to different stages of growth. In addition, we must build crop models to learn the growth stages of crops and the nutrients and agricultural work the crops need at certain stages, similar to how a child's needs are taken care of. Knowledge of growth stages was previously obtained by human observation in the field, but if we want to do it unmanned, we need more sensors to determine how crops grow. Based on these perceptions, you can determine what agronomic guidance to follow, as well as the corresponding farming operations.

Remote-sensing drones not only help to gain a big picture understanding of farmland, but can also measure fine details. Remote sensing drones can accurately measure the height of crop growth with a margin of error of no more than 1 cm. People can

check on their farmland only once every 3 to 7 days, using machines to do the rest, completing in a moment what used to take hours to do. By improving the frequency of care, we can better control the input of water, fertilizer, and pesticides. The biggest difference between machines and people is the ability to find the most appropriate times and amounts, as well as the ability to adjust much faster. The machine's ability to care for crops is not affected by their sense of responsibility, it can be more careful than people, and it is not dependent on experience.

There will be at least two scenarios of unmanned farmland management in the future—unmanned management of water fields and unmanned management of dry fields—so we need at least two solutions. From a technical point of view, to realize

unmanned farmland management, we need the maturity of technologies such as autonomous driving, big data, environmental awareness, artificial intelligence, and robotics.

The starting point for unmanned farmland management is in deployment, where people no longer need to transport machines to the operation site, but where the machines and equipment themselves are deployed in the farmland. Water fields are deployed with agricultural drones with a landing system, like a phone booth, with the tops of drones used for taking off and landing and the bottom part used to store pesticides and other supplies. Dry field deployment will need an unmanned vehicle plus a docking system, with ground walking agricultural drones departing from the docking point to perform farming tasks

and returning automatically afterwards. The managers of the farmland do not need to be on site as the farming is done by the machines, and people are only needed to work in front of a remotely-operated computer.

This is what the future of unmanned farming looks like, and this future is not too far away. It will be realized within five years. Don't underestimate the cumulative effects of time. Just as it only took us five years to get agricultural drones to scale, we can clearly expect what the next five years will look like for XAG.

▌ Rushing Toward the Future of Smart Agriculture

As we can see, the development of smart agriculture is still in an incremental market phase, and the demand for intelligent technology in the production of agriculture is still very high. Smart agriculture is not a wave, but a current, and the trend of development is unstoppable, even if XAG does not participate.

In China for example, there are currently 2 billion mu of arable land and about 27 million tractors and agricultural equipment of all kinds. According to data released by the National Bureau of Statistics, China's urbanization rate is currently 59.6%, and will reach 75% by 2035. This means that rural populations will decrease by another 200 million people. Excluding children and elderly people, there may be only 20 million laborers who will participate in agricultural production,

each managing 100 mu or more of farmland on average. For one person to be able to manage a larger area of farmland, a lot of intelligent and unmanned equipment will be needed to help. The market space is huge.
So, in 2020, despite the impact of the pandemic, XAG saw overall growth of 253%. At the same time, XAG received its largest financing since its founding in 2020, harvesting support from first-tier investors in the capital market, meaning that the value created by XAG was widely recognized. In the next few years, XAG will accelerate the scale of manufacturing capacity through its own efforts, so that farmlands everywhere will be equipped with robots.

In addition to the maturity of unmanned technology, production cost is also an important factor that greatly limits the popularity of farm

robots. The three major elements that determine production cost are the materials used, production efficiency, and production quantity. In the new year, XAG will start building its first super factory, a factory that will automate 80% of the production processes. It is expected to be completed by 2023, after which it will be able to produce 1 million farm robots per year. At that time, the maturity of the technology combined with extremely low-cost farm robots will completely change the way agricultural production is managed.

At the moment, the power of the pandemic and capital is accelerating the arrival of an unmanned and digital society. In the future, there will be hundreds of millions of robots deployed in farmlands to solve the problems of food production. I

believe there will still be people in the countryside in the future, but instead of being engaged in farming, the fields will be planted by robots and people will watch over the robots. Robots are not replacing humans—they are just replacing the heavy physical labor of planting. The revenue generated by robots will also need to be distributed to the people who maintain these machines, and a new model of harmonious coexistence between humans and robots will emerge.

I hope that through these thoughts, we can have a clear understanding of XAG's mission of "Advancing Agriculture", so that clear goals are clear in our minds and we understand why we are doing what we do. In 2021, we will continue to work tirelessly! ▯

Creating Change

The Next Decade of Digital Agriculture

Winston Churchill famously said, "Never let a good crisis go to waste". The sentiment holds true as a crisis can—and will—test a country or a nation. 2020 has certainly been a year of challenge. Since the Covid-19 breakout during the Spring Festival period, we have experienced numerous such "crises" which have seen the very fabric of human society tested and subject to the most extreme of circumstances. The lockdown of Wuhan, the nationwide fight against the pandemic, the economic downturn, the technology decoupling... we found ourselves under pressure and facing the grueling challenges brought upon by trial after trial. Yet in the midst of uncertainty, clarity struck. Now, more than ever, we are confident about one thing: technological innovation will bring about change.

Author / Justin Gong

In 2020, the watershed year, we can foresee human society undergoing organizational and structural revolution, a change that will reach and deeply affect all industries. What will be the biggest variable in Chinese agriculture over the next decade? What role will technological innovation play in agricultural development? This question is on our minds every day.

"Digital Men" and "Natural Men"

Around 1920, a flu outbreak took the lives of tens of millions of people worldwide. In 2020, a similar virus struck, overwhelming the defenses of modern society and posing a huge risk to the world economy. The number of fatalities resulting from this pandemic are much lower than they would have been 100 years ago under a similar outbreak. Credit for this outcome belongs to a multitude of forces, and by any measure, digital technology is a prominent contributor. Technologies such as health codes and cloud consultation have improved the efficiency of the health system in fighting the pandemic; online entertainment and social networking have effectively curtailed discontent and negative emotions; and virtual offices and video conferences have significantly reduced the impact of the epidemic on the production and business.

Since the beginning of human society, social activities have predominantly been based on direct contact. Human beings, after all, are social creatures

who need connection. Given that the virus is also spreading via human-to-human contact, digital technology, which is contact-free by nature, has become our best weapon against the virus during this critical period. The pandemic highlighted the superior capabilities of the digital world, and humans, having inhabited the physical world for hundreds of thousands of years, began a massive migration to the digital world. Many places in the physical world have become "manless" while the digital world has simultaneously seen the introduction of more and more "digital men". As explored in Steven Spielberg's movie "Ready Player One", every natural person will have one or more digital identities in the future. Digital people can lead all kinds of lives in the virtual game world. They can travel around the world without ever leaving home, work remotely across borders without traveling, and run and manage farms in the physical world digitally.

With the rapid development of 5G, cloud computing, and artificial intelligence technology, the power of digital people will become even stronger. Digital interaction will gradually become the basic form of social participation, and in a sense, human beings can achieve a kind of "digital immortality". This may be the biggest change in human society in the 21st century and its development will have a profound impact on history.

To replace or to empower people?

From David Ricardo to John Maynard

Keynes, who respectively lived two centuries and one century ago, economists have always been concerned with the question of whether machines will replace humans. There is a term called "technological unemployment" in economics, which refers to unemployemnt resulting from technological progress. This concern has been present and much debated throughout recent history.

As we enter the 21st century, the aging population is one of the major challenges facing China and its future economy. People, both as producers and consumers, show different economic characteristics at different ages. People are primarily consumers in their early and old age, consuming more than they produce. The number of working-age people in China began to decline significantly after 2008, and the producer-to-consumer ratio also began to fall after 2018. In China, there are fewer and fewer producers while the number of consumers continue to rise. The increasing supply shortage in recent years has led to increased inflation and declined savings, which in turn drives up interest rates in China.

So what role will digital technology advances play in rural China during the next decade? We might glean some insight from the extreme situation created by this pandemic and see that technology can both replace and empower people. For example, in the service industry, including food and beverage delivery, e-commerce, and shared mobility, without the empowerment of mobile networks, smartphones, GPS, and other digital technologies, human services would

be much less efficient. For teleworking, online diagnosis, and online education, machines can't replace white-collar workers, doctors, or teachers but are useful aids that empower these workers. While in other fields, such as autonomous driving, unmanned delivery, unmanned factories, and the rapidly developing industry of unmanned farms, machines are taking over human jobs. In fact, technology will simultaneously replace and empower people both in the near and far future, which is a characteristic of our society.

Digital agriculture was first introduced in the United States in the 1980s

to solve the problem of inefficient agricultural labor and wasted resources. The earliest application of digital technology in agriculture was the collection and analysis of weather and soil data, which constituted an early form of technological empowerment. Then the direction of technology shifted as the U.S. workforce continued to decline and the farming community struggled under an aging workforce. The equipment we now see in U.S. farmland, such as automatic sprinklers, automated farm machinery and automated transport vehicles, are all used to replace people. According to data published by the U.S. Department of Agriculture from

1965 to 2017, digitization has led to a 9.6% increase in U.S. agricultural productivity and approximately 3% reduction in costs, with the advantages concentrated in production. In terms of technological penetration in the U.S., the larger the farm, the higher the penetration rate of digital technology. For example, GPS-based automatic navigation technology is used by more than 80% of farms over 3800 acres (about 1,5370 ha.), while uptake falls to 12% for farms under 600 acres (about 242ha.). And with the same level of digitalization, large-scale farms are on average about 2.8% more profitable than small and medium-sized farms. Thus, in the U.S., digital technology is making large farms more competitive and keeps them ahead of the pack.

In rural China, digital technology currently plays more of an enabling role, which is determined by the country's rural production structure. Although China is experiencing rapid urbanization with increasing land transfers and large-scale operations, the mainstay of China's rural economy will remain small and medium-sized farms, cooperatives and family farms for a long time to come. Along with the pressure of rural hollowing and population aging, the main force of agricultural production will be local agricultural service organizations and farmers' cooperatives. Compared to the United States, China's rural labor force is relatively abundant and considerably cheaper. But even in the digital economy, the cost of labor and the price of essential productive factors remain a decisive factor of the economic development pattern. Driven by arbitrage, machines as tradable goods will increasingly stabilize

globally in price and efficiency. Labor is relatively less tradable and essentially a localized service. This factor alone is the cause for the large difference in efficiency. Facilitating synergy between digital technology and people, enabling digital people to empower natural people, and implementing the scale and network effect of digital technology will be important objectives for Chinese agriculture in the next decade.

From a macroeconomic point of view, at the moment capital is still relatively cheap in the United States, while China has a cheaper labor force. Therefore, the digital economy is substituting human labor in the US, which is economically beneficial to the capital and detrimental to the labor force. In China, the digital economy is more characterized by the synergy between machine and humans, which is economically unfavorable to the capital and favorable to the labor force.

Micro-foundations

of Digital Agriculture

In the era of agriculture 1.0, land and labor were the most important factors of production. The efficiency of agriculture depended entirely on the scale of the land and the level of the work force, and the factors of production were extremely critical. In the era of agriculture 2.0, technology and capital has become the new factors of agricultural production. Technologies such as agricultural machinery, breeding, fertilizers and pesticides effectively increased the production capacity per unit of land, and large-scale agriculture emerged. But the production activities such as operating equipment and surveying farming conditions still relied heavily on people. In the era of agriculture 3.0 (digitalization) and agriculture 4.0 (intelligence), data and computing power will become the most important factors of production. These two factors of production are less competitive than land, capital and labor, while generating much

larger economies of scale, network effects and economies of scope. In other words, digital agriculture brings a higher potential for production efficiency improvement than traditional agriculture.

In October 2019, the Fourth Plenary Session of the 19th CPC Central Committee proposed that data was a new factor of production, and this was proposed for the first time in an official document. As a factor of production, data is significant for agricultural production in three ways: first, like traditional factors of production, the improvement of data quality and quantity can improve the quality and quantity of agricultural products; second, like traditional factors of production, data can not only participate in output distribution, but also influence the substitution relationship among factors, which in turn changes the income distribution relationship among technology, labor and capital; third, data has qualitied different from traditional factors, minutely differentiating digital agriculture from traditional agriculture.

Transiton of Prodction Factors

Agricultural Economy	Industrial Economy	Industrial Economy
Land	Capital	Capital
Labor	Labor	Labor
		Data

Data as a new production factor, is the microscopic attribute of what makes digital economy vary from traditional economy.

Some say that data is the oil of our time and the most important factor of production, but this is only partially correct. The total amount of oil on earth is limited; one barrel extracted is one barrel less. Data resources, on the other hand, can be replicated in bulk infinitely. Using data does not reduce its amount but enriches it by providing feedback. To use the example of data generated by XAG devices, to date we have about 100,000 digital agricultural devices around the world, including agricultural drones, unmanned vehicles, IoT, etc. They generate about 100T of data daily, which is either stored locally or in the cloud in its raw state. Once the data is used by users (usually for image identification, route planning, data research, etc.), new data is generated and higher dimensional information can be mined. This characteristic of data is unmatched by other factors of production. The data and information generated by these devices will be the main means of production used by the "digital" farmers of the future.

In the agricultural society, to gain the most value from the distribution, the first move was to get the distribution right of the factors of production. In the digital era, the right to distribute data assets will become the primary resource that major interest groups will compete for. While digital agriculture will enhance production efficiency, it will also further intensify market competition. There will be winners and losers and a wealth gap will emerge. The development of digital economy will also lead to resources becoming concentrated in the hands of star companies, platforms and individuals. If the winner takes all, social income

inequality will grow. This requires the government to establish a sound system and maintain order to ensure that digital competition is carried out prudently while adhering to the principle of fair market distribution and ensuring that the majority of people, especially ordinary farmers, can enjoy the fruits of economic development.

Distribution Relations Will be Redefined

In the past decade or so, we have discussed digital agriculture mainly around the idea of how to quantitively (or precisely) manage farmlands based on sensors and automated facilities. There has been less discussion in academia about the changes in production relations brought about by technology and the reorganization of the value chain. When we look to the next decade for the technology and investment landscape, we need to look closely at the digital transformation of agriculture. Industrial change invites business opportunities, so we must pay attention to when the great changes will occur and how much value they will bring or take away.

First, if we think of the entire social production system as a factory, technological progress will increase the share of inefficient sectors in income distribution. For example, in the past, a lot of people in rural parts of China had to work in the farmlands in order to feed the nation. As technology progressed and productivity increased, a large amount of surplus labor shifted

to the manufacturing sector. The same is true for the manufacturing industry. With the automated production lines and increased productivity of the manufacturing industry, the surplus labor shifted to the less automated and productive service industry. So now, the service sector comprises of a larger proportion of the Chinese economy, and all this relates to income distribution.

A socio-economic paradox seems to arise here: the faster a sector takes advantage of technological progresses, the less benefit it enjoys. For example, technological progress has improved the productivity of automotive parts, but it does not mean workers making the automobile parts will be paid more. Instead, workers working in those less productive sectors get paid more, because the products they make are always in short supply. The demand for products from highly efficient sectors will increase due to the rise in business revenue, while the prices of those products from low-productivity sectors will rise faster because of short supply, raising the wages of workers of the low-productivity sectors. This paradox is called "Baumol's disease" in economics, referring to the rising importance of low-productivity sectors.

Chinese Farmers Benefit from the Digital Economy

So the question remains: will Chinese farmers benefit from the adoption and wide application of digital technology in the coming years? This has been a concern of many scholars in the past,

but now it seems that the benefits will outweigh the disadvantages. In fact, there are two concerns: First, will farmers lose their livelihood after unmanned agriculture becomes a reality due to technological advances? Second, will farmers lose their right in the distribution of new factors of production in the digital economy? The first question will be answered from an economic perspective, and the second from a sociological perspective.

In response to the question of whether farmers will lose their jobs, we need to revisit the fact that the population of China has started to age. According to the National Bureau of Statistics, the proportion of over-aged rural laborers over 55 years old is already over 34%, and about 12 million people migrate from rural to urban areas each year, transforming from producers into consumers. It is projected that by 2030, the number of farmers involved in farming in China will drop to less than 30 million, with more than half of them being over-aged. As we can see from Japan's example, China's rural labor supply will be severely tested at that time, leading to a significant increase in the price of agricultural products such as grain, vegetables and fruits. In this decade, digital and unmanned technologies will help trade off the pressure of an aging population. In fact, the "unmanned farming" technology under development is not designed to replace farmers, but rather to take over the inefficient, high-risk, and repetitive tasks that were previously performed by farmers, for example, the use of drones for field patrol, unmanned vehicles for pesticide spraying, and the self-driving technology for tractors to

work precisely. Their emergence actually empowers the farmers and agricultural service organizations that have acquired them to do their work more efficiently, while at the same time reducing environmental pollution and protecting the ecology to some extent. This is distinctly different from the robotic technology used by large-scale agricultural groups in Europe and the United States, such as automated hydroponic growing greenhouses, which are more likely to completely replace manual labor. In addition, the government plays the role of benefit distributor in China's economic development. Go-west campaign, environmental management, targeted poverty alleviation and other political projects are actually "redirecting the benefits" to balance economic development.

As for the second question, although China is gradually opening up its agricultural market, the planting and purchasing of basic crops such as cotton and grain are still mainly regulated by the state. This means that the power to allocate new factors of production, such as technology and data, is mainly in the hands of the government. For example, the subsidy policy for agricultural drones can directly influence the speed and penetration rate of drone technology in rural areas. On the other hand, the nature of the new factors of production make agricultural services much more tradable. The original localized agricultural services can all be exported to other places in the future through 5G, AR, VR and other technologies. Livestreaming and online tourism cut down the distance between consumers and farmers, and

a farmer can even manage farms at different latitudes at the same time to achieve year-round uninterrupted farming and significantly increase income. The tradability of digital agriculture services will also bring more healthy competition, technology spillover, innovative thought, new ideas and new technologies to improve the overall efficiency of the agricultural economy, which is also XAG's mission of "advancing agriculture".

In general, digital technology will improve the overall efficiency of China's agricultural industry and generate more economic value. It is important for the government to realize the universality of technology and the benefits it confers to farmers through the effective deployment of new production factors. This is fully in line with the Chinese government's governing philosophy, and Chinese farmers can certainly benefit from it.

‖ China Will Become the Global Center of Digital Agriculture

As I have expressed at the XAG technology conference 2020 (XAAC 2020), China is likely to become the global center of digital agriculture because it is well-prepared due to the four following factors: first, the comprehensive rural infrastructure development; second, strong industrial manufacturing capabilities; third, a sound urban and rural supply chain

system; and fourth, national support for industrial transformation. To develop smart agriculture, we must first realize the digitization of agricultural production, where all the four prerequisites are indispensable. Within ten years, only China out of all countries can meet these four conditions.

In addition to the above four supply-side conditions, the growth of consumer capacity is also an important driver. In 2020, when the whole world was hit hard by the pandemic, China's economy maintained continual and stable growth. On the one hand, this reflects the capacity of the nation's pandemic prevention system, and on the other hand, it demonstrates the internal growth dynamic brought about by urbanization and consumer upgrading. The increasing number of middle-class families, nationwide improvement of health consciousness, and the promotion of

online celebrities have all driven the improvement of supply-side capacity, constantly demanding more and more high-quality agricultural products and promoting the upgrade of the agricultural industry.

According to Huawei's "The Connected Farm" data, the global market size of digital agriculture will be valued at around RMB 180 billion in 2020, and China's RMB 20 billion will account for 13%. From the perspective of digital agriculture application, automatic navigation farming machines, precision livestock feeding equipment, harvest measuring equipment and agricultural drones together accounted for 55% of the global digital agriculture market in 2020. Following this trend, the first wave of digital agriculture will appear in the field of digital agricultural equipment. This also means that countries supplying the world with these devices will be trendsetters.

Farmers are a very cost-sensitive demographic in both developed and developing countries, and the popularization of agricultural technology and farming equipment depends heavily on their return-on-investment cycle. According to our research data, the current average farm size in developed countries is more than 600 acres, and the price of their manufactured farm machinery is generally 2 to 3 times higher than that of developing countries, which is more suitable for larger scale farms and market-oriented crop production. In developing countries such as China, India, Latin America and Southeast Asia, farm size is usually less than 100 acres, and the return cycle of large farm machinery is much longer than that of developed countries. At present, China has major advantages in manufacturing IT products and agricultural equipment, far exceeding India and Southeast Asian countries in

terms of product manufacturing capacity and substantially outperforming European and American countries in terms of product manufacturing efficiency and cost.

Also, China uses the most agricultural drones in the world. In 2020, 10 million hectare of arable land in China, accounting for 8.3% of the country's total, utilized plant protection and remote sensing drones, which is 100 times more than those used in Japan. At the same time, digital platforms to help improve the efficiency of farmland management are becoming increasingly popular. Just as industrial management software at factories has greatly improved the efficiency of manufacturing, the power of digital management platforms for agriculture is gradually coming to the fore. A new generation of Chinese agro-technology companies, spearheaded by XAG, Huawei, Dayu Water-saving Group Co Ltd and New Hope Group, will be the main force driving the application and popularity of digital agriculture technology worldwide.

▐▌ Imagining the Farm of the Future

In the next decade, as the land transfer accelerates and the labor force continues to decline in China's rural area, more and more farmland will be connected to a whole new production system through digital technology. Firstly of all, tools of the producers, such as drones, unmanned vehicles, self-driving tractors, as well as the IoT and digital management platforms for farmland, will basically make a "digital twin" of each farm. A digital twin is a digital farm model inside the digital (bit) world that corresponds exactly to the one in the physical (atomic) world. After modeling, every production activity in the real farm will be presented and recorded one to one in the digital farm. Within the digital farm, the "digital people" we talked about earlier, or in this case "digital farmers", come into play.

Digital farmers can be workers in this real farm, or remote agricultural experts from thousands of miles away, who obtain farm data through the IoT, perform more scientific analysis and enact decision-making with the help of cloud computing and AI, and then control various devices in the farm through the mobile Internet to achieve precise crop management.

Further, as crops, soil, and climate data become more abundant, the accuracy of AI crop growth simulation technology will also be greatly improved. Before sowing in the physical world, digital farmers can "rehearse" farming on a digital farm. This process is as simple as stock buying simulation, where farmers can set up various variables, try out different "combinations" of seed, medicine, water and fertilizer, and choose the combination with the highest yield or quality to "invest in".

With digital farms, the risk of agricultural production will be greatly reduced, and a large amount of capital and talent will come to the rural areas, bringing about a second wave of growth. At this stage, the training of professional digital farmers will become an important part of the process. Just as the technical schools brought vitality to urban construction and manufacturing more than a decade ago, new agricultural skill training organizations such as XAG Academy will emerge in large numbers. At the same time, agricultural technology training will also be digitalized. The "digital" students can build their own farms in the virtual world, just like playing a video game, simulating the cultivation of different crops in different regions through crop models and various databases, and greatly reduce the time to try new methods and ideas.

Of course, in reality the development of digital agriculture is still constrained by many factors. Besides the challenges of capital, policy and technological maturity, agriculture is an industry with a long ROI cycle. And new technologies often require farms to transform their existing farming models. Automated orchard management needs unmanned machinery as well as water and fertilizer drip irrigation facilities, but the production cycle of orchards is often relatively long, for example, citrus trees take 3 to 4 years to produce a good yield, and farmers are not willing to transform the orchard within 3 to 5 years after the production of fruits. The long cycle of agricultural production will be an important limiting factor for the digital upgrade of many farms. Therefore, we believe that the first "unmanned farms" will be field crops, such as rice, wheat and cotton.

Overall, with the demographic pressure and technological advances, catalyzed by the pandemic, the digitization of Chinese agriculture is rapidly taking off. The next decade will see the emergence of digital agriculture around the world, and there are many issues in need of our in-depth study and consideration. And we will share with you our most recent developments. ▢

Bold Innovation for *Something Unique*

Bravery is the rarest of all human virtues.

The unexpected, surging popularity of the buzzword "involution" in 2020 reveals people's mixed feelings about this social phenomenon: we hate it, we fear it, yet we all are a part of it. Given the pervasive involution in the drone industry, it is no wonder that V40 was hailed as a game-changer on site after its stunning debut at XAAC 2020 - even social media trolls were struck dumb by the extraordinary premiere.

Basically, questions about V40 could be grouped into two categories: first, the specific features of V40, and second, the idea behind XAG's bold innovation. Answers to the former are quite straightforward, but not so for the latter. The brave creators of V40 may be able to provide some clues, however.

» Struggling and Striving

The last thing Hailong would imagine when he assumed responsibility for the develop-ment of V40's steering gear, was his ideas would be so formidable to vendors.

As the industry's first dual tilt-wing, dual-rotor agricultural drone, V40, unlike traditional multi-rotor drones, relied on steering gear to adjust its flying attitudes by changing the angle between propellers and the horizontal plane, which made it a core component of V40. As we all know, the steering gear consists of two parts: the engine to provide power, and the reduction gearbox to increase torque.

In the beginning, in-house development of steering gear was not on the to-do list of the project team. After all, steering gears were by no means new in the mechanics sector, and vendor solutions might be "good enough". Test results proved otherwise. Vendor solu-tions were not only suboptimal in performance - responsiveness, positional accuracy and angular backlash, for example - but also too large for V40. J6, head of XAG's Industrial Design, was responsible for the efficient integration of all parts and components. When he recalled the first time he saw vendors' steering gears, he called it a nightmare: a 20cm steering gear simply would not fit under the rotors.

As a result, two months later, an inhouse development team was pulled together, and Hai-long was appointed the team leader. The problem was, neither he nor anybody in XAG had the required expertise. Besides, such a component didn't exist on four-rotor drones at all, which meant he didn't have a playbook. Worse still, almost all vendors considered XAG's requirements "unrealistic". That was something Hailong could not ignore - there must be some reasons for those professionals to make such claims.

"Struggling and Striving!" are the words that occurred to Hailong when he recalled this most difficult of times. Back then, as the optimized design involved significant manufac-turing risks, he was turned down by more than a dozen vendors before finally find some-one "bold enough" to give it a try. One step at a time, they reduced the size of reduction gearbox, and pushed the motor to its limits. They even changed the motor, as the original one could not meet the performance requirements. After that, they discovered that reduc-tion gearbox could be smaller in size; after six iterations, it was reduced to half the size of the original, and the steering gear offered two-times higher torque in two-thirds of the size - which was better than their best expectations. XAG had created the industry's best

steering gear on the first attempt.

Despite the outstanding achievements, Hailong remained calm and prudent. In his words, he was still far from being called an expert. For him, the current version was just "usable"; more "struggling and striving" spirit will be required in the future for further improvements.

» When the Old Rules No Longer Apply

It is a common knowledge to military fans around the world that the U.S. F15 jet fighter is a masterpiece of design. It weighs 30 tons but no single gram of that weight is superfluous. Weight efficiency is the gold standard for any flying machine in the demanding environment of the skies. For the two-rotor V40 to effortlessly carry 20 kg while maintaining sufficient efficiency, bare weight must be significantly reduced so that every gram of weight is used to maximum effect.

As Head of Industrial Design for the V40, J6 encountered two major challenges when tackling this problem. First, structural design—weight reduction and the airframe's structural strength are inherently at odds, but neither can structural strength be sacrificed for the sake of weight reduction. Second, material innovation—an avoidable necessity in order to ultimately reduce weight and also reasonably control cost. To significantly reduce weight and maintain sufficient strength, the design rules for the body structure of four-

rotor drones must be abandoned and a new path starting from the nature of the structure and materials must be taken. In other words, J6 had to revolutionize.

In terms of structure, no matter what materials are used, weight reduction always means discounted overall strength. However, the needs for strength vary in different parts of the airframe. Reinforcement at pressure points and weight reduction at non-pressure points is at the core of structural optimization. Simple as it seems, it is extremely complicated to put it in practice.

Without established concepts or examples for reference, J6 had to blaze a new path with finite element analysis and through trial and error. The first engineering prototype version over-designed many force points. Attempts to reduce weight, volume and thickness were made upon this realization. The whole process was greatly extended because we mulled it over gram by gram, even making the screws smaller where necessary. Every small adjustment led to re-sampling. A dozen samples were made in total, while the P series only needed one or two samples before completion.

Then it came to materials. We all knew that polymer could be a good choice, as it is light weight, impact resistant, highly consistent, one-time molded for fast production, and allows for significant weight reduction. However, no player in the industry has ever used polymer as the main structural material on a large agricultural drone because extensive use of polymer can result in a lack of strength. But with the

pressing challenge of weight reduction, finding the right polymer material for the "backbone" of the V40 may be the only way forward.

After extensive research, the J6 team found a new material in the rocket–carbonfibre reinforced polymer. Widely used in aircraft, rockets, missiles, and astronautics, the material is an effective replacement for aluminum or titanium alloys and can significantly reduce weight while maintaining strength. This discovery redoubled the morale of the design team, and achieved a truly light and strong design after repeatedly adjusting the percentage of carbon fiber in the polymer. It is impressive that the new material, combined with the new unibody molding process, allowed a significant reduction in weight of body parts, with the number of frame parts reduced from more than 20 to just three now.

J6 felt determined to create a ground-breaking product when he heard the "dual-rotator" concept for the first time. After one year's struggle and strife, he was only more determined than ever.

» I Almost Quitted

Xinchen was quite embarrassed by his first thought about V40:

"I thought that would be a piece of cake!"

He was wrong. It turned out the biggest challenge in his career.

PID controller algorithm has long

been used for multi-rotor drones to control its flying attitudes in a "hyper-correction" way. Despite its benefits including simplicity, robustness and reliability, PID is not suitable for dual-rotor drones. As multi-rotor drones are relatively stable, and corrections are unlikely to cause sensible instability, while dual-rotor drones are more prone to accidents under "hyper-correction". At first, Xinchen used traditional PID controller algorithm for V40, and the results were quite disappointing. Even after a whole month's hard work, he hardly made any progress. In October, the development team decided to switch to other algorithms. At that time, V40 had been slated as one of the highlights at the press conference. For the algorithm team, this decision was more a burden than a blessing.

Dozens of algorithms were tested, but none worked. Hopes were diminishing. Jiachen was driven into a dilemma by the failure of PID and other algorithms: "No kidding, I seriously considered quitting." Even

Jiaren, the most important mind behind the final solution, became hesitant in experimentation, because there were only two V40s left. "We would run out of prototypes if accidents continued to happen".

Fortunately, the darkest hours ended with a dramatic turn: when all hopes seemed lost, another algorithm saved them. With some improvements, it finally realized stable control of V40 on Dec 14 - one day before the press conference. For months, the whole team had remained in the dark, like a fetus in the womb. It was their tenacity that saved V40 from dystocia in the last minute.

» Commitment to Innovation

For Xinchen, in addition to a little bit of luck, it was MG, the product manager, who inspired the algorithm team. He saw in MG some sort of "courage" whenever a problem emerged MG

always found the right solution, and he was always decisive at pivotal points. It seems nothing was a real problem to MG. Hailong agreed with him: whenever they met a seemingly unsolvable problem, MG found an answer.

For MG, each option, each alternative, and each solution entailed enormous weighing. And weighing alone was not enough all problems had to be solved to ensure the success of projects. "All these miseries, struggles, pains and overtimes were about one thing our commitment to innovation: we wanted to make the best product, so we did our utmost."

How could XAG be so boldly innovative? When people ask such questions, they take V40's success for granted. However, a closer look at the development work would reveal immense courage of XAG to solve problems and to embrace failures. That was what in-spired us to push the boundary step by step, and finally, stun the world. **X**

The 'Transformer'
on
Farm

On July 2020, XAG R150 Unmanned Ground Vehicle was officially on sales, marking the debut of the world's first mass-produced farm robot in the commercial market. From crop spraying and on-farm transport to seeding and mowing, the potential of R150 is being further explored by XAG's engineers to uncover more application scenarios.

XAG R150 Unmanned Ground Vehicle is a four-wheeled multifunctional, lightweight robotic platform, developed to unshackle human labour from tedious, dirty farming operations on both open and rugged terrains. This is a ground-breaking invention in the field of agriculture, as it is endowed with various kinds of superpowers that have never been achieved by its predecessors or counterparts.

» From Air to Ground

Starting as a drone maker in 2007, XAG has been delving into the applicability of drones in agriculture. In pursuit of a smart agriculture ecosystem, it is recognised that the drone itself can only solve problems specific to certain farming process. And here comes the birth of R150 Unmanned Ground Vehicle, the first-mass produced agricultural robotic platform of its kind.

XAG R150 is invented as a highly scalable automation technology to help small-and-midsized farms sustainably improve their agricultural productivity. Unlike the highly mechanised large-scale agriculture, these farms depend on manpower to grow crops and apply an overdose of pesticides and fertilisers due to lack of smart tools. With long hours of toiling on the fields and occupational exposure to pesticides, many farmers develop a range of chronic health problems.

Large ground equipment such as tractors cannot scale up in smallholder farms because of the smaller size of land plots, high cost and varied terrains. Besides, a considerable proportion of China's farmlands is located on hills or mountains, creating a strong market demand for small-to-medium sized agricultural machinery with unmanned driving system.

The advent of XAG R150 allows multiple farming activities to be done with only one single machine. In a modular design, R150 can be equipped with different kinds of custom payloads to add adjustable functions. It can flexibly traverse varied terrains with ease and high precision to help farmers sow seeds, scout the fields, monitor plant growth, deliver harvested fruits and vegetables, and spray crops against pest diseases or harmful weeds.

On XAG Annual Conference 2020, the potential applications of R150 were further tapped by launching two new payload systems for large-scale broadcast and precision mowing. Thanks to the centimetre-level navigation network, farm workers only need to press a few buttons and this lightweight farm robot can operate automatically under precision control.

For instance, the majority of rice fields are traditionally transplanted by hand, a manual process that is time-consuming while causing uneven seed distribution and lower crop yields. The broadcast edition of XAG R150 aims to resolve this kind of problem by offering large-scale unmanned spreading operation in open fields and orchards. When embarking on a 220L container and the RevoCast system, it can effortlessly deliver crop seeds, grass seeds, solids, organic fertilisers, etc. into the targeted areas.

Another R150 mower edition, as opposed to the existing manual push mower, can provide users with a 5-time more effective method to combat the growth of weeds and enhance the ease of weed control.

66
The advent of R150 allows multiple farming activities to be done with only one single machine.
99

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» The Much-anticipated Market Debut

technology iterations behind R150 come from years of field investigation and the insights into the actual needs of farmers in China. Keeping its feet on the ground, XAG has infused user feedback to make the robot more adaptable, flexible and simple-to-use.

Based on the SUPERX real-time kinetic (RTK) driving control system, XAG R150 can accurately follow a pre-programmed route, automatically avoid any surrounding obstacles, and traverse a variety of tricky terrains, no matter waterlogged, sloped, or wooded fields. Machine control is designed into the easiest pattern that automatic operations would be initiated simply via a few tabs on the mobile app to set up parameters.

Since market debut in July 2020, XAG R150 has been adopted in China's remote rural areas for cost-effective crop protection, field scouting and on-farm delivery. With fully autonomous, high-precision operation capability, they are helping to alleviate farmers' physical burden, as well as reducing the use of pesticides and agricultural water. X

XP 2020 MODEL

THE AGRIFUTURE IN YOUR HAND

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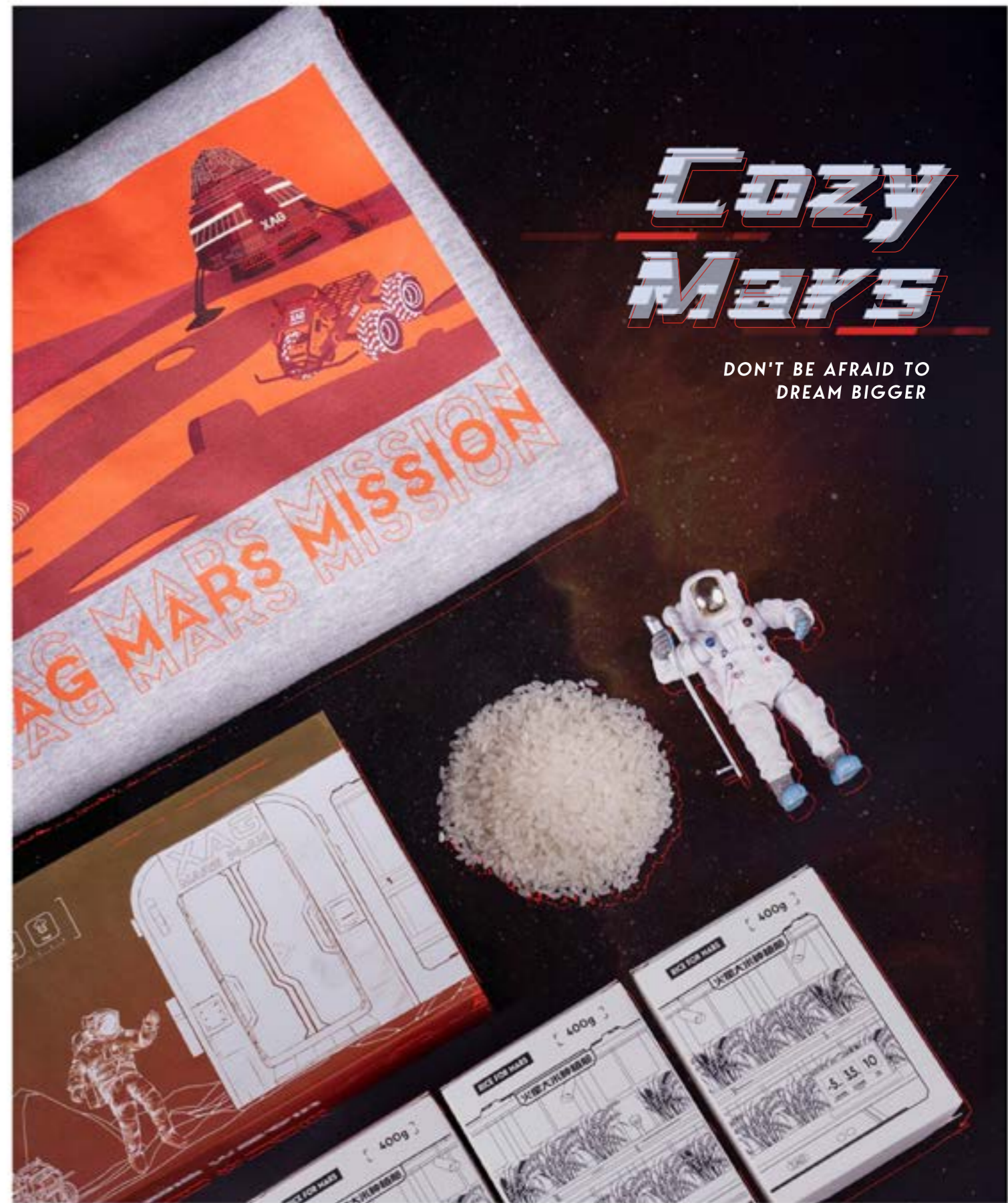
Cozy Mars

DON'T BE AFRAID TO
DREAM BIGGER

Creating More Value with $182m

Those that wear the crown must bear its weight. Making its mark towards a new blueprint, XAG bears a heavy responsibility after it bagged the largest single commercial funding in China's agri-tech sector.

16th November 2020 witnessed a major milestone for XAG, which announced that the company has raised USD182 million in a new funding round. For the rising agri-tech industry in China, this is reportedly the largest single investment so far, co-led by Baidu Ventures and SoftBank Vision Fund II, with the participation of Sinovation Ventures, Guangzhou Yuexiu Industrial Investment Fund Management, Guangzhou Emerging Industry Development Fund and existing investors, Chengwei Capital and Mingtai Capital.

As the discrepancy between rural aging population and the increasing demand for food production widens,

agriculture has reached a tipping point for transformation. This presents a Blue Ocean Market for investors who has been pouring more and more capital into agricultural technology, with the ambitious aim to generate tremendous growth opportunities in the untapped space.

» The Hotspot for Venture Funding

Agriculture as the primary industry has always been the last option for commercial investment. Until recently, investors start to realise that technology is breathing new lease of life into this sector, which presents a

new growth point for every stakeholder to reap benefits with social impacts.

It is no wonder that XAG can earn the favour of top-level venture capital funds. It is among the trailblazers who apply digital technologies, such as drones, robots, and artificial intelligence (AI), to resolve the pain points of agriculture and rural development.

According to the United Nations, the economic recession caused by the COVID-19 pandemic has aggravated the acute global food crisis, pushing up to 132 million people into hunger by the end of 2020. The vulnerabilities and uncertainties of our global food system have been intensified,

which particularly underlines the great significance of agriculture that is essential for daily sustenance. Safeguarding food security and maintaining safe, heathy food supply become the mission of many.

However, the pandemic is the trigger but not the source of current food challenge. With the deepening of urbanisation, there has been a huge outflow of young workforce from rural areas to cities every year, leaving most elderly people to manage the farms. The urbanisation rate in 2019 published by National Bureau of Statistics is 59.58%, and this figure is anticipated to raise to 75% in the next five years, which means there would be another 15% of rural population moving out of the villages. Moreover, 34% of Chinese agricultural workforce has reached above 55 years old.

"No man to farm" could become a long-term problem for sustainable agriculture, but it is also a double-edged sword facilitating the digital transformation of agriculture. XAG was aware very early of the plight of labour shortage on farm in 2013, when it had decided to focus on the research and development of autonomous agricultural drones that help farmers seed, fertilise, and spray their fields cost-effectively.

» The largest Investment in China's Agritech

"In the future, there would be self-driving robots, instead of an old farmer, on the fields to take care

of the crops," envisioned by Peng Bin, Founder and CEO of XAG. This seems to be something that only exist in science-fiction stories, because agriculture used to be the last option for technology application. So, when such a big investment falls into this industry, people are quite curious about how XAG can stand out.

Dr. Chen Xun, Managing Partner of SoftBank Vision Fund, are confident about the future of smart agriculture, anticipating that XAG will continue to introduce disruptive innovations and lead a new era of agriculture. "We hope that technology can bring positive changes to the world's agriculture system as well as promoting sustainable development and food safety," he said.

Dr. Li Kaifu, Chairman and CEO of Sinovation Ventures said that XAG empowers the world with agriculture technology solution based on AI, which in just a few years has transformed the industry with thousand years of history. "XAG has disruptively advanced the level of digital farming infrastructure, and we believe that the XAG team can create both commercial and social values to all the stakeholders," he commented.

» Plans to Secure Future

XAG has been in business for almost 14 years, with highs and lows. During the past 8 years, through scaling up drone application in rural areas, XAG has proved that agriculture needs not only technology but also the most

advanced, sophisticated technologies. It is one of the few profitable companies which can achieve mass-production of agricultural unmanned systems.

Peng Bin said: "After the initial excitement, we're looking at the funding success only as a little milestone. More importantly, we have to think comprehensively about how to use the fund to create more value for the company in the next 3 to 5 years. While outsiders remain curious about how XAG won the largest investment in agriculture tech, XAG is focused on working out ways to put the money into good use, live up to the trust of investors, and seize the emergent opportunity of digital agriculture in China."

According to Peng, XAG will harness the investment funds further strengthen its competitive advantage in R&D and manufacturing, improve channel service ability, speed up the construction of digital farming infrastructure and develop more intelligent farming equipment for the realisation of "unmanned farms".

In the past, XAG always found out its future direction through thorough reflection and carries out long-term and careful perfection of its performance in a low-profile way. But what's different today is that XAG is not only dictating the tide of technological change, but also the tide of social values, telling the world loudly how it thinks about the future.

XAG has not only brought value to its investors, but also helped millions of farmers improve their efficiency and bring safer, healthier food to the tables of hundreds of millions of people. X

2020 Reuters Responsible Business Awards:

XAG Recognised for Sustainability Innovation in Tackling Rural Ageing

One year after earning the 'Agri-Oscar' of the crop science industry in London, XAG once again received recognition for its sustainable farming solutions. And this time, it was at a bigger international arena - Reuters Responsible Business Awards 2020, where XAG shone its light on the ageing rural society.

The Reuters Responsible Business Awards is the world's leading awards celebrating leadership in sustainable business. It recognises those that truly have an impact on business, society, and the environment. For the past 11 years winners of the Awards spanned the globe, covering both industry giants and new tech forces, such as Unilever, IKEA, Intel, Mastercard, Coca-Cola, Goldman Sachs, UPS and etc, which developed innovative strategies pushing forward the boundary of corporate responsibility and sustainability.

At the virtual ceremony held on 8-9 October 2020, XAG was named a winner of the Sustainability Innovation category with its unremitting efforts to scale up agricultural drones, robots, Internet-of-things, and artificial intelligence in rural areas of developing countries. As food insecurity is aggravated in the wake of COVID-19, these unmanned technologies have been leveraged to shape the future of smart farms by addressing rural ageing crisis and loss of biodiversity.

> *An excellent example of utilising technologies to drive social, environmental impacts.*

» Sustainably Grow More with Less

The sustainability Innovation Award, one of the thirteen award categories, was given to XAG for putting sustainability at the heart of its business strategy. The company has been committed to empowering smallholder farmers with smart agtech, to grow more nutritious food with less environmental footprint on the planet. This is achieved through the three core pillars of smart agriculture solutions that are incomparable in terms of scope, impact, and scalability.

• Collaborate with local government to build digital farming infrastructure, such as centimetre-level RTK (real-time kinematic) high accuracy navigation network and high-definition field maps, which enables autonomous operations of drones and robots in rural areas.

• Develop precision farming equipment, including drones and unmanned ground vehicles, which are nimble, flexible enough to adapt to farms of different sizes and operate on varied terrains.

• Integrate AI cloud computing platform and IoT systems to collect agriculture big data and analyse crop growth cycle, assisting farm owners in making scientific decisions on production.

The judges were very impressed by the innovative and scalable actions of XAG to bridge the gap between resources and skills for smallholders and family run farms. "This is an excellent example of utilising technologies to drive social, environmental impacts which have been demonstrated immediately, particularly in the developing part of this world," said Aris Vrettos, Director of Centre for Business Transformation, Cambridge Institute for Sustainability Leadership (CISL).

» Unmanned Technology to Safeguard Food Security

Since the transition from drone maker to agtech innovator in 2013, XAG has managed to introduce over 66,000 unmanned farming devices across 42 countries and regions.

A wide range of drone operations involving precision agriculture practices, from sowing seeds and spreading fertilisers to crop spraying and field monitoring, have been delivered to 931 million farmers on 52 million hectares of farmlands.

The use of drones and robots in agriculture not only helps efficiently improve crop yield, but also protects the health and safety of agricultural workers by eliminating the risks of chemical exposure on fields.

Besides cutting down carbon emissions in response to climate change, the replacement of diesel tractors and knapsack sprayers with electric-powered drones also reduces the use of pesticides and fertilisers, as well as conserving water resources.

XAG's agtech scale-up actions were initiated under the challenge that, with less workers to farm and no more arable land to exploit, the global food system will be struggling to feed the world's whopping 10 billion people by 2050.

Small and midsized farms are the major forces of food production in most developing countries; however, they still depend on manpower to grow crops and usually apply an overdose of pesticides due to lack of smart tools. Large ground equipment cannot be adopted in these areas because of the varied terrains, smaller size of land and high cost.

It is true that the barriers to scale-up do exist in this brand-new sector. But with strong faith in tech and passion for land, XAG has been striving to dispel farmers' suspicions about new technology through continuous training and demonstration.

"Our ultimate goal is to create a smart agriculture ecosystem in which all the repetitive, tedious, and dangerous jobs are handed over to drones and robots, therefore farmers can focus on the process of decision making with the aid of big data and AI," said Justin Gong, Co-founder of XAG. **X**

The Mars Farming Plan:

Agri-tech that Challenge the Extreme

The exploration on Mars is not just about discovering a planet. Deep down, it also inspires tech developers to challenge the extreme. Coming to XAG's tech realm, the agri-tech for Mars isn't being discussed simply out of curiosity, but also reflects the efforts put to develop innovative unmanned agricultural technologies with maximum flexibility and durability, even in adverse environments.

In September 2020, XAG hosted a first-of-its-kind international webinar on Mars farming to explore the possibility of growing food on the Red Planet, amid three daring probe missions on their way to Mars. Themed "The Hungry Mars", this seminar featured plant scientists and agricultural experts from Wageningen University & Research, XAG, ID Capital Pte, and VCearth, diving deep into the solutions of growing crops with Martian soil, as well as developing a closed agricultural ecosystem on Mars through the use of autonomous farming technologies, such as drone, robot, and internet-of-things.

» A New Urgency for Sustainable Development

The one-hour webinar opened up with expert views to reveal the hidden reasons behind the Mars farming exploration projects." Justin Gong, considered the Mars adventure as a strategic vision to solve sustainability issues. To ease the environmental, social tensions here on earth, humans need to have a higher mission, such as aiming eyes for the outer space.

"Agriculture is now facing great challenges, such as rural aging population and lack of farming workforce, that would threaten human survival and existence. For example, in China, there are 12 million people moving from rural areas to cities every year, with no inclination to take over the tedious, laborious farm works from their old generations. This means that we need to figure out a solution of sustainably producing more food to feed the growing global population," he said.

"However, climate change, loss of biodiversity, and political uncertainties have been making the scenarios more complicated and multifaceted. If these problems keep exacerbating, it is possible that Earth might one day become as hostile as Mars. We need to take wise precautions early on and harness the power of technology to sustain human life in the future," Justin Gong added.

Riding the wave of industry 4.0 to transform the traditional agricultural production system, XAG develops smart agriculture technologies, including autonomous drones, unmanned ground vehicles, and IoT systems, that have been introduced to remote rural areas across 42 countries and regions. Having been tested under extreme conditions, these unmanned devices were specifically designed to operate in various types of complex, tough environments, no matter rugged terrains or waterlogged fields.

As XAG is committed to providing the

world with sufficient, diversified, and safe food, this mission reflects an ambitious goal that also benefits future Martians. The idea is to verify the flexibility and robustness of unmanned technologies in growing crops under simulated Mars circumstances.

Isabelle Decitre, Founder & CEO of ID Capital Pte, has years of experience in agtech and foodtech investment and sees the innovative Mars farming solution as a product of multi-disciplinary fusion. "We could think of Mars as the extreme environment of Earth, which helps us take in new insights and push the limits of inventions to change the future of agriculture on Earth."

» Martian Crops for a Self-sustaining Colony

The webinar also delved into a mysterious topic for open discussion: Does the "The Martian" method of growing potatoes could work in reality and what are the crop species most likely to thrive on Mars? Dr. Wieger Wamelink, a senior plant ecologist of Wageningen University & Research addressed the questions by proving the feasibility of growing Martian crops, which suggests that the idea of living on Mars might no longer be just a sci-fi dream.

Since 2013, Dr. Wamelink has been leading an innovative research project "Food for Mars and Moon" that, for the first time, utilises Mars soil stimulant provided by NASA to cultivate crops. So far, he and his team have made a significant breakthrough in successfully growing and harvesting nine different crop species, including rocket, tomato, radish, rye, peas, and leek, under greenhouse conditions.

The simulation soils come from the volcano of Hawaii, whose texture and composition very resemble those of the real nutrient-poor Martian regolith, lacking in reactive nitrogen and containing a high level of heavy metal and perchlorates. It was previously

believed that Martian soils were uninhabitable for plant growth.

"Back then, this was an untapped research area that prompted us to make bold innovations. We have conducted comparative experiments with 14 crop species, using Earth river sands as well as Mars and Moon soils stimulants mixed with organic matter as fertiliser. It turned out that the research went far more smoothly than we had expected. Some seeds started to germinate within only 24 hours, then flowered and borne fruits as usual as normal earth crops," Dr. Wamelink explained. More surprisingly, the vegetables grown from Martian soil stimulants were tested to be safe to eat without traces of metals.

He particularly pointed out that potatoes grew very well in the experiments. From the perspective of plant biology, this carbohydrate-rich vegetable is most likely to serve as the first dish if humans set foot on Mars, he added.

"Potatoes not only taste good and show many health and nutrition benefits, but also easy to grow and take up less space. Even under greenhouse environment less desirable for plant growth, we could still harvest a batch of potatoes in 10 weeks. On Mars, all the construction works would be extremely costly and difficult, so it means a lot to secure food production if we could grow crops in large quantities with less space."

» Unmanned Farming as Key

Pathway to Turn Mars Green

It is agreed that scarcity of agricultural labour would be a major challenge when it comes to terraforming Mars. This provides opportunities for the existing unmanned farming technologies on Earth to empower Martian farmers and increase food productivity on the Red Planet.

According to Justin Gong, developing hands-free farms over the dreadful wildness of Mars first involves the construction of intelligent greenhouse, followed by the supply of fertile soils and water resources, with no exception to run through the entire agricultural production processes from seeding, crop management to harvest. Undoubtedly, this would require a large number of automated equipment.

But the problem is that machine cannot be remotely controlled in real-time since it takes more than 20 minutes for radio signals to travel the distance between Earth and Mars. "In this case, we would need agricultural drones and robots that could operate fully autonomously and precisely to spray crops, spread fertilisers, and pollinate the plants. Meanwhile, the IoT and AI systems could collect and analyse multi-dimensional farm data on crop growth, soil condition, and microclimate to identify various problems, assisting future Martians with scientific farming decisions," Justin said.

The introduction of microorganisms and pollinators would also be required to create a sustainable closed-loop

agricultural ecosystem on Mars. This is what Dr. Wamelink and his team attempt to investigate in the latest phase of Martian soil experiments, with focus on adding human urine as source of struvite to improve crop yield.

He argued that it was nearly impossible to grow crops on the open surface of Mars, because the atmosphere is too cold and thin to support life, with dangerous cosmic radiation and low gravity. "Crop cultivation could only be carried out in a smart greenhouse. We could consider introducing bumblebee as insect pollinators, while leveraging fungi, bacteria, and worms to decompose organic matters that allow recirculation of nutrients in the Martian soils. Future Martian would play an important role in this cycle where their faeces could be reused to stimulate crop growth," he said. Dr. Wamelink has confirmed in his previous research that earthworm can survive and even reproduce in the Mars soil stimulants.

As a professional venture capitalist, Isabelle Decitre concluded the discussion saying that these Mars farming exploration projects have immeasurable potential that is attracting a considerable amount of private funding. "We need long shot projects such as this one. I am very keen on people who can work out innovative solutions. And I think aiming at Mars has great potential as now many countries are willing to invest lots of money in space research and development." ☒

Media perspective:

Hello AgriFuture!

In 2020, XAG dove deeper into smart agriculture and created more efficient tools to help farmers under the media's continued attention. In 2021, XAG will stay true to its mission & keep moving forward.

» The Middle East North Africa Financial Network

By innovatively using drones for direct seeding, XAG has transformed the way ecosystem restoration works are conducted. Seeding by hand or ground equipment is inapplicable to Lake Cobrico where part of the peat swamp is difficult to access; this approach might also disturb the vulnerable post-fire vegetation and soil. Aerial seeding by plane or helicopter can cover a larger area, but besides costly, it might result in seed drift and uneven distribution that might adversely affect a successful outcome.

» South China Morning Post

Compared with large-scale agriculture in major economies like the US, most Asian countries where rice is their staple crop cannot use large expensive machinery, such as driverless tractors, because of the complex terrain and small size of many farms. By comparison, XAG's drones are more agile and economical for rice farmers in this region.

» The News International

Bayer has also partnered with XAG, a leading drone manufacturer, in efforts towards introducing agriculture drone technology in the country. Drones allow more precise, efficient and safe application of pesticides, enable direct seeding in select crops and provide valuable data insights to aid key farming decisions.

» Financial News

Drones are designed by XAG to facilitate precision application in agriculture. They can smoothly operate on various terrains, no matter steep slopes or irregular-shaped plots, which are common places where most South African sugarcane plants are grown. Owing to real-time kinematic (RTK) positioning and the special atomised nozzles, XAG drones can spray more precisely and evenly on target areas without affecting the neighbouring fields not yet ready for ripening.

» CGTN

Seeding, sprinkling fertilizers and spraying pesticides – these farm essentials were once laborious, grueling and often lacked efficiency, especially in poverty-hit areas, which usually rely heavily on agriculture. But the advent of drones has proved to be a game-changer.

By flying above the cotton farm, a drone avoids causing extra harm. With sensors and AI vision technology, it can monitor the well-being of the crops and spray chemicals with precision. One drone is estimated to be able to do the work of 60 farmers in one hour, significantly saving time and labor cost.

» UAS Vision

With XAG 's autonomous drone, farmers can even target at individual plants and skip the spacing between trees.

Results from the trial phase also showed that droplets were broken down into tiny particles of different sizes that could reach the lower foliar of the macadamia trees. The big picture here is trying to help macadamia growers prioritise the protection of water, minimise pesticide usage from traditional techniques, and eliminate possible chemical drifts. Given that water shortage has been a persistent issue in Australia, such benefits of drone applications should be seen across the entire agriculture industry which accounts for three quarters of total water use.

» CHINADAILY

China's largest agricultural drone maker XAG has also provided its drone users with technical support to properly carry out aerial disinfectant sprays, especially in rural villages with weaker health systems and poorer sanitation.

» AP News

Tractor-mounted spray cannons are still widely used as the spray tool for pest and disease management in macadamia orchards. As the industry is committed to minimising its carbon output, the use of heavy diesel machinery should be further limited, and this creates an untapped area where drone-based solutions from XAG can reduce 30% chemical use and conserve up to 90% water.

» CHINA org

As well as being both cost and time effective, the drones also avoid the necessity of putting people on the ground in affected areas, potentially causing more damage to the ecosystem, or being hurt themselves.

With bushfires expected to be an increasing influence not just in Australia but globally, the technique pioneered in partnership by Australian and Chinese innovators XAG may play a role in future regeneration efforts worldwide.

XAG 2020 Highlights

Battling the COVID-19 pandemic, restoring wildfire ravished lands, fighting against the locust swarm outbreak.2020 was a unique year for many of us. Despite the ongoing challenges, XAG is still deeply invested in, and delving into, smart agriculture.

February

Funds allocated to support the fight against COVID-19

To address the urgent need for strengthening disease prevention measures, XAG announced on 31 January that it would set up a 5-million-yuan coronavirus response fund, and called upon XAG users to conduct voluntary drone disinfection operations in China, which was hardest hit by the pandemic.

2/20

XAG 's agricultural drone is displayed at the Guggenheim Museum's "Rural Future" Global Exhibition in New York, US

3/18

BAYER & XAG

XAG signed a comprehensive strategic cooperation agreement with Bayer SEAP to promote the adoption of smart agricultural technologies in Southeast Asia and Pakistan (SEAP)

to help farmers meet agricultural production challenges.

3/26

British local authorities have decided to use XAG's drones for pandemic prevention and control

British local authorities have decided to use Chinese drones in pandemic prevention and control efforts. As a major force in domestic pandemic prevention and control, GIAF will provide solutions and technical support for UAV units across 48 police departments and emergency services across 100 fire departments in the UK, a testament to China's contribution towards global pandemic prevention and control.

4/01

XAG'S 13TH ANNIVERSARY

Today is XAG's thirteenth birthday. Technology and product lines have become more sophisticated as a result of the implementation of smart agricultural systems. XAG has grown from a start-up company to a world-class smart agricultural technology company. XAG's new mission: Advancing Agriculture.

XAG's new vision: We aim to build the agricultural infrastructure of the next 100 years to provide the world with sufficient, diversified and safe food.

5/16

Fortune 40 Under 40

Peng Bin, founder of XAG has been named as one of the Fortune's '40 under 40'

7/28

XAG launched a new series of R150 Unmanned Ground Vehicle

8/20

The 2020 Intelligent Agriculture and Intelligent Equipment Achievements Technology Exchange Conference

The 2020 Intelligent Agriculture and Intelligent Equipment Achievements Technology Exchange Conference held in Nanjing. XAG's founder,Peng Bin, delivered a speech on "Best Practices of the XAG Smart Farm" and discussed XAG's innovation and application of science and technology in the field of smart agriculture over the years.

9/23

The 2020 UK-China Tech Forum organzation by the CBBC & techUK held online.

The 2020 UK-China Tech Forum organzation by the CBBC & techUK held online.Co-founder,Justin Gong,deliver a speech on how Chinese enterprises use agricultural technology innovation to protect nature and empower rural development, and shared the cooperation cases of XAG and British academic and government agencies to tackle global challenges.

10/09

XAG Wins Reuters Events RBAwards20

XAG has been announced as the winner of the category Sustainability Innovation Award from Reuters Events Responsible Business Awards 2020!

11/12

Former UN Under-Secretary-General Wu Hongbo led the European diplomatic delegation to China to visit XAG

11/29

XAG's Smart Farm was selected as one of the top 10 digital agricultural technology application cases in China

11/30

The 2020 Digital Agriculture solution forum organzation by the FAO & ITU held online

The 2020 Digital Agriculture solution forum organzation by the FAO & ITU held online.Co-founder,Justin Gong,deliver a speech on How to use equal and mutually beneficial "unmanned" technology to empower farmers, improve agricultural production efficiency, improve the livelihood of rural communities, and at the same time build a sustainable intelligent agricultural ecosystem.

12/13

The 2020 World Digital Agriculture Conference

The 2020 World Digital Agriculture Conference held in GuangZhou. founder,Peng Bin,deliver a speech on "Highlights and achievements of XAG in digital agriculture".At the same time,XAG was also selected as a "Digital Agricultural Pioneer"&"Ten innovative cases of world digital agriculture".

12/15

XAAC 2020

XAG has launched a new series of smart agri-tech at its annual conference (XAAC 2020) hosted on 15 December, introducing more in-depth digital unmanned solutions to make farming easier and more sustainable.

The new releases include three models of XAG Agricultural Drone and two editions of R150 Unmanned Ground Vehicle for broadcast and mower, which will soon be commercially available in the Chinese market.

Geek Farmer

Hello Agrifuture!

XAG's chapter of year 2020 has come to an end. We've gone through tough times, confused periods, and ever-changing society. What keeps the team strong is the swift mind to cope with changes, and the trust we built among each other. With a clear goal of advancing agriculture, we are inviting you to open up the new chapter of future farming together. Please feel free to write down your closure after reading our Geek Farmer stories of the year 2020 and share your wishes of the 'Agrifuture' with friends like-minded!

XA.COM

BRINGING AGRICULTURAL INTELLIGENCE

XAG R150 Unmanned Ground Vehicle
Unmanned operations with smart control,
one system for multiple jobs.

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