

THE DIGITALISATION OF AFRICAN AGRICULTURE REPORT

2018–2019

EXECUTIVE
SUMMARY

Dalberg Advisors



FOREWORD



CTA

Michael Hailu, Director, CTA

Agricultural transformation is a priority in the policy agenda of African governments in their quest to meet the challenges of food and nutrition insecurity, climate change, youth unemployment and overall economic growth. With the right policies, innovation and investment, the continent's agriculture could be transformed into a powerhouse not only to feed a growing population but to create decent employment for millions of young people.

Technology, as we have seen in other sectors, is critical to affecting change and driving development. It is bringing countries closer together, reducing barriers to trade and offering a window of opportunity to 'digital native' youth entrepreneurs at the vanguard of innovation applied to different economic sectors. In agriculture, digitalisation could be a game changer in boosting productivity, profitability and resilience to climate change.

An inclusive, digitally-enabled agricultural transformation could help achieve meaningful livelihood improvements

for Africa's smallholder farmers and pastoralists. It could drive greater engagement in agriculture from women and youth and create employment opportunities along the value chain.

There has been significant growth in digitalisation for agriculture (D4Ag) over the last ten years. In 2019 both the European Union-African Union Task Force Rural Africa Report (TFRA) and the Communiqué from the Global Forum for Food and Agriculture (GFFA) highlighted the power of digitalisation in transforming agriculture.

However, despite growth, progress towards D4Ag has been somewhat slow to serve the smallholders that produce 80% of Africa's agricultural output. Nevertheless, the opportunity is there. Agriculture is expected to be a trillion-dollar market by 2030, ripe for innovation that will drive greater efficiency, sustainable increases in productivity, yield and income.

At CTA we staked a claim on this power of digitalisation to more systematically transform agriculture early on. Digitalisation, focusing on not individual ICTs but the application of these technologies to entire value chains, is a theme that cuts across all of our work. In youth entrepreneurship, we are fostering a new breed of young ICT 'agripreneurs'. In climate-smart agriculture multiple projects provide information that can help towards building resilience for smallholder farmers. And in women empowerment we are supporting digital platforms to drive greater inclusion for women entrepreneurs in agricultural value chains.

In other words, at CTA, we know and understand the power to digitalise African agriculture. But we also understand that the evidence that will attract targeted investments to further develop D4Ag on the continent is lacking.

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With the right policies, innovation and investment, the continent's agriculture could be transformed into a powerhouse not only to feed a growing population but to create decent employment for millions of young people. ”



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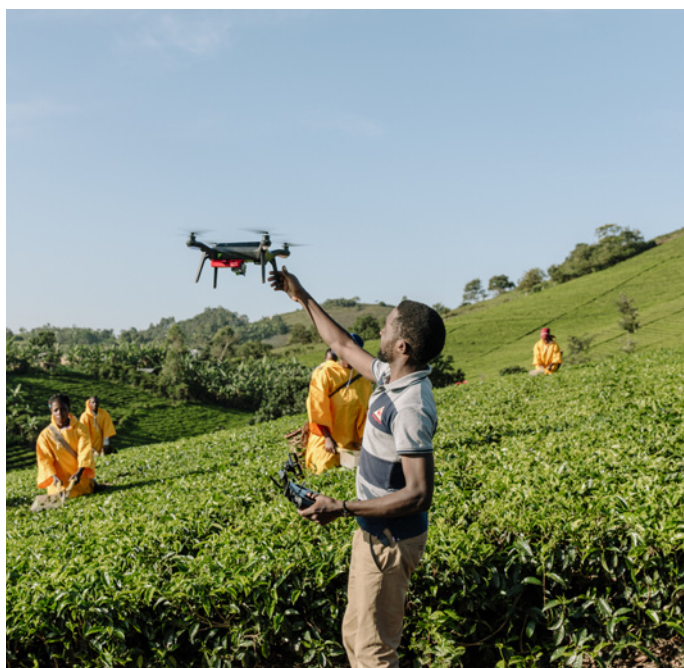
And as long as we learn from lessons, do it right and manage risks and take into account data sovereignty, inclusivity, sustainability, we will all benefit.”

We realised that it is time to chart the scale of the opportunity and make some projections that will help in guiding policy and investment decisions. It is why we have produced this report together with Dalberg Advisors and supported by a high-level Advisory Council bringing together the key stakeholders that have been engaged in the space. The report is the first attempt to consolidate evidence and provide proof of impacts and the knowledge that will allow evidence-based investments.

While, in the report, we find a young sector, it is clear that the appetite for D4Ag is burgeoning. However, without the right policy focus and investment there is a danger that the development will be piecemeal, neither sustainable nor inclusive. To capitalise on this opportunity we need to ensure that development is coordinated, that best practices are shared and a collaborative approach to rolling out and scaling-up digital innovation, primarily focused on increasing use by farmers, is adopted.

With the baseline that this report provides I believe we are well positioned to start scaling out solutions through partnerships, linking solutions providers, farmers' organisations, governments, development partners and others.

CTA



They say data is the new oil. While I prefer a more sustainable analogy, for Africa it is certainly the case that data might be the fuel that drives the transformation of smallholder farming and keeps the continent on track to meet its food and nutrition demands into this century and beyond. All the indicators point to a market that is ripe for investment now. And as long as we learn from lessons, do it right and manage risks and take into account data sovereignty, inclusivity, sustainability, we will all benefit.

This report is a valuable first step, we have seen an appetite to continually improve our understanding of the D4Ag landscape and chart the opportunity it offers for entrepreneurs, investors and governments. I hope our efforts will be valuable in guiding the opportunity and look forward to the collaborative push that I believe will bring D4Ag to life for the benefit of Africa's smallholder farmers and food and nutrition security across the continent.

Michael Hailu, Director

WRITTEN BY:

Michael Tsan, Dalberg
Swetha Totapally, Dalberg
Michael Hailu, CTA
Benjamin K Addom, CTA

EDITORIAL COORDINATION:

Michael Tsan, Dalberg
Benjamin K Addom, CTA
Toby Johnson, CTA
Murielle Vandreck, CTA

EDITED BY:

Jesse Lichtenstein, Dalberg
Martin Schnapf, Dalberg
Bianca Beks, CTA

LAYOUT AND INFOGRAPHICS:

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United Kingdom

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D4AG IN AFRICA AT A GLANCE

Size of the opportunity



33 million

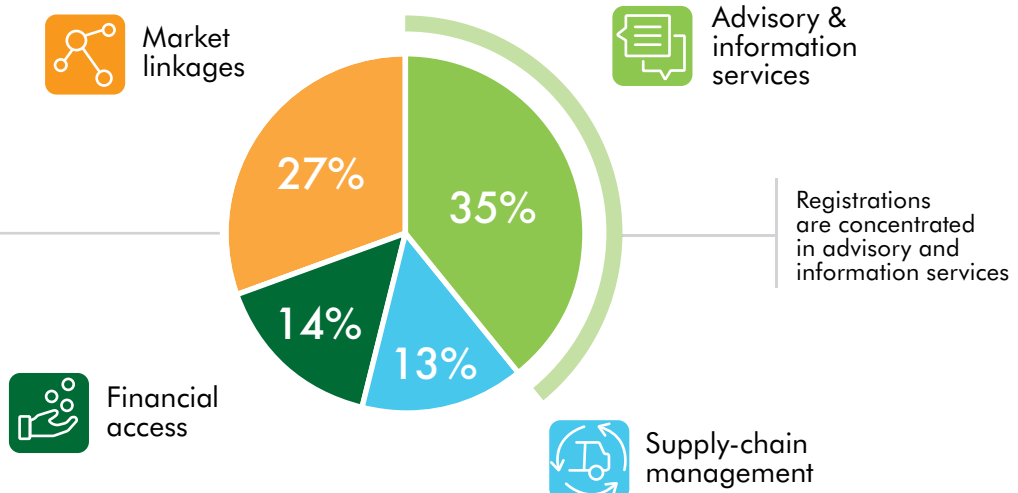
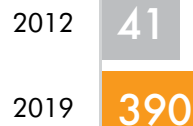
Registered smallholder farmers and pastoralists across the continent by D4Ag solutions in 2019

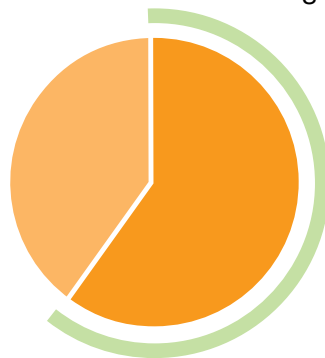
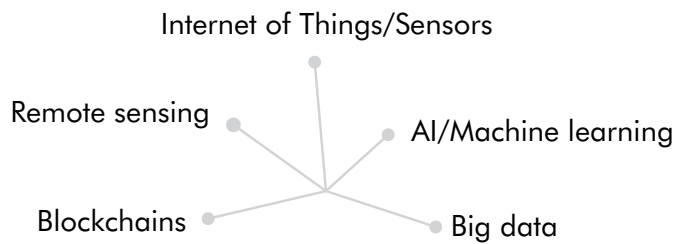


200 million

Expected registered smallholder farmers and pastoralists across the continent by D4Ag solutions by 2030

D4Ag solutions





60% of solutions

will incorporate advanced technologies
in the next three years



Bundling
services can increase

income by
57%



yields by
168%



**New investment needed to move
D4Ag ecosystem forward...**

**...including the creation of a new
multi-stakeholder D4Ag alliance to:**

Develop human
capital at all levels
of D4Ag ecosystem

Invest in the
missing middle
infrastructure

Invest in the D4Ag
knowledge agenda

Invest in good
data stewardship
and design for risks

Drive greater
business model
sustainability

Create greater impact
by bringing D4Ag to
less-served populations

Attract greater
investment

Develop capacity

Facilitate deeper
relationships
and collaboration

Develop indicators
for monitoring/
tracking progress

Build knowledge
and produce
periodic reports

Link agricultural
technology innovation
to big technology players

EXECUTIVE SUMMARY



Fredrick Omondi, CTA

Context and methodology

Agricultural transformation remains one of Africa's most pressing priorities but has been difficult to achieve. The statistics are well-known: Africa, especially Sub-Saharan Africa (SSA), needs to double (and perhaps even triple) current levels of agricultural productivity to meet continental demand and stave off food and nutrition insecurity.¹ The continent must achieve these targets while simultaneously adapting to climate change. Climate change is already impacting the agricultural sector with increasing climate volatility and the destructive effects of droughts, floods, new pests and diseases. With so much at stake, it is no surprise that most African countries have prioritised agricultural transformation as a key pillar of their national strategies. Yet, as the African Union's 2018 biennial review of the Malabo Declaration shows, fewer than half of countries (20 out of 47) are currently on track to meet their commitments by 2025.

Against this backdrop, digitalisation for agriculture (D4Ag) can be a game changer in supporting and accelerating agricultural transformation across the continent. D4Ag addresses a wide scope of factors and conditions affecting farms, farmers and the agri-food sector as a whole. The volume of data – and the supporting layer of new digital agricultural solutions – is growing exponentially at the same time that the quality of that data is rapidly evolving. For the first time, it is possible to precisely capture data from individual farms and fields, combine it in macro-level data sets, and utilise those sets in increasingly cost-effective ways. Why are digital solutions and agriculture data potentially so transformative? For farmers, they offer access to tailored information and insights that allow individuals to optimise their production, gain access to appropriate products and services, and explore new linkages with markets. D4Ag provides enterprises deeper understanding of their target segments, allowing them



¹ Food and Agriculture Organization of the United Nations (FAO). 2017. 'The future of food and agriculture: Trends and challenges' (www.fao.org/3/a-i6583e.pdf).

“

D4Ag can be a game changer in supporting and accelerating agricultural transformation across the continent.”

to better tailor their interventions to the needs of smallholder farmers. Governments, likewise, can use improved understanding of farmer segments to improve macro-decision policy-making, as well as the design and implementation of their programmes. The result – if fully implemented at scale – would be a highly connected, intelligent, real-time agricultural ecosystem that is vastly more productive, efficient and transparent than ever before. The growing quantity and quality of agricultural data and digital agricultural solutions *significantly reduce the costs* of service, inputs and information delivery for farmers and other value chain intermediaries. This enables them to productively transform their traditional business models.

D4Ag has the potential not only to support agricultural transformation but to do so sustainably and inclusively.

An inclusive, digitally-enabled agricultural transformation could help achieve meaningful

livelihood improvements for Africa’s 250 million smallholder farmers and pastoralists. It could drive greater engagement in agriculture from women and young people and support employment opportunities along the agricultural value chain – and it could help build resilience to climate change (Fig. 1). Still, D4Ag is not a replacement for physical infrastructure, human networks and human interaction. Digital tools can improve market efficiency, transparency, aggregation and integration, but parallel investments in physical infrastructure (e.g., roads and electricity) are still needed to deliver inputs to farmers and to deliver farm products to market. Furthermore, human infrastructure (e.g., extensions, financial agents, agro-dealers and agent networks), though it entails significant investment and ongoing costs, is crucial to achieving real agricultural transformation and impact. While it may not be a cure-all, it is clear that D4Ag’s potential to contribute to Africa’s inclusive growth story is significant.



CTA

Figure 1 **Links to inclusive growth, sustainable food security agendas**

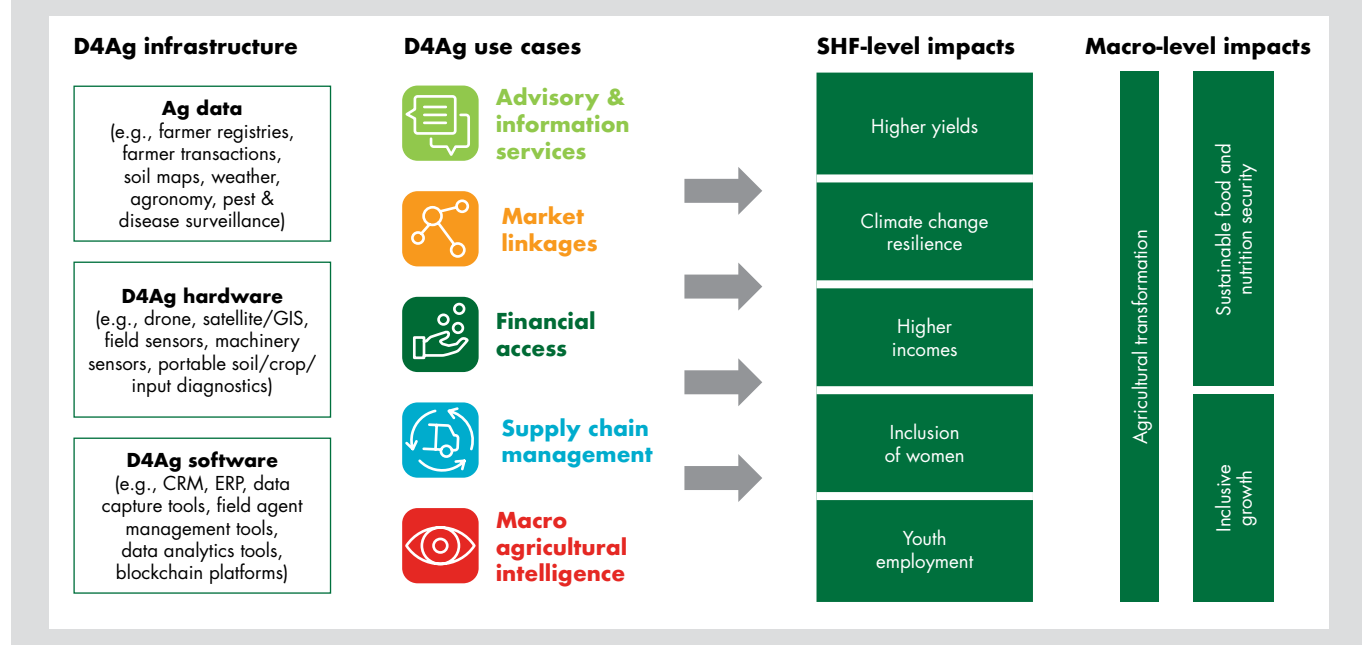
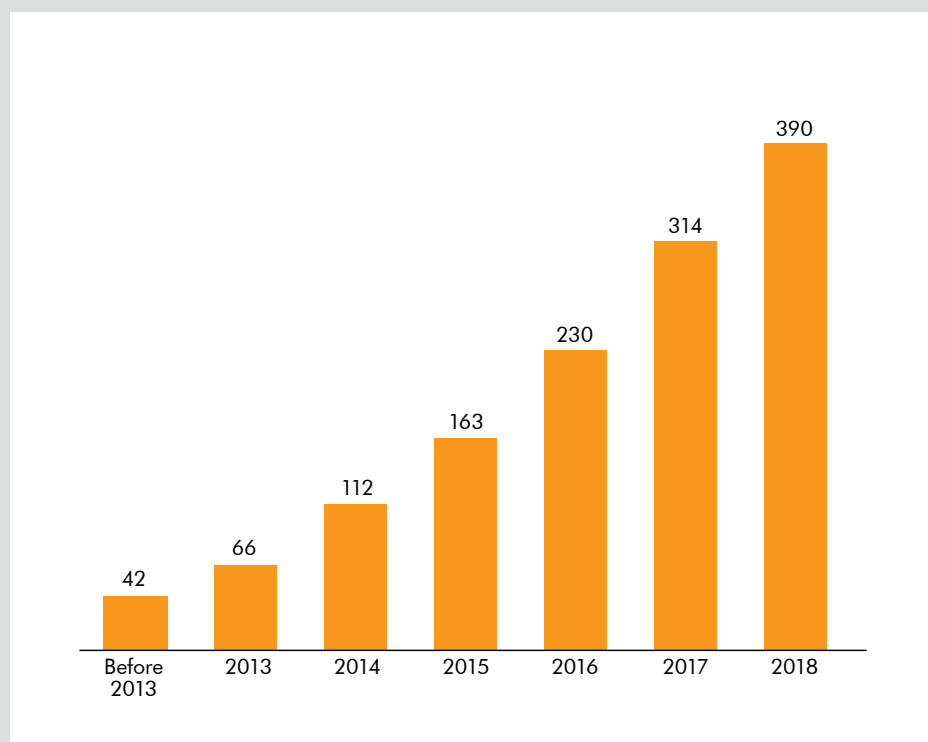


Figure 2 **Number of solutions by year**

In this report, we set out to explore the gains D4Ag has made toward reaching its potential. Our ambition, therefore, is for this report to serve as a barometer for the current state of D4Ag in Africa. Specifically, we (i) define D4Ag and establish a common language for the sector – the solutions, their use cases and their potential; (ii) share how far the sector has advanced as of 2019; (iii) offer our perspective on where the sector will go in the next 3–5 years; and (iv) shed light on what it will take to further unlock the potential of the sector and explore the roles of different stakeholders.

Our findings are based on the triangulation of an extensive set of primary and secondary sources. These include (i) a survey that was sent to 430 D4Ag enterprises, with 175 responses received; (ii) a database that tracks 390 active D4Ag solutions in SSA and more than 70 defunct solutions with detailed information (where available) on each,

including type of business model, reach, geographic presence, revenue and impact; (iii) interviews with more than 120 agribusiness leaders, technology experts, D4Ag solution providers, donors, investors, policymakers and academics; (iv) field visits and country case studies in Ethiopia, Nigeria, Senegal, Ghana and Rwanda, as well as lighter touch reviews of Kenya and the Sahel region; and (v) secondary research on D4Ag market assessments, business models, end-user needs and impact evidence.

Key findings

Sector reach and growth

■ **A large number of players comprise this relatively young sector.** As of 2019, there are at least 390 distinct, active D4Ag solutions across the continent (Fig. 2). As an indication of how quickly the sector is growing, nearly 60% of these were launched in the last three years, and approximately 20% were launched since 2018.



Figure 3 **D4Ag solutions by use case**

100% = 390 solutions

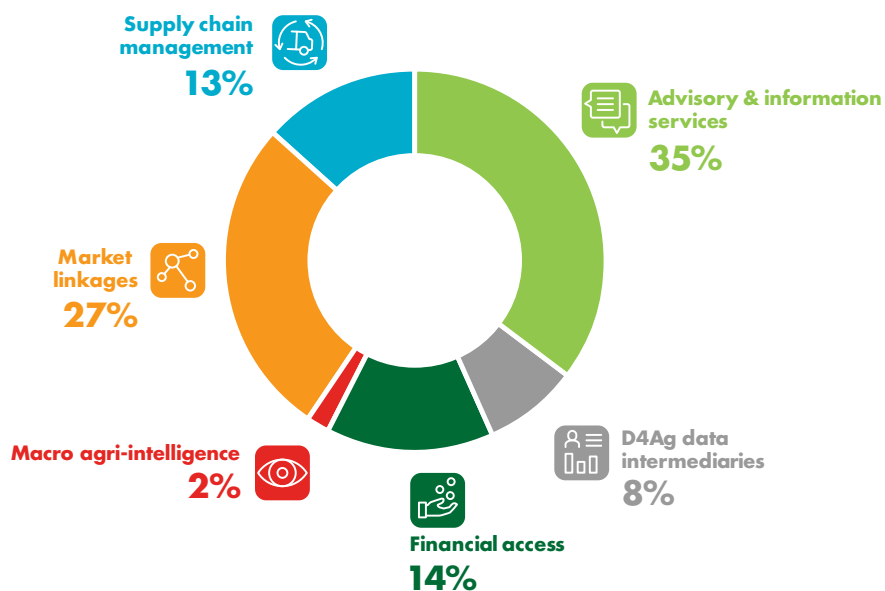
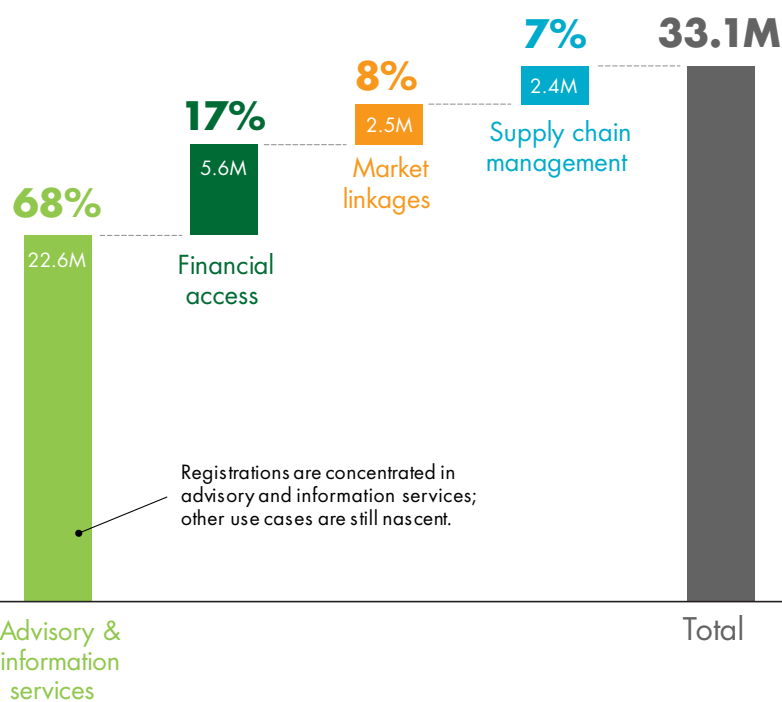
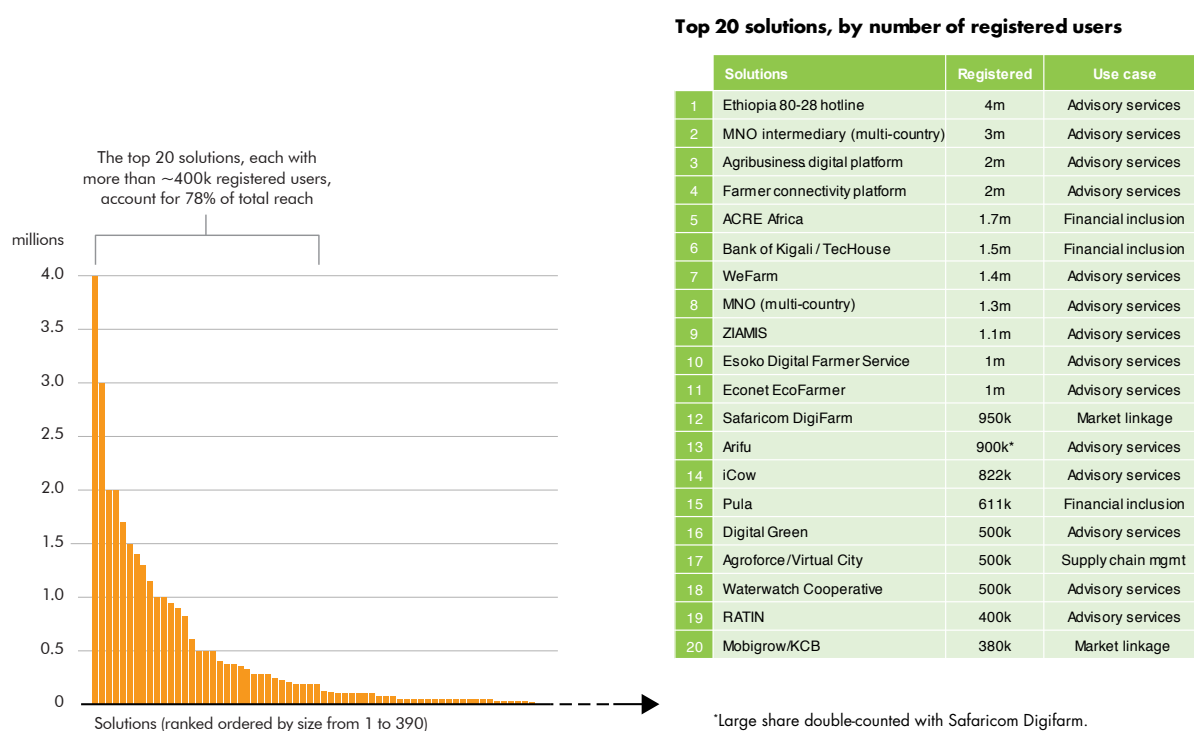
Figure 4 **Smallholder registrations by use case**

Figure 5 D4Ag solutions by number of registered farmers



The solutions span five major use cases: advisory services, market linkages, financial access, supply chain management and macro agricultural intelligence. Additional use cases include D4Ag data intermediaries that focus on multiple downstream solutions (Fig. 3). Furthermore, the amount of bundling is increasing – over 50% of active solutions combine more than one use case.

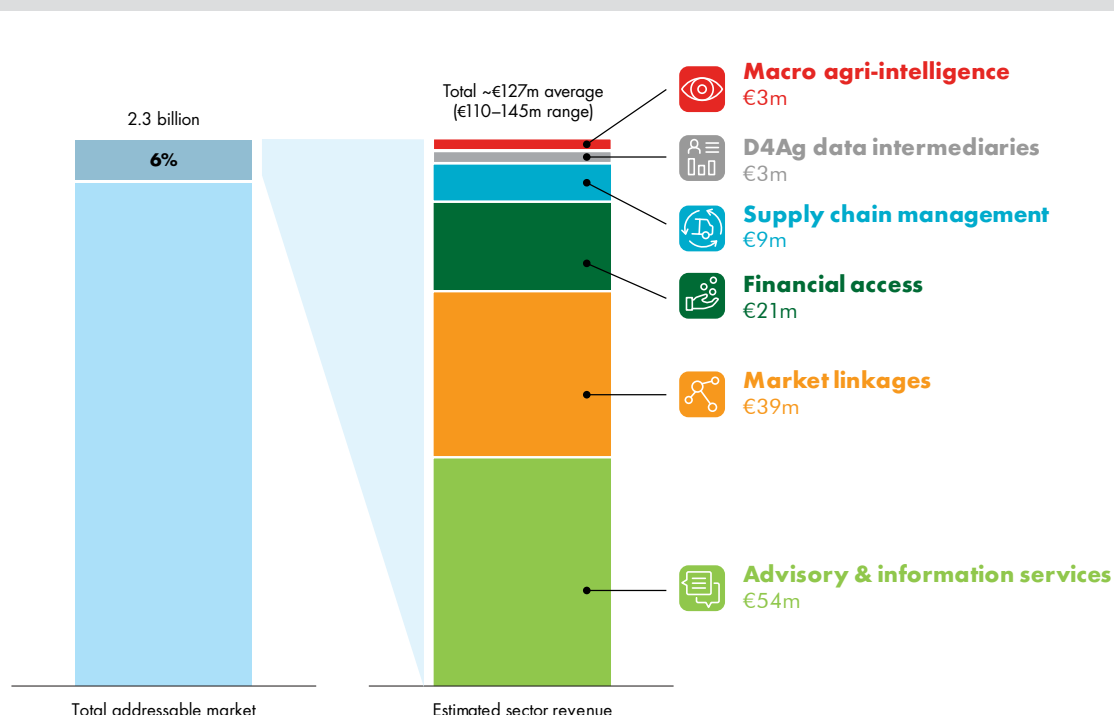
- Reach is growing quickly.** D4Ag solutions have already registered over 33 million smallholder farmers and pastoralists across the continent (13% of all SSA smallholders and pastoralists (Fig. 4) and up to 45% of smallholder households, depending on assumptions used to calculate penetration). The sector has been growing at about 44% per annum over the last three years in terms of the number of farmers reached (i.e., registered for solutions). A small minority of companies (about 15, most of which focus on advisory services as their current primary

focus) have begun to reach notable scale with 1 million plus registered farmers each (Fig. 5).

- The economics are improving, and a handful of players are beginning to develop viable businesses with attractive financial models.** We estimate that 70% of enterprises generate some revenue and 80% of those revenue-generating enterprises maintain several revenue streams. Of our survey participants, 26% were breaking even. While robust baseline data are not available for comparison, we believe that these results are significantly higher than even a few years ago. Importantly, a small but growing number of players are developing strong business models and demonstrating that it is possible to generate up to €90 of revenue per farmer annually, though the average is much lower (e.g., ~€5 for advisory services, ~€25 for market linkages, and €4 for digital financial service intermediaries and supply



Figure 6 Annual D4Ag sector revenues



chain management solutions). While the cost structures for generating these revenues, of course, vary by solution type, there is evidence that some companies are able to achieve 30–40% gross margins. We do not expect all businesses to achieve this level of revenue or margin, but the data indicate that strong economics are achievable.

- **The addressable market is in the low billions, though only a fraction of it is being realised today.** We estimate that the total addressable market revenue is likely €2.3 billion (mid-range estimate, potentially as high as €5.3 billion in 2019), of which an estimated €127 million of sector revenues (€107–145 million) are being realised today (~6% penetration of the total addressable market) (Fig. 6). The addressable market will continue to grow rapidly over the next decade with the growth of the smallholder population, improvements in connectivity and rising revenues per farmer as D4Ag

business models become more established. These numbers shed light on business opportunities to significantly grow revenue, but they also suggest that D4Ag companies are still working out their business models and likely need to create more value for farmers and other customers across the value chain.

- **Registrations are concentrated.** While there are D4Ag solutions present in at least 43 out of 49 SSA countries, over half of the solutions are headquartered in East Africa and nearly two-thirds of registered farmers across all solutions are based in East Africa, with Kenya leading the way (Fig. 7-8). Similarly, the largest 20 solutions account for nearly 80% of farmer registrations. Moreover, while products are diversifying to address newer use cases like supply chain management, advisory services continue to dominate the market (two-thirds of total registrations).



Figure 7 Regional distribution of users and solutions

Solutions and registered users (millions) by sub-region of HQ and sub-region of primary focus, EOY (2018)

Western Africa

Solutions	Users
HQ: 145	3.1M
Focus: 162	4.3M

27 solutions headquartered in the G5 Sahel, account for 573k users. Another 33 solutions have users in the region.

Central Africa

Solutions	Users
HQ: 18	0.60M
Focus: 20	0.85M

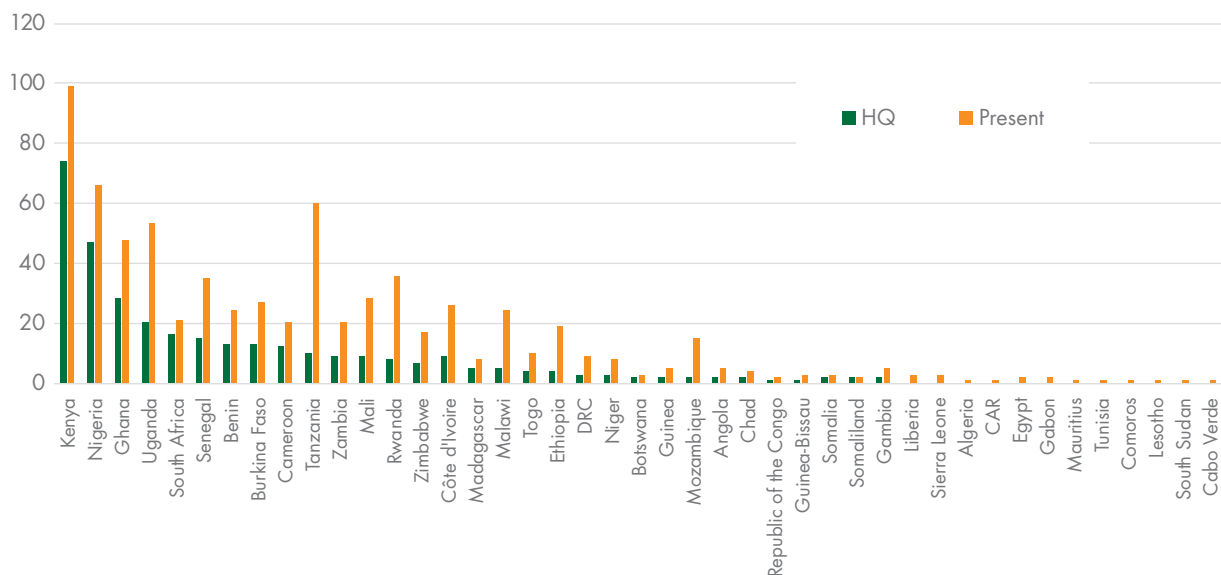
Eastern Africa

Solutions	Users
HQ: 124	21.0M
Focus: 146	21.8M

Southern Africa

Solutions	Users
HQ: 43	3.9M
Focus: 46	5.8M

Figure 8 Distribution by country



- Investments remain small, and primarily fuelled by donors, while private investment is lagging. Donors are increasingly making D4Ag an important part of their portfolios. We estimate approximately €175 million in annual donor funding flows for D4Ag (Fig. 9). Private

sector investment is even more limited – in 2018, there was investment of approximately €47 million into Africa-focused D4Ag enterprises, including both start-ups and later stage enterprises (Fig. 10). Investment into Africa-based D4Ag start-ups represented 3–6% of all Africa tech start-up investment



Figure 9 **Grant funding**

€ millions, SSA, 2018

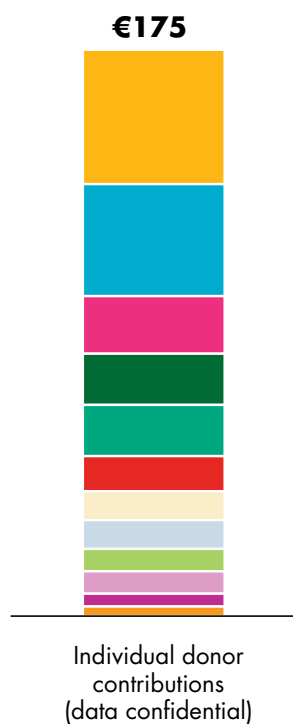
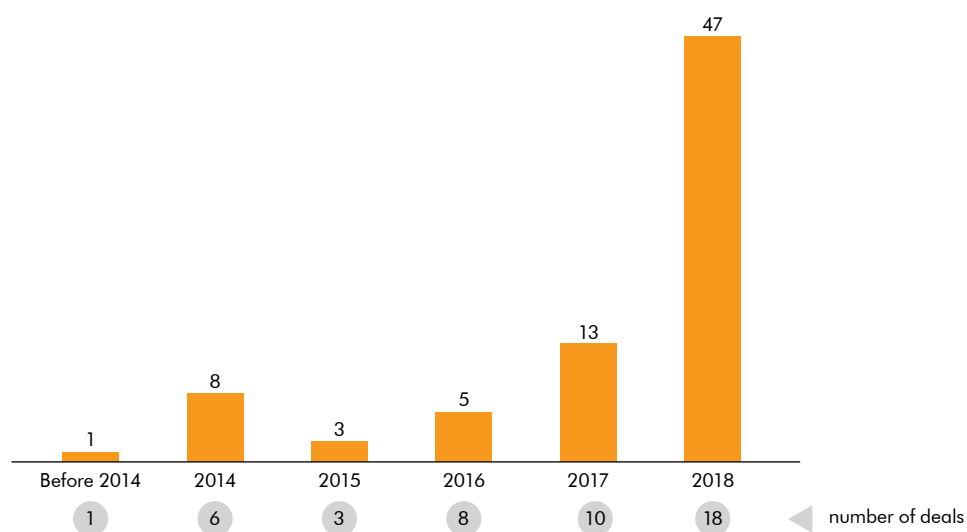
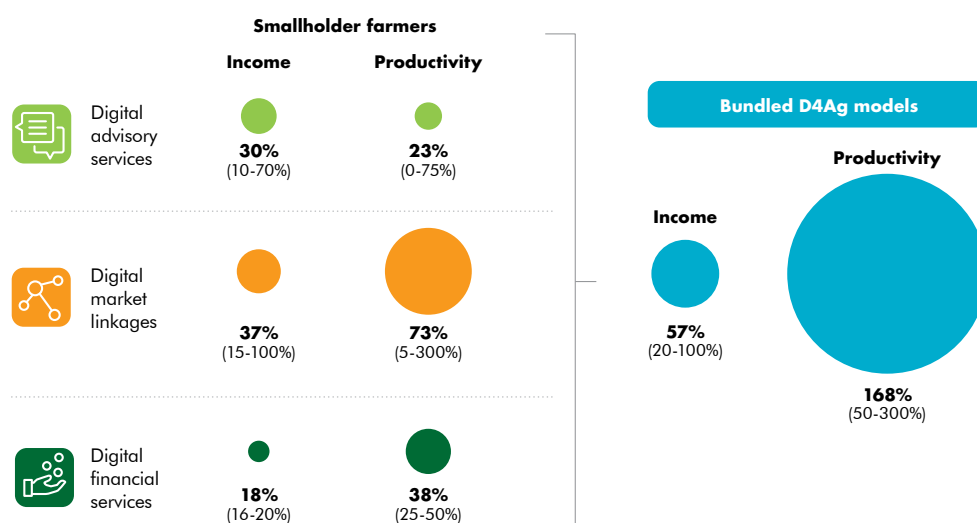
**Top global D4Ag funders**Figure 10 **Value and volume of D4Ag investments**

Figure 11 Impact data suggests power of bundling



in 2018. Because these figures are not well documented publicly, we likely have not fully captured all private investment. Still, these figures are quite small relative to the needs of commercial enterprises on the ground and represent a tiny fraction of the global investment flows to agricultural technology, which by some estimates reached nearly €1.8 billion in 2017. Most of the funding has gone to specific enterprises; far fewer investments have been made in D4Ag infrastructure (e.g., farmer registries, soil testing infrastructure, weather stations).

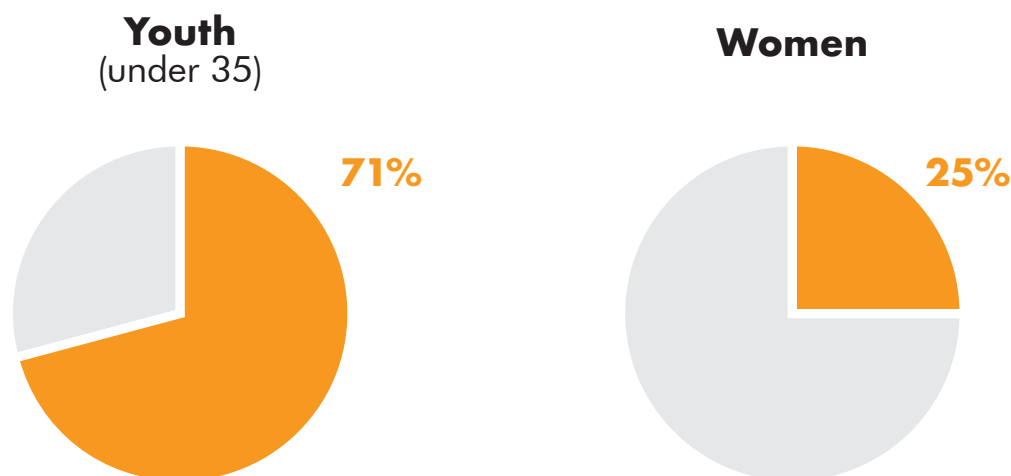
D4Ag use and impact

- **While D4Ag's reach figures are impressive given the relative nascence of the space, use remains low.** Our estimates suggest that 42% of registered farmers and pastoralists actually used the solutions they registered for with any frequency. While there is no standard definition for 'use' and the nature of farmer interaction with solutions differs depending on the solution type (e.g., digital financial product vs digital advisory service), the number of highly active users is likely even

lower – i.e., likely in the 15–30% range, on average (based on self-reported data) across all use case areas.

- **Some promising impact metrics are emerging. Though early, limited and in some cases, mixed, the overall results suggest that D4Ag solutions could achieve transformative results.** There are not many verified examples yet, but the few self-reported examples we do have suggest that some D4Ag enterprises are seeing highly positive direct and indirect impacts on smallholder farmers. The greatest amount of evidence points to a link between D4Ag and yield and income metrics. Here, a handful of players are leading the way with noteworthy results. Evidence for youth engagement and climate change is early but promising. The link to employment is largely hypothetical, though also promising. In terms of gender equity, however, the data suggests that, barring a handful of exceptions in which companies have made a focused effort to reach female farmers, the sector has made little progress.



Figure 12 **Share of users that are women and youth**

■ **Yield and income:** A sample of approximately 50 impact data points, including both self-reported and independently validated impact studies, with average yield improvements across all data points of roughly 20% for advisory services, 70% for market linkages, and 40% for digital financial services, with corresponding income improvements typically ranging between 20% to 40%. Bundled models seem to have increased potential. Based on self-reported data, we see yield improvements in the range of 50–300% and income improvements on the order of 20–100% (Fig. 11). While these numbers likely represent the most positive outliers, they are encouraging and demonstrate that some players have been able to achieve not just incremental but actually transformative results through D4Ag. Still, it is important to note that these figures represent the total impact on the yield and income of digitally-enabled solutions, not just the incremental impact of digitalisation. Anecdotally, these figures are higher than those of purely analogue solutions and are generated at reduced cost and thus higher return on investment (ROI). Nonetheless,

much more research needs to be done to quantify the advantages of digital over analogue solutions.

■ **Youth:** The high share of youth engagement – more than 70% of registered users – is good news. At the same time, this figure likely also indicates an important age divide that must be overcome in order to engage the significant proportion of farmers from older groups (Fig. 12).

■ **Women:** The relative uptake among women is low – especially considering the disproportionate burden they bear on the farm. In SSA, where 40–50% of smallholder farmers are women, only 25% are registered users of D4Ag solutions (Fig. 12). Companies that explicitly target female farmers and make this an important measure of their success tend to do better. Overall, the data suggests that companies are not sufficiently prioritising gender as part of their product design, marketing and user engagement efforts.

■ **Climate resilience:** D4Ag has likely already helped reduce some effects of



Figure 13 Potential D4Ag impact on jobs



D4Ag enterprise staff and management

Tens of thousands of new high-income jobs for D4Ag solution IT developers, engineers, sales and support staff, and management; already 5-10k employed across ~400 D4Ag solutions



Digitally-enabled D4Ag field agents

D4Ag solutions can make it economically rational to recruit, upskill and support digitally-enabled field agents at ratios of 1:100 to 1:500 farmers; increased agent density across markets should create **hundreds of thousands to low millions** of new jobs.



High quality digitalised farmer and agri value chain jobs

D4Ag solutions can increase the share of smallholders incorporated in commercial value chains and generate new off-farm jobs in agri inputs, mechanisation, agri-processing, and trading; this would mean new agriculture sector jobs OR much higher quality employment for **tens of millions of farmers and rural youth**.

climate change by improving resource use (e.g., soil and water conservation due to advisory services), building resilience (e.g., via digitally-enabled agri-index insurance), and lowering postharvest losses for some farmers. However, the number of data points on climate impact is too limited to make compelling generalisations. Experts suggest that we have just begun to see the effects of D4Ag on climate resilience and that we should expect much more progress in this area in the coming years.

- **Employment:** While the sector currently lacks precise quantitative data or evidence on employment impacts, we believe that D4Ag will likely be a net job creator. In fact, it could even be a significant job creator (Fig. 13), opening up hundreds of thousands of jobs in agricultural technology, D4Ag support, agricultural processing and

agricultural manufacturing jobs. As digital solutions justify upscaling, digitally-enabled human agent networks will play a critical role in linking farmers to inputs, finance and knowledge. It is also possible that D4Ag could help increase the share of smallholders in tight value chains and the quality of smallholder jobs.

Forward-looking trends

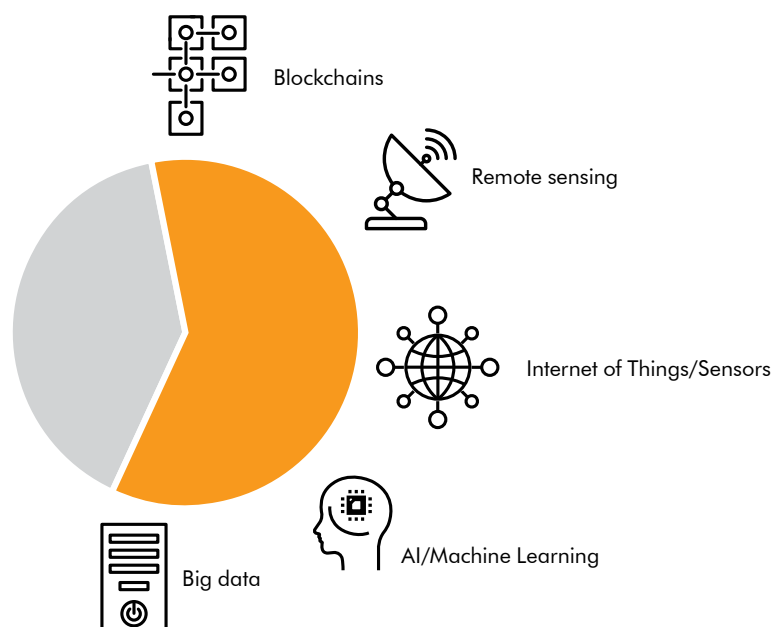
- **Several of today's barriers – notably, limited access to technology and connectivity – will begin to be overcome.** In particular, we expect that most farmers will have access to a mobile phone by 2030 (~50% penetration for unique mobile subscribers in rural SSA, but likely 80+%, based on current trends for share of smallholder households that have access to at least one mobile



Figure 14 Use of advanced technologies

60%

of respondents expect to integrate new technologies over the next three years, the most popular of which are IoT, blockchains and machine learning.



phone and reasonable connectivity). Many will also have access to smartphones – already more than 25% of smallholder farmers in countries like Kenya and Senegal report access to smartphones; these numbers are projected to grow quickly. The cost of data will continue to fall and growing, thriving mobile money ecosystems around the continent will serve as a strong foundation upon which to build platforms for D4Ag transactions.

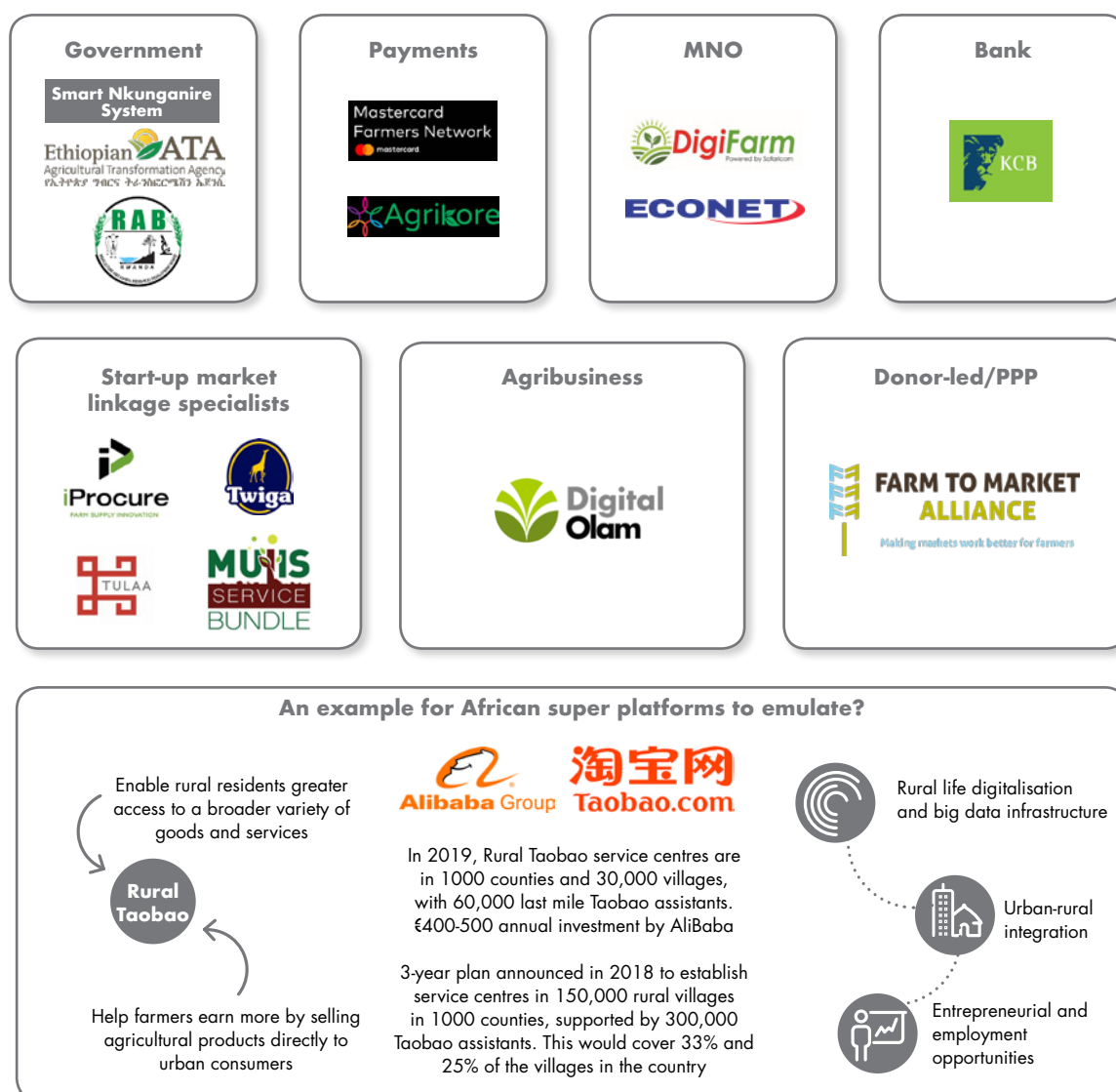
- **D4Ag products and services will continue to improve.** Over one-third of our D4Ag sector survey respondents already use at least one form of advanced technology (e.g., drones, blockchain, machine learning, internet of things, or big data), and nearly 60% of respondents expect to integrate new technologies in the next three years (Fig. 14).

D4Ag solutions will leverage cutting-edge technologies fuelled by new sources of data and analytical capabilities – to reduce costs, increase their value proposition and enhance their precision, customisability and overall capabilities even as they become easier for farmers to access and use. We will move from a state in which we primarily have observational data to a state in which we can offer users real-time insights and predictive capabilities.

- **New entrants in the D4Ag space – including ‘big tech’ players like Microsoft, Google, IBM, Bosch and Alibaba, as well as ‘big agri’ incumbents like Bayer, Syngenta, Yara, John Deere and UPL – will change the sector’s scale and scope.** Many of these players have already begun to enter the market via exploratory acquisitions,



Figure 15 D4Ag super platform solution examples



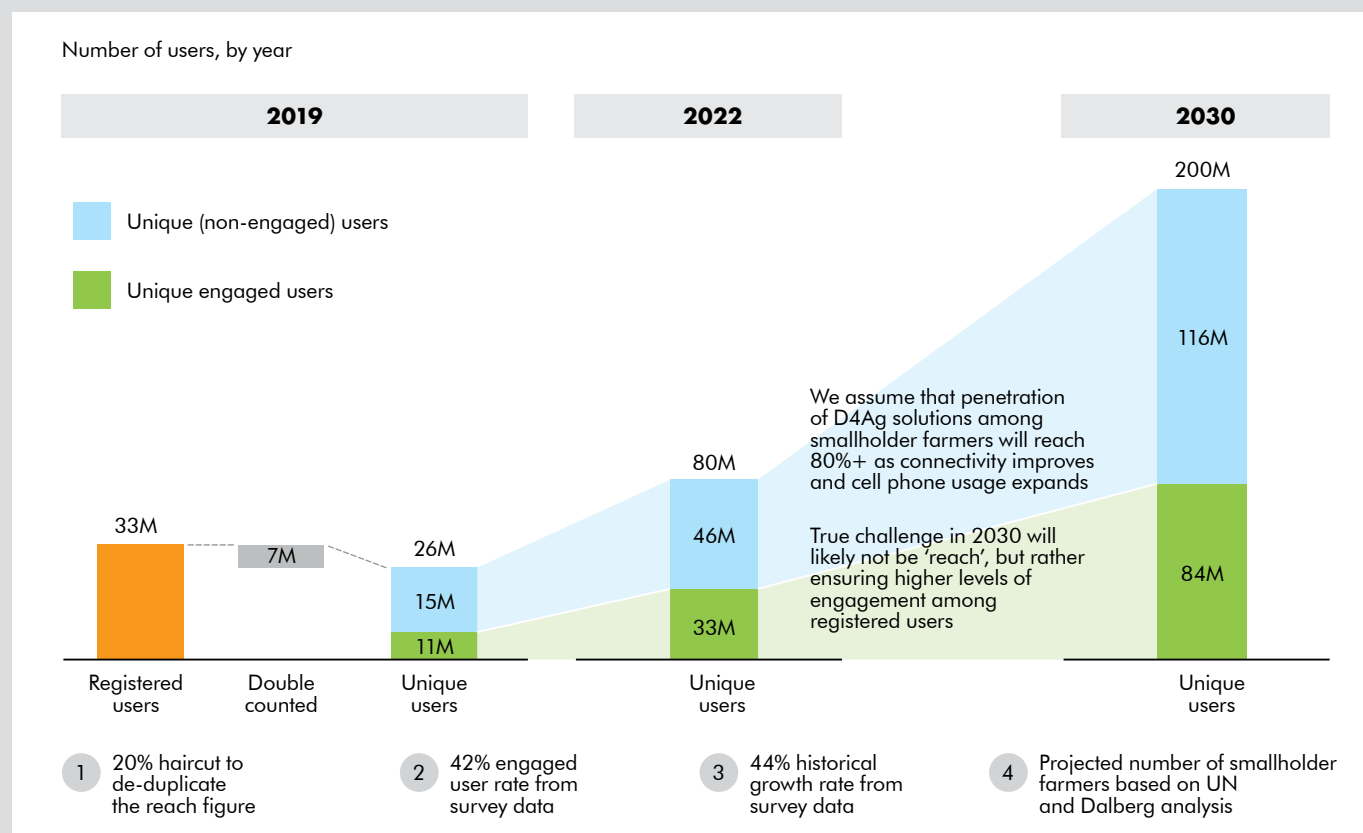
innovative partnerships and new product development. Others are more quietly holding exploratory conversations and initiating small-scale pilot programmes. Their presence will bring increased financial, human and technological resources to the sector, and may be accompanied by major investment in important underlying infrastructure. Such improvements could significantly improve sector growth. Still, their entry does not replace the need for strong local talent. The capabilities of big tech should complement

organisations on the ground that are well positioned to design products that can serve the needs of farmers in their region and business models that will work given local conditions. The best models will pair localised knowledge with big tech capabilities.

■ **We will enter a platform-led era.**

Platforms that bring together several use cases, diverse value chains and the best capabilities of multiple players are the most likely to succeed. Such D4Ag 'super



Figure 16 **Projected unique registrants and engaged users, 2019–2030**

platforms' are already emerging, with a range of private, donor-led, government-led, and public-private partnership models (Fig. 15). While we cannot predict who will emerge as the leader(s), and there are likely to be multiple different successful models depending on the country, we expect that these platform players, in partnership with some of today's leading specialist D4Ag solution providers, will bring about a step change in the D4Ag sector's reach and impact.

- **The reach of digital solutions will continue to grow and may include as much as 80% of the smallholder farmer population.** At 44% per annum, the sector's growth rate is currently very high; access to technology is likely the main limiting factor for the spread of D4Ag solutions. Given that Africa will achieve near universal phone access in the coming years,

current growth trends suggest that 100 million smallholder farmers could be registered for D4Ag services within three years and as many as 200 million smallholders will sign on by 2030 (Fig. 16). This estimate may be high, however, and a more conservative scenario of ~60 million registered farmers by 2022 is probably more credible, as it will become progressively harder to reach additional smallholder farmers from remote and vulnerable populations living in less stable and poorly connected environments. Nevertheless, the core implication of these numbers is that reaching farmers will not be the main bottleneck for D4Ag solutions; rather, the next phase will require a tight focus on increasing use among and impact for smallholder farmers.





Georgina Smith, CIAT

Challenges

- **The sophistication of D4Ag solutions has begun to outpace the readiness of entrepreneurs, users and government actors to embrace and leverage them.**

As discussed above, the underlying technologies and capabilities of D4Ag solutions are advancing quickly. We now have an opportunity to shift focus from technologies and solutions to the underlying enabling environment. For example, insufficient human capital development remains a major barrier: 49% of D4Ag enterprises that responded to the survey reported that this was a key growth challenge. Similarly, 28% of survey respondents cited consumer-level barriers (e.g., digital literacy) as one of the top three challenges to adoption and use.

- **Most companies are still working to develop a viable business model.**

While some companies have started to reach scale and earn profits, the vast majority of businesses still rely on donor funding and continue to experiment with business models that are attractive to funders and customers. In recent years, the sectors have learned a lot about what models *do not work*; we are

still in the earliest stages of understanding what models *work*. For example, experience from several businesses suggests that farmers are unlikely to pay for D4Ag services (especially advisory services) and that data is challenging to monetise. Drawing on these experiences, companies are beginning to experiment with new approaches, e.g., taking a cut of the value created for customer segments. This may have strong promise, but companies will have to continue to deliver greater value to farmers – and thereby translate customer reach to customer use – in order to achieve improved business economics. In the meantime, many companies whose full attention is fixed on developing a viable business model deprioritise or miss important issues like impact and data stewardship, viewing them as secondary in importance or even running counter to their objective of turning a profit.

- **The lack of D4Ag infrastructure – farmer registries, digital agronomy data, soil mapping, pest and disease surveillance, and weather data infrastructure – in most contexts reduces the effectiveness of D4Ag solutions.** Such investments are important building blocks for individual enterprises



and for the D4Ag ecosystem more broadly because they drastically reduce transaction costs, drive efficiency and increase the effectiveness of solutions. Yet, investment in such public goods and enablers is quite limited and just beginning to emerge at national and local levels. The case for making such investments is not always straightforward; based on some existing approaches, they could produce results at the expense of good data stewardship (e.g., customer privacy, appropriate consent, security, etc.). Good data stewardship and strong middleware can coexist, but we have not yet seen a strong focus on this in the sector.

- **High degrees of country-level and regional variation in investment expose uneven D4Ag growth across the continent.** While market-driven growth in D4Ag solutions in countries like Kenya, Ghana, Nigeria, Senegal, Rwanda and Côte d'Ivoire serves as a strong inspiration for others, the level of variation across countries highlights some important challenges. For example, it indicates that donors, investors and, to a somewhat lesser extent, enterprises are still risk-averse and likely prioritise the easiest-to-reach markets (e.g., markets where other providers already exist and where the ecosystem is stronger). This also occurs within individual countries, where companies largely target the easiest to reach customers. Such uneven growth could further worsen the digital divide between different communities. The experience of other base-of-pyramid markets, such as that for energy access, suggests that the transfer of technological innovation from more advanced geographies to lagging ones is not an automatic process and can, in many cases, be quite slow in the absence of well-targeted investments and policies.

Recommendations

Efforts of digital agricultural services to become sustainable and scalable continue to face challenges. How does the sector

transition from short-lived, donor-funded projects to self-sustaining, business-driven initiatives that create demonstrable impact for smallholder farmers – and how does it do so equitably?

Together, enterprises, donors, investors, agribusinesses and governments must create an environment in which digital agricultural solutions can thrive and produce impact. Here we lay out seven priorities that will help the D4Ag sector succeed in a way that is impactful, sustainable and inclusive. These are not wildly provocative investments or 'silver bullets' for D4Ag. Rather, they are important foundational steps that will help build a sustainable D4Ag ecosystem in Africa – one that can support the mainstreaming of D4Ag efforts going forward. Political will, commitment and engagement are fundamental to the implementation of these recommendations and need to flow across government institutions, not just agricultural ministries.

Much greater investment – on the order of billions of euro rather than a couple hundred million euro – is also needed. For instance, in the US the government invests ~€1 billion annually into financing climate systems that support the US agriculture community. In Africa, in comparison, investments into weather infrastructure do not exceed 10s of millions.

Here we focus on recommendations for donors, investors and governments given they are the primary audiences for this report. We do not, herein, discuss important enablers that are not specific to D4Ag, like investments in rural connectivity, given how well understood and covered such efforts already are in other reports.

1. Develop human capital at every level of the D4Ag ecosystem

Developing human capacity will be critical to building D4Ag readiness across the ecosystem, from farmers to government ministers. The necessary growth in human capital includes increased



awareness of D4Ag, improved digital literacy and greater digital skill building among smallholder populations. Such growth will require deeper investment across Africa in those areas of the developer ecosystem most capable of boosting human capital, i.e., start-up ecosystems, incubators, accelerators, etc. Efforts must also be made to increase the capacity of government workers in relevant ministries to understand how to use and deploy D4Ag tools in various government initiatives.

We recommend that governments:

- Invest in ongoing training to build the digital and D4Ag skills of individuals (from legislators and ministers to IT leads and local extension agents) throughout their agricultural ministries and in other relevant ministries.
- Implement farmer digital literacy and D4Ag training programmes (with the support of the appropriate ministries, where applicable).
- Support the start-up ecosystem and encourage youth participation in incubators, accelerators and local university initiatives.
- Participate in knowledge transfer programmes across departments and with other countries.

We recommend that donors:

- Increase support for initiatives such as incubators, hackathons, prize competitions, university classes, etc., to foster local digital skill development.
- Earmark funding for capacity building initiatives as a standard condition of grants to D4Ag enterprises.
- Help create partnerships with D4Ag enterprises and non-profits experienced in digital literacy training.
- Offer technical assistance to government capacity building initiatives.

We recommend that investors:

- Bring in developers from other geographies to share knowledge with and build skills among investees.
- Support incubators and accelerators, especially those with a strong focus on young entrepreneurs.
- Insist that investees incorporate strong digital literacy and consumer-training programmes into their business plans.

Georgina Smith, CLAT



2. Drive greater business model sustainability

While a handful of companies are starting to see positive returns, the vast majority still struggle to achieve economic and operational sustainability. Most start-ups are unlikely to succeed. While this is consistent with other sectors and in other geographies, Africa needs to prove that D4Ag deployments can be sustainable in order to drive greater investment.

Governments, donors and investors can help achieve greater sustainability of D4Ag businesses.

We recommend:

- Increased funding for a more diverse set of business models rather than just for those models that have already attracted funding.
- Greater focus on improved product design and consortium/platform-based approaches to drive greater value for farmers.
- A continued push toward B2B models so that enterprises can attract paying clients.
- Deeper research on D4Ag business models (see recommendation 6 for additional details).

We recommend that governments:

- Make direct investments in promising D4Ag models, where appropriate, in partnership with private investors, particularly for those agriculture value chains where governments are already active in market support or public procurement.
- Serve as paying clients for promising D4Ag solutions, especially at the proof of concept stage.
- Promote the creation of consortia that take a more holistic approach to value creation.

We recommend that donors:

- Fund high impact studies on successful – and failed – business models and share best practices.

- Require investees to share and communicate financial results (anonymously as appropriate) with the broader D4Ag community.
- Share lessons learned and best practices from investees (anonymously, as appropriate) with the broader D4Ag community.
- De-risk investments in high-impact models for investors through co-funding and increased grant/subsidy period of projects to 5–7 years for products to be ready for market.
- Promote bundling and consortium-based approaches among investees.

We recommend that investors:

- Channel greater investments into D4Ag by building upon and scaling up viable models supported by donors.
- Shift focus from companies that have already attracted significant investment to those that have attracted less investment but have promising business models.
- Allocate greater funding for product design and prototyping.
- Consider more flexible investment approaches (patient capital, innovative funding models, etc.) that are better suited to the needs of investees.
- Help build partnerships between investees, private actors and technology providers in order to reduce technology and operational costs.
- Share lessons learned and best practices from investees (anonymously, as appropriate) with the broader D4Ag community.

3. Create greater impact by bringing D4Ag to less-served populations

Today, D4Ag solutions primarily reach the lowest-hanging fruit – farmers in tight value chains – and many enterprises fail to prioritise outreach to women and other marginalised segments. To achieve equitable growth, D4Ag needs to be more inclusive.



We recommend that sector actors:

- Offer greater support for enterprises in geographies that have historically attracted less investment but enjoy strong enabling environments.
- Incentivise D4Ag enterprises to target marginalised segments, especially women, who are systematically left behind.

We recommend that governments:

- Attract new investors by publicly supporting D4Ag and highlighting the benefits of local enabling conditions.
- Incentivise impact-oriented investments by entering public-private partnerships with D4Ag enterprises that are committed to impact.
- Prioritise and take into account the needs of marginalised segments as part of their D4Ag investments.

We recommend that donors:

Incentivise D4Ag enterprises to engage the hardest-to-reach smallholder farmers segments, especially women by:

- Incorporating gender targets as part of their investment portfolios and explicitly fund grantees who prioritise women.
- De-risking the cost of designing for specific segments – e.g., by offering grants to enterprises for the development of product offerings tailored to the needs of women.
- Investing in gender-disaggregated data that both governments and enterprises can use to build more appropriate solutions and models.
- Directly funding and focussing attention on organisations in geographies that have traditionally received minimal funding.
- Shifting expectations toward a slower ROI than the typical three-to-five-year window. With patience comes greater opportunity for these enterprises to reach beyond the low-hanging fruit.

We recommend that investors:

- Invest in promising D4Ag businesses even if they are not located in the most obvious target markets.
- Support organisations that may be less known but that are equally as promising as those that have already received support.

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- Consider incorporating specific impact metrics related to marginalised segments into their investment criteria.
- Take on the role of a catalytic investor that can help unlock funds for D4Ag in Africa from others. (Note: not all investors need to do this, but even a few investors taking on this role could have outsized impact).

4. Invest in the missing middleware infrastructure

Successful D4Ag solutions require access to a wide range of data (from remote sensing data to farmer-specific data) in order to deliver high-quality services to farmers. This data needs to be accurate, precise, and, in many cases, available in real time. However, it is neither efficient nor effective for each D4Ag enterprise to individually collect, store and analyse all the data it would like to access.

We therefore recommend investments in a robust D4Ag middleware layer that includes, among other items, farmer registries, digital agronomy data, soil mapping, pest and disease surveillance, and weather data infrastructure. These public goods would immediately impact side actors and could eventually benefit smallholder farmers directly. A strong, coordinated effort – rather than one-off, small-scale efforts – by multiple actors is critical to the success of such initiatives.

We recommend that governments:

- Make investments – in partnership with research agencies and donors – toward the creation of D4Ag data infrastructure and ensure that data about/for the most marginalised groups is captured as part of these efforts.
- Deploy the data infrastructure for high priority uses within their own efforts (e.g., national soil cards).
- Promote open standards and modular systems so that other government agencies and other actors can plug into and use the new D4Ag infrastructure.

We recommend that donors:

Rebalance portfolios to include a greater share of investments in the D4Ag data infrastructure layer. Specifically, we recommend that they:

- Fund investments in D4Ag data infrastructure alongside governments.
- Offer technical assistance and advisory support to governments as they design and make use of D4Ag data infrastructure.
- Help identify strong implementation partners.
- Share best practices from prior efforts.

Investors, for their part, are likely to play a relatively smaller role in the creation of these public goods. Still, they can help open new markets by investing in ecosystem enablers while or even before making direct investments in enterprises.

We recommend that investors:

- Partner with technology companies to build common solutions for their investees.
- Invest in public-private partnerships (PPPs) that offer revenue-generating (perhaps with the help of subsidies) public goods, e.g., weather services, soil and crop diagnostics, etc.

5. Invest in good data stewardship and design for the risks and limitations of digital systems

The need for good data stewardship will only grow. Actors in the sector increasingly rely on algorithms. As greater investment flows into the middleware layer and as ever more significant volumes of data are captured, aggregated and analysed, clear, conscientious standards will be necessary.

We recommend the creation and incorporation of strong D4Ag data policies and practices across Africa. Data policies should incorporate the values of good data stewardship (e.g., protections for digital ID, user privacy, etc.) writ large and should span multiple sectors. Such values are exemplified by



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the emerging digital principles for development and can be augmented with recommendations that focus specifically on D4Ag (e.g., farmer registry guidelines).

Governments must lead the way on strong data stewardship efforts.

We recommend that governments:

- Work in conjunction with regional bodies to develop and enact strong privacy, security and consumer protection laws tailored to the local context and in line with regional needs.
- Incorporate best practices and lessons learned from other geographies into the design and implementation of these laws.

Fredrick Omondi, CTA

- Work with technology actors to ensure that they understand and will abide by these principles.
- Consider developing shorter-term ‘codes of conduct’, which can achieve outcomes similar to legislation but with shorter lead-time.
- Invest in strong data protection measures and abide by their own policies as part of their data infrastructure investments and data collection efforts.

Donors can play an important advisory and technical assistance role in these efforts.

We recommend that donors:

- Help governments and legislators develop data policies by offering technical assistance and funding for such initiatives.
- Consider the balance of risks and returns in data privacy/security regulation. Support market development policies that ensure consumer protection while managing the downsides of overregulation.
- Familiarise government decision makers with the issues and risks inherent to capacity



building and then assist their efforts to build actual capacity that attends to the technological and legal aspects of data privacy, data regulation and cyber security. Expertise in this field is often absent today.

- Share best practices and lessons learned from other geographies.
- Invest in research that will promote the creation and adoption of good data policies. This could include behavioural research that explores D4Ag user experience and willingness to share data in order to establish a business case for company adoption of strong privacy practices.
- Advocate for and promote greater transparency among enterprises to help fight against algorithmic bias against specific segments.

Investors serve as stewards of good data policies.

We recommend that investors:

- Prioritise privacy and consumer protection as key elements of their diligence processes.
- Help build shared infrastructure for their investees, e.g., through partnerships with cyber security firms, to help investees protect their data.

6. Invest in the D4Ag research agenda

The D4Ag space is evolving rapidly.

New approaches, business models, and ideas are continually being tested. Yet, broadly speaking, stakeholders have focused more on experimentation than on sharing insights and lessons. As the sector matures, there is a valuable opportunity to develop both a stronger set of indicators, best practices and lessons learned and a stronger community with which to share these practices.

We recommend knowledge investments in three major areas:

- **User-centric research and design.** Immersive, farmer-centric research will enhance the sector's understanding of what farmers want, how farmers are responding to existing products, what drives the adoption and use of such products, and ultimately, how offerings can evolve to increasingly generate value for farmers. This kind of research can help address the needs of underserved and marginalised groups like women. It should be part of day-to-day product design, so that enterprises build solutions rooted in the needs and preferences of their customers. While this may sound obvious, companies often overlook this step.
- **Better market and business model intelligence.** Case studies on successful actors – e.g., how they were set up, their revenue models, the pivots they made along their journey – will provide valuable insights into the key factors that drive success in D4Ag. Case studies on less successful examples are equally important and will allow the sector to also learn from shortfalls and mistakes. Similarly, we need continued investment in market intelligence that regularly updates and builds upon the baseline developed in this report.
- **Systematic research on impact.** We need more evidence about the impact on the ground. Impact metrics should be more standardised so we can make stronger comparisons across use cases and business models. Also, in many cases, the evidence needs to be more rigorous (e.g., driven by a third party, rather than purely in-house metrics). When collecting evidence, it is crucial that we better understand the contribution of digital vs other business model enablers in creating the impact in question.



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Donors should take the lead in advancing the research agenda.

We recommend that donors:

- Fund the proposed knowledge initiatives in conjunction with governments, D4Ag enterprises, researchers and others as appropriate.
- Facilitate sharing of best practices and lessons learned.
- Promote greater standardisation of impact metrics and data collection practices.

Governments have an important role to play in contributing to the research agenda.

We recommend that governments:

- Open their own databases for research purposes, especially as they invest in and expand their D4Ag data infrastructure.
- Fund or co-fund investments in data collection efforts, especially those that involve large-scale data collection at the level of individual farmers.
- Integrate emerging lessons and findings into their own plans and programmes.

We expect that **investors** will primarily be consumers of knowledge products, but they can still play an important role in generating and sharing knowledge.

We recommend that investors:

- Fund or co-fund market-building research initiatives, for example by partnering with governments that test and bring new technologies to market.
- Contribute to broader sector efforts by sharing (even confidentially) important information about their D4Ag investments – including information that may not be public, e.g., amount and mix of funding and strategic plans.
- Transfer knowledge across and between regions in which they work.

7. Create an alliance of key stakeholders to promote greater investment, knowledge sharing and partnership building

Strong leadership and improved partnerships between sector actors are needed in order for the opportunities identified in this report to come to fruition. Given the fragmented nature of existing initiatives, this is not likely to happen automatically. Rather, D4Ag needs a strong alliance and a knowledge clearing house to drive the sector.

We recommend establishing such a D4Ag alliance with the following key objectives:

- Attracting greater investment in the D4Ag sector, for example by supporting pipeline generation and facilitation.
- Facilitating deeper relationships and collaboration amongst D4Ag actors.
- Helping connect various aspects of the ecosystem together, for example by linking agricultural technology innovation to big technology players or helping link agronomy insights to various actors' D4Ag efforts.
- Building knowledge and producing periodic reports about the state, progress and challenges of the D4Ag sector.
- Developing capacity – especially among governments, farmers and young entrepreneurs – to realise the potential of D4Ag.
- Developing indicators for monitoring/ tracking progress and reporting to the key stakeholders through regular convening.

For the alliance to be successful, we recommend a partnership between governments, donors, investors and other value chain actors who are dedicated to advancing inclusive, sustainable D4Ag across Africa and beyond. Members must make a public commitment to this initiative, inform its mandate and priorities, offer resources for its operations, and serve as active



participants and contributors to its agenda and activities. They should also back and support the priorities and recommendations of the alliance – where possible and in line with their own priorities – and serve as champions for its efforts. The success of similar alliances in other sectors, e.g., in health, highlights the promise of such an approach.

We also recommend that the alliance invest in building a deep membership base that is excited about its mission and offering. Beyond the core group of sponsors, the alliance will need to attract the interest of the broader sector: non-sponsors, enterprises, farmer organisations, etc. These groups will play important roles as active participants and contributors to the alliance's efforts and will serve as consumers and beneficiaries of its knowledge products and convenings.

In order to ensure its relevance for the sector, the alliance should maintain a deep understanding of D4Ag, the needs and perspectives of farmers, and the priorities of the full ecosystem of actors, especially regional and local priorities.

It should incorporate those priorities as it defines its mandate and should revisit these priorities on an ongoing basis so that its efforts remain complementary to existing efforts on the ground. As such, we recommend that the alliance be nimble in its approach and capable of adjusting to the dynamic needs of the space.

V. Atakos, CCAFS



COUNTRY CASE STUDIES: MAIN TRENDS

- For more detailed information, look at the full report: <https://hdl.handle.net/10568/101498>

ETHIOPIA

- Ethiopia has shown that a state-led development model for D4Ag can deliver rapid scaling. In the long term, however, the sector will likely require greater private sector involvement to realise its potential.

GHANA

- Ghana has created an environment that is well suited to rapid D4Ag scale up, but existing solutions must be tweaked before their full impact potential will be achieved.

NIGERIA

- Nigeria provides an example of how the private sector can drive an innovative digital transformation of agriculture, but it also illustrates how this development can leave more rural and vulnerable farmers behind.

SENEGAL

- D4Ag could accelerate Senegal's agricultural transformation but greater policy support and help from incubators/early stage investors is needed for it to take off.

KENYA

- D4Ag has flourished in Kenya. This success will continue if ecosystem players work together to manage risk.

RWANDA

- Rwanda's government has led remarkable growth in D4Ag. It is now shifting toward a more market-driven approach to scaling up solutions.

SAHEL

- The analysis of the G5 countries (Niger, Burkina Faso, Mali, Chad and Mauritania) was not done with the same level of detail as the Senegal case study. Nevertheless, the intention is to give a flavour of the specific challenges in these countries based on desk study, interviews, and responses to a survey. The Sahel countries face unique challenges to D4Ag scale-up, making them different from neighbouring countries. Solutions, however, could make a large impact in the region, and a few early movers have provided precedents to potential entrants, even under difficult conditions.



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Comments from Advisory Council Members

“Technologies can help stimulate innovation for sustainable agri-food systems and produce better and safer food while preserving natural resources and biodiversity. But we need to be conscious and support solutions that are sustainable and that are tailored to countries’ needs, and embedded into conducive and broader innovation systems. This is in line with the EU’s Digital4Development and SDGs agendas that we are proudly promoting.” **Leonard Mizzi, Head of Unit at the European Commission, Directorate-General (DG) for International Cooperation and Development**

“This essential report provides a detailed and comprehensive view, a snap shot, of the rapidly evolving digital agriculture industry in Africa. Establishing regularity of such a report is essential for stakeholders to keep pace with trends of D4Ag. Africa needs to accelerate inclusive agricultural transformation, hence the key role of digital innovation – more coordinated, efficient, targeted and relevant application of tools and services for smallholder farmers.” **Enock Chikava, Deputy Director for Agriculture Development – Bill & Melinda Gates Foundation**

“As more impact and commercial investments are coming into AgriTech space in the coming five years, we as an agricultural development community need to be extremely careful not to distort the market and have common understanding of the viable business models as well as appropriate financial instruments at each stage of innovation.” **Natalia Pshenichnaya, Head of AgriTech Programme – GSMA**

“The landmark report provides desperately needed intelligence on the market of digital agriculture solutions in SSA. Stakeholders across the sector including donors, governments, investors but also implementers and solution providers need to understand size, character and coverage of the market to optimise interventions, select the best solution, define roll out and go to market strategies, etc.” **Christian Merz, Senior Advisor – GIZ**

“The broad range of D4Ag solutions makes it well suited to the different needs and diversity of smallholders. It also offers a basket of choices. Investments in digital literacy as well as in public ICT infrastructure by donors and governments should increase the value of D4Ag solutions for smallholders.” **Ishmael Sunga, Chief Executive Officer – Southern African Confederation of Agricultural Unions (SACAU)**

“This tremendous assessment demonstrates that the plethora of digital ag solutions have been created and are now available to millions of smallholders. The final frontier is the business model to reduce the cost to the users and increase the interoperability of these solutions to reach scale across borders. The majority of African smallholder farmers, especially youth, are the agripreneurs of the 2020’s!” **Vanessa Adams, Vice President Country Support and Delivery – Alliance for a Green Revolution in Africa (AGRA)**

“This is an important baseline study that gives us as donors valuable information about the state of the D4Ag sector: who are the players, which models do they use and what is the impact on smallholder farmers? I see opportunities for collaboration with other sector actors in developing viable business models, better capturing impact data, particularly on climate adaptation and gender, and in investing in data infrastructure as a public good.” **Paul van de Logt, Head Food and Nutrition Security – Dutch Ministry of Foreign Affairs**



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<https://hdl.handle.net/10568/101498>**



The Technical Centre for Agricultural and Rural Cooperation (CTA)
PO Box 380 6700 AJ Wageningen The Netherlands
www.cta.int