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The causes, course and consequences of the surge in Venture Capital AgTech investments

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Abstract

Between 2018-2022, there was a significant surge of venture capital in Agtech. The causes were many: the rise in global population and its consequences, AgTech developments themselves, the search for new investment sectors by VCs themselves, and even the pandemic all played a part. The surge brought investment to locations that hitherto had been completely outside the VC radar, notably Asia but now also Africa. Now that the surge has ebbed, along with VC investment as a whole, it is possible to begin to take stock. The evidence to date suggests that the majority of investment during the surge has flowed into downstream companies with the opportunity for rapid growth and high valuations. No global champion has yet emerged for upstream AgTech, whether in plant genetics, animal health or even novel farming systems. The impact of the surge in raising yields therefore rests on exits to or partnerships with major corporates, as they have the capacity to deliver technology at scale.

Key words:

Agribusiness, Agricultural Technology (AgTech), venture capital

JEL classifications:

Q14 Agricultural Finance, Q16 R&D, Agricultural Technology, Biofuels, Agricultural Extension Services, G24 Investment Banking, Venture Capital, Brokerage, Ratings and Ratings Agencies.

Introduction

Global food requirements are rising rapidly, both because of population growth and dietary change, but agricultural production growth remains constrained by the area of available land and by the level of attained yields (Van Dijk, 2021). The lure of technology as a potential solution to the problem is therefore strong. In recent years, venture capitalists have turned their attention to agricultural technology. What has driven this turn, how has it evolved, and to what extent has the surge led to greater opportunities for raising agricultural yields?

What is venture capital?

Venture capital (VC) itself has been variously defined. Most definitions circle around (a) investment in early-stage companies with excellent growth prospects and unique, or at least very distinctive, technologies or service offerings, frequently operating in fast-moving markets, but which (b) are unable to access capital markets (whether debt or more conventional equity) as a result of negative cashflows and/or high levels of risk (NASDAQ, 2022; Gompers & Lerner, 2001:145; OECD, 2014:1; Guilhon & Montchaud, 2020: xiii-xiv). The distinction between *venture capital* (VC) and *private equity* (PE) remains important. This is so even if some organisations engage in both and the rise of venture debt with its accountancy advantages has blurred the traditional line between the financial expertise and leverage of private equity and the equity-focused, value-added approach of venture capital. But although there are significant exceptions, VC investments remain generally smaller, riskier and at earlier stages in the company's development (Seed, and successive Series from A onwards). VCs themselves are financial intermediaries, receiving investor capital and channelling it, after exhaustive due diligence over many potential investments, towards carefully selected privately-owned growth companies. They then take an active role in mentoring them, seeking themselves to exit their investments through a sale or an IPO. Typically, VC funds are established with a timeframe of approximately a decade – 2-3 years to make investments in companies, 3-5 years to nurture them and 3-4 years to exit.

What type of agricultural business suits VC investment?

From these definitions and understanding of what VCs seek to achieve, it is possible to identify the types of agricultural businesses in which venture capital is or is not likely to invest. Traditional agriculture and farmland are in the latter category: not that either has performed poorly as a long-term investment by comparison to other investment classes. For example, they remain the top primary industry for capital secured in Australia, accounting for a third of the total capital raised in unlisted infrastructure outside natural resource funds between 2020 and 2021 (AIC/Prequin, 2022:27). But individual farmland investments rarely if ever possess the capacity to generate spectacular individual returns of the calibre VCs seek. So is agribusiness in general, from farm to fork, although it has broadened its meaning since its original definition (Davis & Goldberg, 1957:9) to include, e.g., urban agriculture and aquaculture, which might be regarded as a better potential source of high-growth companies, as most agribusiness investment opportunities reside in companies that are established businesses rather than new entrants, wherever they are situated along the supply chain. Even the majority of new entrants aim at established markets and are as unlikely as farmland even to promise their investors spectacular returns.

What that leaves, for agribusiness as for other industries such as manufacturing or telecoms, is the technological frontier. In the case of agriculture, it has been defined as Agricultural Technology (AgTech): innovative technologies aimed at raising productivity, improving resource use efficiency, and

reducing ecological impact (Dutia, 2014, p.172), especially if they deliver patented technology (USSC, 2018). By contrast to agriculture and agribusiness more generally, AgTech is entirely suitable in principle for VC funding.

Opinion is divided, however: There is significant evidence that VC investment *succeeds* (Dumanska, 2018), including in developing countries, both in terms of returns (Graff *et al.*, 2021) and in rate of growth (Kato & Tsoka, 2020), including specifically for agribusiness SMEs (Kato & Germinah, 2022). On the other hand, there has also been ‘push-back’ against VC investment in Agtech, with it portrayed as hype (Fairbairn, *et al.*, 2022), a reflection of the financialisation of agriculture, with the implication that it carries little real likelihood of increasing yield, despite its own supporting narrative (Sippel & Dolinga, 2022). Investigation now — even at a relatively short remove from the end of the surge, paralleling a downturn in VC investment globally — may help to sway the argument.

Are there explanations for the surge?

Venture capitalists and analysts themselves present a very similar list of reasons why VCs turned to AgTech, which can broadly be divided into primary, or underlying, reasons, secondary reasons that concern the global business environment, and finally changes in the structure of the VC industry worldwide.

The most obvious is the growing global population, set to reach 8.5bn by 2030 (United Nations, 2023). Climate change and global warming, leading to increasing constraints on natural resources, particularly land and water, has been at least partly responsible for waves of high commodity prices, which have been identified as significantly positively correlated with venture capital first turning to Agtech, between 1996-2017 (Graff *et al.*, 2021). Accompanying this population growth has also been changing consumer demands, including both increased demand for meat protein in emerging markets and conversely, increased demand for plant-based meat substitutes and the rise of health objectives in dietary choices, e.g., concern for obesity, driving reduced demand for processed food, both especially in developed countries. Finally, there have been international policy drives to cut food waste: in Australia, an estimated 7.6m tonnes annually (Australian Government, 2022). In developing countries, the amount can be even higher, with particular challenges around logistics and refrigeration.

The secondary explanations relating to the business environment are principally those of sustainability and the perceived need to respond to global hunger. The issue of sustainability in the agriculture and food sector has been a global concern for decades (Aigner *et al.*, 2003). But now, this awareness has fully spread to the private equity and venture capital industry. A ‘new generation’ of impact investors and specialist VCs perceive that the industry was ripe for transition to sustainability, transparency and better productivity was observed a decade ago (Kerslake, 2012) and these investors have acted on that perception. Concern over global hunger and COP26 climate goals meshes well with AgTech investment, with e.g., carbon sequestration to combat climate change, reduction of synthetic crop input products to support environmental sustainability and vertical farming (Agfunder, 2021). With millennials driving its rise, ESG investing has become more prominent, for example in Australia, with super funds leading the way. As at March 2023, for example, Australasia as a whole has 275 signatories to the United Nations’ Principles for Responsible Investment (UNPRI, 2023). Meanwhile, the ‘gap’ between agri-tech and renewable investment continues to diminish, e.g., with Agri-PV systems (Bretzel, 2022). There is also continued interest in traceability, including via regulatory drivers (e.g., the EU). Finally, the pandemic also encouraged investment in potential supply-chain solutions, e.g., Infarm in Germany (Pothering & Burswood-Taylor, 2021). VCs themselves can take only a very small credit for these opportunities, despite claims that agrifoodtech entrepreneurs were responsible for keeping smallholder farmers and food supply chains afloat (Agfunder & Omnivore, 2021:4), but these factors

together have encouraged greater investment in a range of AgTechs, providing in turn many more more opportunities in which to invest.

A third set of reasons are connected with the changes in the global VC industry itself. The industry grew apace and was actively looking for new potential investment destinations: more than 30,000 venture-backed startups were funded with US\$669bn of investment in 2021—up from 3,500 companies in 2006. AgTech was one of several sectors that benefitted. Conversely, macro trends and the resultant general slowdown in deal activity and overall VC investment were strongly correlated with the fall in AgTech investment that was seen in 2022. Secondly, recognising potential challenges from VC-funded startups, and amid regulatory pressure to make the food system greener and more sustainable, for example to reduce fertilizer use, large agribusinesses such as ADM and Bayer, as well as innovative conglomerates such as BayWa, have been increasing the scale of their corporate venturing (AgFunder, 2021:9, 22). The result was to create a ‘snowball effect’. In the past, stellar returns have been available from technology companies (e.g., in 1998, Google took just 16 days from launch to reach 10m users) but this was not so easily achieved in the 2010s. But the growth of companies such as Impossible Foods and Beyond Meat showed that in food-tech, at least, spectacular returns were possible. In no small measure as a result of these individual success stories, Agfunder was able to report that its early portfolios were tracking 23%+ Internal Rate of Return (IRR) and that over 75% of rounds it participated in were oversubscribed (Agfunder, 2022). Agribusiness VC investment therefore became something of a virtuous circle: more willingness by VCs to make Series A, B and C investments in agribusinesses/AgTech encouraged others to step in at preceding stages, given a perception of easier exits and good returns. As a result, using a sample of 150 best-in-class agtech start-ups, McKinsey concluded that a typical AgTech recipient of VC funds during the surge spent 15 to 20 months between rounds, with funding levels typically growing from a median of US\$3.5m million seed to US\$65.0 million in series C (Asthana *et al.*, 2022).

Returns must, however, be matched by liquidity. Historically, the most likely path to an exit and liquidity for an agtech startup investment was to sell it to a large but focused acquirer such as Corteva or a conglomerate with substantial reach into the AgTech space, e.g., Bayer or John Deere. The more funds that invest in Series A and later, providing opportunities for Seed exits, and so on along the chain, the greater the level of comfort with exits for Seed investors. At the other end of the chain, over the past decade, US public markets, in particular, became more receptive to AgTech companies, with flotations on public stock exchanges (Initial Public Offerings — IPOs) occurring through Special Purpose Acquisition Companies (SPACs), specially formed companies for listing (e.g., Novus/AppHarvest) or the traditional IPO route (e.g., Greenlight Biosciences). Even some measure of diversification for investors became possible through Exchange-Traded Funds for AgTech, although on a very small scale (VanEck, 2022).

The importance of institutions in the snowball effect should also be recognised. Agfunder (USA/UK) has been a stalwart and continuing institutional bulwark for disseminating knowledge of the sector to VCs, also acting as a conduit between VCs and investees. Now, even a Japanese bank like Norinchukin is comfortable investing (Norinchukin Bank, 2022; Agfunder, 2022a). By contrast, in Australia, individual experts began by establishing consultancy organisations and disseminating information, linking with the public sector in so doing (Agthentic, 2019)

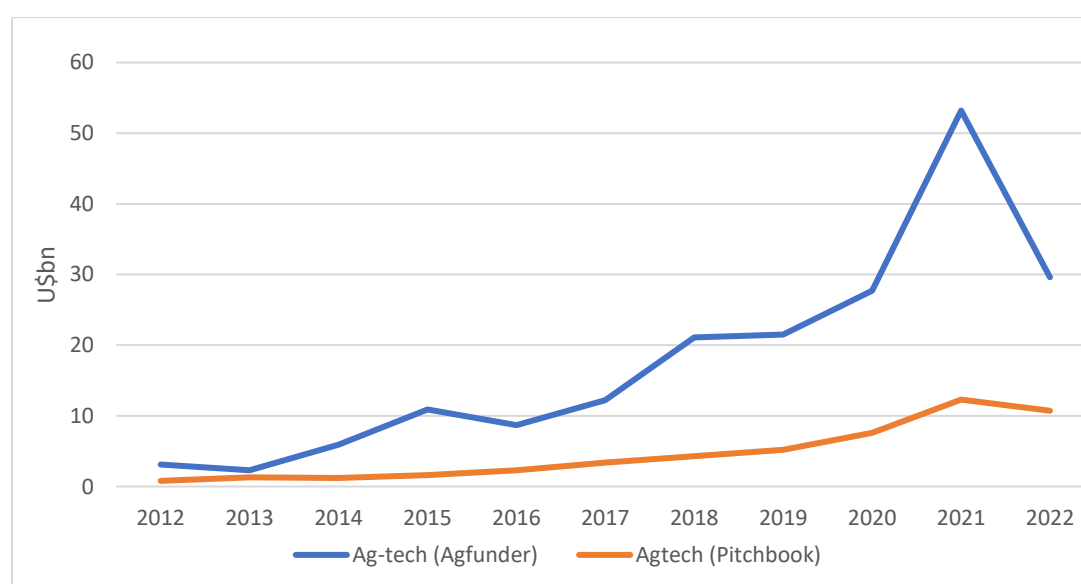
What has happened?

A decade ago, research suggests that: ‘the decision to fund a new startup is mainly shaped by the entrepreneur’s industry experience, product stage, revenues, time of applying to the VC fund, and the size of the entrepreneur’s social network’ (Ismail & Medhat, 2021:25). One of the easiest ways of

culling the pile of business plans is therefore to ignore industries that are unfamiliar. The bulk of VC investment is in technology — especially software — and biotech, so few VCs have agriculture backgrounds (Kerslake, 2012). VCs were sceptical of the potential for speedy returns in fields such as rooftop farming and local food systems. Even VC investors in developed country with a large and advanced agricultural sector such as Australia tended not to have a solid enough understanding of the nascent sector or the networks (of trusted experts to perform due diligence on start-ups) to make the most of it; while those few experienced agrifood investors overseas saw Australia as too small an opportunity, and too far away, to commit to (Ellis, 2021).

As a result, a decade ago, only US\$6.4 billion was invested in the *entire* food and agriculture sector by private equity investors, just 3% of total investment, whilst agribusiness startups even in the USA were complaining that venture capitalist did not invest in the sector (Kerslake, 2012). What has happened since? There are problems of definition that complicate the task of understanding how much VC investment has found its way into AgTech, notably between AgTech as a whole and ‘Agri Food Tech’, ‘...the small but growing segment of the startup and venture capital universe that’s aiming to improve or disrupt the global food and agriculture industry’ (Agfunder, 2017), a broad definition that encompasses upstream crop and livestock biotech, property management systems and payments, biomaterials and meat alternatives, as well as downstream tech platforms for food delivery. Other reporting sources such as Culterra Capital categorise differently, dividing AgTech between Farm and Food Supply Chain Tech, with the farm gate representing the figurative (and porous) dividing line between them, whilst Juniper Research provides only examples of AgTech firm types (Kane and Shonkwiler, 2022). As a result of these varying definitions, together with different organisations collecting and publishing data on VC investment in AgTech and changes to sector boundaries, statistics inevitably do not tally. However, all sources agree that the past decade has seen a radical change, with a rapid and sustained increase in VC investment in AgTech. Two key sources are Pitchbook and Agfunder; their statistics are shown below in Figure 1.

Figure O1 VC Agtech global volumes 2012-2022.

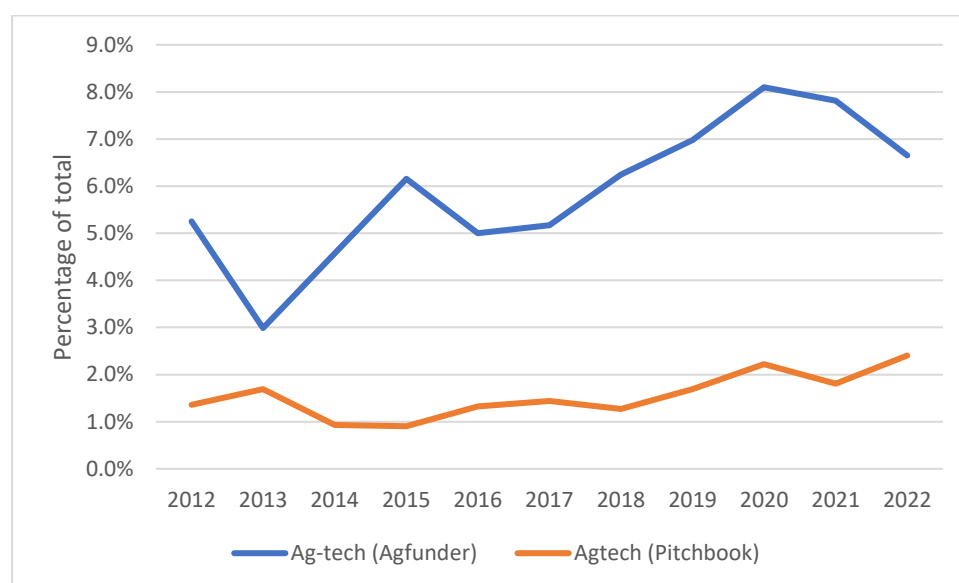


Sources: Agfunder (2023) and Pitchbook (2023)

Agfunder casts its net wider than Pitchbook, including more in the category of AgTech, hence its higher numbers overall. Contradictory statistics on deal numbers from the two data sources also reflect this disparity: the number of Agtech VC deals globally (655) either actually increased by 13.5% (Pitchbook, 2023), or fell to 2,797, a fall of 19% from 2021 (Agfunder, 2023).

The inter-industry VC investment data provided by Crunchbase makes it possible to compare the scale of VC AgTech investment with the overall total. The disparities in data collection methods between Pitchbook and Agfunder account for the disparity in 2022, as Figure 2 below indicates, but the surge is unmistakable.

Figure 2: Agtech share of global VC investment, 2012-2022



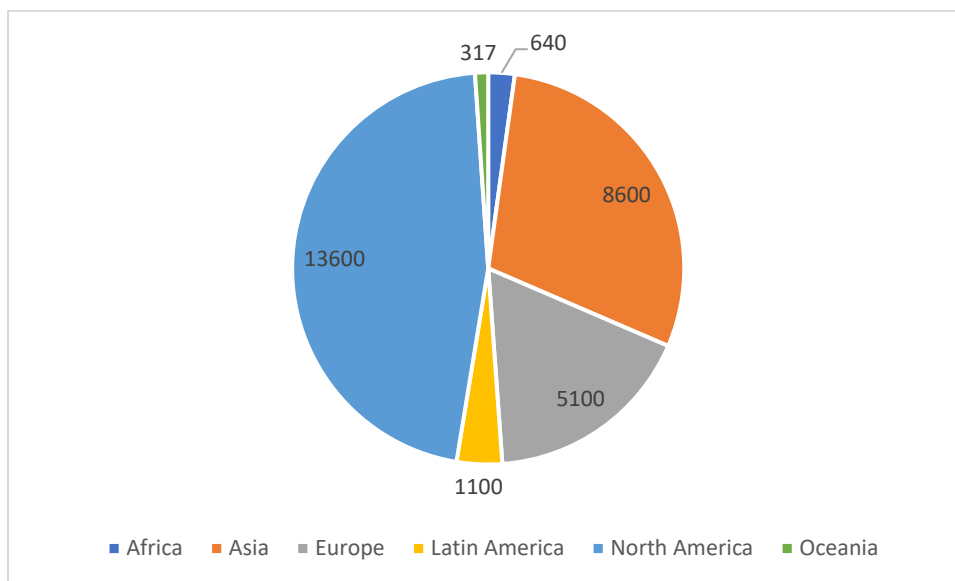
Sources: Agfunder (2023), Pitchbook (2023) and Crunchbase (Teare, 2023).

By contrast, evidence on the scale of VC investment by comparison to that of the AgTech industry as a whole is sparse, hampered by both boundary issues, lack of data from start-ups generally, and lack of geographically specific VC investment data in order to make a comparison. An initial snapshot based on 2020 data for the US State of Georgia, however, using AgFunder and NAIC industry data, estimated US\$79m of VC investment compared to just US\$58.6m sales by AgTech businesses, a 1.35 ratio. (Kane & Shonkwiler, 2022). Whilst it is not possible to derive from these two data points an estimate of what percentage of Georgia AgTech is VC funded, evidently, VC investment powers at least a significant proportion, especially as, if anything, the NAICS code boundary for AgTech was drawn more widely than the AgFunder equivalent.

The geographical distribution of VC Agtech

The evidence from both Pitchbook and Agfunder data suggests that the dominance of North America in AgTech investment has continued throughout the surge, although as Agfunder indicated in its latest report, the share of VC Agtech investment directed at the Asia-Pacific region has grown steadily, reaching 30% of the total by 2022, which Figure 3 shows in context (Agfunder, 2022b).

Figure 3 VC investment by region 2022 (US\$bn)



There have been good reasons for this concentration: as Microsoft has pointed out, much successful Agtech relies on accurate data, but with more than 40% of the global population still without internet access and connectivity issues surfacing even in the USA, the statistics above demonstrate that AgTech solutions continue to be unevenly distributed geographically (Burwood-Taylor, 2022). Yet from slow beginnings, VC investment in AgTech throughout the developing world is beginning to accelerate, even as it slows in the developed world. The globalisation of VC investment into AgTech can be illustrated by two examples of jurisdictions, India and Australia. From 2012 to July 2022, about 72.8% of agritech deals took place on the American continent; by 2022 the Americas took half the total (Agfunder, 2023:27), but Indian initiatives in particular (Agfunder, 2022b) indicate that the traditional dominance of the USA in attracting VC Agtech investment may be about to change, as whilst in 2022 US deals volume and value fell 17.5% and 16.3% respectively, the opposite was true in India where the equivalent volume and value data were 79.5% and 49.9% growth respectively. If this trend continues, the traditional dominance of the US over VC Agtech may be slipping.

India now has both impact funds such as Lok, Aavishkaar, Aspada, Elevar, Ankur, Unitus and generalist VC funds such as Accel, IDG, Matrix, Kalaari, Nexus, all generally focused on agri startups, some with a particular focus, e.g., Aavishkaar Capital's investment in low-income states. Omnivore, dedicated to agribusiness, is probably the most well-known Indian agribusiness fund manager. Some of the investors in its first close included German government-owned development bank-KfW, SIDBI, DGGF, AXA Investment Managers, The Rockefeller Foundation, Ceniath, RBL Bank, and the Sorenson Impact Foundation. It closed its second fund in 2019, focused on digital platforms, precision ag, IoT, UAVs, remote sensing, and Big Data solutions. The firm also looks for investment opportunities in companies creating branded food products and novel ingredients, along with start-ups looking to improve rural livelihoods with supply chain, water management, and fintech solutions for smallholder farmers. It announced in April 2022 it was launching a third fund focused on early stage-technology driven start-ups focusing on agriculture, food, climate change and rural development, aiming to raise US\$130m with final close in 2023.

By comparison, in particular to US standards, Australian AgTech investment is very modest (1/50 per capita) and circumscribed (Maughan *et al.*, 2018; Meers *et al.*, 2020). There even remain significant concerns in most jurisdictions about the appropriateness of the traditional VC model for agribusiness, even AgTech, including in Australia (Campbell, 2022). Despite the significance of its agricultural sector

for the economy, Australia secured only US\$348m of AgTech funding in 2022 across 34 deals, compared to Singapore, an entirely urban country, \$1.1bn across 63 deals. There are specialised VC AgTech funds, of which the first and most well-known is Tenacious, which raised A\$19m in 2019 first close, the Clean Energy Finance Corporation (CEFC) and Grok Ventures committed A\$8m each in cornerstone funding. Its second close was in June 2021 at A\$35 million. It targets Seed and Series A investments, including Food-tech. In February 2022, Tenacious made the 10th investment from its inaugural fund, A\$1.6m pre-seed into Cecil, a natural capital software platform. This follows other investments in Goterra, an autonomous agricultural vehicle platform, SwarmFarm Robotics; a US-based carbon marketplace Nori, a cellular agriculture company Vow, a digital crop protection platform RapidAIM, a sustainable protein company, Nowadays, a crop management and analytics firm Regrow; electrochemical tech Jupiter Ionics, and blockchain fintech firm Geora (Kemp, 2022). By late 2022, its fund was approximately 60% deployed.

Finally, also also by way of comparison to what is happening in India and elsewhere in Asia, although its absolute volume of investments has risen dramatically from a negligible level as late as 2019, and with that its proportion of the overall total, Africa has been a significant loser in the VC surge. By way of example, the largest VC investment to date in Africa, where midstream technologies have dominated, has been Twiga Foods, a B2B platform aimed at streamlining fresh produce supply chains, which raised US\$50 million in Series C funding in 2021 (AgFunder, 2022c). It is encouraging that FAO has recognised the extent of specific VC funding problems in Africa, although they have not yet devised the kind of development funding solution that has worked for infrastructure (Paquette *et al.*, 2023).

VC Agtech investment by category

The evidence from the surge suggests that even using the narrower definition of Agtech preferred by Pitchbook, the majority of investment was not in technology aimed directly at raising yields. In fact, even combining both crop and animal investment, only just over a tenth of surge investment was placed with companies at aimed directly at crops and livestock. To that should be added the category of novel farming systems, which also promise to attack the yield problem, which constituted a fifth of the total, but which during the surge exhibited a ‘series of failures prompting a sharper focus on models with proven unit economics and financial returns’ (Agfunder, 2023:64). Companies in the remaining categories can all be expected to have indirectly beneficial effects on agricultural yields, but the amounts of investment are less impressive than those headed towards alternative proteins — as yet not capable of large-scale replacement of existing food sources — or novel farming systems. From a development perspective, VC investment by category during the surge, as indicated in Figure 4, was only tangential to the priorities that international organisations such as FAO have set out as required to increase global food production, including seed innovation, but mainly concentrating on diffusion of technology to developing countries, which the FAO is itself attempting to mediate through its own initiatives in agrifood systems and technologies (FAO, 2022).

Figure AgTech investment by category, 2022

Sector	Amount (US\$bn)	Percentage of total AgTech investment
Alternative Protein, Processing, Food Tech, Feed Production, Food Upcycling and Ingredients	\$2.29	21.4%
Animal Health, Nutrition, Production, Breeding and Monitoring	\$0.30	2.8%
Aquaculture Management and Inputs	\$0.15	1.4%

Biological, Pollination, Novel Crop inputs and Protection	\$0.84	7.9%
Climate Monitoring, Crop Insurance, Farmer Credit, Financial Services and Carbon Trading Initiatives	\$0.97	9.1%
Controlled Environment Agriculture	\$2.11	19.7%
Digital Agronomy, In Fields Sensors, Decision Support and Farm Management Software	\$0.62	5.8%
Farm Robotics, Automation and Labour Planning	\$0.29	2.7%
Food Preservation, Safety, Shelf-Life Extension, Waste Reduction and Reprocessing	\$0.99	9.3%
New Crops and Genetics	\$0.43	4.1%
Supply Chain, Trading, Tracking, Traceability and eCommerce	\$1.65	15.4%
Other	\$0.03	0.3%
Total	\$10.67	100%

Source: Croplife (2023) using Crunchbase data

What has been the result?

It would be tempting to argue that the impact of heightened technological investment in AgTech will be widespread and positive, with scientists looking forward to increased crop yields, analysts anticipating raised productivity, a stream of new products and the emergence of new market leaders (Global Data, 2022), together resulting in ‘significant disruption and value creation within the agrifood sector to take place over the next decade’ (Finistere Ventures, 2021:22), and policymakers and innovative companies encouraged alike both by more efficient land use by agriculture and by a switch to meat alternatives and healthier diets (BayWa, 2023).

There are however several reasons that together should serve to temper this enthusiasm.

Firstly, the important caveat that the development of markets and the impact of technology on a sector is far from instantaneous; it may also be too easy to expect change in a shorter timeframe than is plausible, as comparisons with the tech sector may not be appropriate and ‘agriculture was/still probably is the least digitised industry in the world’ (Burswood-Taylor, 2022). Forecasts such as the claim that agricultural robots would become commercially viable within a five-to-six-year horizon are also now looking too optimistic (Leclerc, 2019); likewise, a US\$500bn estimate for the potential value-add from IT connectivity in agriculture by 2030 (Goedde *et al.*, 2020:6) already seems unlikely. There may also be environmental concerns with many AgTech innovations that will either halt, or at least retard, their introduction at scale. Worst would be the trajectory of plastics, where decades after the invention of nylon, cotton, wool and silk are still in high demand for clothing, whilst plastics have been the subject of numerous environmental concerns. More likely is a gradual erosion of consumer resistance, whether to GM crops, lab-grown meat or even the inclusion of insects in the diet.

Secondly, and of equal concern from a development perspective, because of its geographical concentration on developed countries, and on the USA in particular, the impact of this surge will not be experienced evenly across sectors and jurisdictions. For AgTech to have a significant impact in

developing countries, it is likely to be investments that occur in subsequent years, not the pathfinders of the surge, that will have greatest impact, barring a technology developed during the surge finding its way into developing countries as a result of the acquisition process noted below.

Thirdly, significant global impact for the raising of yields globally, the really important potential development impact of Agtech, requires equally global reach, which may suggest that the right place to look for eventual impact of may be from the use by established global companies of technology originally developed by VC-funded Agtech companies, either as a result of acquiring them, or through licensing arrangements and strategic partnerships, as has been suggested for the future of cellular agriculture (Gagnon *et al.*, 2023), or as exists between insect technology company Innovafeed and ADM. As the FAO notes, the level of R&D expenditures by established firms ‘almost certainly exceeds the funds flowing into new ventures’ (FAO, 2022:26). And this may yet occur, as relatively early on during the surge, Agfunder reported a clutch of acquisitions of VC-backed Agtech companies by leading multinationals — Antelliq by Merck, The Climate Corporation by Monsanto, Agraquest by Bayer, Blue River Technologies by Deere, and Granular by DuPont (Agfunder, 2019). All of these were US acquisitions with the exception of the first. VC exits of this kind have continued, for example the 2022 acquisition of Agrivida by Novus.

Fourthly, if on the contrary the VC surge is to result in least some Agtech firms having not only the capacity to be performance outliers, but actually to do so, to grow into large, international ‘winners’ in the same way that Amazon or Google did before them — and likewise to have significant effects worldwide, to become industry champions, they would have to have that capacity in principle to begin with. Yet the overwhelming majority of AgTech companies are sufficiently specialised that even if their technology is proved to scale up and provide ample returns for the VCs that have invested in them, their impact will inevitably be incremental, part of the continued global efforts to raise yields or improve supply chain efficiency, rather than revolutionary in their impact. The number of sectors with even potential international ‘winners’ is few – their existence can be judged from relative corporate valuations from AgTech investment exits onto public markets, which provide some indication of which firms private and public markets, at least, believe are the companies that will deliver significant disruptive improvement to supply chains, or whose technology will serve to enhance agricultural yields.

In one sense this is certainly true, as almost all venture capital investment can only take a firm so far: beyond that point either larger-scale investment, whether a government programme, private equity, public markets or some combination of them, or immediate sales success, is always required for the delivery of any new technology at scale. In another sense, however, current valuations from AgTech VC investment are decidedly doubtful as an indicator of future impact. Forecasts of corporate success are notoriously fickle, for example when ‘Chinese investors pulled back dramatically from the food delivery startups they backed with gusto during lockdown’ (Agfunder, 2023:6), with the result that companies which had seemed destined for greatness, such as eGrocer Xingsheng Youxuan or Xingsheng Youxuan, quickly declined in value as the consequences of their rapid cash burn rate became obvious. Moreover, not only have corporate lifespans become shorter, but the difficulties of working from valuations are compounded by the problem of distinguishing between early and late-stage IPOs. Amazon’s IPO in 1997 valued the company at only US\$438m (a current value of approximately US\$780m), much less than the largest AgTech valuations (it is now worth approximately \$1trn). By contrast, Google’s IPO in 2004 valued the company at US\$23bn (a current value of approximately US\$34.5bn), and it is now worth US\$1.3trn. Finally, even existing valuations for private companies are subject to significant margins of error, whilst those of public companies can vary rapidly depending on short-term market conditions and perceptions of the company. With these reservations in mind, however, the evidence from valuations points in a very particular direction.

Figure 5: Selected valuable AgTech companies¹

Company	Sector	Valuation US\$	Notes to Valuation
DoorDash	On-demand delivery	\$18bn	Down two-thirds from its IPO valuation in 2021.
GoPuff	On-demand delivery	\$15bn	Based on a Series H funding round in 2021
Getir	On-demand delivery	\$12bn	Based on a Series E funding round in 2022
Swiggy	On-demand delivery	\$10.7bn	Based on a Series K funding round in 2022
Impossible Foods	Innovative Food	\$7bn	Based on a Series H funding round in 2021
Indigo	Agricultural biotechnology	\$5bn ²	Based on a Series H funding round in 2022.
Farmers Business Network	Agricultural Marketplaces	\$3.9bn	Based on a Series H funding round in 2021
Zomato	On-demand delivery	\$5.6bn	Down two-thirds from its peak valuation in 2022, continues to be loss-making
InnovaFeed	Novel farming systems	\$1bn- \$1.5bn	Dealroom estimate as of September 2022. The Series D round in 2022 was for \$250m, but the valuation was not disclosed.
Vanguard Renewables	Ag Biotechnology	\$700m	A leveraged buyout in 2022, led by BlackRock private equity.
DeHaat	Farmer Services	\$700m	Based on a Series E funding round in 2022.
Lanza Tech	Ag+other biotechnology	\$675m	Bioethanol focused chemical company; Series H funding

Source: Crunchbase (2023) and Stock Exchange data.

Valuations continue — despite losses in China in particular — to suggest that, at least from a current perspective, on-demand delivery companies are — at least if the broader Agfunder boundaries are accepted — the real winners from the VC AgTech surge, despite their risks, followed by innovative food companies, notwithstanding their continued losses and their own set of risks. If the Agtech VC surge repeats the experience of previous venture capital surges, moreover, notably in technology, these companies have first mover advantage, so Agtech VC investment will become a victim of diminishing marginal returns derived from its own success, as has happened with technology and other sectors. It is only on a lesser scale that valuations encounter companies more closely associated with possible yield growth technologies, such as farm robotics and farm management software. It is instructive that the most valuable European insect technology company is worth a fifth of the leading Indian home-delivery service. Even those biotech companies with high valuations tend to be focused on chemicals, such as Lanza Tech, or have direct or indirect connections with renewable energy. No global AgTech champion

¹ Data compiled in March 2023 from Crunchbase.com

² Valuation not disclosed, median of Crunchbase range

(from the narrower Pitchbook boundaries) has emerged from the surge to combine a high valuation with technology that can globalised yield improvements: perhaps what was once considered the prime candidate for an AgTech champion, Indigo AG, has not imitated its tech predecessors with a stellar IPO and as of early 2023 was reported as reducing its headcount.

Conclusion

The high degree of correlation with overall VC investment levels may have brought a flattening curve to the decade-long surge in VC AgTech investment, but the evidence of the last decade provided a strong indication that AgTech has become firmly entrenched in the VC repertoire of sectors and now has a global reach.

Whilst the consequences of this investment are difficult to disentangle from the overall increase in AgTech investment worldwide, VC investment has underpinned at least a significant proportion, contributing both to the emergence of food production at scale reliant on AgTech and the concomitant creation of international food-tech enterprises. It remains the case that when we or our descendants look back, technology developed during this AgTech surge may be recognised as having been pivotal both in the globalisation of AgTech investment and in the global transformation of food production away from traditional agriculture towards a new location within industry. But the relatively small-scale valuations of even the largest companies within the narrower Pitchbook boundaries of the AgTech sector suggest that favourable outcomes from the surge will occur through one or both of two mechanisms. Either AgTech has yet to find its own Amazon or Google, or the actual effects of the Agtech VC surge may percolate through to higher agricultural yields and supply chain improvements only slowly, even imperceptibly, and largely as a result of the actions of the global concerns that have acquired valuable technology from VC-backed AgTech, rather than through the emergence of a new global industry champion.

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