Climate Capital:
Financing Adaptation Pathways for Smallholder Farmers

ISF

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About this report

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About AgFunder

AgFunder is a world-leading venture capital and intelligence platform for the global food and agriculture industry. AgFunder's team of award-winning journalists and researchers reports on and analyzes the people, companies, and technologies aiming to improve human and planetary health via its news site and research platform. AgFunder is also one of the most active agrifoodtech investors globally, using technology, media and networks to invest in and support transformational founders and technologies.

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About ISF

ISF Advisors is the leading strategic and financial advisory group committed to mobilizing capital for a more sustainable, equitable, and productive global food system. ISF's combination of research with strategic and financial advisory expertise allows us to analyze problems with a systems lens and structure investment solutions that mobilize different forms of capital.

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Executive summary

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Climate change is here, and getting worse.

"We are in an adaptation emergency. We must act like it."

UN Secretary-General António Guterres at COP28

Wherever you are in the world, you no doubt experienced extreme weather events these past 12 months. In fact, nearly half the global population – some 3.6 billion people – is highly vulnerable to climate change impacts[1], from droughts, floods and storms to heat stress and food insecurity[2]. And climate hazards are only expected to worsen.

Agriculture and food production is at risk. Smallholder farmers in emerging markets are most vulnerable.

Developing nations are disproportionately affected by climate change; a Stanford University study found that economic inequality between developed and developing nations has increased by 25% since 1960 due to climate change[3].

These developing economies are heavily dependent on agriculture and are home to the majority of the world's 500 million smallholder farmers, as well as fishers, herders, and forest-dependent communities - whose livelihoods are derived from renewable natural resources[4]. These populations with the highest dependency on agriculture and the lowest adaptive capacity, particularly in developing economies, will continue to be the most severely impacted by the effects of climate change.

Agriculture must adapt to increasingly inhospitable growing conditions; as early as 2030, corn and wheat yields could drop by as much as 24% and 17% respectively as a result of climate change[5]. In Sub-Saharan Africa, land providing 70% of crop value will be prone to extreme heat stress by 2050[6] . Some $15 billion of annual adaptation investment in agriculture is needed on the continent, according to the Global Center on Adaptation[7].

Given that smallholder farmers (SHFs) produce one-third of the world's food, their ability to adapt to climate change impacts us all.

Despite this, adaptation remains largely underfunded.

Adaptation finance remains a fraction of what's needed – some $212 billion a year by 2030 in developing countries alone[8].

Adaptation initiatives globally have been sidelined by the focus on climate change mitigation – the measurable reduction of greenhouse gas emissions – and the race to "net zero."

Mitigation efforts currently receive 90% of global public and private climate financing, and while adaptation financing reached an all-time high of $63 million in 2021/2022, mitigation finance grew at a faster rate[9].

Agrifood adaptation investment is complicated, yet possible.

Both mitigation and adaptation financing is necessary to help smallholder farmers adapt to climate change. However there are many challenges associated with investing in adaptation in particular, including:

- **Lack of definition.** There is no one-size-fits-all definition of adaptation - definitions range from very broad to very specific. For the purpose of this report, we define climate adaptation as "measures taken to minimize the adverse impacts of actual or expected future climate change or to exploit beneficial opportunities." (see further details in **section two**)
- **Context specificity.** Adaptation is very context-specific; what's needed in a drought-prone region is very different than a flood-prone region
- **Data limitations.** It is hard if not impossible to track certain funding flows to climate adaptation, including agrifood corporations and banks
- **Diverse funding needs.** A range of investor types are needed to scale agrifood adaptation initiatives at different financing stages

Focusing on the world's smallholder farmers - including farmers, fishers and herders - this report is a first look at private sector actors investing in adaptation. Included in this report:

- High-level view of the varied types of capital needed for tech and non-tech adaptation initiatives for SHFs
- Deep dive into where investment has been flowing for climate adaptation agrifood technology startups relevant for SHFs.
- Detailed taxonomy to categorize investments
- Six key agrifood adaptation investment opportunities for a range of private sector actors, plus callouts on where public funding sources can play a catalytic role.

Overall, our analysis demonstrates that investing in climate adaptation for agriculture in low and medium-income countries can be tough, but is very much possible and necessary to uphold our food systems in the face of climate change.

Above
Stock image

Left
Josephine Kimonyi, farmer, at her home in Makueni County, Kenya on November 13, 2022.

Key findings:

1. Varied private capital sources are investing in SHF adaptation

Most financing for small agribusinesses and SHFs comes from commercial banks, followed by non-banking financial institutions and microfinance providers. Financial institutions are an important channel for agriculture adaptation finance, but granular data is not readily available because financial institutions don't classify loans according to adaptation solutions.

Private investors are also investing in climate adaptation, including large multinational corporations, local and international impact funds, farmland funds and even Silicon Valley-based venture firms.

The most robust data findings in this report rely on AgFunder's database of investment deals in agrifood technology startups, from predominantly venture capital investors. Although it is a relatively smaller channel in overall volume, venture capital and other agrifoodtech investments are often a precursor to other forms of financing and therefore a proxy for future trends.

SHF adaptation funding supply*

A range of actors provide adaptation finance for SHF-relevant products & services, however data is largely under-tracked

87% of FIs expect climate change to pose a material risk to their business

NBFIs provide necessary working capital – generally with smaller ticket sizes - to smallholder farmers and agri-SMEs to help fill the gap of commercial banks

$2.4 bn
In annual adaptation funding for low and middle-income economies was committed by MDBs in 2021

$518m
Average annual SHF adaptation agrifoodtech investment targeting SHFs between 2012 and 2023

63% of the 79 companies assessed by FAIRR have made regenerative ag commitments, but only 36% of companies with commitments have quantifiable targets

*Sources: Deloitte and EDF; ISF Agri-SME; FAIRR; ISF & AFN Analysis,
Note: Size of bubbles based on financing flows to SHFs and agri-SMEs according to ISF Agri-SME report and AgFunder analysis

Key findings:

2. Adaptation investment is increasing, but not as a portion of all climate finance

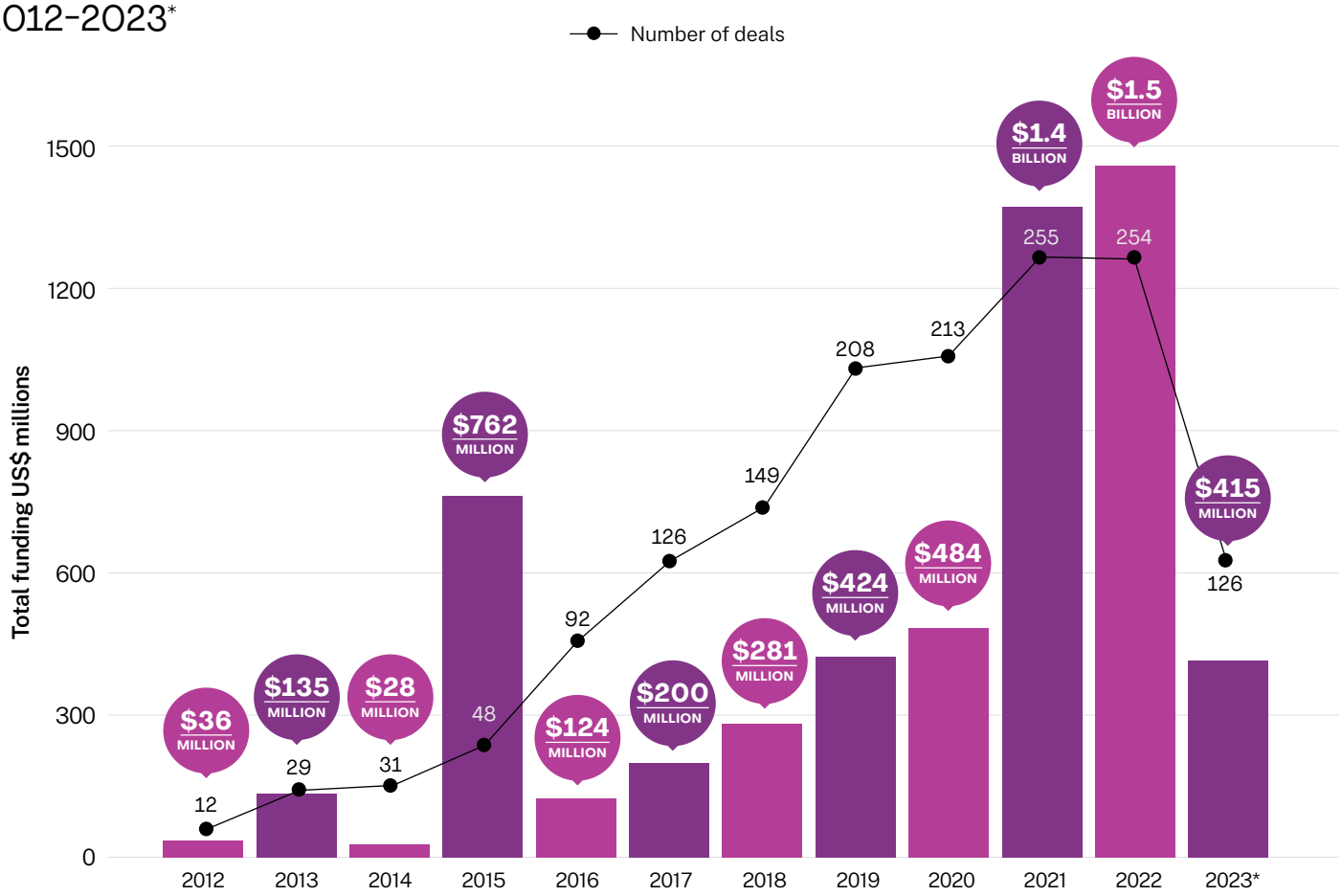
Multilateral development banks are investing at an increasing pace; in 2021, they doubled adaptation investment in food, agricultural and ecological resources to just over $2.4 billion compared to the year before[10].

Tech investors – predominantly venture capital, private equity and impact funds – have put over $5.7 billion of funding to work on adaptation tools and services for SHFs since 2012, increasing year-over-year, except in 2023 when the whole VC market experienced a downturn, according to the analysis showcased in this report based on AgFunder data.

Low-tech adaptation initiatives are also gaining investment, such as local and international efforts to transition farmers to climate-smart and regenerative farming practices, particularly by local and international banks and corporations. Nearly 50 corporates that control a third of the agrifood sector's $9 trillion in revenues mention regenerative agriculture as part of their investment strategies[11].

But funding for climate mitigation is growing at a faster rate than adaptation[12].

SHF adaptation agrifoodtech funding by year 2012-2023*



 *as reported at October 31, 2023

Key findings:

3. Digital tools are the most popular adaptation investment for venture capital...

Within agrifoodtech, digital agribusiness marketplaces are the most invested category as early-stage investors back the scalable aggregation of SHFs to supply inputs and markets typically unreachable to them, as noted in the graphic below.

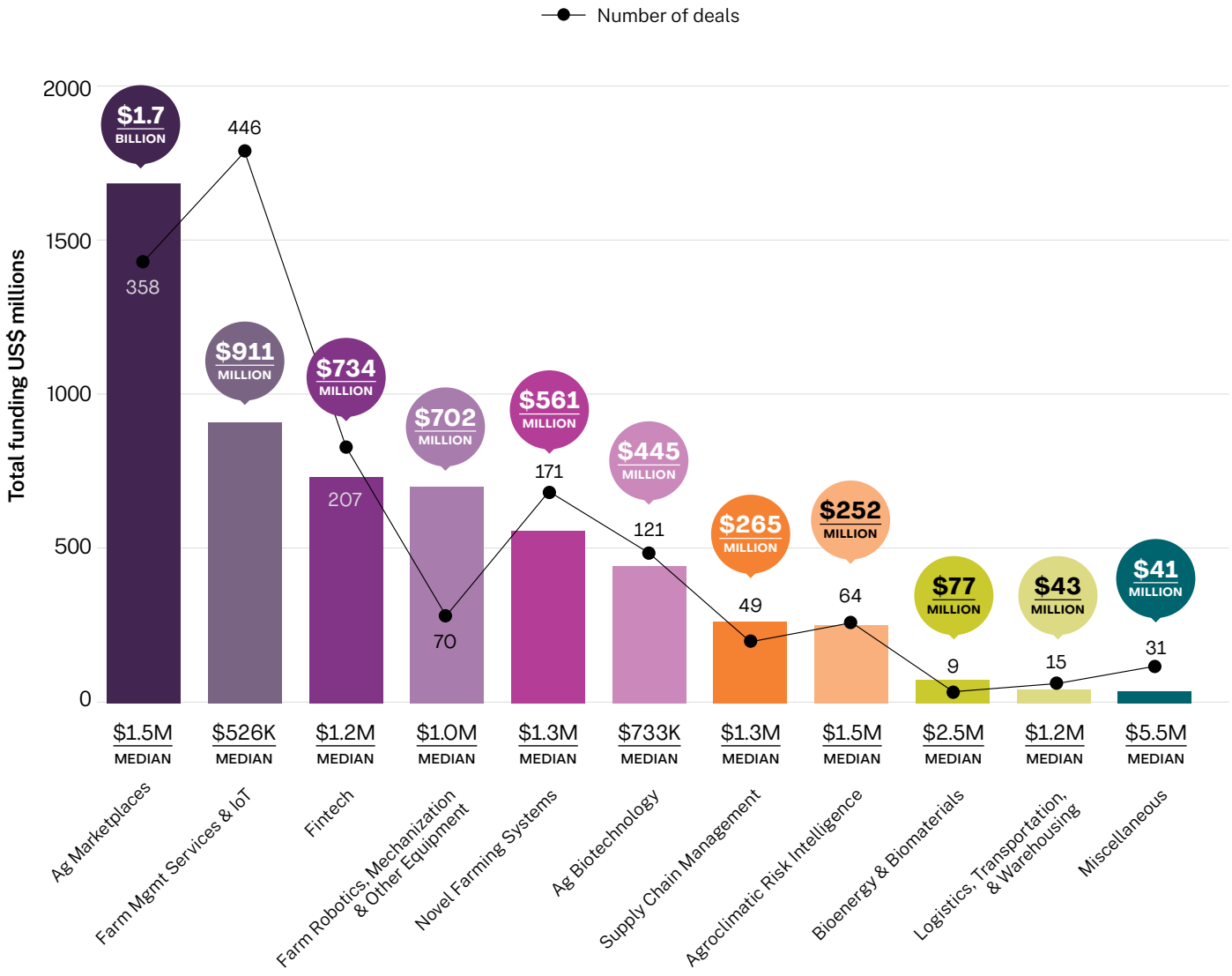
Runner up is farm management services, which enable the adoption of precision agriculture practices and a better understanding of crop yields

Third is fintech tools which also enable SHF financial resilience through access to credit and insurance.

...and India is the leading country for tech investment in adaptation by company HQ location

01	India	$1.9 b
02	Israel	$1.4 b
03	Indonesia	$390 m
04	South Africa	$385 m
05	Kenya	$213 m
06	South Korea	$212 m
07	Japan	$182 m
08	United States	$147 m
09	Uruguay	$124 m
10	Nigeria	$123 m

SHF adaptation agrifoodtech funding by category 2012-2023*



Key findings:

4. Concessional finance and government support are often needed to supplement adaptation funding from private sector actors

To date, climate finance for small-scale agriculture has been sourced 95% from the public sector, including governmental donors, multilateral development finance institutions and bilateral development financial institutions, with grants the predominant financial instrument providing 50% of committed finance, followed by concessional and non-concessional debt[13].

Approximately 14% of the adaptation agrifoodtech companies in our dataset received grants before other private investments.

Many of the successful fund managers we spoke with are tapping public, concessional, or "blended" sources of capital.

Several funds also have grant-funded "technical assistance" facilities that complement their investments by offering pre-or post-investment support to investee companies. And good monitoring and impact management is often supported by grants.

Forward-thinking investors are aligning themselves closely with local government strategies. While private investors can't always wait for governments to catch up – nor should they at the expense of progress – government initiatives can help accelerate private investment in climate adaptation for SHFs. The Government of Rwanda's **Ireme Invest** program is a good example of strategic coordination between public and private sector players to support green business growth. The program is supported by various bilateral and multi-lateral donors and channels investment through the Development Bank of Rwanda and the Rwanda Green Fund.

While investing in climate adaptation can be difficult, there are ample opportunities for a wide range of private investors. In the report, we have identified six investable opportunities that can help smallholder farmers adapt to climate change:

Opportunity		Sample Investments
On-Farm and Post-Farm Infrastructure	Changing temperatures and natural disasters will require innovative on-farm and post-farm solutions for smallholders, including solar irrigation, climate-controlled environments, drying equipment, cold storage solutions, and feasible transportation channels.	SunCulture ecozen
Enabling Data and Intelligence	Emerging sets of software providers - including precision agriculture, traceability, monitoring, reporting, and verification, and agroclimatic risk providers - are key to collecting, interpreting, and delivering data and information to players across the value chain, thereby allowing for improved forecasting and risk assessments before, during, and after production.	aquaconnect® Cropin
Adapted Inputs	Various applications of adapted inputs can assist SHFs in adapting to climate change through adapted crops that offer more stable yields, enhanced pest and disease resistance, improved water efficiency, and improved soil health. Both high-quality inputs and the right distribution channels are instrumental in promoting adaptation.	puna.bio String
Financial Services	Climate change will pose additional challenges in the agriculture sector, therefore making working capital even more constrained and necessitating increased and alternative finance sources for SHFs, including the need for increased insurance.	Degas EQUITY
Climate Adaptive Value Chain Actors	Many midstream value chain companies (e.g. agro-processors) directly engage with farmers, and can be a channel for encouraging and providing the necessary training/inputs to help them adapt to climate-smart practices.	TomatoJos HERSHEY
Ag Marketplaces	Innovative marketplace solutions can be instrumental in promoting supply chain connectivity and access to better markets and inputs for SHFs across crop systems, livestock, and aquaculture in the face of climate change.	DeHaat Seeds to Market AFEX

Investing in adaptation is not only necessary but urgent. As our analysis shows, adaptation is a readily investable theme where many investors are finding opportunities. It is not easy, and much more investment is required across all the opportunities described above.

Despite this growth much more investment is required across all the opportunities described above. Private investment will in some cases need to be paired with public investment and government action to enable relevant technologies and solutions to reach smallholder farmers.

This study represents a first step towards more transparency around private investment flows in climate adaptation for smallholder farmer agriculture systems. However several data and knowledge barriers remain, particularly regarding investment among commercial banks, non-banking financial institutions, and corporate supply chains. We hope this report is a useful tool for investors and serves as a launching pad for additional research in climate adaptation investment for the benefit of smallholder farmers.

Urgency of Investment

Sub-Saharan Africa Deep Dive

$15b

Cost of action
(annual)*

$201b

Cost of inaction
(annual)*

When it comes to investing in climate adaptation in agriculture and food systems in Sub-Saharan Africa, the cost of action is less than a tenth of the cost of inaction[14], so the economic case is clear.

* *Source https://gca.org/wp-content/uploads/2023/01/GCA_State-and-Trends-in-Adaptation-2022_Adaptation-Finance-Flows-in-Africa.pdf?_gl=1*1shvmx5*_ga*MTEyMDM5MjIwNC4xNzA3NzU5ODcy*_up*MQ.*

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Introduction

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Introduction

2030 is fast approaching. The global community must hit the accelerator hard on both funding and innovation to achieve the Sustainable Development Goals and slow the pace of global warming. But climate change and **its related hazards** are already here; wherever you are in the world, you no doubt experienced extreme weather events these past 12 months. In fact, nearly half the global population – some 3.6 billion people – are highly vulnerable to climate change impacts[1], from droughts, floods and storms to heat stress and food insecurity[2]. And climate hazards are only expected to worsen.

Climate adaptation is often referenced as a critical need by world leaders – before COP 28, the UN Secretary-General António Guterres said, "We are in an adaptation emergency. We must act like it."

The Global Goal on Adaptation, which aims to provide targets and frameworks for global adaptation initiatives and improve support for adaptation in developing nations, **finally took shape** in Dubai this past November after eight years in the making. However, it still lacks quantified, measurable targets, as well as implementation measures to mobilize finance, technology and capacity building for adaptation.

Adaptation finance reached an all-time high of $63 billion in 2021/2022, a 28% year-over-year increase, yet it declined as a portion of overall climate finance – to 5% from 7% – as climate mitigation finance grew at a faster rate[3].

Further, it's a fraction of what's needed; low and middle-income countries alone need some $212 billion a year by 2030[4].

Low and middle-income countries, where both population and carbon emissions are on the rise, are the most susceptible to climate threats and least equipped to finance adaptation and a sustainable economic transition.

What's at risk if we don't take action? Global food supplies. Food security. Billions of livelihoods. Much more. Smallholder farmers -largely based in low and middle-income countries -produce a third of the world's food[5].

Consider that daily staples (and luxuries) like coffee, tea, bananas, rice, and chocolate are largely grown in emerging markets and exported around the world. Agricultural productivity is already negatively impacted by climate change[6]; the intensifying climate vulnerability of smallholder farmers affects everyone, at the grocery store, bodega and kirana shop till. Capital to support the world's 500 million+ smallholder farmers – and the 2 billion people whose livelihoods depend on them[7] – as they adapt to climate change is in woefully short supply.

The good news: there's plenty of opportunity and a role to play for everyone, no matter what type of capital or resources are at their disposal. AgFunder and ISF Advisors, with support from the Bill & Melinda Gates Foundation, have staked out the climate adaptation investment landscape for the agriculture sector in emerging markets, with an emphasis on smallholder farmers. In a first-of-its-kind report:

- We highlight the current barriers to adaptation finance, and also pinpoint six key investment opportunities that will be crucial to smallholder farmers' climate adaptation and transition potential. These include: climate-smart inputs, on-farm/off-farm infrastructure, financial services, supply chain connectors, data and intelligence, and marketplaces.
- Leveraging data from **AgFunder** and other industry peers, we estimate the current levels of investment in each of these categories and map geographic and investment-specific opportunities where funders can engage.

- We pinpoint opportunities for engagement from the broader financial services and impact ecosystems, including: the strategic use of concessional and philanthropic capital to de-risk investments and prove out products, services and markets; delivery of technical assistance and advisory services to bolster interventions' chance of success and deepen their impact; and applications of impact measurement and management frameworks to improve transparency, accountability and replicability of investment opportunities.

A key takeaway: Technology will be a critical enabler of adaptation strategies, but adaptation investment needs to extend beyond the underlying technologies. For example, digital agriculture marketplaces are helping connect farmers to quality and affordable inputs, equipment, storage facilities, logistics providers and buyers, but the success of such businesses will depend on more than venture capital. Companies may require strategic grants to enter new markets or test services with new customer segments; working capital or inventory finance to cover upfront costs; or technical assistance facilities to train farmers in novel farming techniques.

Furthermore, our research uncovered the increasing need for collaboration between different types of investors in adaptation projects – co-investing in the same deals as well as at different times in a company or project's lifetime, as well as partnering more tangibly on the ground; all investor types are needed to finance climate adaptation for smallholder farmers.

What does agriculture climate vulnerability look like?

- Climate-related disasters have caused about $3.8 trillion worth of lost crops and livestock production over the past three decades globally[8].
- The number of climate-related disasters increased 83% between 2000 and 2019 compared to the previous period[9].
- Farmers are facing declining productivity as a result of extreme weather events and the emergence of new pests and diseases. The resulting supply and price volatility add to farmers' income stress.
- More than 70% of Africa's farmland will face severe heat stress by 2050[10]. Similar threats will face smallholders in other regions.
- In India, Ethiopia, and Mexico, nearly 80% of smallholder farmers will be susceptible to at least one climate hazard by 2050[11].
- Global soil moisture content has declined steadily in the 21st century and 33% of soils are already degraded - that could reach 90% by 2050[12].
- Severe food insecurity and undernourishment have been on the rise since 2015; by 2050, the risk of hunger and malnutrition could increase 20%[13].
- In aquaculture, West African marine fisheries are expected to lose a fifth of annual landed value, half of all fisheries-related jobs, and $311 million annually in foregone income across the food system under a 3°C scenario[14].

How we define 'adaptation'

For the purpose of this report, we define climate adaptation as "measures taken to minimize the adverse impacts of actual or expected future climate change or to exploit beneficial opportunities." (see more in **section two** of this report.)

Yes, it is broad, but as we discuss in our findings, a broad definition of adaptation is necessary for emerging markets because the lines between adaptation, resilience, and mitigation are often blurry. A smart irrigation system helps a farmer adapt to today's climate impacts, but adopted at scale, can help mitigate future stresses through better collective water management.

Why we wrote this report

The lack of adaptation finance in the agriculture sector is an urgent issue for the global community. Numerous barriers inhibit investment but there are also investments being made seemingly under the radar.

Our goal is to shed light on some of these investments, highlight where activity is happening, and offer a taxonomy and actionable pathways for the global investor and donor communities to meaningfully (and, in many cases, profitably) put their money to work.

Barriers to adaptation finance

Why is there such a significant shortage of financing for agriculture climate adaptation?

First, global investors perceive greater risks and costs for investing in low-and middle-income countries, dampening the total available supply of capital, particularly in a difficult global economy. Compounding that issue is investors' heightened sense of risk in agriculture specifically: smallholder farmers have been historically difficult to reach, underwrite, and track.

Second, there is a lack of general knowledge about the solutions available and in development to address climate-related challenges. Every practitioner has a slightly different definition of what adaptation entails. Compared to mitigation finance, which always focuses on reducing greenhouse gas emissions, adaptation requires a broad definition and range of actions that are then tailored to specific climate hazards and locations.

There is also a need for more knowledge about viable and investable business models for adaptation. Deciding which adaptation issues to address is complicated by uncertainty around how significant future hazards will be, and the cost and rewards of investing in solutions relative to their likely impact. The evolving landscape of climate hazard forecasting will help direct the market.

Also, taxonomies tend to center around adaptation-related products and services but often fail to account for the type of business, which is crucial to the success of said products and services. This deters investors because it creates the impression that there is a lack of investable opportunities beyond a few well-known technologies, like solar-powered irrigation.

Also missing: an understanding of how and what types of capital must be deployed for climate-smart businesses to become investment-ready. A potentially viable model may initially need grant capital for product development, or concessional capital to prove its target customer base. Investors often (mis)perceive that companies that depend on grants or concessional financing terms in the early days haven't set up their businesses to be profitable long-term. Investments in adaptation may also have longer pay-back timelines, deterring traditional venture or private equity investors that invest on a five or 10-year timeline.

Third, climate adaptation investment data isn't widely available or tracked, which means investments and trends are hard to spot.

Moreover, adaptation finance activity may be bigger than we realize as investments may be undercounted. AI could help uncover and track deals, however. In AgFunder's dataset, just two companies explicitly called out adaptation in their company descriptions versus the 710 companies we unearthed using natural language processing alongside keywords and contextual assumptions.

One complicating factor is that adaptation approaches differ, by necessity, from location to location. Climate impacts and hazards are context-specific and look different in different places; the solutions therefore need to be locally relevant (and some may not be scalable or applicable in certain regions).

Introduction

A key takeaway: Investing in climate adaptation and resilience can have financial benefits for private sector players, but agriculture is harder than other sectors. A recent BCG report found that investing in regenerative agriculture can deliver an economic benefit-to-cost ratio as high as 5:1 in emerging markets[15]. While this indicates there is the potential for financial returns in agriculture, it's much lower than other adaptation initiatives such as water collection, which delivers a benefit-to-cost ratio of up to 50:1.

How to use this report

There is something here for all types of investors, whether you're curious to learn more about climate adaptation in agriculture or you're already actively funding it.

Our investment trends data draws heavily from the tech sector – which is predominantly supported by venture capital investors – to make climate adaptation for SHFs and food supply chains possible. That's in part because this is where climate adaptation finance data is most robust and readily available.

But this data can be illuminating for non-VC funders as well, many of whom participate in supporting tech companies' growth and impact while not investing in the tech itself. VC trends often signal movement and evolution in a sector. New technologies addressing or smoothing market pain points for agriculture-dependent societies are working on the frontlines of financial inclusion, energy access, rural livelihoods, women's economic empowerment and more.

Our Investment Opportunities section is designed to help funders think about and group the different types of adaptation solutions in agriculture as a way to better understand the landscape and also situate themselves and potential opportunities in the ecosystem. We include short case studies to highlight how different types of funders and investors are putting capital to work and what they're learning.

This first attempt at mapping climate adaptation investments in emerging market agriculture isn't perfect or comprehensive, but we hope it sets a usable baseline from which others can build and share information..

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What is climate adaptation for smallhold farmers?

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Climate adaptation can mean different things to different people in different locations. It is a highly fragmented process with a wide variety of adaptation definitions and objectives.

Across our nearly 40 stakeholder interviews, we probably received 20 different responses to the question of what climate adaptation is for smallhold farmers. As a result, investors and donors have varying objectives, approaches, and measures of success.

Climate adaptation in agriculture depends heavily on the local context, geography, regional climate hazards or vulnerabilities. An impactful tool in one region – such as a solar-powered irrigation pump in the Sahel – may be ineffective or even contribute to maladaptation* in another, such as one with overly abundant rainfall.

Given the nuanced nature of climate adaptation in different geographies and facing different climate hazards, we chose to use the following definitions of adaptation and adaptive capacity.

Adaptation:
Adaptation comprises the measures taken to minimize the adverse impacts of actual or expected future climate change or exploit beneficial opportunities.

Adaptive Capacity:
The ability to adjust practices to reduce potential damage associated with adverse events or conditions, to respond to consequences of the same, or to take advantage of opportunities.

This may seem broad and it is to account for direct and indirect adaptation. A drought-resistant seed, in a drought-prone region, clearly has a direct climate adaptation benefit for a producer. Access to data and intelligence gives producers adaptive capacity as it can enable them to make more informed decisions and reduce the potential damage of climate events. Similarly, insurance will minimize the adverse financial impact of a crop-destroying storm. More indirectly, a digital marketplace in which to sell your produce in a timely fashion could make a major difference to your bottom line, a bottom line that's at threat from climate change. Examples abound but it's not always easy to see the adaptive capacity of a tool or service on the face of it.

*The UN IPPC **defines climate maladaptation** as "any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead"

Data Methodology

The definitional challenges around climate adaptation for smallholder farmers meant it was difficult to identify investments using the typical method research organizations employ, namely keyword searches. For example, when we searched for the word “adaptation” among AgFunder’s database of over 25,000 agrifoodtech investments, just two companies surfaced.

Purely using keywords borrowed from other taxonomies, such as the Climate Policy Initiative’s, returned just 156 deals. So instead, we used a combination of natural language processing, keyword searches and contextual assumptions based on our definition of adaptation, to search investment databases. (See more on the methodology in the **appendix**.)

Similarly, when using keywords gleaned from other adaptation research and taxonomies out there, many adaptive companies were missing. Even with this multifaceted approach and manual checking, it is likely there are adaptive innovations and projects missing from our dataset.

See more details on data methodology in the **appendix.**

Above
Stock image

Left
Prema Devi, uses BioPrime AgriSolutions pest controller and Kamal Kisan pesticide spray on her farm land in Gauripur village, Amauli, Uttar Pradesh, India on November 30, 2022.

Climate adaptation taxonomy

We also developed a comprehensive taxonomy of climate adaptation investment opportunities for smallholder farmers to bring more definition to the space.

To do so, we benchmarked nine different adaptation taxonomies, including Lightsmith's Adaptation SME Accelerator Project (ASAP), the EU Taxonomy, and others. In doing so, we determined that while there are several industry-leading taxonomies, most focus on segmenting opportunities based on solution type or climate hazard.

While the solution type and climate hazard help address the climate challenges and risks faced by smallholders, private investors require more definition on the types of investable businesses that deploy adaptation solutions such as financial institutions, traditional value chain businesses, and agtech businesses.

As a result, we developed an agri-focused, 3-part taxonomy (primarily adapted from ASAP), which allows investors to characterize and segment investment opportunities by business-type in addition to the adaptation solution and type of climate hazard.

Climate Adaptation Taxonomy

01
Type of Business

Categorizing how the solution is being implemented

These include businesses that are:
- Enablers of adaptation (e.g., investments into Ag/ClimateTechs)
- Adapters of adaptation (e.g., investment into climate-proofing agribusiness operations)

02
Adaptation Solution

Showcasing which products, services, practices, or solutions are supporting adaptation and/or adaptive capacity.

For instance, is the solution promoting adaptation intelligence or directly providing products/services.

03
Climate Hazard and Risks

Linking the financing sources to the underlying climate hazard(s) being addressed.

This will help :
- inform the supply / demand for climate solutions
- support climate-related financial disclosure aligned with Task Force on Climate-Related Financial Disclosures

The taxonomy, broken down

First, the categorization of business models in the ag and climate tech sub-category was refined from AgFunder's agrifoodtech categorization. Notably, we classified each business type as either an enabler, adapter, or both. Based on the European Parliament "EU Taxonomy for Sustainable Activities," adopters are businesses that have adapted activities to context-specific physical climate risks (e.g., a farmer who uses improved irrigation techniques on their farm), and enablers are companies that provide products or services to others that reduce the context-specific physical climate risks in other economic activities or address systemic barriers (e.g., a company that sells drought-resistant seeds to farmers).

1. Type of Business

Sub Category	Type of Investable Business	Example	Enabler	Adaptor
Ag/Climate Techs	Agriculture FinTech	Apollo Agriculture	X	
	Agriculture Marketplace	FarmX	X	
	Farm Robotics, Mechanization & Equipment	SunCulture	X	
	Ag Biotech, Bioenergy & Biomaterials	Terrawaste	X	
	Novel Farming Systems	Blue Protein	X	
	Farm Management Services	Cropin	X	
	Agroclimatic Risk Intelligence Services and Products	Satelligence	X	
	Food Traceability & Supply Chain Management	eProd	X	
	Food Processing Technologies	Passtur	X	
	Logistics, Transportation, and Warehousing Infrastructure	SokoFresh	X	
Financial Institutions	State Bank	Central Bank of Kenya	X	
	MFI	Accion	X	
	Commercial Bank	Sterling Bank	X	
	Community Based FI	SACCO	X	
	Insurance Provider	Pula	X	
Upstream Actors	Input Manufacturer (e.g., fertilizer, seed)	Golden Fertilizer	X	X
	Input Distributor	Various agro-dealers	X	X
	Farmer/Farmer Organization	Busana Coffee Growers	X	X
Midstream Actors	Traders and Exporters	Jojus	X	X
	Transport and Warehousing	AgroZ	X	X
	Other Midstream	Tomato Jos	X	X
Landscape-Based Solutions	Project Developer	Hummingbirds	X	X

The taxonomy, broken down

Secondly, ASAP has developed a taxonomy of adaptation solutions, which has been adjusted below to include physical climate smart inputs and noting which solutions are 'out of scope' given the adaptation focus of this report. This taxonomy distinguishes between climate adaptation solutions focused on products and services versus those focused on climate intelligence.

2. Type of Adaption Solution

	Proposed Adaptation Solutions (in scope)	Non-adaptation solutions (out of scope)
Climate Adaptation Products & Services	**Physical climate risk management and infrastructure**, e.g., water efficient irrigation technology, crop storage, rainwater harvesting	• Systems-based solutions focused on improving SHF resilience beyond agriculture (e.g., diversified income sources) • Climate change mitigation efforts (e.g., carbon capture; renewable energy investments)
	Physical climate risk transfer, e.g., parametric insurance	
	Physical climate smart inputs, e.g., seeds, fertilizer; crop protection	
Climate Adaptation Intelligence	**Advisory services**, e.g., for climate risk exposure and vulnerability identification and assessment	
	Data management and operations, e.g., provision of weather data, climate change applications	
	Decision-support tools, e.g., early warning systems, software performing cost/benefit analysis of adaptation solutions	
	Physical climate risk identification and impact assessment, e.g. spatial hazard/vulnerability mapping analysis, disaster risk assessment tools, remote sensing	

 ©Gates Archive/Prashant Panjiar

The taxonomy, broken down

Finally, ASAP has also classified climate hazards and climate risks.

3. Type of Climate Hazard and Risk

— EU-taxonomy classification of climate-related hazards —

	Key climate-related hazards	Key risks on physical and biological systems	Key risks on human and managed systems
Temperature-related	• Temperature variability • Changing temperature (air, freshwater, marine water)	• Heat stress • Heat wave • Cold wave/front • Wildfires • Frost • Hail	• Reduced agricultural productivity and food security • Damages to physical infrastructure, property, and critical services • Reduction in water availability, quality, and security • Business disruptions • Spread of pests, and vector-borne and water-borne diseases • Impact to human health, and loss of livelihoods
Wind-related	• Changing wind patterns • Cyclone, hurricane, typhoon • Storm • Tornado		
Water-related	• Changing precipitation patterns and types (rain, hail, snow/ice) • Precipitation variability • Heavy precipitation	• Ocean acidification • Saline intrusion • Seal level rise • Water stress • Drought • Flood • Glacial lake outburst • Sea surface temp. rise	
Solid Mass -related		• Glacial retreat, changes in ice, snowcover, permafrost thawing • Coastal erosion • Soil degredation and erosion • Solifluction • Ecosystem and biodiversity loss • Avalanche • Landslide • Forest degradation • Land degradation & GHG emissions	

Comprehensively, an investor can use these three frameworks to look at the who (i.e., what kind of business), what (i.e., type of adaptation solution), and why (i.e., hazards or risks being addressed). Throughout our report, we have used these frameworks to look at investment trends and flows from different perspectives of climate adaptation.

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State of investment in agrifood adaptation for smallholder farmers

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This section offers quantitative and qualitative insights on the state of investment in adaptation for smallholder farmers.

While this report focuses on the need and opportunities for private investment, and offers the most granular insight into venture capital and technology investment, all capital types are needed to close the adaptation financing gap. And in many cases, these capital sources need to invest in the same initiatives – together or at different points in time.

For example, the discovery and creation of new tech tools in and of itself is not enough; those tools need to reach and be adopted by farmers for adaptation to occur. But adoption is influenced by many other factors: policy, access to finance, education, ICT connectivity, land ownership and more. An irrigation pump is only as good as its water supply, for example. These influential factors will have associated costs that various public and private investors and lenders could finance.

Investor landscape

Before we dig into private investment trends, the following infographic highlights the various investor groups backing smallholder adaptation in varying capacities with a few select examples.

Venture Capital:

Private Equity:

Government-backed funds/DFIs:

Corporate VCs:

Banks (intl, regional, national)

International Corporations:

Food and agriculture is a growing but very small investment asset class globally. Of the $11.7 trillion of global private funds under management[1], private food and agriculture funds represent just 1% at an estimated $150 billion[2].

Meanwhile, private climate-focused ESG, sustainability and impact funds including but beyond food and agriculture have reached assets under management of a more impressive $270 billion across 330 funds[3], albeit still just over 2% of total global private fund assets.

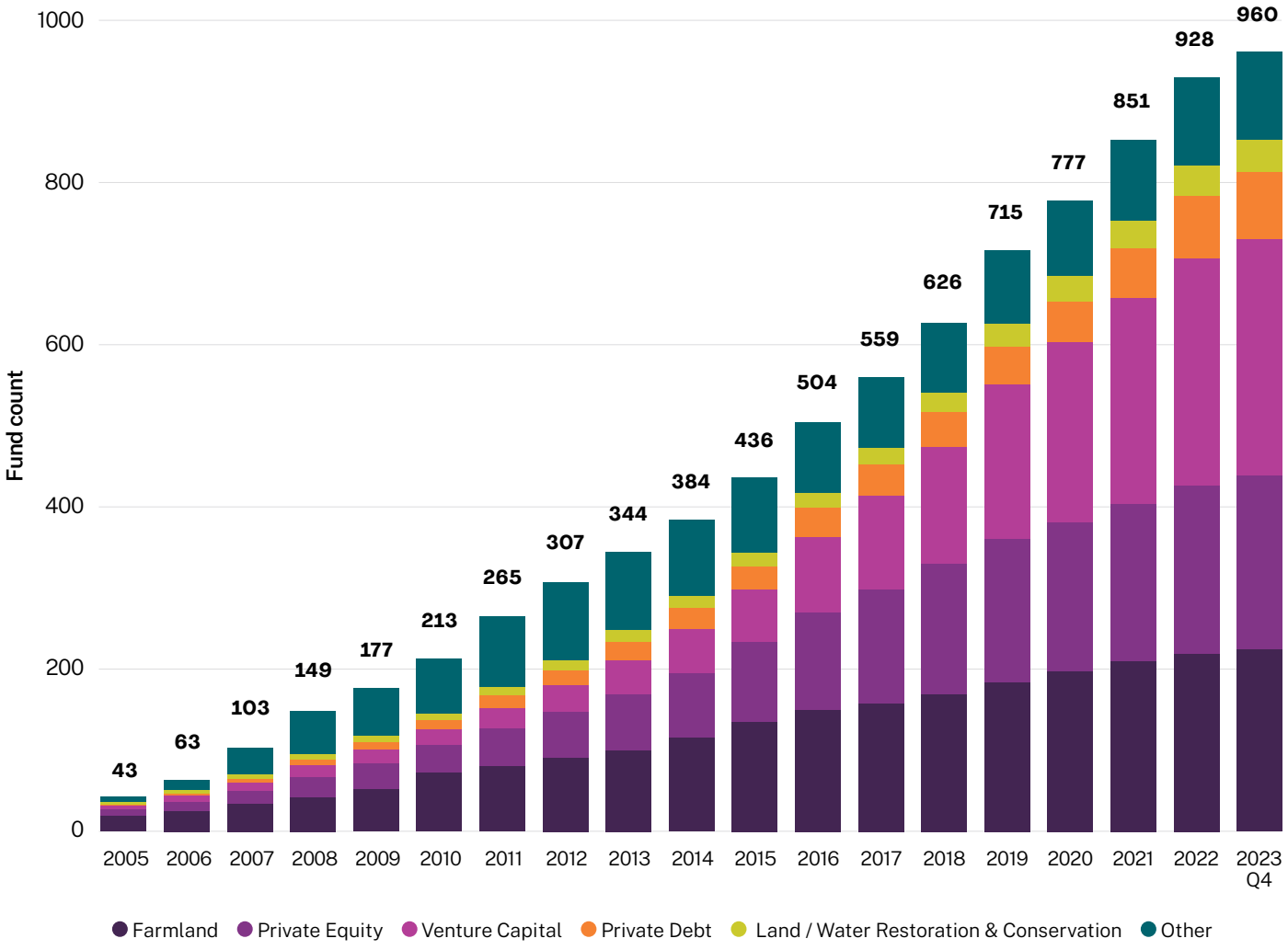
Of these totals, investments are largely skewed towards climate mitigation, capturing 90% of all climate investment[4]. This leaves just a fraction for climate adaptation initiatives. And from that overall adaptation investment, even less has gone to agriculture and smallholder farmers.

To-date, climate finance for small-scale agriculture has been sourced 95% from the public sector, including governmental donors, multilateral development finance institutions and bilateral development financial institutions, with grants the predominant financial instrument providing 50% of committed finance, followed by concessional and non-concessional debt[5].

Private investment trends in food and agriculture

Some 960 private investment funds are investing in food and agriculture globally in 2023. While venture capital is the most popular route for fund managers today, that wasn't always the case; until 2018, farmland and private equity funds were more numerous.

Evolution in number of food & ag investment funds by asset strategy (Total AUM in 2023: $150bn)



While we do not have climate-specific deal data for non-venture capital funds, interviews revealed that many fund managers are considering adaptation when assessing investments.

Most farmland funds today claim that they intend to apply regenerative agriculture practices to the farms they buy. While some of this may be marketing hype to jump on the latest trend, there are various incentives, including the potential to **sell carbon credits** based on the storage of soil carbon, less reliance on inputs markets, and the opportunity to **sell crops to processors at a premium**.

Private equity funds, which buy businesses as opposed to real assets, also increasingly claim that they invest in businesses providing solutions to climate change, such as water solutions or even greenhouses. We have included examples of private equity investments targeting adaptation in **section four** of this report.

Other private funds strategies related to the sector include private debt, conservation, water, commodities and listed equities, with some seemingly more direct adaptation theses. The four main asset classes focused on Africa and Asia-Pacific are targeting farmland, private equity, venture capital and private debt; there are 89 funds across those four asset classes, 46 of which are private equity agribusiness funds[6].

The most robust data findings in this report rely on **AgFunder's** database of venture capital flows to agrifoodtech. Private fund data providers we approached did not have appropriate climate tags for this task and corporate investments beyond venture capital are mostly anecdotal and based on announcements.

Even still, the robust trends presented by AgFunder's venture capital funding data provide a multilayered indication of the general trends for where private investors are placing bets in adaptation for smallholders, and we believe a proxy of future investment trends across adaptation.

Corporate investments often follow venture capital, particularly as tech startups typically aim to "disrupt" business-as-usual. Consider **Bayer's investment to acquire AgraQuest**, a 16-year-old biopesticide "startup" that went on to become the foundation of the corporation's biologicals department. Entrepreneurs usually innovate first.

Tech investment trends are an indicator of local banking activity too. As you'll read in this report, many startup companies focused on SHFs may start as a tech company but often evolve into vertically integrated or supply chain players with tech as just one feature of their overall business model (see **Releaf** and **SunCulture** below). As their businesses evolve, especially those with infrastructural or financing elements, more diverse types of financing are needed.

Private food and agriculture funds by strategy

Investment strategy	Number of funds	AuM (US$ billion)
Farmland	224	**46.6**
Private Equity	214	**53.6**
Venture Capital	291	**15.7**
Private Debt	83	**8b**

Technology investment in climate adaptation for smallholder farmers (SHFs)

Global adaptation agrifoodtech funding since 2012

$56.5bn

Smallholder farmer-focused adaptation agrifoodtech funding since 2012

$5.7bn

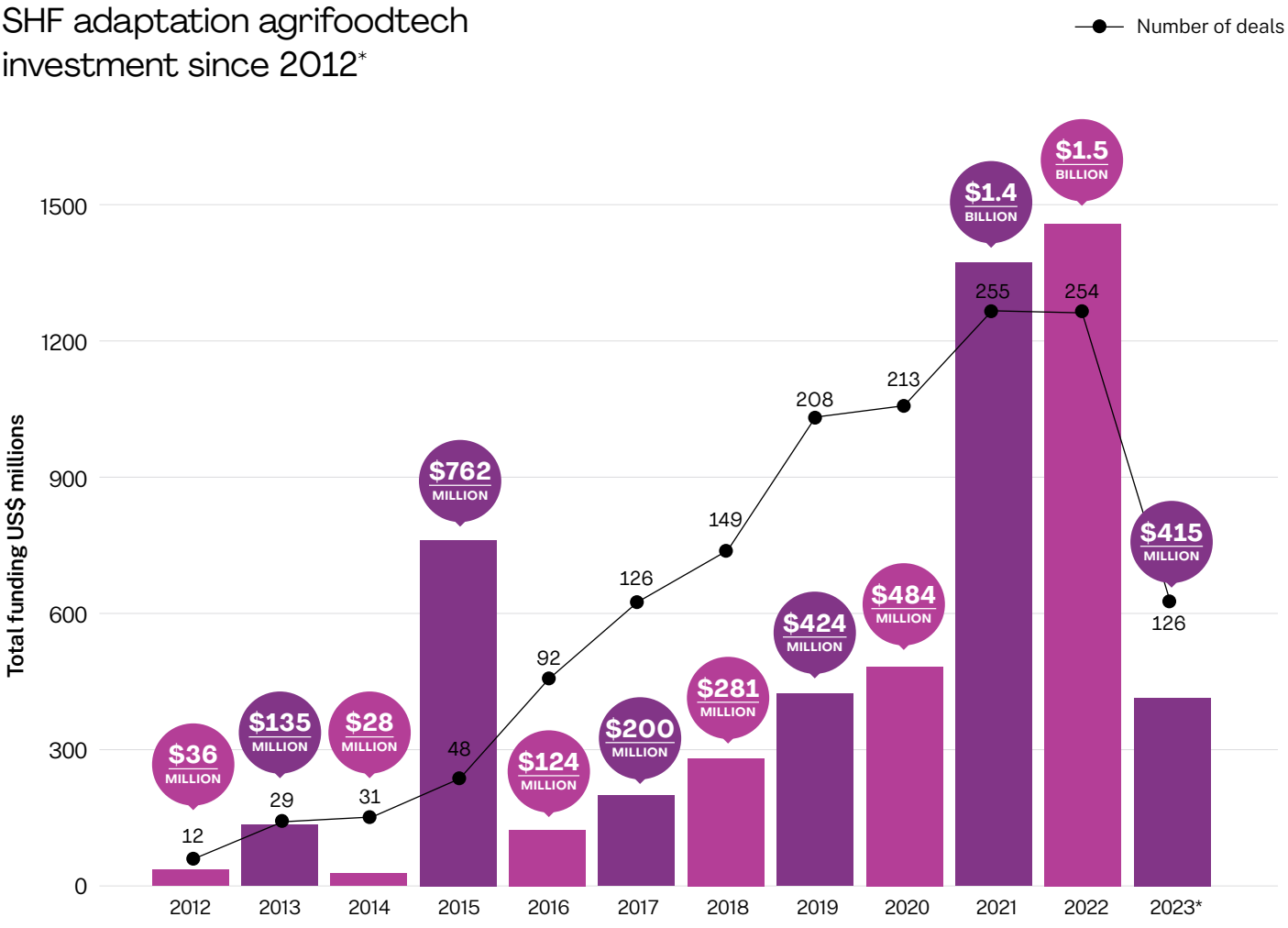
Global adaptation agrifoodtech No. of deals since 2012

6,375

Smallholder farmer-focused adaptation agrifoodtech No. of deals since 2012

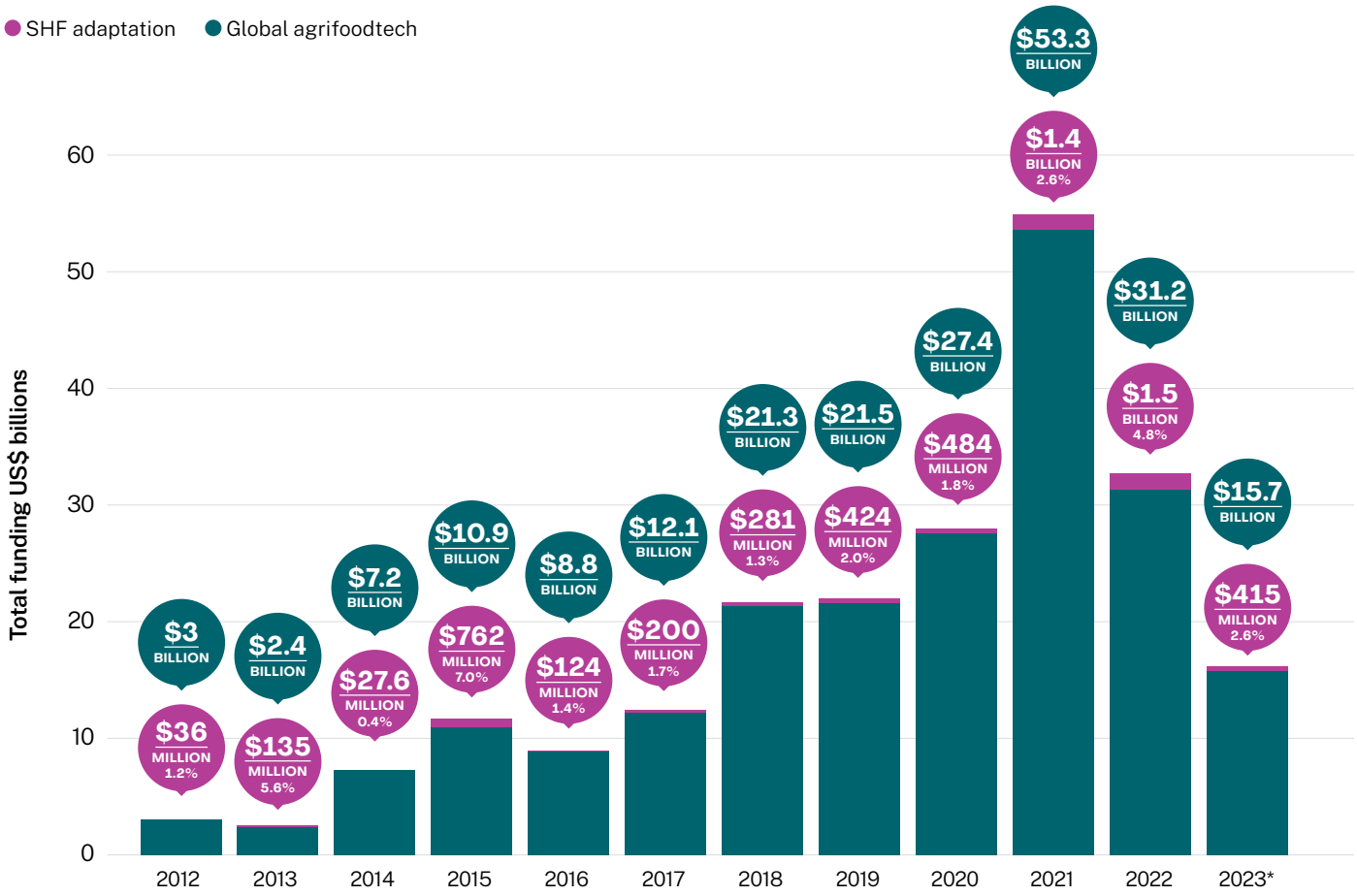
1,543

SHF adaptation agrifoodtech investment since 2012*



*as reported at October 31, 2023

SHF adaptation agrifoodtech investment vs Total global agrifoodtech investment: 2012-2023*



Investment in climate adaptation tech companies has followed a similar trend to the overall agrifoodtech industry since AgFunder records began, except in 2022 when it posted a year-over-year increase against an overall decline in venture capital across sectors.

In 2022, AgFunder noted that climate-related startups[7] were better able to raise funds than non-climate-related agrifoodtech startups. This boost in funding coincides with an increasing, general understanding of food and agriculture's role in the climate crisis, and the potential for technology to both mitigate it and help the industry adapt to it.

In 2023, however, nearly all categories – climate or not – succumbed to the "funding winter" that many startups describe globally as the overall agrifoodtech industry received 49% less funding than in 2022[8].

Funding to climate adaptation for SHFs has generally increased as an overall portion of agrifoodtech investment, highlighting the growing interest in climate tech as a venture capital and private sector investment theme.

Identifying adaptation-related companies and projects for smallholder farmers across various datasets is challenging given the definitional challenges described in **section two** but also because many companies do not describe their businesses as targeting climate adaptation. Just two companies in the whole AgFunder database explicitly call out adaptation in their company descriptions. Find out more about the data tagging process we used in the **appendix.**

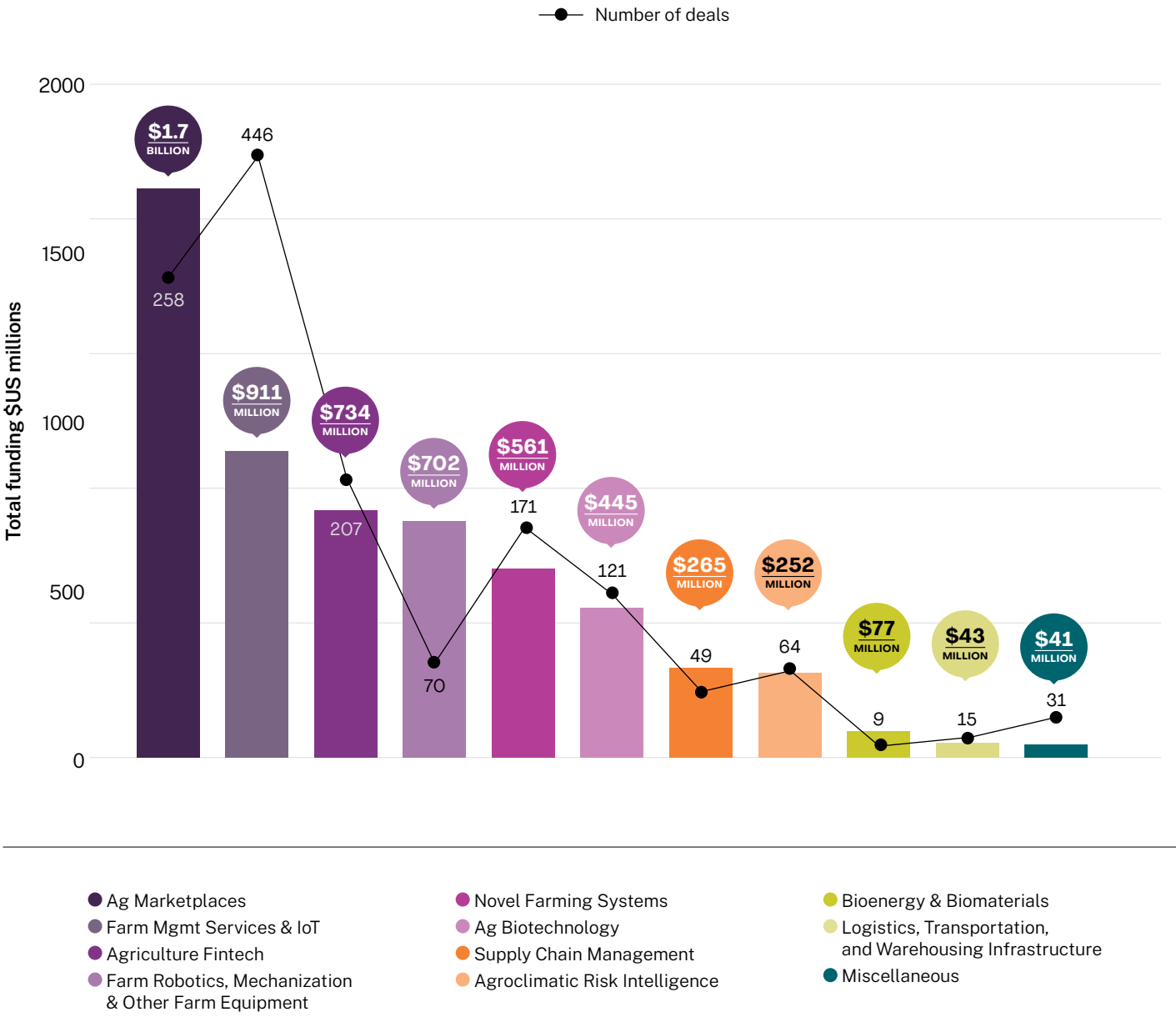
*as reported at October 31, 2023

Category and sector investment

Digital tools are the most invested tech categories for smallholder climate adaptation. Digital ag marketplaces are particularly attractive to investors who are backing the scalable aggregation of SHFs to supply inputs and markets typically unreachable to them; the potential scale of these platforms makes for an exciting investment proposition.

Farm management services & IoT enable the adoption of precision agriculture practices and a better understanding of crop yields, and fintech tools also enable SHF financial resilience through access to credit and insurance.

SHF adaptation investment by agrifoodtech category 2012-2023*



The vast majority of agrifoodtech innovators across the globe are targeting crop systems as the ag sector with the biggest addressable market opportunity.

Given that small-scale fisheries account for at least 40% of global fish catch and support the livelihoods of nearly 500 million people, innovation in fisheries and aquaculture appears underfunded.

Livestock systems are typically excluded as climate solutions given their big carbon footprint, which accounts for nearly 15% of all greenhouse gas emissions globally. In the smallholder farmer context, it can be a different story: livestock are an **important capital asset** and diversified income stream for SHFs.

Not only do they provide food and animal protein for consumption, but they can also produce wool and manure for use as fertilizer, and power for tillage tools. Innovations are also helping increase the efficiency of livestock farming and thereby reduce emissions. While small in number, there are a few climate-adaptive approaches for smallholder ranchers and we include a few example investments in **section four.**

SHF adaptation investment by ag sector since 2012

Number of deals
Crop Systems
1399

Total investment US$
Crop Systems
$5.1bn

Number of companies
Crop Systems
653

Number of deals
Fisheries/Aquaculture
97

Total investment US$
Fisheries/Aquaculture
$423m

Number of companies
Fisheries/Aquaculture
45

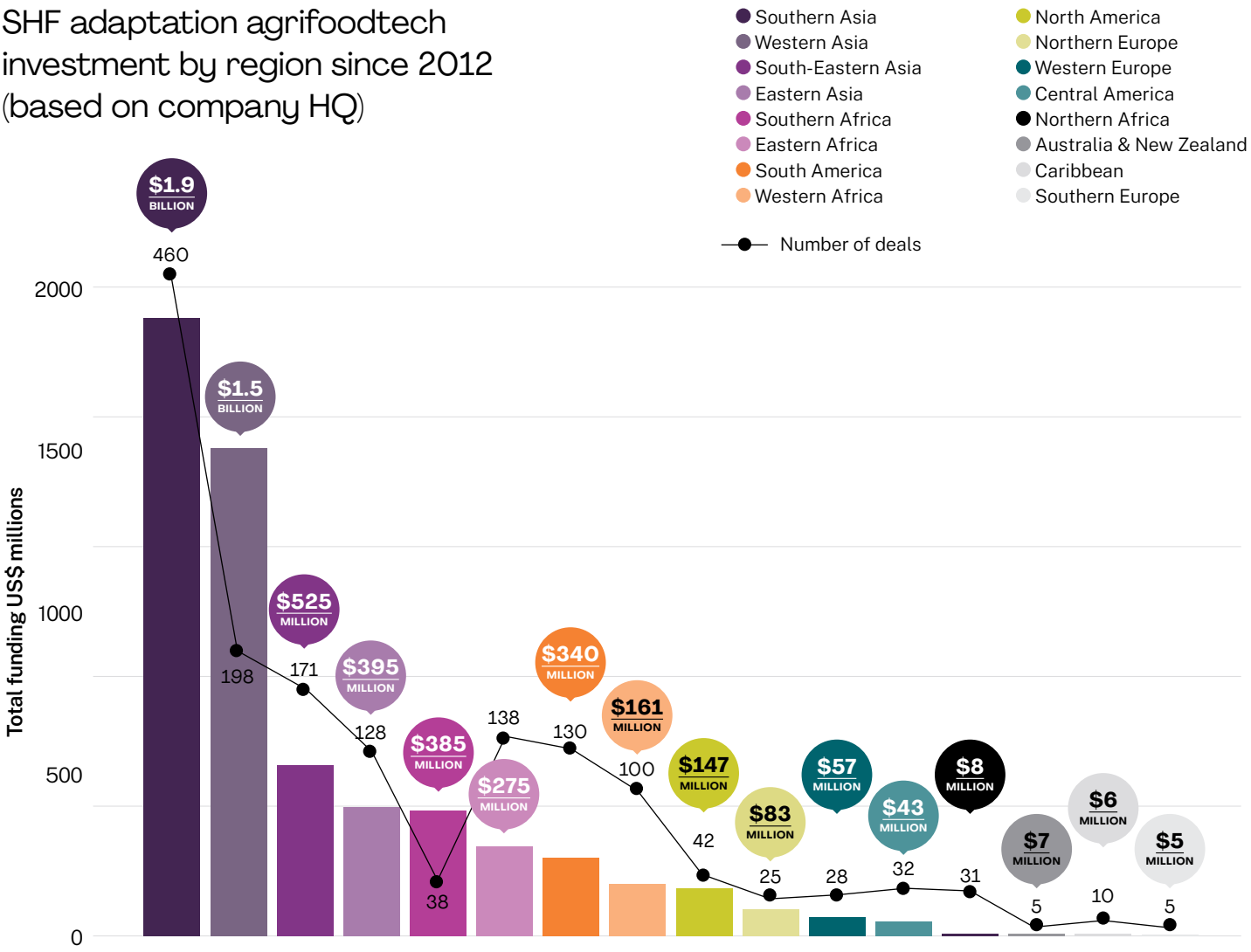
Number of deals
Livestock
64

Total investment US$
Livestock
$202m

Number of companies
Livestock
31

Geographical trends in SHF adaptation agrifoodtech investment

SHF adaptation agrifoodtech investment by region since 2012 (based on company HQ)



As a leading agrifoodtech ecosystem globally – and one of the first to have an agtech industry – it's unsurprising to see India top the charts for funding, bringing the South Asia region with it. Faced with numerous climate hazards, the focus of the country's entrepreneurs on adaptation innovations is equally unsurprising. Israel is another hotbed of agtech innovation with particular strength in irrigation technologies; Israel's Netafim, a precision irrigation company that has since been acquired by Orbia, raised a major debt round in 2015, somewhat skewing totals for the country and Western Asia overall compared with the number of deals. (Netafim targets both large-scale and smallholder farmers with its services.)

There are a small group of companies headquartered in the global north that are focused on smallholder farmers in the global south, and more besides that do not feature in our dataset, which may have indirect applications for smallholder adaptation.

While we managed to extract companies targeting smallholder farmers in developing countries through our search tools, it was not possible to decipher exactly which countries or sub-regions they were targeting with their services. The geographical data in AgFunder's dataset is focused on where each investee business is headquartered and aside from those based in North America, Europe, and Asian nations like Singapore and Israel, it's a fair assumption that companies are providing adaptation solutions to their local market and possibly that of close neighbors.

Top 10 countries for SHF adaptation agrifoodtech investment since 2012 (investee HQ location)

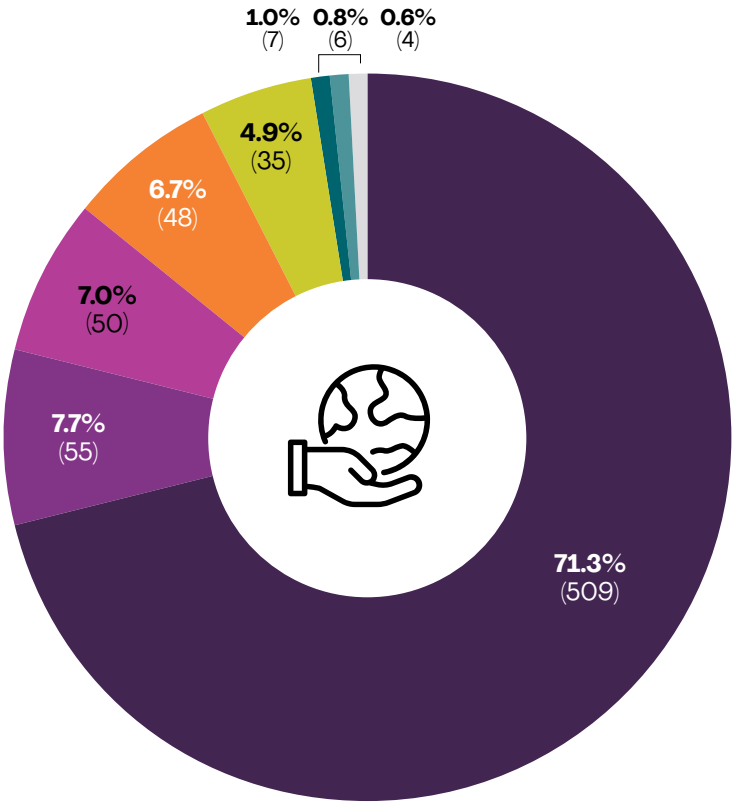
No.	Country	US$	No. deals	No. companies
01	India	**1.9 b**	434	171
02	Israel	**1.4 b**	148	68
03	Indonesia	**390 m**	76	37
04	South Africa	**385 m**	38	18
05	Kenya	**213 m**	92	41
06	Korea, South	**212 m**	23	11
07	Japan	**182 m**	93	38
08	United States	**147 m**	37	14
09	Uruguay	**124 m**	9	3
10	Nigeria	**123 m**	63	29
11	Argentina	**100 m**	77	30

SHF adaptation agrifoodtech investment by climate hazard

Climate adaptation is incredibly context and location-specific. Priorities for adaptation differ by country and climatic region. These differences are mainly driven by varied exposure to climate change hazards and by the farming systems used such as cropping versus livestock production. But in spite of this, there is an overwhelming focus on soil health among climate adaptation solutions for smallholder farmers. That's good news given an estimated 24 billion tonnes of fertile soil are lost due to erosion each year, which translates to 3.4 tonnes lost every year for every person on the planet[9]. Furthermore, **research estimates** that the least developed economies experience the highest soil erosion rates, often associated with expanding the amount of land under cultivation[10]. With limited access to fertilizers and plant nutrition, healthy soils are crucial for smallholder farmer resilience. Healthy soils can also help farmers withstand climate stressors as they better hold water and are less likely to erode.

- Soil Health
- Biodiversity
- Rain Water
- Pests & Disease
- Drought
- Wind / Storm
- Glacial / Snowcover
- Ocean Stress

Number of unique companies targeting each climate hazard



Many companies are targeting more than one climate hazard so the tagging here was not mutually exclusive.

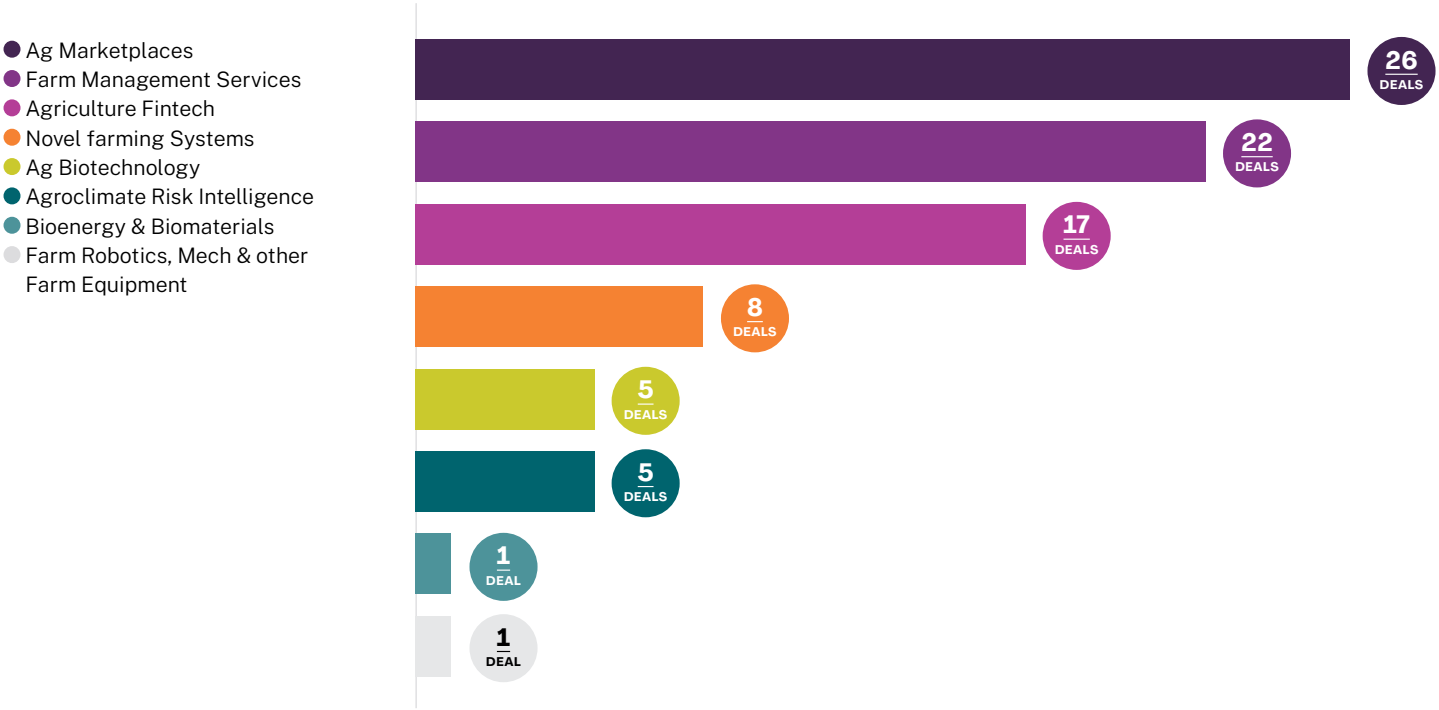
Top adaptation agrifoodtech investors since 2012

It may seem like a surprise to see so many US-based investors at the top of the investor leader board but most of them have accelerator programs that operate in several parts of the world. India is one of the world's leading agtech ecosystems and certainly the leader in the global south, and therefore tops the list. Omnivore, one of the first-ever global agtech investors, has $300 million in funds under management with substantial backing from public funds including development finance institutions FMO and BII. Omnivore primarily invests in India, is now beginning to do deals in Southeast Asia, and has ambitions to invest in Africa in the coming years. While not all of its investments were made with SHF climate adaptation in mind, managing partner Mark Kahn told us his firm sees adaptation as "anything that makes farmers more resilient economically," which is a significant portion of Omnivore's portfolio.

No	Investor	No. deals	HQ
01	Omnivore	54	India
02	Ankur Capital	30	India
03	Techstars	25	USA
04	SOSV	22	USA
05	500 Startups	16	USA
06	AgFunder	15	USA
07	Y Combinator	14	USA
08	Aavishkaar Venture Capital	14	India
09	Mercy Corps	12	USA
10	Better Capital	12	India
11	East Ventures	12	Indonesia
12	Trendlines Group	11	Israel
13	Accel	11	USA
14	Endeavor Catalyst	10	USA
15	Brinc	10	Hong Kong
16	FMO	10	The Netherlands
17	Prosus Ventures	10	The Netherlands
18	Rockstart	10	The Netherlands
19	Syngenta Ventures	10	Switzerland
20	Wavemaker Partners	10	Singapore

Corporate adaptation investments

Adaptation agrifoodtech deals featuring corporate investors since 2012



It's not just financial investors placing bets in agrifood adaptation tech deals; some 47 corporations have made adaptation investments, predominantly from their venturing arms, contributing to $1.1 billion in funding - nearly 20% of the total $5.7 billion in adaptation agrifoodtech funding - across 85 deals. MDI Ventures, the venturing arm of Indonesia's telecommunications giant Telekom, has been the most active corporate venture investor to date, making nine investments, followed by Telefonica's Wayra, Indonesia's Bank Rakyat Indonesia, Malaysian multinational Genting and Norwegian chemicals giant Yara.

Corporations have also invested in adaptation initiatives within their own supply chains, particularly to promote regenerative agriculture practices on the farmland they supply from.

There has been a wealth of corporate commitments to regenerative agriculture in recent years. Some 63% of the 79 companies assessed by the FAIRR investor network mention regenerative agriculture as part of their sustainability strategies[11].

Corporate adaptation investments

A sample of corporate adaptation investments & commitments

- Nestlé is investing over Sf1.2 billion ($1.5 billion) in regenerative agriculture across its supply chain with a target to source 20% of its ingredients regeneratively by 2025 and 50% by 2030[12].
- McCain Foods, the world's largest supplier of frozen potato products, has committed to transition 100% of its potato-growing acreage to regenerative agriculture by 2023[13], and has **kicked off in Canada and South Africa so far.**
- Carlsberg Marston's has pledged for 30% of its raw ingredients, such as barley and hops, to come from regenerative methods by 2030[14] (and 100% a decade later).
- PepsiCo and Walmart have announced a 7-year collaboration to pursue $120m[15] (£94m) worth of investments focused on supporting US and Canadian farmers in their pursuit to improve soil health and water quality.
- Meanwhile, **General Mills has promised to take a regenerative approach on one million acres of farmland by 2030** – and **PepsiCo has set a target of seven million acres** by the same date.

Many of the announcements are **focused on Northern America and Europe**. It is hard to discern when they might expand to the developing world where many of the large agrifood corporations have significant supply chains.

The scale and scope of these corporate investments are also hard to determine. According to FAIRR, only 18 of the 50 projects implementing regenerative agriculture had quantitative targets and only a select few were offering to pay farmers to change their practices[16].

Bank lending, investment and MDBs

While it is hard to track at a granular level, banks, lenders and insurers have a crucial role to play in enabling smallholder farmers to adapt to climate change.

No matter where in the world they are or how big their operations, pretty much all farmers need access to some form of credit during their careers, whether that's an advance on their harvest or inputs on credit. The cyclicality of agriculture can mean just one or two paydays a year depending on the crop, which is an accounting challenge during the rest of the year. Local agribusinesses also need access to credit to adapt their supply chains and support their producers.

Although comprehensive data on bank lending for agriculture adaptation is not specifically tracked, it is well known that banks, lenders and insurers have not been servicing smallholder farmers – and SMEs more broadly – well enough.

In sub-Saharan Africa and Southeast Asia, there is an estimated $160 billion demand for financing by ~220,000 small and medium-sized agriculture companies, including farmer cooperatives and organizations. But ISF research estimates that only $54 billion – some 34% – is currently being met through formal finance channels — leaving an annual financing gap of $106 billion[17]. A further $240 billion in annual financing is needed by 270 million smallholder farmers and pastoralists across Latin America, sub-Saharan Africa and South and Southeast Asia, with only $70 billion supplied by formal financial institutions, value chain actors, and informal or community-based institutions[18].

If smallholder farmers are going to adapt to climate change, banks will need to make investments, such as in new technologies or in transitioning to climate-smart practices.

Bank lending, investment and MDBs

Innovative initiatives, such as **Aceli Africa** -a firm mobilizing finance for agricultural SMEs -have been established to help close the financing gap. Aceli helped catalyze 1,567 loans totalling $152 million between 2020 and 2023. Aceli offers additional incentives for loans that support climate smart practices.

Furthermore, the smallholder farmer financing gap has spurred the creation of a wealth of fintech tools, which are increasingly relevant as climate change exacerbates agricultural risks. In fact, funding better financial services for smallholder farmers is one of our key investment opportunities in **section four** of this report.

Playing a role can be in the interests of the financiers themselves; according to research by Deloitte and the Environmental Defence Fund (EDF), 87% of agricultural finance institutions expect climate change to present material risks to their businesses in the future[19]. The research offered an example:

Example: A farm you finance does not adjust its crop rotation to adapt to lower annual precipitation and experiences low crop yields more frequently as a result.

This tightens the farm's cash flows, leading to default. Your business has a reduction in cash inflow — and lower revenue and profits — because the borrower fails to repay part of the interest and principal of the loan. The decrease in cash inflows grows if more farmers in your region have not adapted to the changing precipitation patterns. Conversely, those finance institutions that seize the opportunity to introduce financial and advisory products to help farmers transition to climate-resilient crop rotations could see both a growth in market share and a relatively lower impact from climate risks.

International and local bank investment examples

Dutch food and agriculture bank Rabobank is working to demonstrate that climate change will have an impact on the loan portfolios, credit processes and policies of banks in Kenya, Tanzania and Uganda. Through a partnership called **CRAFT (Climate Resilient Agribusiness for Tomorrow)** alongside SNV, CGIAR, Wageningen University & Research (WUR) and Agriterra, Rabobank wants to assist these financial institutions in increasing investments in climate smart solutions.

Climate adaptation could also be an opportunity; some 59% of the ag financiers Deloitte and EDF surveyed think that climate change will present opportunities for their businesses in the short-term and long-term[20].

Commercial banks are also making direct investments in climate adaptation for smallholder farmers.

For example, Equity Bank Kenya was lauded by the International Finance Corporation (IFC) for its climate financing, **which reached KSh 24.7 billion** ($154 million) in October 2023, of which 66% went to climate adaptation and water efficiency.

More will be needed from other financing institutions. The Glasgow Financial Alliance for Net Zero **recently formed an Africa Network** which will work with banks, asset owners, and other financial institutions in Africa to support capacity-building on climate finance and bolster lending.

Illustrative Examples of Regional Bank Investments

Investor	USD $	Location	Description
CRDB - Tanzania Agriculture Climate Adaptation Technology Deployment Programme (TACATDP)	**$200m**	Tanzania	The Green Climate Fund and CRDB Bank in Tanzania established a lending and de-risking facility designed to make climate adaptive technologies affordable to local farmers and SMEs. The project is valued at $200 mn ($100 mn from GCF; $100 mn from CRDB) and is currently under implementation.
Equity Bank - ARCAFIM	**$180m**	Kenya, Rwanda, Tanzania, Uganda	Equity Bank will be the implementing partner of IFAD's Africa Rural Climate Adaptation Finance Mechanism to promote SHFs in adapting to climate change in four sub-Saharan African countries. Equity Bank and IFAD will both contribute $90 mn to the initiative.
BAAC - AgriCRF	-	Thailand	BAAC and GIZ are collaborating in a three-year project to improve access to finance for essential adaptation resources to over four million Thai farmers
Banco Solidario - Green Bond	**$7.5m**	Ecuador	Symbiotics Investments provided a green bond to channel lending for Banco Solidario to enhance sustainable agriculture and climate-adapted financing.

Multilateral development banks are also investing at an increasing pace; in 2021, they committed just over $25 billion to climate change adaptation finance in low and middle-income economies, of which $4.4 billion was to crop and food production, and agricultural and ecological resources, nearly double the year before. Some $3.3 billion went to water and wastewater systems. A further $2.2 billion went to institutional capacity support and technical assistance across industries[21].

GREEN CLIMATE FUND

Date founded: **2010**
Target size (USD): **$12.8 billion**
Fund status: **Investing** –
$4.2 billion in capital dispersed
(as of 18 March 2024)

As the world's largest climate fund, **Green Climate Fund** (GCF) is focused on accelerating climate action in developing countries through country-owned partnerships, flexible financing mechanisms, and climate expertise. They view the private sector as an instrumental actor in creating an enabling environment for adaptation in food systems and beyond.

GCF currently works in over 100 countries on 250+ projects. Over time, they aim to have a 50:50 balance of adaptation and mitigation projects, with many projects enabling dual adaptation and mitigation benefits.

Catalytic and additional sources of SHF adaptation funding

Venture capital is a powerful route to funding innovation at scale but with just 10 climate tech exits in Africa on record and none in agrifood, it will take some time for it to truly scale. Even at scale, VC will provide just a fraction of what's needed to fund climate adaptation for SHFs and should typically be seen as startup capital.

Even at the startup stages, public and philanthropic dollars have an important role to play in getting tech and non-tech-focused adaptation initiatives for SHFs off the ground.

In the broader climate finance context (not just adaptation), grants have represented over 50% of climate finance for SHFs, followed by concessional debt (33%)[22].

On the adaptation agrifoodtech side, 484 companies raised grants totalling at least $121 million before raising private venture capital dollars, according to our analysis of AgFunder data. Those companies went on to raise nearly $1.6 billion in private investment afterwards. While those totals may sound impressive, many investors we interviewed spoke to the need for more concessionary and blended finance to fund adaptation initiatives across technology and non-tech initiatives.

In a **recent climate tech report** for Africa, the Catalyst Fund stated that low levels of grant and soft capital were "particularly worrying given that startups in Africa take longer to raise venture capital than startups in other ecosystems. Across Africa, half of all startups needed approximately two years of soft capital before raising a pre-seed round, and climate tech startups needed an additional year on average, pointing to the need for more, and more patient, concessional capital[23]."

In 2017 and 2018, some 90% of climate finance for small-scale agriculture came from the public sector, including governmental donors, multilateral development finance institutions and bilateral development financial institutions each contributing 39%, 32% and 16% respectively[24].

Some of this public funding was concessionary in grant or loan format, as described above, and some is in the form of direct, financial investments, such as those by development finance institutions (DFIs) and specific adaptation funds.

Some 31 DFIs have invested in 63 agrifoodtech adaptation deals since 2012, according to AgFunder data. The most active are The Netherlands' FMO, Finland's Finnfund, the International Finance Corp and British Investment (BII).

"Developing more diverse sources of capital will allow for more diverse types of enterprises, which will be important to achieving climate action at speed and at scale in Africa. Blended finance[25] approaches can attract more private funding to the sector, de-risking the journey of entrepreneurs as well as investors."

The Catalyst Fund

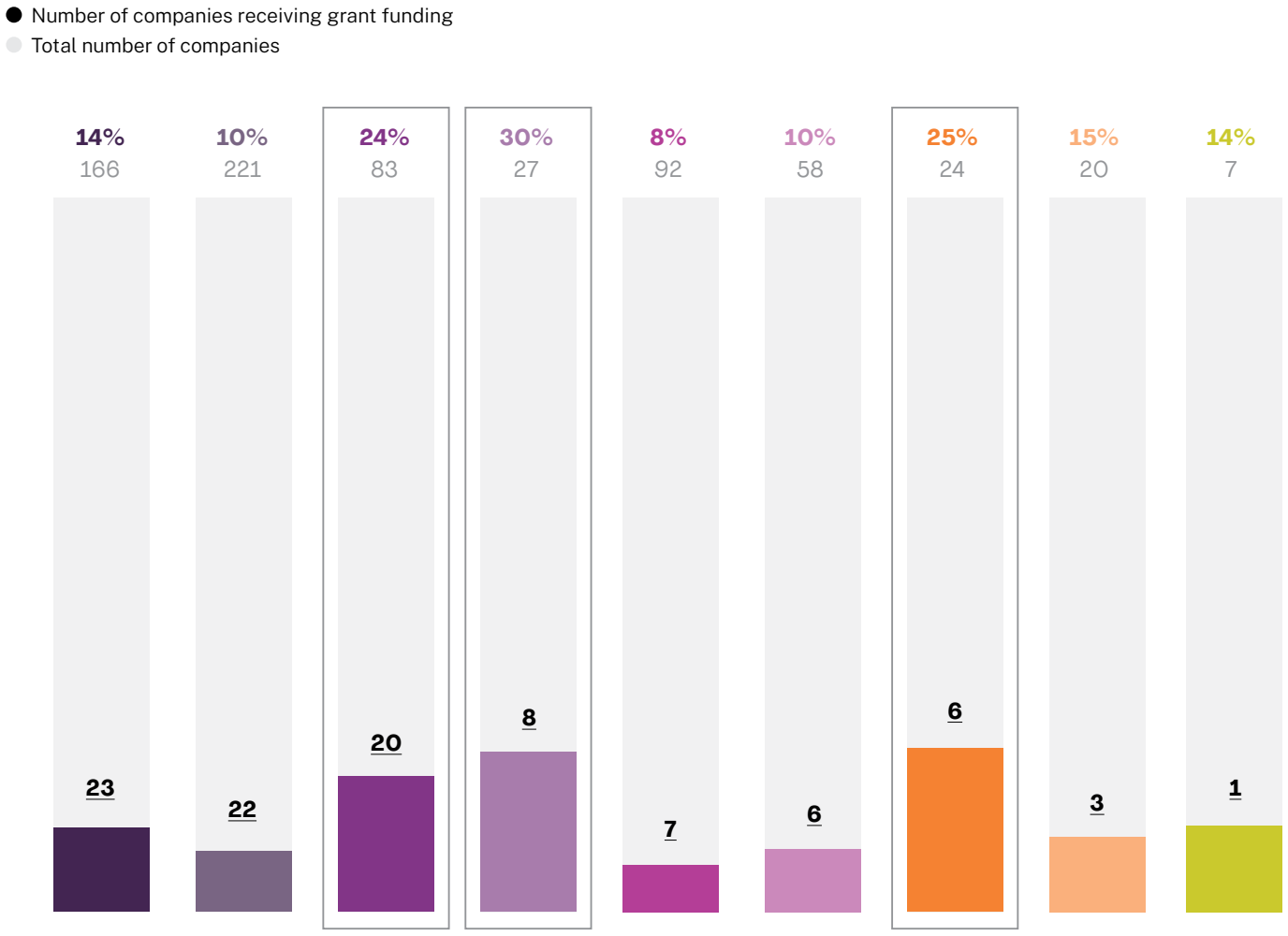
Catalytic and additional sources of SHF adaptation funding

Adaptation agrifoodtech grant funding vs overall tech funding by category since 2012

Overall, 14% of companies received grant funding in addition to investment capital.

FinTech, Farm Robotics, and Supply Chain Management companies received the highest proportion of grants relevant to overall investments.

Adaptation tech funding - % Grant-funded companies vs. Total companies



Donor Incentive Programs to promote adaptation

Government-led donor incentive programs provide more direct concessionary support.

Program name	Impact focus	Instrument used
Climate Gender Equity Fund (CGEF)	**Gender / Climate**	**Grants**
CGEF is a target USD 60 million program aimed at providing climate finance to gender-responsive, women-led, and women-benefiting organizations that address climate change. The fund is managed by the 2x Challenge and is part of USAID CDFA.		
CLIC Agrifood Investment Connector	**Climate**	**Technical Assistance**
CLIC's AIC is an investment facilitation program designed to support agri-food SMEs focused on low-carbon, climate-resilient, and nature-positive solutions by providing TA and connecting them with like-minded investors.		
Ireme Invest	**Climate mitigation and adaptation**	**Project preparation facility: grants, equity, TACredit facility: Loans, guarantees**
Ireme Invest is a financing facility, supported by the Rwanda Green Fund and the Development Bank of Rwanda, which provides support and credit to private sector-led sustainable and climate-resilient projects throughout Rwanda. The program is composed of two separate facilities: i) The Project Preparation Facility, geared towards supporting projects from ideation to bankability, and ii) The Credit Facility aimed at providing funding to SMEs		
Africa Rural Climate Adaptation Finance Mechanism (ARCAFIM)	**Climate adaptation**	**Debt, TA**
ARCAFIM is a financing mechanism from IFAD that provides Equity Bank with around USD 90M in concessional capital to advance loans to SHFs and MSMEs to improve climate adaptation across Kenya, Tanzania, Rwanda, and Uganda		
Convergence Catalytic Climate Finance Facility (CCFF)	**Climate mitigation and adaptation**	**Grants, TA**
The CCFF is a catalytic facility developed as a partnership between Convergence and CPI, which provides design grants to funds and enterprises of up to $500k to develop blended finance structures and vehicles that target climate adaptation and/or mitigation efforts in emerging markets.		
Aceli Africa	**Agriculture**	**First-loss grants Origination incentives**
Aceli Africa is a market incentive facility that provides first-loss grants and origination incentives to financial institutions to lend to traditionally underfinanced agri-SMEs across Africa. Aceli includes an extra incentive payment for investments that meet climate smart criteria.		
Dutch Fund for Climate and Development (DFCD)	**Climate mitigation, resilience, and adaptation**	**Grants, Equity, Debt, TA**
DFCD is a ~$174M fund managed by FMO that aims to invest in climate adaptation and mitigation projects in emerging markets. The fund has three facilities, the Land Use and Water facility, and an origination facility which acts as pipeline development for the fund's two main facilities		

Case Study: DryGro

UK startup **DryGro** has received both grant funding and non-equity assistance for its water lentil production technology. Controlled environment agriculture is an expensive endeavor and trailblazers in this segment like DryGro have needed to invest a lot of capital on developing the most cost-efficient processes. This makes grant funding particularly important as the timelines to scale are unpredictable for financial investors.

DryGro

Founded: **2015**
Location: **UK & Kenya**
Total funding: **$5.8M**

A fast-growing, freshwater aquatic crop, Water Lentils are a nutritious, neutral-tasting, and versatile source of protein for humans and animals, which are less resource-intensive than meat or soy. Water Lentils can be grown all year round in a range of climates, without arable land, pesticides or herbicides. They're grown and processed on a very short supply chain with little impact on biodiversity, zero deforestation, and without the use of GMOs.

DryGro has received financial support from a broad range of public and private investors including the European Space Agency, Innovate UK, EIT Climate-KIC and EIT Food. It has raised a total $5.8 million; other investors include the UK VC firm Sustainable Ventures and the Becht Family Charitable Trust.

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Investment opportunities in climate adaptation for smallholder farmers

ISF

AgFUNDER

In this section we profile six investment opportunities that a range of investor types can explore to support climate adaptation among smallholder farmers:

On-Farm and Post-Farm Infrastructure – think irrigation and cold storage;

Climate Smart Inputs – think drought-resistant seeds and soil health-enhancing microbes;

Enabling Data & Intelligence – think precision ag tools and agroclimatic risk intelligence;

Financial Services – fintech, insurance, and other innovative financing solutions;

Climate Adaptive Value Chain Actors – supply chain players adopting climate-smart practices; and

Digital Marketplaces – digital platforms to match farmers with better inputs and markets.

Some of them are more directly-linked to adaptation than others but they can all increase the adaptive capacity of agriculture across the global south. At the end of the section, we have a graphic to provide guidance as to which types of investors are better suited to which investment opportunities.

While our most robust investment data comes from agrifoodtech funding flows given the previously mentioned data collection constraints for other types of capital, it should still provide an indication as to the size and scope of private investment generally in these categories and where obvious funding gaps lie. Furthermore, where possible, we have highlighted examples of deals and investment strategies from outside the tech industry (e.g., corporate supply chain investments, commercial banking, etc.)

01 On-farm & Post-farm infrastructure

Adaptive capacity

Develop and supply affordable physical equipment and infrastructure on and off the farm for farmers to better withstand climate hazards.

Few smallholder farmers (SHFs) in emerging markets have access to the equipment and tools that farmers in advanced markets take for granted. Irrigation systems. Greenhouses. Processing equipment. Refrigeration and crop storage. Helping farmers upgrade their operations with existing and emerging infrastructure and tools like these is a natural starting point to help them transition to more climate-resilient agriculture. While there are numerous barriers to scaling these capital intensive solutions, there are many innovators who have grown successful businesses in this space.

This pathway includes systems and innovations that enable more efficient and resilient growing conditions on the farm, and more resourceful processing and transport of crops from the farm so farmers reap as many earnings as possible.

On the farm, this can include greenhouse infrastructure to help farmers mitigate increasingly unpredictable weather patterns and earn income by growing year-round in controlled conditions. It also includes smart irrigation systems, including solar-powered irrigation, so farmers are less dependent on rainfall, which is becoming less predictable;

just 3% of cropland in Sub-Saharan Africa is irrigated or equipped for irrigation.

Renewably-powered systems help farmers adopt irrigation technology without the added fuel costs that come with generator-powered systems. Waste-to-fuel systems, like biodigesters, run a double duty of helping farmers manage crop and livestock waste, while generating inputs (fertilizer) and fuel (biogas) for farm and household use.

Off the farm, crop processing and storage is a huge opportunity for emerging market smallholder farmers. A principle reason for food (and income) loss is inadequate cold and logistics chains. Modular and renewably-powered refrigeration systems are ensuring crops don't spoil before they can be sold. Grain and other storage infrastructure also prevents spoilage and helps farmers sell year-round, capturing better pricing on their goods. Processing equipment, including renewably-powered machinery, ensures that products that are unfit for traditional markets and retail can be remade and sold as other products (think: vegetables processed into canned goods and dried spices for export).

01 On-farm & Post-farm infrastructure

Despite the promise of these infrastructure solutions, various barriers have constrained adoption to date. In the case of irrigation, SHFs often lack an understanding and awareness of both the benefits and technical requirements associated with these systems. Even if this knowledge barrier is addressed, the high upfront (especially with solar pumps) and ongoing costs associated with irrigation infrastructure is a fundamental barrier to adoption. Scaling smart irrigation for smallholder farmers is thus constrained by this lack of investment capacity, the need for technical support and maintenance, unreliable access to markets, and often erratic access to water sources.

While SHFs have struggled to access such technologies until recently because of costs and logistics, in recent years innovators have started developing more affordable designs, offering SHFs innovative finance options such as pay-as-you-go, and reinventing business models to improve accessibility. Israel-based N-Drip is making "micro" gravity-based drip irrigation systems for small farms. India-based Ecozen makes portable, solar-powered refrigerators and irrigation systems. Arya, also in India, operates a network of storage facilities near farming communities and offers financial services to cover farmers until their goods are sold.

Supportive infrastructure businesses require more than equity capital to succeed. Many need government intervention; grant funding for early product development and iteration; working capital to cover equipment, lab and manufacturing costs; and debt to extend credit to customers, many of whom can't pay upfront for such technologies. Advisory and technical assistance is also crucial to teach farmers about how to use new technologies and ensure long-term adoption.

There are also many larger-scale infrastructure developments needed across the Global South to enable adaptation. Road-building is a key example and one that African Development Bank has put significant investment towards the construction of 17 cross-border road corridors impacting agriculture on the continent between 2004 and 2016, impacting 239 million people. According to the Global Center of Adaptation (GCA),

> "when chosen as an adaptation strategy, road building needs to be augmented with rural feeder roads and storage facilities to benefit small-scale farmers."

Large scale irrigation is another example; GCA argues that irrigation infrastructure could be expanded to up to 38 million hectares compared to the current 7.7 million[1].

01 On-farm & Post-farm infrastructure

Investment trends

The below insights are based on early-stage VC, PE and other tech investment in SHF-relevant companies in the following categories that best fit this investment opportunity based on our taxonomy: farm robotics, mechanization and equipment, novel farming systems and some supply chain management and infrastructural bioenergy solutions for smallholder farmers. But there are other investments in the broader category of climate-smart infrastructure, which are not counted, including more general private equity investment and catalytic grants as well as other non-private investments and advisory services.

Total raised since 2012

$1.4bn

Median deal size

$1.3m

Number of companies that raised investment

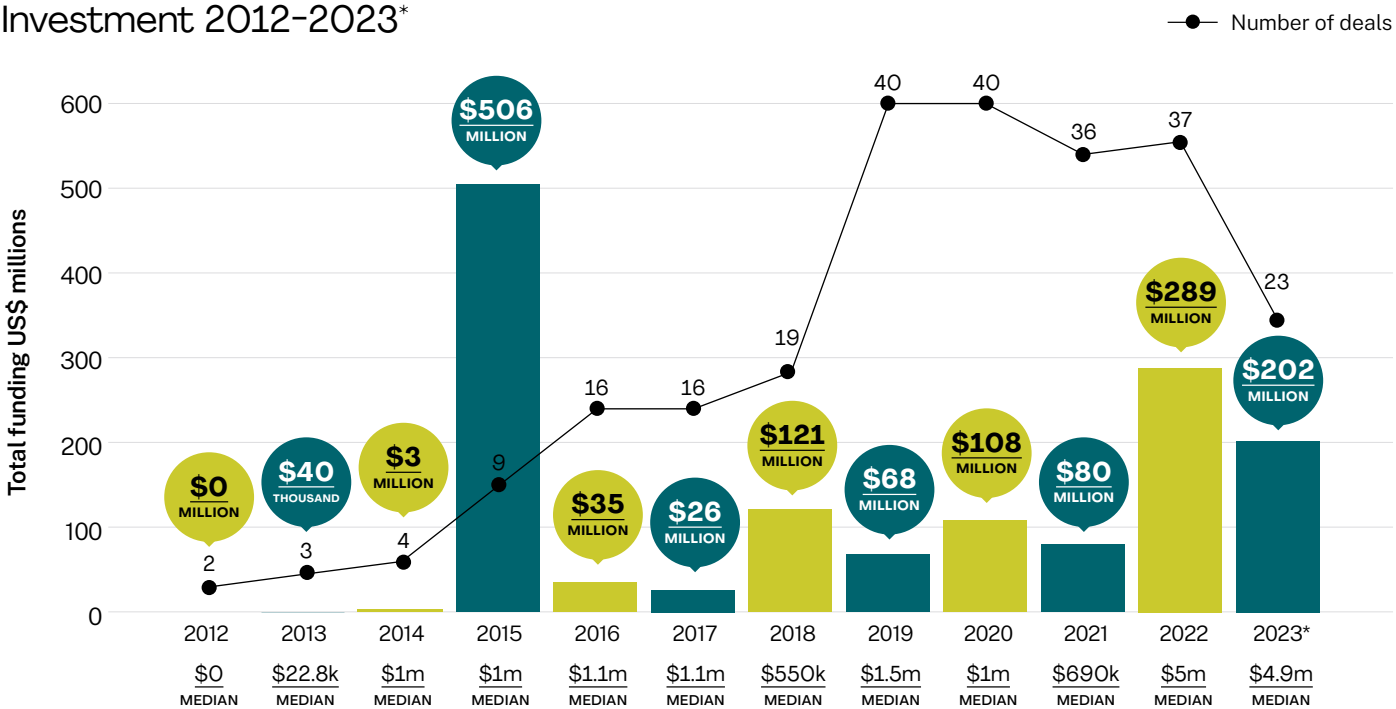
239

Number of deals closed

246

Investment in this area has been on a gradual upward trend since 2012. 2015 was an outlier, due to a large $500 million debt deal for Israeli irrigation tech Netafim. Deal activity doubled previous years starting in 2019, in part due to increased investor interest in these technologies, as well as an overall frothier VC market that made companies with longer time horizons to market more attractive from a valuation perspective. 2023's dip in both deal count and invested dollars reflects the broader market downturn, but median deal size continues to skew upward, suggesting that companies in this sector are maturing and raising bigger rounds.

On-farm & Post-farm Infrastructure Investment 2012-2023*



*as reported at October 31, 2023

01 On-farm & Post-farm infrastructure

Top deals

Netafim — $500 million

DEBT / 2015

An irrigation company that provides irrigation solutions to fighting scarcity of food, water, and land, for a sustainable future.

Farm Robotics, Mechanization & Other Farm Equipment

SAEL — $61.5 million

LATE / 2023

An end-to-end solution for agro-energy products and services. They have successfully forayed into procurement, processing, refining, warehousing, and distribution of rice, rice by-products, solvent extraction, and renewable energy solutions.

Bioenergy & Biomaterials

Arya (Collateral Warehousing Services) — $46 million

SERIES C / 2022

Providing post-harvest services including warehousing, warehouse receipt financing, rural storage discovery, collateral management and market linkages.

Ag Marketplaces

N-Drip — $44 million

SERIES C / 2023

Deeloping gravity micro-irrigation systems to reduce water use in agriculture. The company's system assists farmers in irrigating precisely and efficiently, optimizing yields without the need for expensive pumps or pressure-based filters.

Farm Robotics, Mechanization & Other Farm Equipment

Victory Farms — $35 million

SERIES B / 2023

An aquaculture farm for tilapia fish comprising of hatcheries, nursery ponds and deep-water cages for farming.

Novel Farming Systems

Ecozen — $25 million

SERIES C / 2023

Ecozen has a range of products for farmers. Ecofrost-solar powered, portable cold room based on thermal energy storage, Ecotron-smart controller for irrigation pumps, Eco-Connect-platform that connects farmers growing perishables with organized buyers.

Farm Robotics, Mechanization & Other Farm Equipment

Red Sea Farms — $18.5 million

SERIES B / 2022

Offering diverse products and services including produce technology and consultancy. Their patent-pending technology enables greenhouse and hydroponic farms to grow more and better food with less water and energy.

Novel Farming Systems

SunCulture — $14 million

SERIES A / 2020

Selling the AgroSolar Irrigation Kit, an entirely solar-powered drip irrigation system. The kit combines solar water pumping technology with high-efficiency drip irrigation and includes everything a farmer needs to grow more while spending less, in a sustainable and energy-efficient way.

Farm Robotics, Mechanization & Other Farm Equipment

Investment case studies

While the data above showcases tech investment in this theme, there is plenty of room and need for non-VC to successfully roll out this infrastructure, including catalytic grant funders for early-stage product development and market testing, concessional lenders and working capital providers for companies' lab, manufacturing, real estate leasing and equipment costs, alternative finance providers using creative and flexible equity alternatives, like revenue-based and future-profit-based financing, and debt investors to support product financing loans for companies' sales channels (most affordable on-farm products must be coupled with pay-as-you-go lending; storage providers may need capital to inventory credit).

Blended finance example: SunCulture

Kenya-based SunCulture has been working for more than a decade on developing low-cost solar-powered irrigation pumps for Africa's smallholder farmers. The company is a persistent pioneer in what has been a difficult market. Clever uses of financing have enabled the company to support thousands of farmers.

Investment deal: $2.6 million, carbon financing structure (2023)

Investors: British International Investment and Shell Foundation

Selling expensive hardware, like solar irrigation kits, to low-income farming communities is hard; farmers are reluctant to spend money experimenting because the cost of failure for them is high. A $40 solar irrigation pump costs a third of a Kenyan farmer's monthly income. Products like SunCulture's must therefore often be accompanied by credit, or pay-as-you-go financing which SunCulture has been providing since 2017.

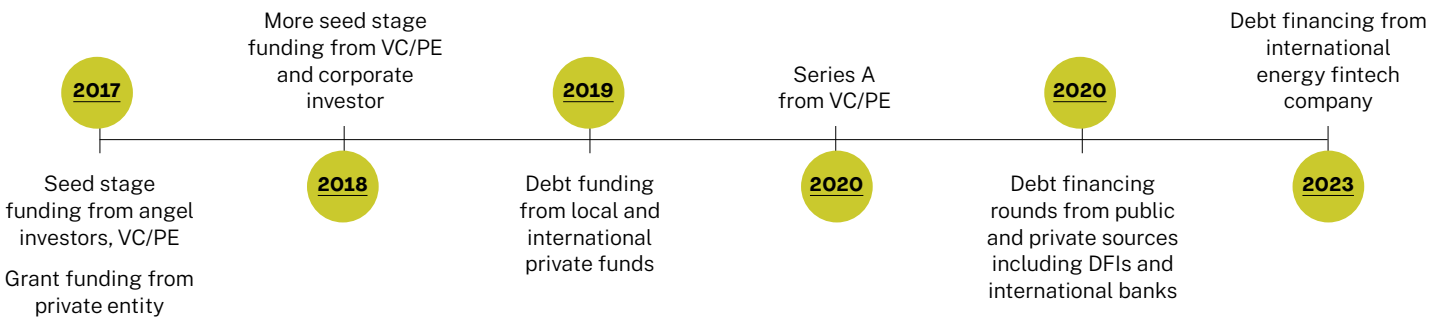
In December 2023, the company announced a new blended-concessional finance initiative to try and get its equipment in the hands of more farmers.

With $2.6 million from British International Investment and Shell Ventures, SunCulture will be able to reduce the cost of its pumps by between 25% and 40%. Carbon credits that are tracked, verified and sold from the impact of its products will repay the pilot facility and support discounts on future sales.

More than 90% of SunCulture's customers say they've increased their crop production and nearly all report being able to save enough money to cover emergency expenses, "which translates to increased resilience against future shocks." With this innovative facility, SunCulture wants to bring access to its solar pumps to 9,000 Kenyan farmers. Said CEO Samir Ibrahim, "Carbon finance must be used to accelerate the scaling of green technology in emerging markets, and I hope this structure inspires other financing organizations to offer similar solutions."

Nick O'Donohoe, BII CEO said: "Our intention is that this investment with SunCulture will catalyse private capital from the carbon markets to climate-smart solutions for smallholder farmers in Kenya and across Africa."

Funding timeline:



01 On-farm & Post-farm infrastructure

Focused fund example: ARCH Cold Chain Solutions East Africa Fund

ARCH Cold Chain Solutions East Africa Fund (CCSEAF) is managed by UK-domiciled emerging market specialist firm ARCH Emerging Markets Partners. CCSEAF's primary objective is to reduce food loss, increase food security and improve economic development across Africa. The fund focuses on designing, building and operating multi-purpose, state-of-the-art, temperature-controlled storage facilities across East Africa. Each facility in the region will be complemented by a fleet of temperature-controlled trucks that will assist with maintaining the end-to-end cold chain through inner city and long-haul routes, transforming the landscape of East Africa's supply chain and logistics industry.

Fund size: $81 million

Investors/limited partners include: European Investment Bank

02 Climate smart inputs

Adaptive capacity

Develop and supply climate-resilient and adaptive seeds and other inputs for farmers to better withstand climate hazards.

They say a workman is only as good as his tools. The problem in farming is that one of your main "tools" is the weather which you can't control. Operating in an increasingly adverse climate, farmers need the best tools they can get and most importantly that means high-quality seeds, crop nutrition (fertilizers), and pest control.

Governments, companies, and foundations have been developing new inputs for farmers for generations. The Green Revolution was a particular turning point but without getting into the long-winded and controversial history, high-quality, novel, resilience-building inputs are often out of reach for smallholder farmers. This makes the development and delivery of 'climate smart inputs' an exciting investment destination. A range of players - from multinational corporations to scrappy startups - are innovating in this space.

In developing markets in particular, it's important for the private sector to play a role in agriculture R&D. GCA's report found that in 33 countries in sub-Saharan Africa, less than one percent of agricultural GDP was spent on agricultural research. In contrast, this was as high as 2.5% in OECD countries[2].

This pathway includes innovations that provide farmers with more climate-resilient seeds, feeds, and farm products, typically developed with biological technologies.

For crop systems, this can include crops that are bred to be resistant to stressors including drought, heat, floods, pests, and disease. This includes higher yielding crops for farmers that may have decreasing land resources as a result of climate change. Many of these crops are accompanied by shorter growth cycles and higher nutritional content. Furthermore, inputs focused on boosting soil health are particularly important as soils are degrading and with limited access to fertilizers and plant nutrition, healthy soils are crucial for smallholder farmer resilience. Healthy soils can also help farmers withstand climate stressors as they better hold water and are less likely to erode in extreme weather conditions. Biological inputs are also complementary to regenerative agriculture, an ecologically-founded farming practice that's gathering pace across the world and in these regions. In livestock and aquaculture, innovations such as Nutri-san, are improving feed efficiency. Companies and projects are also breeding livestock to better withstand adverse environments, such as gene-edited cattle with thinner fur and darkened skin. There are also projects focused on preserving local, hardy cattle breeds such as Sanjevani Goats.

The development of vaccines and medicines can improve the health and welfare of livestock, reducing the need for antibiotics and other pharmaceutical interventions, which are costly and often hard to access.

Despite the multitude of innovations, these novel inputs are often inaccessible for SHFs given the many infrastructural, logistical and affordability challenges facing them. SHFs are also not well educated on biological alternatives making it hard to know what is real and what is a scam. Investments in supportive advisory extension services, digital marketplaces, and novel delivery mechanisms and infrastructure could help accelerate their distribution and adoption. The evolution of fintech companies and other SHF tech providers into broader marketplaces and supply chain platforms could foster adoption too. Take ThriveAgric, a Nigerian fintech startup that launched in 2017 to provide SHFs with inputs on credit; the company now does much more including owning and operating warehouses for inputs distribution and conducting soil tests and analyses. Climate-smart inputs providers could partner with such a platform to help distribute their products.

AgBiotech investment trends

The below insights are based on private, mostly venture capital, investment in agbiotech, which involves the development of climate smart inputs and best fits this investment opportunity based on our taxonomy. But there are other investments in the broader category of climate-smart inputs that are not counted, including more general private equity investment and acquisitions, such as Zamseed described below, as well as other non-private investment needs and advisory services as described above.

Total raised since 2012

$445m

Median deal size

$733k

Number of companies that raised investment

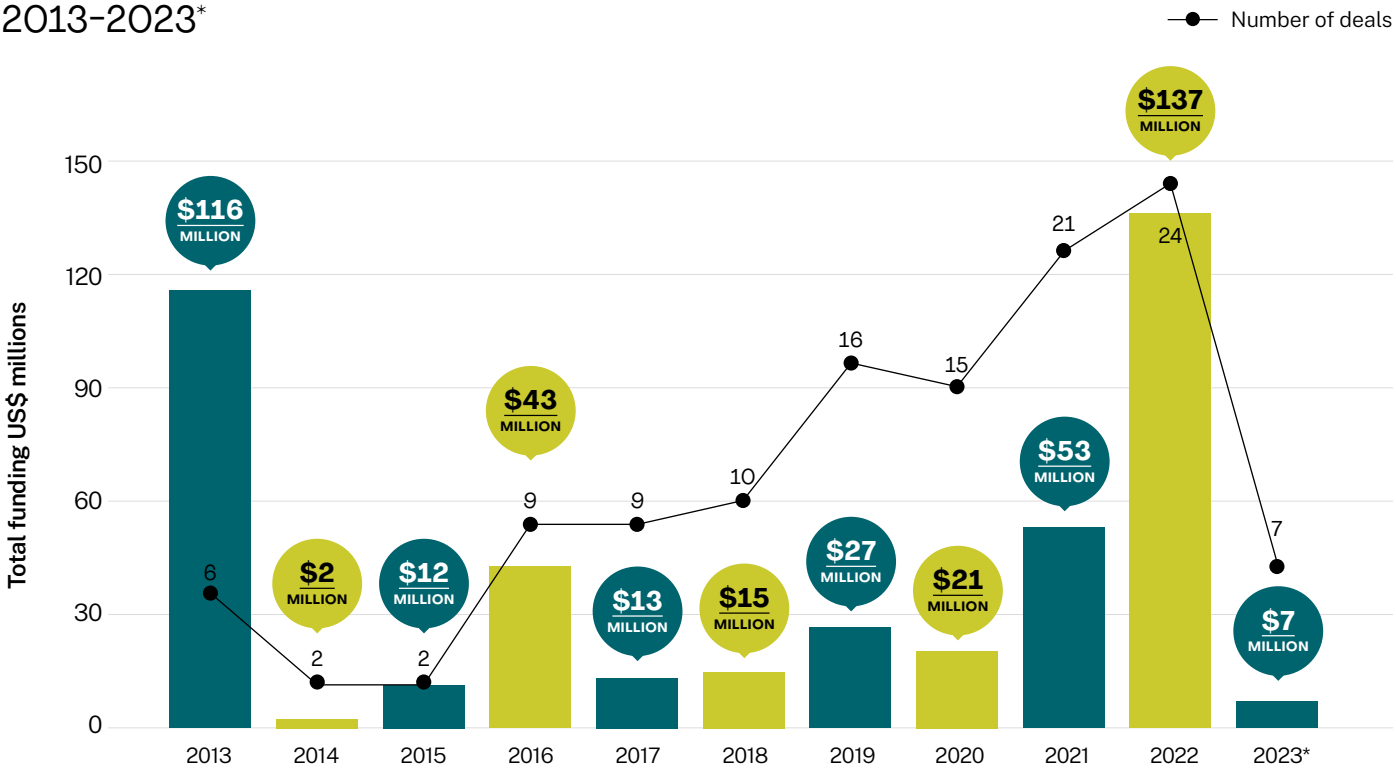
58

Number of deals closed

121

While investment has increased over the past 10 years, one or two large deals can skew the total funding data, as was the case in 2013. But the increasing deal count confirms a steady increase in interest in this category from investors in both developed and developing markets. It's a similar story on the global stage where Ag Biotech has typically been one of the best-funded agrifoodtech categories.

Ag Biotech Investment: 2013-2023*



 *as reported at October 31, 2023

02 Climate smart inputs

Top deals

Absolute Foods — $100 million

SERIES B / 2022

Serving 2 million farmers with a range of bioabled agri inputs. It claims its Nature Intelligence Platform is one of the largest collections of microorganisms, biomolecules and enzymes found in nature.

Ag Biotech

Kaiima — $65 million

LATE / 2013

Kaiima has developed a non-GMO, technology platform, which it coupled with advanced breeding programs to boost the inherent productivity and resource usage efficiency of high-impact food and energy crops.

Ag Biotech

SeedWorks International — $40 million

LATE / 2016

Breeds, produces and markets hybrid Rice, Cotton, Pearl Millet and Corn seeds. The company's research programs are based in Hyderabad with trial locations situated in the key agro-climatic zones of India.

Ag Biotech

String Bio — $20 million

SERIES B / 2022

Converts methane into 'environment-friendly solutions' for animal nutrition and valuable crop inputs, which not only increase yield and productivity but also reduce methane emissions from the farming process.

Ag Biotech

Unibio — $15 million

LATE / 2019

Converts natural gas into a highly concentrated protein product, Uniprotein®, which can be used as a direct supplement in feed for animals. It can substitute for fishmeal, a traditional feed component, and an increasingly scarce resource.

Ag Biotech

BetterSeeds — $12 million

SERIES A / 2021

Uses gene editing to adapt crops to sustain the challenges arising from climate change.

Ag Biotech

Origene Seeds — $10 million

SEED / 2015

Develops new hybrids with novel traits of quality, taste, flavor, uniformity, high nutrition values, shelf life, combine with high yield and environmental friendly.

Ag Biotech

Rootility — $10 million

SERIES C / 2018

Develops and uses innovative, GMO-free, root-focused plant breeding methods to dramatically increase crop yields and overall agronomic performance, while preserving crop quality.

Ag Biotech

Lavie bio — $10 million

SEED / 2022

Develops bacterial compositions that are sprayed on plants, used to coat seeds, or are integrated in the soil around the plant in order to improve the crop or the plant's features.

Ag Biotech

Enzootic — $8 million

SERIES B / 2017

A Singapore-based, shellfish genetics company with an innovation hub in Israel and commercial production facilities in

Ag Biotech

Investment case studies

Depending on the type of investor and risk profile a firm may have, there are different ways to invest in the climate-smart inputs theme. The below is a snapshot of a few.

Private equity example: Zamseed

Zambia's Zamseed is the country's first seed company with a broad seed product portfolio including maize, beans, pigeon peas, sorghum, millet, sunflower, vegetables, soya beans, wheat, groundnuts, rice, cowpeas and other crops. Zamseed products are specifically focused on the needs of smallholder farmers with traits like drought and disease-tolerance, as well as yield enhancement.

Investment round:
$5 million (K91 million), growth capital, 2020

Investor: SilverStreet Capital
an investment advisor managing two of Africa's largest agriculture funds with some $500 million in assets under management and an investor base of US and European pension funds, foundations, endowments and family offices.

Zamseed **was named** as one of Africa's fastest-growing companies by the Financial Times in 2022.

SilverStreet **said of the company:**

"One of the most effective methods to reduce deforestation, and improve incomes and climate resilience in Sub-Saharan Africa is to increase access to non-GMO hybrid seed. Watch as we support Zamseed to expand regionally and increase the number of smallholder farmers directly benefitting from the company's smallholder-specific, drought-tolerant hybrid seed varieties."

Corporate R&D/internal investment examples:

Nestle

The **Nestle Cocoa Plan** was introduced in 2016 in West Africa where suitable farmland for the crop is expected to shrink substantially amid changing climate conditions. The Plan distributed over 2 million higher-yielding cocoa plants to local farmers to help them produce more on less land.

Bayer

Bayer **announced plans to invest €220 million in R&D** to develop crop protection products that are suitable for regenerative agriculture: "next generation chemicals for a sustainable future." It will be the "largest single investment in its Crop Protection business in Germany since the founding of the Monheim campus in 1979."

Venture capital example: PunaBio

Argentina's Puna Bio is developing a seed treatment that leverages the power of extremophiles — living microorganisms able to develop and survive in extreme conditions — to strengthen crops against the impacts of climate change and soil degradation. The company has presented its soybean product for regulatory approval in Argentina, and is currently carrying out field trials for wheat and corn products (under development).

Investment round: $3.7 million, seed stage funding, 2022

Investors:

- **Silicon Valley venture firms:** At One Ventures and Builders VC
- **Brazilian agrifoodtech VC:** SP Ventures
- **Incubators and accelerators:** IndieBio, GLOCAL, and Grid Exponential (the latter two are local, industry-focused players.)

Investor insight - **SP Ventures:** Invest early based on where you think the market is headed. The firm invests in specific types of businesses that they think will mature due to shifting market dynamics or be in increased demand due to impacts of climate change, such as Ag Biotech and Fintech

Fund factsheet: SP Ventures' Fund II is a Brazil-based early-stage investment fund investing equity in tech-enabled businesses in the food and agriculture space across Latin America. SP Ventures has been investing in agriculture since its first fund in 2008 and has increasingly become more focused on investing in climate adaptation solutions in agriculture.

Date founded: 2021

Fund status: Investing - $33.5 million in capital deployed (as of 31 December 2022)

03 Enabling data & intelligence

Adaptive capacity

Enhance smallholder farmer decision-making, forecasting and risk assessments throughout the growing season to better respond to climate shocks and build financial resilience.

With the introduction of GIS technology to the agriculture industry in the 1980s, followed by GPS in the 1990s, farmers globally are using more data and digital tools than ever before.

From digitally mapping out their farms to collecting varied data about the weather, soil parameters, crop health, geography and geology from sensors, drones, weather stations and satellite imagery, ag data can be integrated and analyzed to generate customized, actionable information and insights that meet the needs of individual farms and farmers and delivered to them via accessible technologies like mobile phones.

As the quality and reliability of the data captured improved, so did the need for more advanced computational models to create insights from that data. Many entrepreneurs have taken on this challenge, bringing the latest machine learning and artificial intelligence tools to bear on an ever-growing wealth of data points.

Similarly, the business models using this data have evolved; no longer is the data just of interest to farmers in developed markets wanting to perform precision agriculture. Increasingly downstream actors who operate in small-scale producer markets are using these tools to climate-proof their supply chains, predict future supply, better interact with and support their farmer suppliers, or improve their compliance in the wake of increasing regulation. Furthermore, FSPs are leveraging third-party agroclimatic risk data providers such as ADAPTA or Yapu to help inform lending decisions.

On the farm, extension agents use data tools to enhance their **advisory services** and better inform farmers of short-term, seasonal variability due to climate change – including early warning systems on natural disasters, pest outbreaks and local weather forecasts – as well as longer-term trends.

In fact, the Food & Agriculture Organization of the United Nations recently stated the

> "urgent need for improving data collection tools and systems to support evidence-based policies, practices and solutions for risk reduction and resilience building in agriculture," saying that to-date, data for about the impact of disasters on the food system was "partial and inconsistent[3]."

Data for describing the impact of disasters on agriculture and agrifood systems is partial and inconsistent, especially in the fisheries and aquaculture and forestry subsectors.

This pathway is incredibly broad and involves i) on-farm, precision ag tools helping smallholder farmers in the production phase ii) enabling supply chain intelligence providers to promote traceability and climate-proof supply chains, and iii) agroclimatic risk intelligence providers used by other value chain actors - such as FSPs - who leverage data to inform their own decision-making, such as the provision of credit.

03 Enabling data & intelligence

Investment trends

Total raised since 2012

$1.4b

Median deal size

$645k

Number of companies that raised investment

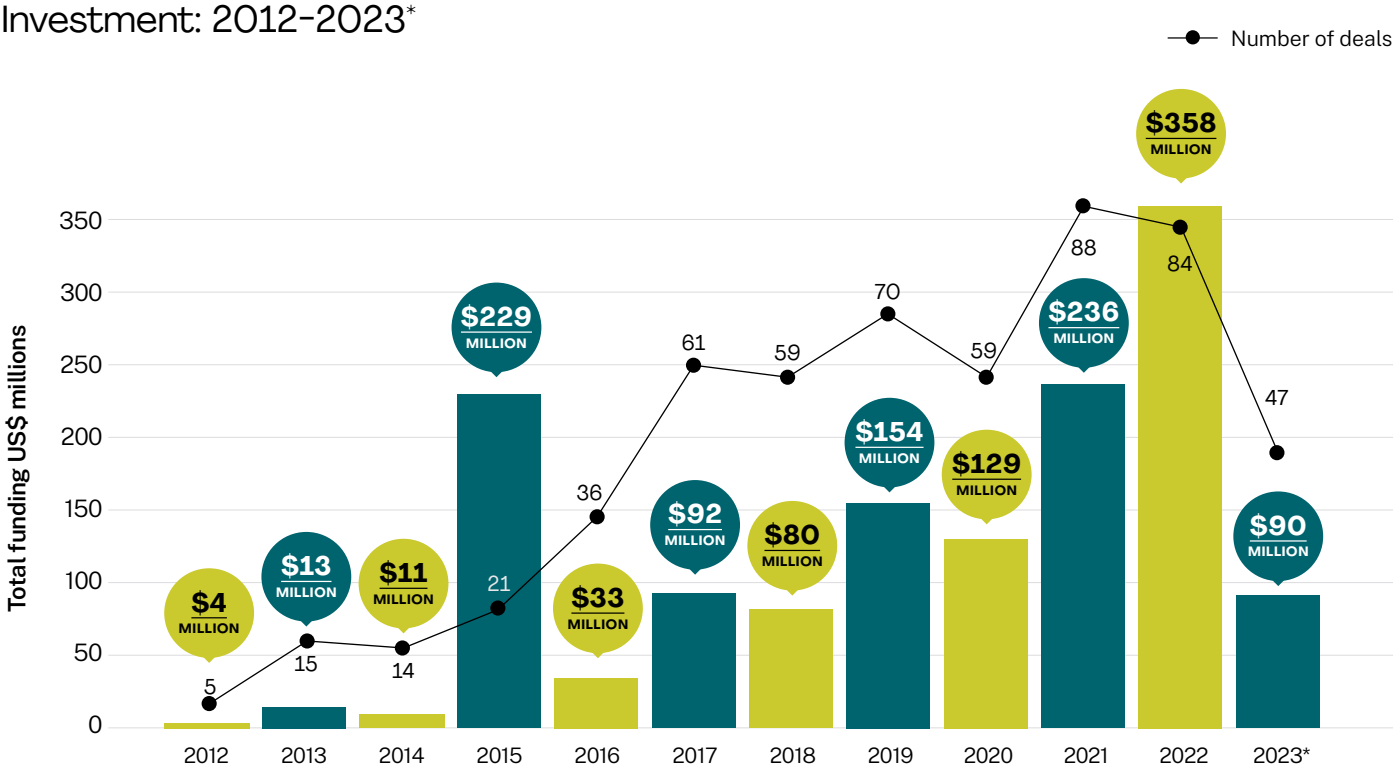
264

Number of deals closed

559

The high number of deals in this category highlights just how well versed venture capitalists are in software and big data. Many of the solutions operate as a business-to-business (B2B) model, targeting local, regional, or multinational agribusinesses and financial institutions who use these technologies for better data and insights regarding their supply chains or portfolios, many of which include smallholder farmers. The geographical diversity of the startups showcases the potential for data and intelligence solutions to be developed almost anywhere in the world with relatively straightforward export opportunities compared to some of the other more location and context-specific investment pathways. The size of the largest deals underlines how mature this pathway is as an agtech investment destination.

Enabling Data & Intelligence Investment: 2012-2023*



*as reported at October 31, 2023

03 Enabling data & intelligence

Top deals

AutoAgronom — $180 million

LATE / 2015

By measuring chemical and physical changes in the root zone, AutoAgronom developed a new sustainable precision agriculture solution that allows growers to save up to 50% of their water, 70% of their fertilizer and increases the yield up to 30%.

Farm Management, Services and IoT

Stable — $60 million

SERIES B / 2022

Stable is a risk management platform that helps businesses protect themselves from the untraded commodity price volatility derivatives market.

Supply Chain Management

Tridge — $37 million

SERIES D / 2022

Tridge collects, curates, processes, and analyzes data and content related to the global trading of food and agriculture to help people better understand the industry and global market to help make well-informed business decisions.

Supply Chain Management

FieldIn — $30 million

SERIES B / 2021

Helping farmers and their stakeholders track operational progress and reduce work errors, offering new, previously inaccessible layers of information that support decision makers at every junction. FieldIn combines innovative hardware with an array of sensors, agricultural best-practices, data science analytics and proprietary algorithms into one integrative solution that captures the farm's pulse, reduces work errors, and helps farmers and their stakeholders track operational progress.

Farm Management, Services and IoT

SeeTree — $30 million

SERIES B / 2020

An "Intelligence Platform for Trees" providing per-tree intelligence to growers to track their trees' health and productivity. Using drones, satellites, IoT sensors, weather information and more, they scan and analyze hundreds of millions of trees.

Farm Management, Services and IoT

Satellogic — $30 million

SERIES C / 2019

The first company to develop a scalable earth observation platform with the ability to remap the entire planet at both high-frequency and high-resolution.

Agroclimatic Risk Intelligence

SupPlant — $27 million

SERIES A / 2022

Offering a unique artificial intelligence system that is able to analyze data generated from crops through sensors and translate this data into irrigation commands, saving water on a global scale and improving productivity and yields.

Farm Management, Services and IoT

Agritask — $26 million

SERIES B / 2022

An Agronomic Intelligence & Analytics Platform, that powers collaboration across the agri-food value chain. The platform connects Food & Beverage enterprises with growers and suppliers to build predictable, sustainable, and resilient supply chains.

Agroclimatic Risk Intelligence

Phytech — $23.5 million

SERIES C / 2020

Provides growers with a decision support service to increase their yields and to optimize irrigation. The service is based on innovative plant sensors that monitor the plant's growth in real-time and provide the grower critical alerts through the web and mobile applications.

Farm Management, Services and IoT

Cropin — $20 million

SERIES C / 2021

Founded in 2010, Cropin is a pioneer in the Agtech space, having built the first global Intelligent Agriculture Cloud. Cropin's platform enables various stakeholders in the agri-ecosystem to leverage digitization and AI at scale to make decisions that increase efficiency, scale productivity, and strengthen sustainability.

Farm Management, Services and IoT

03 Enabling data & intelligence

Investment opportunities

- Precision agriculture startups
- Supply chain data startups
- Agroclimatic risk intelligence providers
- Digitally-enabled extension/advisory services

Investment case studies

Depending on the type of investor and risk profile a firm may have, there are different ways to invest in the data & intelligence theme. Below is a snapshot of two avenues but there are many more including supply chain companies' internal investments and initiatives, government-led investments in data infrastructure, and support from advisory and extension services.

Strategic bank investment example: SatSure

Founded in 2017, India's SatSure leverages satellite imagery and AI to deliver decision intelligence from space, translating to valuable insights for various industries, including agriculture, banking, and critical infrastructure. Current use cases which the firm caters to are spread across enabling farmer financial inclusion, improved debt service management in the rural areas, mortgage loan monitoring, enabling agrichemicals hyperlocal sales intelligence and distribution strategy, aeronautical data management, vegetation monitoring for utilities, construction change detection, and commodities procurement intelligence, to name a few.

Investment deal: pre-Series A strategic round, 2023

Investors: ICICI Bank, Kotak Mahindra Bank and HDFC

"We have been following SatSure's journey for the past couple of years now and have seen their product evolve and mature in the banking sector, especially in the space of building technology towards enabling financial inclusion of farmers in India. Investment in SatSure strategically aligns with our goal of partnering with companies that have a high potential to create large scale impact across different sectors." said Mr. Jaimin Bhatt, Group President and Group CFO of Kotak Mahindra Bank.

The round was followed by a Series A including Indian funds Baring Private Equity Partners India, **xto10x Technologies**, impact fund, Omidyar Network India, and Silicon Valley VC: Promus Ventures

International VC, impact fund and corporate investment example: Aquaconnect

Founded in 2017, India's Aquaconnect works with fish farmers and shrimp farmers to improve farm productivity, financial access, and market linkage through intelligent technology solutions. Since its inception, Aquaconnect has assisted over 90,000 farmers through its unique AI & GIS-powered advisory platform and is helping connect aquaculture farmers with stakeholders in the value chain, such as feed producers, farm equipment manufacturers, banks, insurers, importers, processors, exporters, and certifying bodies.

Investment deal: $15 million Series A, 2022

Investors:

Local Indian investors: Lok Capital led the round, joined by existing local investor Omnivore.

Asian investors: Singapore's Rebright Partners and Japanese investment group Suneight Investment.

Silicon Valley venture firms: AgFunder and Flourish Ventures

Corporate investors: Louis Dreyfus Corporate Ventures

Incubators and accelerators: HATCH

Aquaconnect planned to use the new capital to build up its product portfolio for both pre-harvest and post-harvest services.

Corporate & agtech partnership: Yara & CropNuts

Input provider Yara and agtech startup CropNuts partnered to provide integrated precision agriculture soil testing solutions to smallholder farmers across Kenya. Through this partnership, Yara underwrote 50% of tests performed by CropNuts, which enabled farmers to access soil health information and tailored inputs, increasing farm productivity.

Corporate partnership: Bayer, GenZero and Shell

Last year, **Bayer, GenZero, and Shell partnered to launch a program** in India focused on reducing emissions from rice farming using remote sensing and digital tools to measure, report on and verify those reductions as well as bring training, support, and guidance to smallholder farmers. While the crux of this program is climate mitigation, it also promotes climate adaptation, starting with introducing the practice of Alternate Wetting and Drying (AWD) – using intermittent flooding instead of continuously flooding fields as is usually practiced – and Direct Seeded Rice (DSR) – which involves limited flooding and no transplanting operations.

AWD is known for significantly reducing methane emissions – around 48% – but it can also reduce water use by up to 30%[4]. Meanwhile DSR can reduce water use by a minimum of 18%[5], although Bayer's estimates are higher at 40%[6].

The partnership aims to to scale up the program's coverage to 25,000 hectares over the 2023-24 seasons.

As Frederick Teo, CEO of GenZero said:

"With this program, we aim to transform the future of rice cultivation by driving the adoption of alternative wetting and drying as well as direct seeding techniques across smallholder farmers in India. The aim is to reduce the amount of water required for farming across many water-stressed agricultural regions in India and reduce methane emissions arising from rice cultivation, supporting the transition of the agricultural industry towards a low-carbon future."

04 Financial services

Adaptive capacity

Build financial resilience to climate change through improved access to finance and insurance against climate shocks.

Access to finance and insurance may be the number one barrier to smallholder farmers ability to adapt their livelihoods to a changing climate. Every sector discussed in this report is dependent on farmers' ability to pay: for seeds, for equipment, for data insights, for logistics services and cold storage.

But capital is one thing most emerging market smallholder farmers don't have. ISF has pegged the farmer and small agri-business finance gap at nearly $280 billion annually[7]. Financial institutions, whether those are in microfinance, private credit or commercial banking, supply just $70 billion of an annual $240 billion demand from farmers, and just $54 billion of the annual $160 billion demand from agribusinesses.

Furthermore, insurance is crucial for smallholder farmers to literally weather the storm of disasters that have caused about $3.8 trillion worth of lost crops[8] and livestock production over the past three decades globally. ISF estimates that globally less than 20% of smallholder farmers currently have agricultural insurance coverage, a number that drops to less than 3% in sub-Saharan Africa. And that ~270 million smallholder farmers in developing countries require $60-80 billion in agricultural insured value coverage. This amount of coverage represents an annual premium value of roughly $8–$15 billion.

Developing solutions in financial services is, on the one hand, simpler than other pathways because finance and insurance don't depend on hardware or physical products. They can, theoretically, be distributed digitally, eliminating dependence on poor or fragmented physical infrastructure (like bad roads that make it difficult to reach customers.)

But to-date, commercial lenders and insurers have avoided addressing smallholder farmers because of the challenges of reaching and underwriting a largely unbanked population cost-effectively. Primary challenges include:

- High costs to serve agricultural borrowers -especially smallholders, who are often more expensive to reach, due to the lack of structured value chains and geographically disparate nature of many borrowers, and lack of digital financial records
- High risk in agricultural markets -agriculture is notorious for high risks, given the external factors, including climate, that affect the productivity of farmers
- Low investment readiness among borrowers -given that many smallholders and agri-SMEs are unbanked, these groups tend to have relatively low financial literacy and financial management skills. Furthermore, many smallholder farmers are weary of transitioning from cash to digital savings or payment accounts.

Furthermore, financial institutions are increasingly risk-averse in the face of climate change, knowing its potential impact on their bottom lines. In India, over 50% of agricultural finance institutions expect to experience higher losses due to default as a result of the impacts of extreme and **changed weather conditions**.

And while the advent of mobile money and other digital technologies is bringing financial services for SHFs into the 22nd century at last, differing regulations throughout markets often create barriers for these innovative companies to scale across borders.

These challenges showcase that in both tech and non-tech solutions, the provision of finance for smallholder farmers is very difficult. As Acumen and others have **identified**, solving challenges in emerging market agrifood value chains, climate or otherwise, requires multifaceted strategies: farmers often struggle to access everything and rarely can one single intervention materially fix their problems. Thus, companies that provide equipment, inputs, storage and other products and services frequently embed financing into their solutions so farmers can pay for them. **ISF estimates** that approximately 40% of smallholder farmer financing comes from within the value chain rather than from financial institutions. Furthermore, digital agronomy and agroclimatic risk tools are increasingly relevant here as they can provide weather and climate data to trigger payouts when predefined conditions (such as drought or excessive rainfall) occur, as well as in-depth insights into farmers' practices for risk modeling.

Fintech investment trends

The below insights are based on venture capital investment in fintech for smallholder farmers. Companies and deals featured below use finance as their primary intervention but many could easily fit within another category. They're fintech companies that started from the point of expanding access to finance for farmers; many have since branched into other products and services within the agrifood value chain by necessity.

Also, as with the other categories, there are other investments in the broader ecosystem that are not counted, including most smallholder farmer microfinance and lending offered to smallholder farmers by commercial banks.

Total raised since 2012

$734m

Median deal size

$1.2m

Number of companies that raised investment

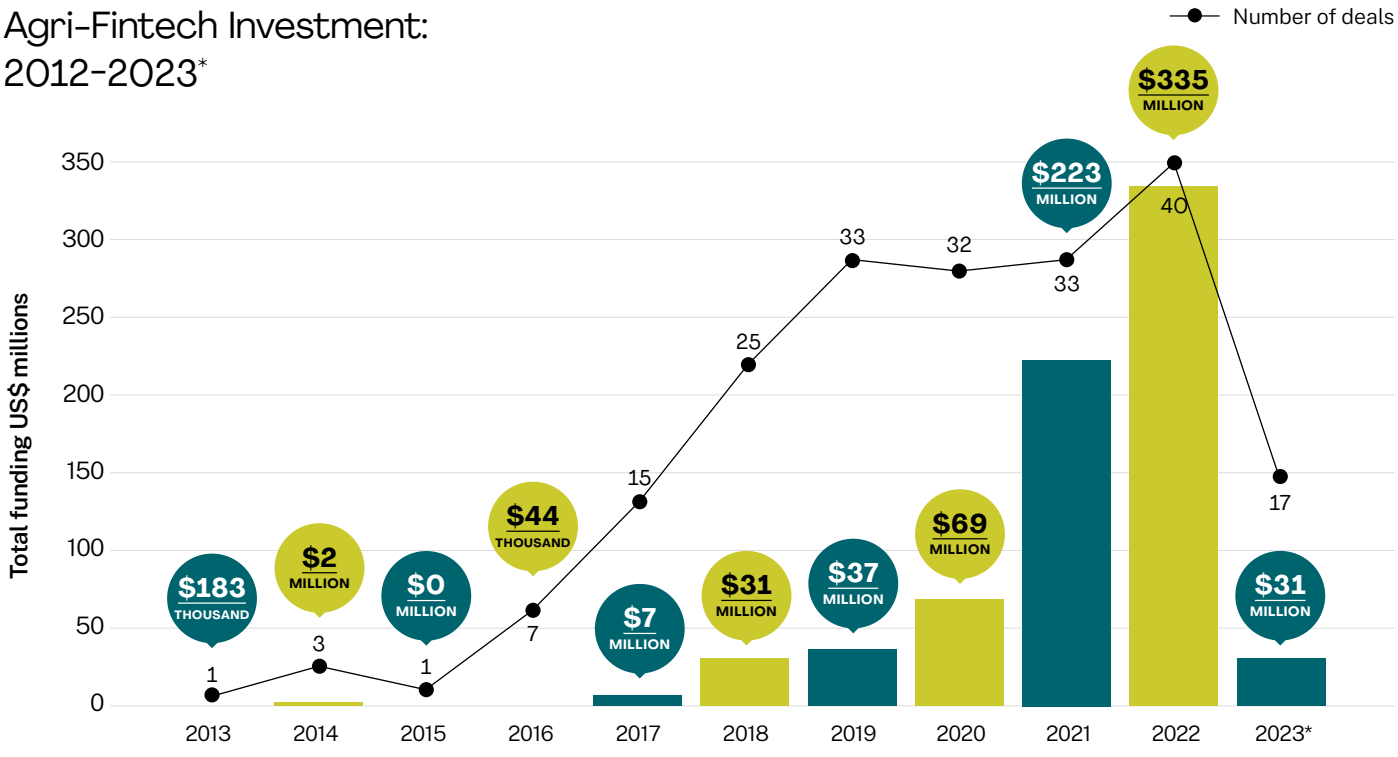
83

Number of deals closed

207

While investment has increased over the past 10 years, 2021 and 2022 appear to be outliers in funding volume. In keeping with the global VC market overall, 2021 and 2022 were record setting years for agri-fintech finance. Several large deals, including a $100 million Series C equity round last year for digital payments company MSF Africa, skew the data.

Agri-Fintech Investment: 2012-2023*



 *as reported at October 31, 2023

04 Financial services

Top deals

Jai Kisan — $49 million

SERIES B / 2022

A Fintech platform that provides sustainable financing for rural emerging markets. Helping farmers understand their financial status through a next-generation/hyper-localized agriculture credit score digitizing their finances & farm capabilities for financial institutions.

Ag Fintech

Apollo Agriculture — $40 million

SERIES B / 2022

Helping farmers in emerging markets maximize their profits. The company uses agronomic machine learning, remote sensing, and mobile phones to deliver a customized package of credit, high-quality farm inputs, and advice that can double farm yields, starting in Kenya.

Ag Fintech

SarvaGram — $35 million

SERIES C / 2022

A fintech startup offering financial and capacity-enhancing products for rural households. Through a data science-enabled platform, SarvaGram provides gold loans, consumer durable loans, farm loans, and business loans.

Ag Fintech

4G Capital — $18.5 million

SERIES C / 2022

Supporting micro-enterprises in Africa since 2013, providing financial literacy training with working capital loans to help small businesses grow sustainably. 4G Capital clients receive a bespoke programme of business training to help them use micro-loans to achieve much higher take-home earnings.

Ag Fintech

Proximity Finance — $14 million

LATE / 2020

One of the country's few farmer-facing microfinance institutions, serves the financial needs of about 100,000 households. The firm aims to nearly double that number over the next five years and have dispersed one million loans.

Ag Fintech

Ergos — $11.5 million

SERIES A / 2021

A transformational bank for the farmer which leverages technology to seamlessly provide custodial services (warehousing, loans, and market-linkages, enabling the farmer to convert his produce to a financial asset.

Ag Fintech

CROWDE — $9 million

SERIES B / 2021

An agricultural-focused technology and financial company based in Indonesia. They aspire to build a sustainable agriculture business ecosystem that provides Indonsian farmers with access to financing, cost-effective inputs, markets for their produce, efficient fresh produce logistics, data-driven market insights, and industry best practices.

Ag Fintech

Unnati — $8.1 million

SERIES A / 2021

A fintech-based agri platform that offers Unnati banking, supplying agri-inputs, and Agronomy services for farmers. It empowers farmers with digital technologies which bring efficiencies to their farm business. Its mission is to create 5 million farm entrepreneurs by empowering small and medium land-holding farmers digitally.

Ag Fintech

Tarfin — $8million

SERIES A / 2021

By leveraging the power of technology and data science, Tarfin is creating Europe's first and most advanced fintech lending solution for farmers and retailers.

Ag Fintech

Degas — $7.8 million

SERIES A / 2023

Providing high quality agri-inputs such as seeds and fertiliser to smallholder farmers in Africa with its proprietary credit scores for each farmer. Over 1.2 million data points are collected to understand bankability of such farmers.

Ag Fintech

04 Financial services

Investment case studies

Depending on the type of investor and risk profile a firm may have, there are different ways to invest in financial services. Equity and various types of debt investments that support on-lending are the most common. Creative uses of philanthropy, such as guarantees, help de-risk opportunities of other investors who may otherwise be reluctant to lend.

Blended-finance example: MCE Social Capital

MCE Social Capital has for 17 years enabled access to affordable loans for small agribusinesses and rural financial services providers. The nonprofit has used philanthropic guarantees to raise commercial capital and invest more than $300 million in organizations serving smallholder farmers in emerging markets. MCE last year **launched its first dedicated fund**, the MCE Empowering Sustainable Agriculture fund, to invest in African and Latin American agribusinesses. The fund focuses in particular on women's climate and economic resilience.

Capital raised: $41.6 million, closing in October 2023

Investors:

- US International Development Finance Corp.
- FMO
- ImpactAssets
- Visa Foundation
- Blink CV
- Imago Dei Fund
- Sall Family Foundation
- Heading for Change

Venture capital example: Jai Kisan

Jai Kisan is a fintech venture that focuses on affordable financing for rural communities in India. The Mumbai-based company uses alternative credit scoring metrics to enable unbanked farmers an entry point into formal financial services. The company raised a $50 million Series B equity round in 2022. Much of the capital it has otherwise raised is debt, for on-lending to farmers.

Investment round: $50 million Series B equity

Investors:

- Yara Growth Ventures
- Blume Ventures
- Snow Leopard Technology
- Mirae Asset
- GMO Venture Partners
- Akram Ventures
- DG Daiwa Ventures
- Angel investors

Insurance deep dive: Pula

Insurance is crucial to help smallholder farmers adapt to climate change, given the heightened risks and uncertainties around shifting weather patterns. Historically, there has been a large gap in smallholder insurance - both due to the farmer perception of insurance and lack of coverage from insurance companies due to farm size and farming practices.

In recent years, innovative insurance providers and partnership models have emerged to help close this gap.

Pula is an agriculture insurtech that delivers yield index crop and livestock insurance products to SHFs. To date, Pula has insured over 15 million farmers and distributed over $40 million in payouts.

The insurtech is funded by a range of players providing grants and commercial capital, recently securing a $6 million **Series A** led by TLcom Capital.

Furthermore, other AgTechs include insurance as part of a bundled offering to farmers. For instance **Apollo** offers Pula's insurance solutions as part of their bundled offering to SHFs, which also includes inputs and agronomic advice.

 ©Mercy Corps

05 Climate adaptive supply chain connectors

Adaptive capacity

Educate farmers in more climate-smart farming practices and build resilience to climate shocks with secure markets and improved livelihoods.

Farmers across the world often have meaningful interactions with their suppliers and offtakers; the relationship between an ag inputs retailer or consultant typically has a direct influence on the type of seed a farmer grows or herbicide he or she deploys. Increasingly crop offtakers – from large multinational food companies to local processors – are also influencing how a farmer operates based on the demands of their consumers.

While this pathway is a bit less direct than others, there are several instances of midstream actors in the global south who are directly engaging with smallholders farmers to encourage and provide them with the necessary training and inputs to help them adapt to climate-smart practices.

For large corporations, it makes business sense to protect their supply chains from the risks of climate change; Diageo, an alcoholic beverage company, believes that climate change could cost the company $77 million in increased costs and production disruption in its **supply chain**. Many large corporations are taking action. In 2011, Nestlé provided technical assistance to over 200,000 farmers, including training more than 16,000 coffee farmers in techniques to adapt to changing weather patterns. **Nestlé is also developing early warning systems, and has engaged governments, farmers, and others to develop vulnerability assessments and climate change adaptation strategies.**

But what is the investment opportunity? A simple investment in these mentioned corporations would by no means classify as a direct adaptation investment in and of itself but there are examples of investments directed at adaptation initiatives within companies, such as investing in a company to help them work with their suppliers and farmers to become more climate adaptive or adapt their own internal operations. The Acumen Resilient Agriculture Fund (ARAF)'s investment in Tomato Jos is a good example of the former: While Tomato Jos is a tomato canning company, which is not inherently climate-adaptive, the ARAF investment was used specifically to enable Tomato Jos to promote regenerative ag practices among its tomato farmers.

And there is clearly a need for more such investment. Root Capital, a non-profit impact investor, which provides loans and support to cooperatives and offtakers across agricultural markets in the Global South, recently surveyed its clients and investees about their climate-related activities. Some 93% said they had invested in climate actions in the past 3 years, and 97% have plans to invest in the next 3 years, with this investment primarily going to the distribution of inputs or technical assistance and landscape-level activities. On average, their clients have invested around $150,000 in climate actions cumulatively over the past 3 years, of which 60% was financed internally. Root Capital's agriculture clients cited a lack of access to capital as the primary reason for not investing in other climate actions; the survey found that groups with external financing were investing two to three times more in climate actions than those who were just funded internally[9].

05 Climate adaptive supply chain connectors

Investment case studies

*This investment opportunity crosses multiple agrifoodtech categories but is also investable through non-tech businesses and offerings. Furthermore, sizing these investments is difficult as the adaptation angle comes from the purpose of the investment – such as to promote regenerative agriculture – and not necessarily the overall business the investment goes to. For that reason, we cannot reasonably indicate estimated investment flows.

The investor landscape for this theme is broad as it includes tech-enabled supply chain startups, food processors with farmer extension services, corporations with adaptation initiatives, and adaptation-focused funds and accelerators.

Venture capital example: Releaf

Nigeria's Releaf is a supply chain technology firm that sources palm oil for African food factories. It aims to create climate-adaptive supply chains and provides extension services to smallholders, acts as a buyer of their products, and converts the raw material into factory-grade inputs for vegetable oil factories. Releaf started out as a hardware developer before expanding into processing, so its origins are in tech. It also uses digital technologies to work seamlessly with its network of over 2,000 smallholder farmers, who have supplied over 15 million kilograms of quality palm kernel nuts to food factories.

Seed stage funding: $2.7 million, 2022

Investors: Samurai Incubate Africa, Future Africa and Consonance Investment Managers with participation from Stephen Pagliuca, Chairman of Bain Capital and Justin Kan (Twitch).

The round followed $1.5 million in grants from The Challenge Fund for Youth Employment (CFYE) and USAID.

The seed funding developed Releaf's industrial food processing technology while the grant enabled Releaf to provide working capital and other value-added services for smallholders and small-scale processors, as well as training, recruitment and retention of more women and youth in the Nigerian palm oil sector through the creation of both digital and technical jobs.

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05 Climate adaptive supply chain connectors

Blended finance example: Koa

Koa is a Swiss-Ghanain sustainable cocoa fruit company, that has unlocked a new decentralized value chain around the previously unused cocoa pulp to boost farmer income and improve climate resilience

Investment size: $3.5 million

Investors:

- **The Landscape Resilience Fund (LRF)**, a blended finance platform co-developed by South Pole and the World Wide Fund for Nature to support and invest in meaningful climate adaptation in rural landscapes.
- **IDH Farmfit Fund**, a €100m de-risking blended finance fund for smallholder farmers.

A critical challenge for the majority of cocoa farmers in West Africa is lacking access to affordable finance so that they can invest in their farms in a way that allows them to be more resilient to the increasingly extreme weather driven by climate change. Koa aims to increase incomes and help farmers adapt to climate change in two ways. Firstly, it provides a meaningful increase in the income of cocoa farmers, paying them on the spot while transparently recording transactions, and at the same time reducing food waste by 40% and making their land use more efficient. And secondly, by training farmers in sustainable agricultural practices and post-harvest processing. This investment supported Koa in setting up a new processing facility in Ghana, increasing production capacity more than tenfold by 2024 and creating additional income for up to 10,000 cocoa farmers.

Blended finance example: &Green Fund

&Green Fund is a thematic investor financing the transition of major commodity supply chains away from deforestation. &Green identifies those businesses directly or indirectly involved in commodity production, downstream and upstream in the supply chain in Brazil, Colombia, Ecuador, Gabon, Indonesia, Lao, Liberia, Peru, Vietnam, and Zambia.

Fund size: $144 million in committed capital through grants, redeemable grants and loans from its investor base

Investor base: NICFI, Norway's International Climate and Forest Initiative, Unilever, Global Environment Facility (GEF), FMO, the UK government's BEIS department, and the Ford Foundation.

&Green is a blended finance fund that provides investments of between $5 million and $30 million in long-term credit or guarantees, along with technical assistance – via a separate vehicle – to prospective clients. They have several projects across smallholder farmer markets in Asia and Latin America. For instance, in Vietnam, where smallholder farmers grow 80% of coffee, &Green provided a **$20 million loan to Mercon Coffee Group** to establish a sustainable, climate-resilient, deforestation-free coffee supply chain. The loan was also intended to enable Mercon to establish a blueprint for sustainable coffee production in Vietnam, with a focus on improved livelihoods for smallholder farmers.

05 Climate adaptive supply chain connectors

Corporate & agtech partnership example:

As part of Hershey's "Cocoa for Good" initiative, the company engaged Ghanain ag marketplace and supply chain management company **Farmerline** to develop CocoaLink, a gamified advisory app that teaches Hershey's cocoa farmers in Cote d'Ivoire sustainable production practices. The app includes various courses, games, and quizzes focused on climate-smart agriculture practices. Partnerships between large companies and agtech companies are becoming more commonplace, especially since agtech platforms can reach smallholder farmers at scale to help companies deliver on their regenerative ag commitments.

Farmerline has received a total $14.4 million in equity and debt funding from a variety of investors including ARAF, FMO, Oikocredit, and Rabobank. Hershey's pledged to invest $500 million in its Cocoa for Good initiative by 2030.

 ©Farmerline

06 Digital marketplaces

Adaptive capacity

Enable more efficient market linkages for farmers to access high-quality, climate-adaptive inputs and services, and secure off-takers to improve financial resilience in the face of climate hazards.

Talk to any farmer-focused agtech company working in an emerging market and the words "fragmented supply chain" are bound to come up. Agribusiness marketplaces commonly arise to solve one problem for farmers — say, access to high-quality seeds — and end up evolving to solve many problems. As Acumen noted in its **Fail Forward** report about portfolio failures:

> "A single product may be necessary to tackle complex problems of poverty, but it is rarely sufficient."[10]

Multifaceted problem-solving is necessary in places where market linkages are inefficient and/or broken. Agri-input distributors may be limited in rural areas, meaning farmers only get the choice of one type of seed, or one type of equipment, which may not be the best or the most affordable or climate resilient. The buy-side end of supply chains often involves numerous middlemen and inefficient logistics. Improved data and intelligence can help increase efficiency and effectiveness and help smallholder farmers reap greater returns.

And then there is access to finance, perhaps the number one barrier to smallholder farmers' livelihood improvement, much less climate adaptation. Every sector discussed in this report is dependent on farmers' access to capital for seeds, for equipment, for data insights, for logistics services and cold storage.

Companies and deals featured in this pathway combine various offerings including software, logistics, and financial and advisory services to connect farmers to the tools and resources they need to succeed. While many marketplaces over the past decade emerged as pure-play digital e-commerce marketplaces for the agriculture sector, in recent years nearly all of the surviving models have pivoted to a range of different 'marketplace hybrid' business model orientations that allow them to integrate deeper in agricultural markets while diversifying revenue streams. These pivots include setting up infrastructure alongside digital marketplaces to claim additional margins on input supply, financial services, or offtake trading.

There are a range of models working at scale on both the input and outputs side. On the input side, India's DeHaat is one of the crowning examples of an impact-driven organization that centers smallholder farmers end-to-end, providing inputs, capital, crop monitoring, farming tips, and access to buyers. On the output side, models such as Origo Commodities provide trade finance and showcase how marketplaces can forward integrate into the commodities markets. Other models, such as Tani Hub in Indonesia, support farmers in finding buyers.

Investment trends

The below insights are based on tech investment in agribusiness marketplaces. Many of the companies have considerable overlap with the climate adaptive supply chain connectors and fintech categories making categorization at times challenging. There are investments in the broader ecosystem that are not counted here, such as non-profit agri-advisory services organizations that connect farmers to inputs and training.

Total raised since 2012

$1.7b

Median deal size

$6.3m

Number of companies that raised investment

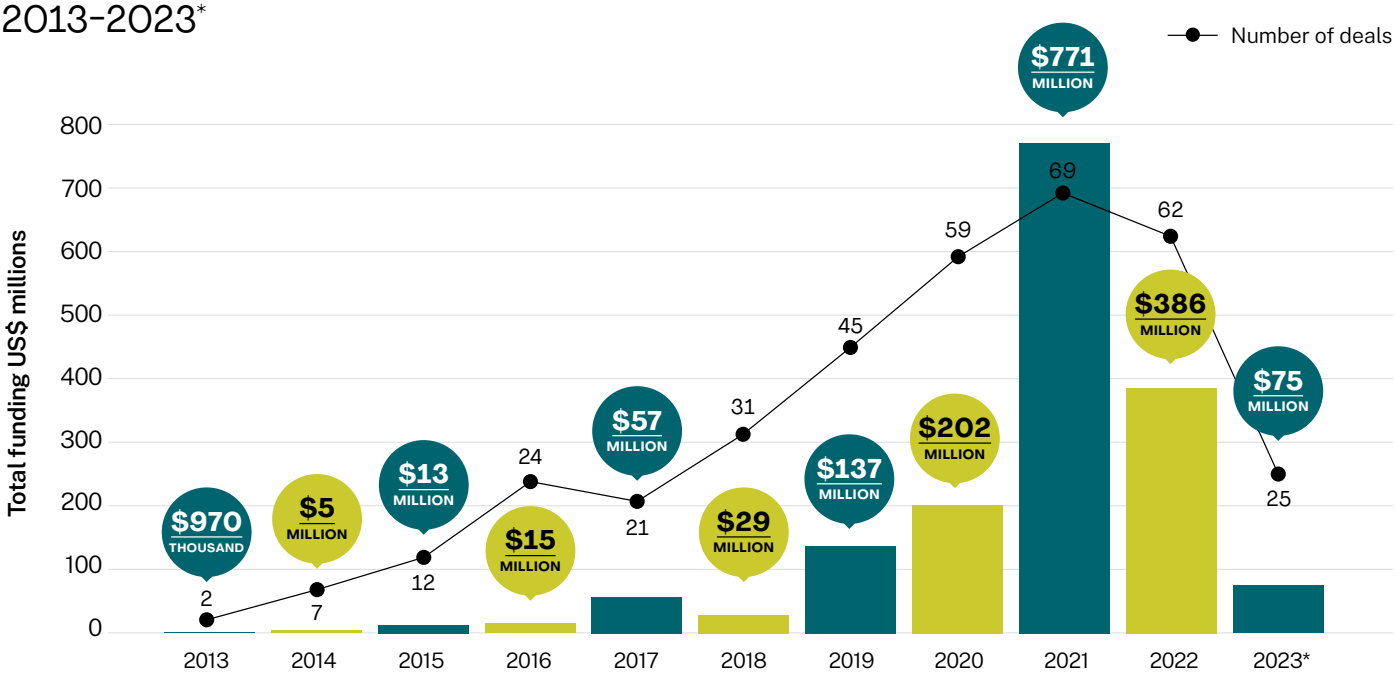
166

Number of deals closed

358

Agribusiness Marketplaces is the largest of the investment categories in this report, both by investment volume and deal count. As with other sectors, investment has increased over the past 10 years, with last year being an exceptionally poor year. 2021 was a frothy year for the sector on account of the pandemic and investors spotting opportunities to strengthen global food supply chains. The VC downturn began showing up earlier in the Agribusiness Marketplaces category than others: investment volume in 2022 was half of 2021's despite deal count being relatively stable. While VC funding shows investor interest in this market, in addition to equity, these Marketplaces necessitate substantial working capital to move large volumes of inputs and outputs, which will likely require more diversified sources of funding.

Marketplaces Investment: 2013-2023*



 *as reported at October 31, 2023

06 Digital marketplaces

Top deals

DeHaat — $115 million

SERIES D / 2021

Connecting small farmers to their various needs – Seeds, fertilizers, equipment, crop advisory, and market linkage through a wide network of trained micro-entrepreneurs. Registered farmers get access to a wide range of agricultural inputs (Seed, Fertilizer, and Crop protection) directly from competitive sources. Subsequently, they get customized crop reminder calls in the local language as well as crop monitoring support from the same DeHaat micro-entrepreneur. Lastly, they sell the farm produce directly to institutional buyers. Farmers place their various demands related to Agri input, field visits or Agri output either through the toll-free number or mobile application and get last-mile services through assigned micro-entrepreneur.

Ag Marketplaces

Jumbotail — $84.9 million

SERIES C / 2021

Building an online marketplace for food and grocery, targeted at wholesale buyers. It also operates a marketplace that connects tens of thousands of these Kirana stores with brands and traders. The company offers a whole suite of services including supply chain logistics, a mobile app for placing orders, integration with point-and-sales devices, and credit solutions to shop owners that can't easily get a loan from banks. Their vision is to organize the food and grocery ecosystem in India using technology, data science, and design. They are building products, platforms, and services for the next billion people of India, who have fundamentally different needs-access, language, selection, supply chain, financial, cultural, and the like.

Ag Marketplaces

AgroStar — $70 million

SERIES D / 2021

One of India's foremost AgTech start-ups, working on the mission of #HelpingFarmersWin. AgroStar's omnichannel platform provides end-to-end solutions for Indian farmers helping them grow better enabling them to increase their yield and reduce their cost of cultivation.

Ag Marketplaces

TaniHub — $65.5 million

SERIES C / 2021

B2B agriculture marketplace that connects farmers with food, hotel, restaurant, and catering business people. It offers an e-commerce platform for agricultural products and empowers local farmers by providing market access and financial access. Through TaniHub, local farmers can sell their crops to individuals as well as micro, small, and medium enterprises (MSMEs) in various regions.

Ag Marketplaces

Tridge — $60 million

SERIES C / 2021

Develops an online trade platform that matches global food agriculture buyers and sellers. Its platform helps from research to ordering and enables buyers to source their food and agriculture items at reasonable prices in more than 150 countries.

Ag Marketplaces

Captain Fresh — $57.3 million

SERIES C / 2022

A freshwater fish and seafood supply chain platform. Captain Fresh is a B2B marketplace leveraging technology to deliver the fastest harvest-to-retail in the industry. The company focuses on aggregating the fragmented retail demand across the country and linking them to the small fishermen and farmers throughout the Indian coast.

Ag Marketplaces

Arya (Collateral Warehousing Services) — $46 million

SERIES C / 2022

Providing post-harvest services including warehousing, warehouse receipt financing, rural storage discovery, collateral management and market linkages.

Ag Marketplaces

Aruna — $35 million

SERIES A / 2021

an Indonesian integrated fishery platform. Aruna helps to create a fair fish trading, improve the livelihood of local fishermen, also bring an affordable and high-quality seafood for communities.

Ag Marketplaces

06 Digital marketplaces

Investment case studies

Depending on the type of investor and risk profile a firm may have, there are different ways to invest in Agribusiness Marketplaces. The below is a snapshot of a few but there are many more from support for advisory and extension services, inputs distributors and supply chains, and government-led research initiatives.

Venture capital example: DeHaat

The biggest Agribusiness Marketplaces VC deal to-date belongs to DeHaat, an end-to-end agricultural services firm in India that centers on smallholder farmers. Since launching 12 years ago, the company has grown to support nearly two million farmers in 12 Indian states, and supports its farmer network with information and services in more than 30 local languages. The company has also raised multiple rounds of venture debt to support its farmer finance and insurance offerings.

Investment round: $115 million Series D equity

Investors: Prosus Ventures, RTP Global, Sequoia India, FMO, Omnivore, AgFunder*

Diversified investor example: Copia

Copia is a rapidly growing B2C ecommerce platform headquartered in Kenya. They are centered around an agent network and offer on-farm products - including organic fertilizers and a variety of seeds - as well as broader household goods and food. In addition to their digital marketplace, they have set up an extensive distribution network in which products are delivered to agent collection points close to the consumer. Unfortunately, Copia was hit by the funding downturn in 2023 and had to **layoff over 30%** of its workforce during the year. Until that point, it had employed over 50,000 agents, of which 81% were women, and has reached nearly 2 million customers.

Investment round: $70 million Series C ($50 million + $20 million extension)

Investors:

- Enza Capital
- Perivoli Foundation
- Goodwell Investments
- DFC
- DEG
- Sorenson Impact Foundation
- elea Foundation
- Zebu Investment Partners
- Lightrock
- KOA Labs
- Perivoli Innovations

Quick guide to investing in adaptation by investor type

VC & PE	**On-farm/Off-farm Infrastructure:** hardware (e.g. solar irrigation) to improve productivity or post-farm (e.g. cold storage) to decrease loss **Enabling Data & Intelligence:** traceability & MRV systems for supply chain visibility or agroclimatic risk providers who improve FI decisioning **Climate-Smart Inputs:** agbiotech companies who offer seed breeding or distribution channels for adapted inputs **Financial Services:** agfintechs offering alternative credig scoring models that provide access to finance for SHFs and agri-SMEs; innovative agriculture insurance solutions **Climate Smart Value Chain Actors:** who promote regenerative ag practices during production and/or innovative processing to reduce food waste **Marketplaces:** digital marketplace hybrids that promote access to inputs and access to agronomic knowledge
Corporates	**Enabling Data & Intelligence:** software solutions to monitor climate impact and promote regenerative practices **Climate-Smart Inputs:** investment in internal R&D programs for smallholder supply chains **Climate Smart Value Chain Actors:** regenerative ag training for SHFs in value chain; co-adaptation and mitigation plays to reduce GHG emissions
Banks / FIs	**On-farm/Off-farm Infrastructure:** large-scale infrastructure project financing **Enabling Data & Intelligence:** leveraging agroclimatic risk providers that incorporate climate decisioning into lending processes **Financial Services:** increased lending that allows SHFs the ability to purchase improved inputs and adopt climate-smart practices during production
Catalytic Capital	**On-farm/Off-farm Infrastructure:** grants for early-stage projects, e.g. development of innovative on-farm solutions that benefit SHFs **Enabling Data & Intelligence:** direct investment in companies that provide weather data or early warning systems for farmers **Climate-Smart Inputs:** promoting development of improved crops and animal feed in climate-prone regions

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Conclusion

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Conclusion

Investing in agriculture is hard. Just 1% of all private fund assets under management are focused on the sector[1]. Funding to agrifoodtech startups is more optimistic but still just 5.5% of all tech investment[2].

When you consider that agriculture is the largest employer in the world, providing livelihoods for 40% of people[3], accounting for at least 10% of global GDP, and contributing to one-third of greenhouse gas emissions, it's fair to say it's underinvested as a sector.

Now consider investment in smallholder farmers and fragmented agriculture supply chains, and the risk profile is even greater. Layering climate adaptation on top becomes even more complicated. As discussed throughout the report, it's an even less trodden path with limited definition and requires context-specific solutions.

But despite these challenges to private sector investment, this report highlights that there are indeed opportunities to invest in climate adaptation for smallholder farmers. A growing number of funds are explicitly focused on building investment pipelines in climate adaptation. And many more investors have allocations to climate adaptation solutions without even realizing they're doing it.

Adaptation-focused funds

- Acumen ARAF
- Lightsmith Climate Resilience Fund
- Kuali Fund (managed by GAWA)
- Landscape Resilience Fund
- Climate Resilient Africa Fund
- Dutch Fund for Climate and Development
- BFA Catalyst Fund
- The Green Climate Fund
- &Green Fund

Both the data and our 30+ investor conversations demonstrate that diversified sources of funding will be needed, including public and concessional money. Collaboration between them will also be important and is already happening – see the ranging investor types in our case studies. Government-backed initiatives like Ireme Investment in Rwanda is a great example here, especially as it incorporates the local context of that country and its national adaptation plan; adaptation is highly contextual.

There are a few investment strategies that can support climate adaptation for private SHFs investors including the use of concessional finance. Blended finance is a particularly popular concept at the moment. Almost all of the agriculture adaptation-focused funds we interviewed leverage blended finance in some form or other, including LightSmith, Acumen ARAF, Climate Resilient Africa Fund, ARCAFIM, &Green and Catalyst Fund.

Several adaptation-focused investors we interviewed also offer technical assistance and advisory to their portfolio companies. Some of them are creating sidecar grant funds or partnering with NGOs on the ground to increase the chance of their investments successfully being adopted by smallholder farmers. Grant-funded facilities can also help support the cost of monitoring and impact evaluation. Root Capital, Catalyst Fund and &Green Fund all provide TA to their investees in various formats.

Deep Dive: Ireme Investment

Date founded: **2023**
Target size (USD): **$40 million**
Fund status: **Investing -**
actively seeking applications
(as of 18 March 2024)

Rwanda's **Ireme Investment** is a groundbreaking facility that leverages public-private collaboration to promote green business growth and support Rwanda in responding to climate change. Ireme offers both a credit facility and project preparatory facility that provides grants, recoverable grants, and equity. They focus on six key investment areas, including climate-smart agriculture - with a dual focus on adaptation and mitigation. The facility is financed by a variety of players, including the Government of Rwanda, Green Climate Fund, European Investment Bank, and other DFIs and philanthropic organizations.

Ireme employs many of the strategies and capabilities we identified for investors deploying adaptation investments in smallholder contexts, including:

- Facilitating Impact Measurement and Management - track a diverse range of impact metrics focused on improved livelihoods, gender, youth, and climate.
- Including TA / Advisory Services technical assistance to support them in scaling.
- Considering Local Contexts the Government of Rwanda, they are inherently aligned to local strategies.
- Incorporating Climate Expertise who recently facilitated work in Rwanda, to better understand the ecosystem challenges and develop investment blueprints accordingly.
- Leveraging Concessional Finance financed by a variety of sources, including grants and guarantees.

This report is a step forward in understanding private investment flows in climate adaptation for the benefit of smallholder farmers.

Other investor strategies we uncovered include incorporating deep climate expertise internally or through partnerships, such as how Swiss debt and equity impact investor responsAbility partnered with CGIAR and experts from its Alliance of Bioversity International and CIAT arm to create the first science-based impact investing solution targeting food systems transformation. The firm has mobilized $106 million for a public-private climate-smart food systems fund.

This report is a step forward in understanding private investment flows in climate adaptation for the benefit of smallholder farmers. But there is still a lot we don't know. We don't know how much local and international banks are investing in climate adaptation for SHFs, nor do we know the funding flows of corporations undertaking adaptation initiatives for their supply chains. And even parts of the private sphere are opaque given the lack of a standardized definition and understanding of climate adaptation among investors, companies and data providers. To truly understand the gaps and unlock all the appropriate financing channels for SHF climate adaptation, we need to understand all funding flows.

Despite the challenges, one thing is certain -adaptation financing is needed, and it's needed now. GCA estimates that for Sub-Saharan Africa, the cost of action on climate adaptation of agriculture and food systems is less than a tenth of the cost of inaction[4]. Taking action now not only means supporting smallholder farmers but climate-proofing our global food system.

Urgency of Investment

Sub-Saharan Africa Deep Dive

$15b

Cost of action
(annual)

$201b

Cost of inaction
(annual)

When it comes to investing in climate adaptation in agriculture and food systems in Sub-Saharan Africa, the cost of action is less than a tenth of the cost of inaction, so the economic case is clear.

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Appendix

Data methodology

The primary/proprietary findings from this report predominantly rely on AgFunder's database of over 25,000 agrifoodtech investments, which date back to 2012. AgFunder has been producing agrifoodtech investment reports since 2014. Its main data partner is Crunchbase, which the firm supplements with data from regional partners across the globe. These partners include: Africa: The Big Deal, Bits x Bites, Briter Bridges, GLOCAL, Omnivore, Shakeup Factory, SP Ventures.

The taxonomy used in this report was co-developed by AgFunder, ISF Advisors and Briter Bridges based off of AgFunder's existing taxonomy.

During the data collection process, AgFunder and ISF examined other data sources and put in requests for granular data about non-tech agrifood adaptation investments but found that no other data sources had sufficient climate tagging for this purpose, or were not additive to AgFunder's dataset.

The process of finding and tagging adaptation deals within AgFunder's dataset went through many iterations; as discussed at length in this report, adaptation is highly contextual and location-specific. It also lacks definition and is therefore rarely explicitly labeled as adaptation. From AgFunder's dataset of 25,000 investments, just 2 companies specifically called out adaptation in their descriptions.

The next step was to use the keyword search methodology typically employed by research companies. We gathered keyword lists from the: Climate Policy Initiative, ASAP and various other climate adaptation reports.

This method was still left wanting as through significant manual checking of thousands of entries, we discovered a large number of both false negatives and false positives. And even after deploying a weighting system to the most relevant keywords, we still found too many false negatives to feel confident in the dataset.

Our next approach was to use semantic search with Cohere's cutting-edge natural language processing model (**Cohere embed V3**). This method uses artificial intelligence to scan for company descriptions that match the contextual meaning of our chosen definition – Activities that reduce or take advantage of the impacts of climate hazards – and keywords 'climate adaptation', 'climate hazard', 'reduce impacts of climate hazards.' This method is also widely known as zero-shot classification. However, rather than directly classifying the investments as adaptation or non-adaptation, we assigned a similarity score from 0 to 4 based on the cosine similarity between the description and the adaptation-focused keywords.

To combine the results of both semantic and lexical keyword search, we combined their ratings. As such, each investment was assigned a rating from 0 to 2 based on the presence of adaptation-focused keywords and also a rating of 0 to 4 based on the semantic similarity. We tagged all investments as adaptation which got a combined rating above 4. This method gives a priority to the results of the semantic search as upon manual inspection we found that investments with a semantic rating above 4 were extremely likely to be adaptation-focused.

After combining the results of the weighted keyword search with the semantic search, we had our baseline of global climate adaption in agrifoodtech funding of $56.5 billion across 6,375 deals.

The next step was to bring in the context of smallholder farmers in emerging economies, which involved auto-including certain categories in certain countries where the likelihood of them serving smallholder farmers in a climate adaptive capacity was extremely high, including Ag Marketplaces, Farm Management Services, Fintech, and Novel Farming Systems, in regions including Africa and South Asia.

Appendix

Data methodology

Next we contextualized the dataset for smallholder farmers more broadly. The first step was a lexical search for the presence of SHF-related keywords[1] in the descriptions of each investee company. We also tagged all investments originating from emerging countries[2] (with the exception of Brazil and China), with the assumption that the majority of their farming populations would be smallholders.

The final step was to combine the various tags to create our ultimate agrifoodtech adaptation for smallholder farmers dataset.

We combined them as follows using AND/OR rules: whether the company (i) originated in emerging countries AND came under the selected default categories, OR (ii) originated in emerging countries AND were tagged as adaptation,(iii) OR was tagged as adaptation AND had SHF-related keywords regardless of their geographic origin.

After algorithmically filtering the investments in this way, we manually checked all investments in the list and curated a final list of SHF-focused investments.

From there we ensured the companies were all matched to the correct taxonomy category and were tagged for the climate hazards[3] they were addressing, using semantic search techniques again.

Lastly, we used the taxonomy categories as well as keyword searches to ascertain investment levels in each of the six investment opportunities pathways we lay out in section 4 of this report as they do not match exactly to the taxonomy and some companies may appear across more than one.

Data methodology step one: Finding climate adaptation in agrifoodtech

Semantic Rating	
0	0%
1	15%
2	20%
3	25%
4	30%

The semantic search seeks to understand the contextual meaning of companies, thereby capturing companies that are not explicitly tagged as adaptation

We leveraged the definition of climate adaptation "activities that reduce or take advantage of the impacts of climate hazards" and extracted three terms for the search:

- Climate adaptation
- Climate hazard
- Reduce impacts of climate hazards

Each company is rated from 0 to 4 based on similarity of contextual meaning in the description

Key Word Rating	
0	Potential adaptation but only if paired with climate hazard keyword OR explicit mention of 'adaptation'
1	Likely adaptation, but need to verify context OR explicit mention of 'adaptation'
2	High confidence of adaptation

The keyword search finds exact keyword matches in the company description. To begin, we established a list of 100+ climate adaptation relevant keywords derived from industry-leading sources (e.g. ASAP, CPI, FAO, FOLU, ISF, McKinsey, BCG)

Since some keywords are more specific to adaptation than others (e.g. drought resilient seeds vs. insurance), we assigned different weightings to the keywords based on how lexically similar it is

Each company is then scored from 0 to 2 based on alignment with keyword matches

Hybrid Rating	
5-6	Extremely likely to be climate adaptation
4	Very likely to be climate adaptation
3	Likely to be climate adaptation
2	Somewhat likely to be climate adaptation
0-1	Unlikely to be climate adaptation

Finally, we combined the scores from both the ratings to create a hybrid rating system from 0 to 6

Companies that scored a 4, 5, or 6 are deemed applicable to the adaptation dataset, as any score above 4 implies either an extremely high similarity rating OR a moderately high similarity rating along with the presence of an adaptation keyword OR both.

Moreover, upon manually checking the list of companies that scored above 4, we a found low false-positive rate.

1 'small-holder', 'smallholder', 'small farming', 'small-scale', 'small scale', 'low-income', 'rural', 'development', 'extension', 'empowerment', 'communities', 'resilience', 'livelihood', 'coffee', 'cacao', 'rice', 'jackfruit', 'cassava', 'teff', 'groundnut', 'bananas', 'paprika'

2 Emerging market (sub-regions) filter for SHF tagging: 'Southern Asia', 'Eastern Asia', 'Western Asia', 'Eastern Africa', 'South-Eastern Asia', 'Eastern Europe', 'Northern Africa', 'Western Africa', 'Central America', 'Caribbean'

3 Climate hazard short-list for climate hazard tagging: 'heat waves', 'wind/storm', 'rain water', 'ocean stress', 'glacial/snowcover', 'drought', 'flood', 'soil health', 'biodiversity', 'pests & disease', 'climate hazard'