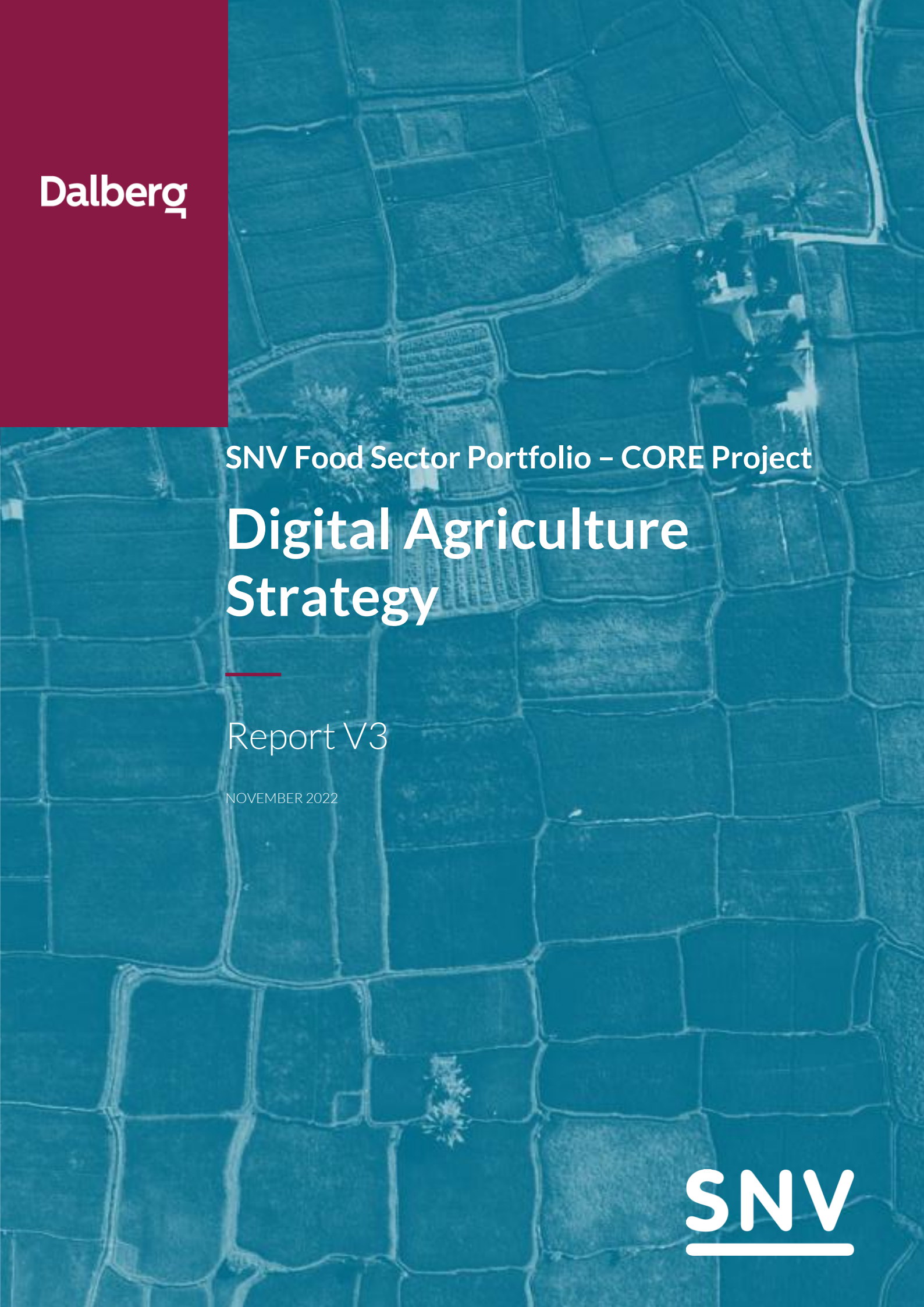

Dalberg

SNV Food Sector Portfolio – CORE Project

Digital Agriculture Strategy

Report V3

NOVEMBER 2022

SNV

Contents

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List of acronyms

ARPU	Average Revenue Per User
BMGF	Bill and Melinda Gates Foundation
BoP	Bottom of the Pyramid
CTA	Technical Centre for Agricultural and Rural Cooperation
CSA	Climate Smart Agriculture
CRM	Customer Relationship Management
D4Ag	Digitalisation for Agriculture
ERP	Enterprise Resource Planning
ESG	Environment, Social, and Governance
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gas
GSMA	Global System for Mobile Communication Associations
IVR	Interactive Voice Response
LMIC	Low- and Middle-Income Countries
MEL	Monitoring, Evaluation and Learning
MNO	Mobile Network Operator
PPP	Public-Private Partnership
SDG	Sustainable Development Goals
SHF	Smallholder farmer
SMS	Short Message Service
TA	Technical Assistance
USSD	Unstructured supplementary service data
VC	Value Chain
VSLA	Village Savings and Loan Association

Glossary

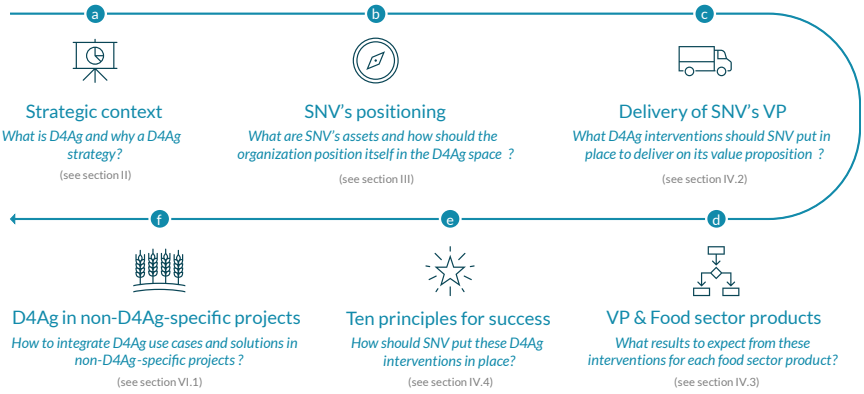
D4Ag ecosystem	The D4Ag ecosystem comprises of the D4ag enabling environment, the D4Ag infrastructure, and the D4Ag use cases.
D4Ag enabling environment	The D4Ag enabling environment drives access and use of the D4Ag solutions, ensures the creation and growth of strong business models and creates a safe environment for users. It includes connectivity, digital enablers, and the business ecosystem.
D4Ag entrepreneur	D4Ag entrepreneurs include talents building D4Ag solutions.
D4Ag infrastructure	The D4Ag infrastructure includes agriculture sector specific data, hardware, and software infrastructure that D4Ag solutions rely on to source information and deliver their services to farmers and other agriculture intermediaries; these are the building blocks that D4Ag solutions use to do what they do.
D4Ag infrastructure vendor	D4Ag infrastructure vendors are private service providers contributing the to the building of the D4Ag infrastructure.
D4Ag public good	D4Ag public goods are elements of the D4Ag infrastructure manage by the public sector.
D4Ag use case	D4Ag use cases represent categories of D4Ag solutions.
D4Ag solution	D4Ag solutions include both D4Ag products and D4Ag services delivered to producers, consumers, or other value chain actors.
D4Ag vendor	D4Ag vendors represent the providers of D4Ag solutions.

EXECUTIVE SUMMARY

The digital agriculture (D4Ag) ecosystem is rapidly evolving and is defined as the combination of (i) an enabling environment; (ii) an infrastructure; as well as (iii) use cases. While the D4Ag use cases – which include both consumer-oriented as well as SME and producer-oriented use cases – present a high potential to foster the required transformation of the agri-food systems, D4Ag is yet to scale and reach the consumers, SMEs, and producers who are most in need in LMICs. Structural barriers include (i) low levels of public investment in the D4Ag ecosystem; as well as the lack of (ii) PPPs to build the D4Ag infrastructure; (iii) regulations to catalyse innovation and protect users; and (iv) scalable business and operating models.

In this context, SNV has a twofold role to play in D4Ag: (i) supporting the development of a sustainable, equitable, and inclusive D4Ag ecosystem and (ii) building internal capacity to leverage D4Ag solutions in its own agri-food sector portfolio. To embrace the first part of this role, SNV will aim to deliver on a value proposition defined by three objectives namely (i) building the D4Ag infrastructure through sustainable PPPs; (ii) maturing the ecosystem of D4Ag vendors with an ESG lens; and (iii) catalysing public sector's involvement and investment in the D4Ag ecosystem along with the private sector. When it comes to the second part of the role the organisation can play in D4Ag, SNV has identified the most relevant D4Ag use cases and solutions for each agri-food sector product component. Additionally, SNV identified 10 principles for success in D4Ag which are transversal and aim at guiding SNV on both how to deliver on its value proposition in D4Ag, as well as how to mainstream D4Ag solutions in SNV's agri-food products.

Figure 1: SNV D4Ag positioning reader journey



While multiple interventions and recommendations on how to implement these interventions have been identified, key dos and don'ts surfaced during the development of this D4Ag positioning strategy. The top three dos include:

- **Inclusive, sustainable, and equitable governance** – integrating a data and digital governance lens to D4Ag initiatives in order to foster agency of the final beneficiaries (e.g., SMEs, producers, consumers) over their data as well as over the design of the D4Ag use cases and solutions delivered to them
- **D4Ag initiating and mainstreaming** – (i) providing for a "D4Ag challenges and opportunities assessment" at the end of each agri-food sector project as a way to initiate new D4Ag-specifc projects and (ii) ensuring integration of D4Ag in non-D4Ag-specific projects by adding a digital lens to all projects from the agri-food sector portfolio
- **Cost and impact measurement** – invest in the measurement of both the impact and the cost of D4Ag initiatives (internal as well as potentially external) in order build the case which will eventually drive the involvement of the public and private sectors in D4Ag

On the don'ts side, it seems critical for SNV to avoid:

- **Leading alone** – not partnering with existing leaders in the market and ending up trying to internalise capabilities which do not align with SNV's mandate (e.g., design of a financially sustainable D4Ag infrastructure)
- **Context agnostic** – overlooking the need for the integration of a readiness lens in each D4Ag initiative as well as the sequencing between interventions (i.e., starting with the D4Ag enabling environment before focusing on the infrastructure and eventually the use cases)
- **Grants provision** – providing grants to D4Ag vendors while several stakeholders are already doing it (e.g., GMSA, Mercy Corps, CGIAR) and SNV could have a larger impact by catalysing financing from donors and investors

In terms of the way forward, three avenues have been identified for SNV to expand its activities in D4Ag and deliver on its value proposition on the short term. These avenues include (i) the replication of the GARBAL service in other countries and with other partners; (ii) the scale up of the GARBAL service, for example across new D4Ag use cases; and (iii) the initiation of new D4Ag projects with different objectives, partners, and scope than the ones from the GARBAL service. Each of these avenues can be explored through different entry points which usually require SNV to secure traction from funder(s) (e.g., BMGF) and beneficiaries (e.g., Ministry of Agriculture) as well as willingness to partner from D4Ag infrastructure provider(s) (e.g., telecom operator) and/or large private stakeholder(s) (e.g., bank, agribusiness). Finally, as a very next step, SNV will be hosting strategic sessions to define internal (e.g., what capacity to build, what internal budget to dedicate to it) and external (e.g., which funders to target, which interventions to start with in which countries) priorities for SNV in terms of D4Ag at the organisation-level as well as at the level of the countries of operation.

I PURPOSE AND APPROACH

The purpose of this document is to define a strategy for SNV's work towards (i) leveraging digital agriculture (D4Ag) technologies in its food sector portfolio and (ii) supporting the D4Ag ecosystem in its countries of operation. The aim of the strategy is to:

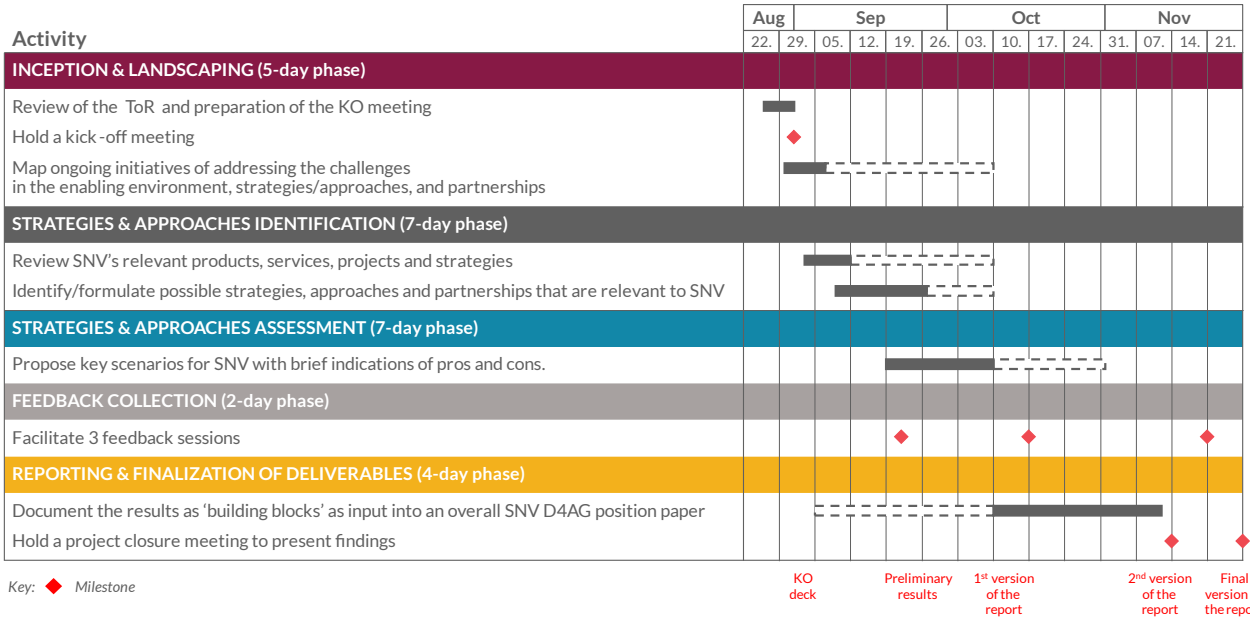
- Articulate SNV's value proposition in D4Ag
- Identify and prioritise opportunities for engagement and collaboration
- Support proactive engagement with stakeholders, such as donor and private sector players

To develop this strategy, the approach was to:

- Start from an ecosystem study and understanding of SNV, before applying criteria for what is most relevant for SNV and its partners
- Highlight high-potential opportunities without 'closing doors', considering the evolving state of the ecosystem and the need for SNV to be demand-driven
- Drive to practical suggestions for potential projects and partnerships while recognising this is only a starting point that SNV will need to evolve further

The strategy was developed over 25 days of work spread across 2 months and based on desk research as well as internal and external stakeholder interviews.

Figure 2: Work plan followed to develop SNV's D4Ag strategy in 2022



Finally, this strategy is seen as living document that will need to be updated and expanded over time as SNV's involvement in the D4Ag sector is at its early stage and the D4Ag ecosystem is still very nascent in low- and middle-income countries (LMICs) and is rapidly evolving.

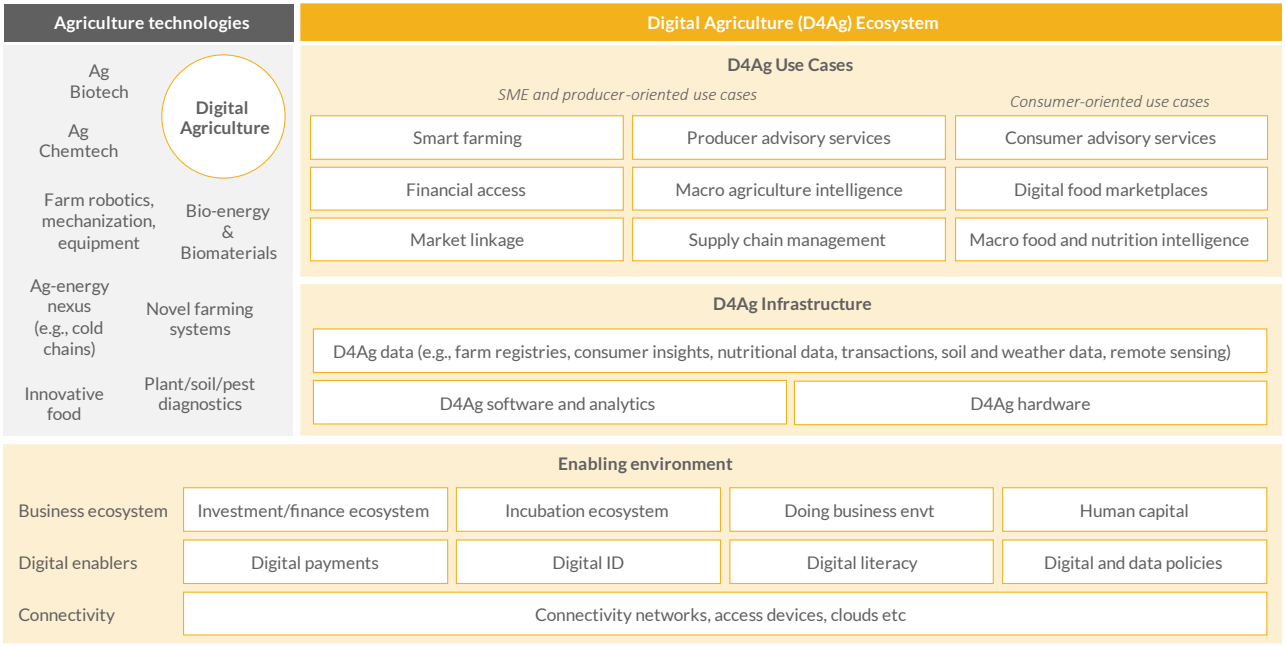
II STRATEGIC CONTEXT

II.1 Introduction to D4Ag

a. D4Ag ecosystem

Digital Agriculture is a type of agriculture technology building on an ecosystem made of use cases, infrastructure, and enabling environment. Digital agriculture technologies enable consumers, producers, and agribusiness entrepreneurs to increase their productivity, efficiency, and competitiveness, facilitate access to markets, improve nutritional outcomes and enhance resilience to climate change.

Figure 3: Digital agriculture ecosystem[1]



D4Ag solutions rely on the broader enabling environment for digital ecosystems including:

- **Business ecosystem** – The business ecosystem includes four components namely (i) the human capital infrastructure that helps supply the talent for product developers and agronomists, (ii) the investment and finance ecosystems that avail investment for D4Ag enterprises, (iii) the incubation ecosystem that enables early-stage D4Ag vendors and the upskilling of young D4Ag entrepreneurs, and (iv) the "Doing Business" environment that includes factors such as business registration, taxation, and investment regulations, that affect operations of D4Ag enterprises.
- **Digital enablers** – D4Ag solutions also depend on the broader digital ecosystem enablers such as digital payments systems, digital ID infrastructure, digital literacy, and favourable digital and data policies.
- **Connectivity** – D4Ag solutions rely on connectivity infrastructure. This includes the penetration and accessibility of communication networks and devices. Another part of this connectivity layer are cloud services and other back-end systems that allow D4Ag enterprises to better leverage data and analyse information.

Beyond the support from the enabling environment, D4Ag use cases and solutions rely on a three-component infrastructure to source information and deliver their services to agri-food systems actors. These components include:

- **D4Ag data** – Agriculture data corresponds to all the factors that might inform D4Ag solutions. It includes farmer and consumer data; agricultural transaction and financing data; land registry data; localized market data; nutrition analytics; pest and disease surveillance data; weather, water, and soil data; sensor data from fields, animals, and machinery; remote sensing data; agronomic data; and agronomic good practices content.
- **Hardware** – D4Ag hardware captures, and stores agriculture data fed into agriculture data systems. Examples include drones, weather stations, soil, pest, and crop diagnostics equipment, and field sensors as well as a wide variety of digital devices relevant for consumers, smallholder farmers and farms.
- **Software** – D4Ag software and analytics processes data and creates reliable content and platforms for D4Agsolutions. Software infrastructure includes a wide range of field data collection tools, agent field-force

[1] Source: Adapted from *The Digitalization of African Agriculture*, by CTA and Dalberg, 2019

management tools, data analytics tools, and software building blocks (e.g., blockchains, AI algorithms, enterprise resource planning (ERP) and customer/consumer relationship management (CRM) modules).

Finally, based on the enabling environment and the D4Ag infrastructure, digitally enabled services are delivered to agri-food system actors through 6 SME and producer-oriented use cases including (i) supply chain management, (ii) macro agri-intelligence, (iii) smart farming, (iv) advisory services, (v) market linkages, and (vi) financial access, as well as 3 consumer-oriented use cases including (i) consumer advisory services, (ii) macro food and nutrition intelligence, and (iii) digital food market places.

Figure 4: Digital agriculture SME and producer-oriented use cases, their impact, and examples of related solutions and organisations [1/2][2]

	Supply chain management	Macro agri-intelligence	Smart farming
Description	Digital supply chain management solutions are B2B services that **help agribusinesses, cooperatives, nucleus farms, input agro dealers and other SHF value chain intermediaries** to **manage their SHF relationships** in ways that lower costs and improve value chain quality through better traceability and accountability	Provides support tools that **integrate data sources on SHFs, SMEs, farms, and markets** and **converts this information into useful country and value-chain level insights and decision tools** for government, policymakers, agronomists, agribusinesses and investors	Involves the **incorporation of digital technology into machinery and equipment as well as the use of sensors in agricultural production systems** to increase the quantity and quality of products as well as optimizing human labor required by production
Impact	• **Improves value chain quality by ensuring** better traceability and accountability • **Increase SME and SHF incomes** by making it easier for commercial players to formally engage with large numbers of SHFs	• **Builds open information and knowledge** access • **Facilitates evidence-based decisions** in agriculture sector	• **Boost yields and improves incomes** for SHFs, livestock keepers, and fishermen • **Increase resilience to climate change**
Example solutions	• Traceability solutions • Supply chain management ERP systems [1] • Logistics management solutions [1]	• Government agriculture sector dashboards • Agriculture extension system mgmt. tools • Agribusiness intelligence • Digital food balance sheets	• Robotics and equipment monitoring • Smart shared assets (tractors) • Sensing technology (soil, water, humidity, temperature)
Example organizations	SAP, Cropin, iProcure	IRRI Intelligence, CGIAR Platform for Big Data in Agriculture, AtlasAI	agrocares, SunCulture, hello tractor

Figure 5: Digital agriculture SME and producer-oriented use cases, their impact, and examples of related solutions and organisations [2/2][3]

	SME and producer advisory services	Market linkages	Financial access
Description	Provides **information on agronomic best practices, pests and diseases, weather, and market information**	• **Links SMEs and SHFs to high-quality farm inputs** (e.g., seeds, fertilizers, and pesticides) • **Provides market linkage solutions for SHFs and SMEs by** linking buyers to farmers in digital marketplaces	**Provides digital financial services** such as **digital payments, savings, smallholder and SME credit, e-subsidies, and agricultural insurance**
Impact	Enables SHFs and SMEs to **make decisions that maximize output** from their land and adapt their practice to climate other conditions, leading to **higher-quality production greater resilience to climate change, and higher income**	Allows SME and SHFs to access **high quality inputs and markets**, leading to **greater productivity and income**	**Increases access to financial products** and equip smallholder farmers with capital to invest in agricultural production, leading to **greater productivity and income, resilience, and asset accumulation**
Example solutions	• Digital extension services, precision agriculture, market information services delivered via: – Business to Farmers – Business to Agent (for enhancing quality of service) – Farmer to farmer (peer learning)	• Digital input distribution • Digitally-enabled market access to off-takers • Ag buyer-seller digital marketplaces	• Farmer-facing digital financial services, e.g., credit, savings and insurance • B2B agri-insurance packaged with input or loans to SHFs and SMEs • Back-end data analytics for digital credit scoring
Example organizations	viamo, Digital Green, UjuziKilimo	Twiga, DigiFarm, Jinukun	farmcrowdy, acre AFRICA, agropay

Figure 6: Digital agriculture consumer-oriented use cases, their impact, and examples of related solutions and organisations

[2] Source: Adapted from *Toolkit to mainstream digital agriculture technologies*, by Dalberg, African Development Bank, FAO, and IITA, 2021

[3] Note: To identify D4Ag organisations in a given country for a certain use case, consider consulting the Digital Agri Hub (see: https://digitalagrihub.org/)

	Consumer advisory services	Macro food and nutrition intelligence	Digital food marketplaces
Description	Provides **information and recommendations to consumers on nutrition and food consumption patterns and best practices**	Provides support tools that **integrate data sources on consumers as well as food and nutrition** and **converts this information into useful country, value-chain, and consumer group level insights and decision tools** for government, policymakers, nutritionists, retailers, consumers, agribusinesses and investors	Digital marketplaces that **connect consumers to producers or retailers** including hyperlocal retail platforms facilitating direct sales between farmers and consumers
Impact	Enables consumers to **make decisions that improve their food consumption patterns** leading to **healthier diets and nutrition improvement**	• **Builds open information and knowledge** access • **Facilitates evidence-based decisions** in agriculture, food, and nutrition sector	Allows consumers to access **nutritious food and markets**, leading to **healthier diets and nutrition improvement**
Example solutions	• Consumption planning apps helping consumers eat healthily and sustainably through personalised meal plans, grocery lists and purchase records • Tools and applications which incentivise sustainable shopping through rewards and the creation of positive habit loops	• Government agriculture, food, and nutrition sector dashboards • Nutrition security alert systems • Digital food and nutrition balance sheets • Quality control systems to ensure that food meets standards of quality, safety, and nutritional value	• Digital food distribution • Digitally-enabled market access to producers and nutritious food
Example organizations	comQuiero, FOODSWITCH, evocco	FSNAU, Food Systems Dashboard, Global Nutrition Cluster	ninjacart, Heyfood, CONSUMO Lo que produzco

While these use cases are presented here separately, many players have been bundling multiple use cases to increase uptake among producers and consumers as well as to enhance financial sustainability. Examples of bundled services include:

- Digital food marketplaces where consumers can access healthy and nutritious produce from producers and SMEs along with recommendations in terms of nutrition
- Market linkage platforms connecting SMEs with D4Ag financial products and services
- Agri-insurance (financial access) packaged with input loans (financial access) to address part of the risk
- E-extension (advisory) offered together with input loans (financial access) to first onboard many customers and help producers and SME to become more productive
- Digital input loans (financial access) offered with digital input distribution (market access) to enhance purchase of input as well as to restrict the use of credit to input purchase
- Direct access to consumer markets (market linkage) coupled with aggregation, traceability systems, transport, storage, and delivery services from farm to market that limit the number of market intermediaries and increase farmer incomes

In this context of bundling, over the last years, the D4Ag ecosystem has seen the arrival of super platforms that bundle multiple use cases and aim for greater reach and sustainability. These platforms are usually anchored by a large organisation, and often bring other players to the platform to complement their capabilities. When led by a business, they come with specific drivers, aligned with their core business objectives, with strong sustainability path in mind. Four archetypes of super platforms are distinguished based on the type of organisation leading the platform.

Figure 7: D4Ag super platform archetypes with their drivers, strengths, and gaps[4]

Archetype	Drivers	Strengths	Gaps
Telco led	• Widens **customer base** • Established presence as a **digital company** • Enhances the **customer value proposition and loyalty**	• Strong **technical expertise** and **data storage capabilities**	• **Limited on ground support** in the form of field agents
Agribusiness led	• Expands and **strengthens the existing agribusiness** • Improves **producer access to inputs** and **quality of produce for offtake** and/or **consumer access to produce** • Secures their **supply chain**	• Strong **agronomic expertise** • Strong **commercial planning** and **marketing expertise**	• **Limited technical expertise** and data capabilities
Bank led	• Expands their **rural client base** • **De-risks agribusiness lending** by meeting financial needs throughout the value chain • Leads in **financial innovation**	• Strong **operational capabilities and processes**	• **Limited agronomic expertise** • **Limited on the ground networks**
Government institution led	• Builds and shares **open information and knowledge** • Leads **digitization of agricultural data and research** in line with government priorities • Facilitates **evidence-based decisions** in agriculture	• Strong **agronomic expertise and established links** through existing **networks of field agents**	• **Limited internal capacity for technology** and **partnership development**

Figure 8: Examples of D4Ag super platforms across Nigeria, Ethiopia, Uganda, Rwanda, and Kenya[5]

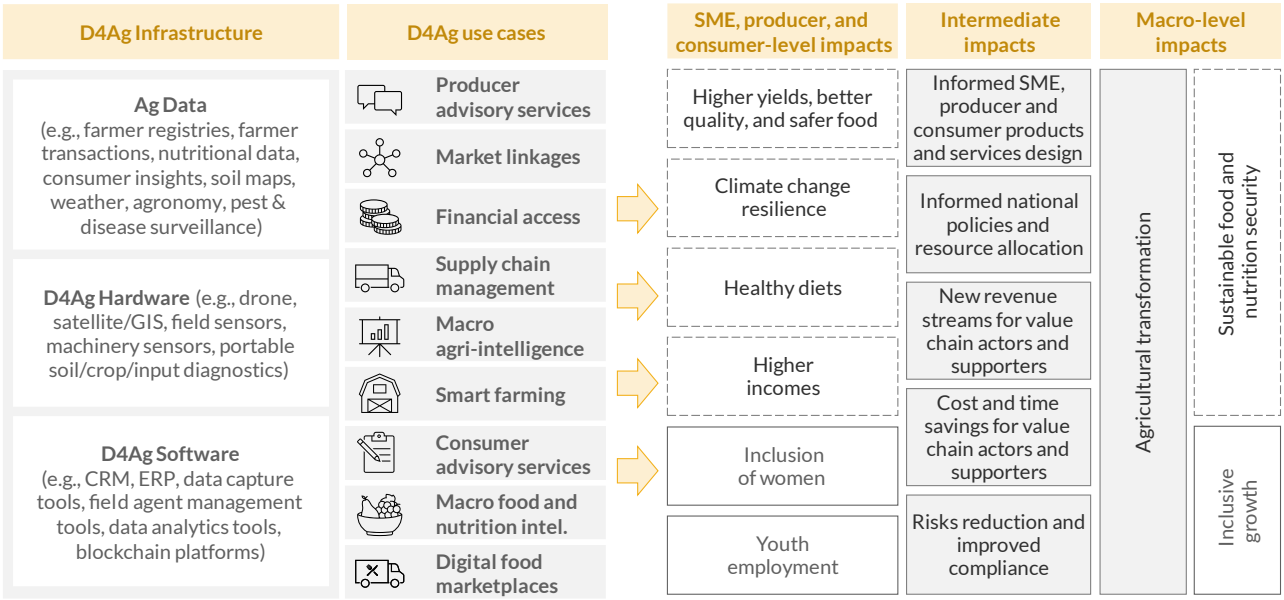
Archetype	Lead platform(s)	Company description
Telco led	DigiFarm	• **Safaricom** is the leading provider of converged telecommunications solutions in Kenya and leads the DigiFarm platform. The platform provides inputs, credit, insurance, market linkage, and advisory services to support SHFs in partnership with different organizations in Kenya
Agribusiness led	FMN Food and Agro-Allied Group	• **Flour Mills Nigeria (FMN)** is one of Nigeria's leading food and agricultural businesses and is developing a platform that will provide input loans along with weather information to farmers
Bank led	Sterling Bank The one-customer bank. Stanbic IBTC	• **Sterling bank (Nigeria)** provides two products. SABEX 1 supports agro -dealers with input provision and credit while SABEX2 provides credit, market access, and warehousing for farmers • **Stanbic Bank (Uganda)** is developing its One Farm services with the aim to provide insurance, market access, agronomic services, and credit for inputs.
Government institution led	Ethiopian ATA Agricultural Transformation Agency; KALRO	• **Kenya Agricultural and Livestock Research Organization (KALRO)** is creating a platform that will aggregate data, centralize research and share information across Kenya's agricultural ecosystem • **Agricultural Transformation Agency (ATA)** developed an agriculture data hub that centralizes and consolidates data making it easier for external partners to leverage the data

b. Impact of D4Ag

D4Ag solutions provide pathways to inclusive growth and sustainable food security agendas through their impact at different levels of the agri-food systems. While stakeholders such as CTA and Mercy Corps have been trying to measure the impact of D4Ag in LMICs at scale, there is a clear data gap when it comes to monitoring, evaluation and learning (MEL) in the D4Ag ecosystem.

[4] Source: Adapted from *Digital Agriculture Platforms*, by GIZ, Mercy Corps Agrifin, and Dalberg, 2021
[5] Source: Ibid

Figure 9: Impacts of D4Ag at the consumer and producer, intermediate, and macro levels [6]

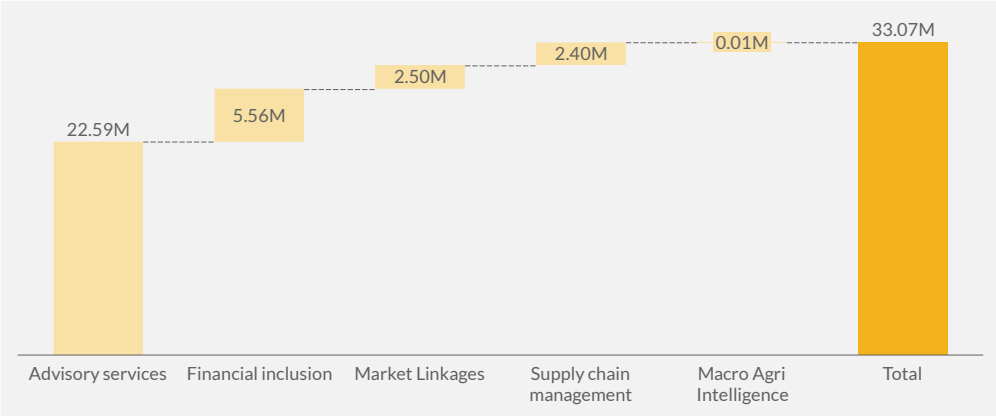


c. Key figures about the D4Ag solutions market[7]

The number of D4g solution providers in LMICs grew by 25% per annum between 2015 and 2019 from 287 to 713 solution providers[8]. To date, the Digital Agri-Hub (a D4Ag knowledge broker and matchmaking platform) registers 751 D4Ag solution providers across 97 LMICs[9]. While digital advisory is the most provided D4Ag use cases in terms of number of D4Ag solutions, it is estimated that more than half of the D4Ag vendors bundle at least two D4Ag use cases[10].

In terms of penetration, in 2018, CTA and Dalberg estimated that 33 million producers have registered to D4Ag solutions in Africa only.

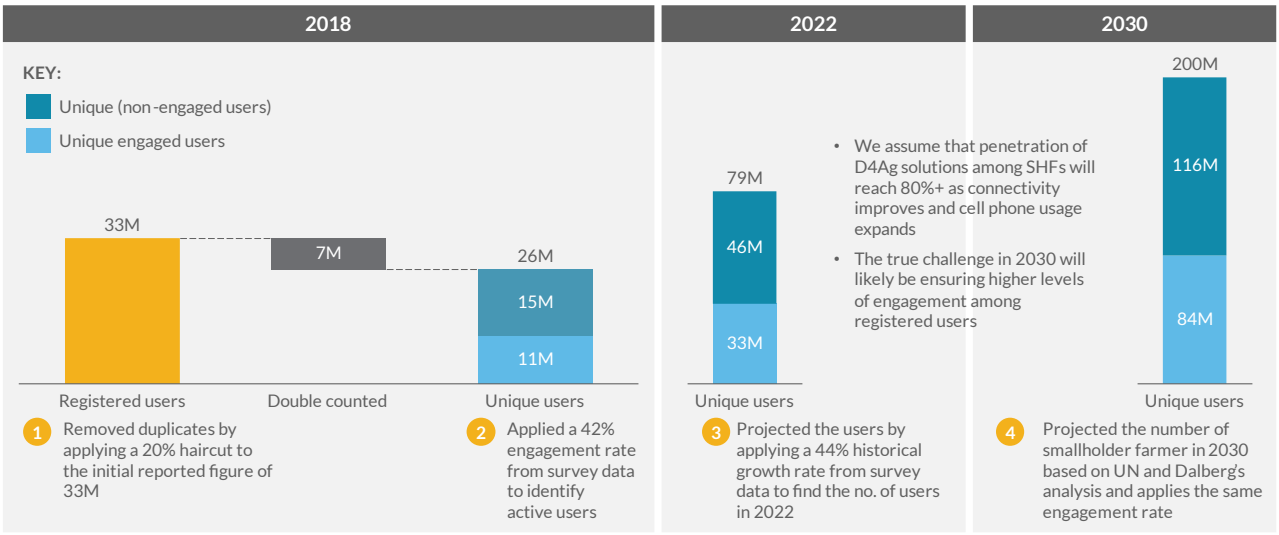
Figure 10: Number of D4Ag registered users in Africa in 2018 [11]



From these 33 million, it was estimated that 7 million are double counted and 15 million are only registered but not active, leaving the number of engaged users actually using the D4Ag solutions at about 11 million. In 2021, Dalberg estimated that this number would reach 84 million by 2030.

[6] Source: Adapted from *The Digitalization of African Agriculture*, by CTA and Dalberg, 2019
[7] Note: The data presented in this section is mostly related to SME and producer-oriented use cases. To date, there is still little research done on the more consumer-oriented use cases.
[8] Source: GSMA, *Digital Agriculture Maps*, 2020
[9] Source: From https://digitalagrihub.org/ (consulted on October 7th, 2022)
[10] Source: Dalberg analysis, 2022
[11] Source: Adapted from *The Digitalization of African Agriculture*, by CTA and Dalberg, 2019

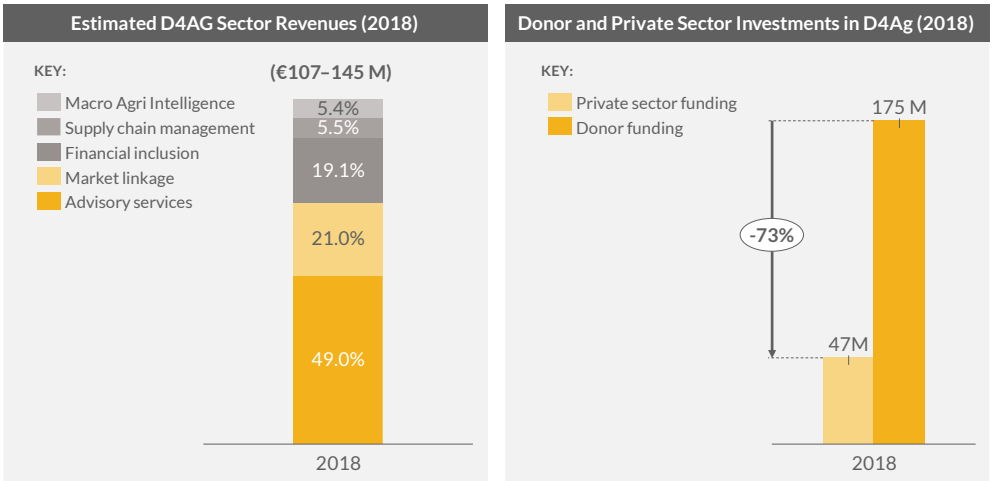
Figure 11: D4Ag engagement measures and projections for Africa[12]



When it comes to revenue, an estimated €115M (actual range is €107–145M) was realized in 2018 which accounts for 6% penetration of the total addressable market. The addressable market will continue to grow rapidly over the next decade driven by (i) the growth of the smallholder famer population, (ii) improvements in connectivity infrastructure, access to technology, and digital literacy, and (iii) rising revenues per farmer as D4Ag business models become more established.

Finally, while D4Ag in Africa has seen growth in investment and number of market players, investment remains relatively low. New entrants in the D4Ag space include 'big tech' players like Microsoft, Google, IBM, Bosch, and Alibaba. Donor funding annually contributes €175 M while the private sector contributes approximately €47 M, although these figures are not well documented. These figures are small relative to the needs of commercial enterprises and represent a tiny fraction of the global investment flows to agricultural technology, which by some estimates reached nearly €1.8 B in 2017[13].

Figure 12: African D4Ag sector revenues and investments in 2018[14]



d. Structural barriers and risks of D4Ag[15]

To both secure the gains and enable an inclusive, sustainable, and equitable deployment of D4Ag in LMICs, SNV must be aware of the limitations and risks related to D4Ag.

STRUCTURAL BARRIERS

D4Ag is yet to scale and reach the producers, consumers, and communities who are most in need in low- and middle-income countries with key structural barriers that need to be addressed to accelerate penetration and effective application of D4Ag in the transformation of agri-food systems. Four main barriers have been identified[16] including:

[12] Source: Dalberg analysis based on data from Dalberg D4Ag Database compiled in May 2021
[13] Source: CTA and Dalberg, *The Digitalization of African Agriculture*, 2019
[14] Source: Ibid
[15] Source: Adapted from *The Digitalization of African Agriculture*, by CTA and Dalberg, 2019
[16] Source: SNV, *Overview of D4Ag sector*, 2020

- **Public investment** – In LMICs, the levels of public investment in the D4Ag ecosystem are usually low. Including in the D4Ag enabling environment – which goes beyond the agriculture sector (see Figure 2) – and the D4Ag infrastructure. These investments are often required to build the foundations enabling the private sector to build and invest in financially sustainable D4Ag products and services.
- **PPPs and D4Ag infrastructure** – There is an important gap in terms of collaboration between the public and the private sector in the D4Ag ecosystem in LMICs. This gap also hampers the capacity of countries in building their D4Ag infrastructure which often requires the involvement of the private sector, especially to provide the underlying technologies (e.g., clouds, relational database management systems, data collection and acquisition tools).
- **Regulations** – The lack of relevant legislations and regulations to control and govern the D4Ag ecosystem is both a constraint for the private sector and a source of risk for the producers, consumers, and other value chain actors benefiting from and contributing to the D4Ag ecosystem. Critical areas to regulate include among others: (i) data ownership, rights, privacy, and security; (ii) entrepreneurship and investment; and (iii) finance, including digital financial services.
- **Scalability** – While the number of D4Ag products and services available in LMICs is rapidly growing, only few of them have succeeded to reach financial sustainability and scalability. There is a clear lack of scalable approaches and operating and business models in the D4Ag ecosystem resulting in only few services and products going beyond the pilot stage and actively used at scale.

RISKS

Next to these limitations, as any technology, D4Ag brings potential risks including but not restricted to:

- **Equity and inclusivity** – 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 and not contribute to the digital divide.
- **Data stewardship** – The need for good data stewardship will only grow, along with the amount of data generated in agricultural value chains in LMICs with actors increasingly relying on algorithms. As greater investment flows into the D4Ag infrastructure layer and as ever more significant volumes of data are captured, aggregated, and analysed, clear, conscientious standards will be necessary. The lack of policies around privacy, security, and customer protection brings unique risks to farmers, particularly in less stable political climates. D4Ag enterprises have seized upon farmer data as a viable revenue source. This has encouraged the collection and dissemination of increasingly specific pieces of personal information – farmer incomes, crops, vulnerabilities to climate change, soil types, water access, consumer data etc. As a result, farmers, consumers, and other VC actors particularly those in politically volatile environments, are left susceptible to risks ranging from unscrupulous business practices to violence. These risks are not unique to the D4Ag space. As D4Ag evolves, such systems must be prioritized more quickly, particularly given the vulnerability and the risks of losing their trust should data or security breaches occur.

e. Macro trends shaping the future of D4Ag in LMICs

D4Ag in LMCs is a sector that is expected to evolve quickly over the coming years with some of the major driving trends including:

- **Overall digitalisation** – The rapid digitalisation will come from the ever-increasing (i) digital literacy in LMICs, including in the rural areas and (ii) availability and democratization of digital technologies, both on-farm (e.g., mobile internet, smartphone) and off-farm (e.g., remote sensing, blockchain)
- **Amount and value of agriculture data** – As in other sectors, the amount (driven by the overall digitalisation) as well as the value of the data is expected to increase across the value chains from pre-production (e.g., due to the increasing amount of data enabling more predictive use cases for the D4Ag vendors) to consumption (e.g., due to the increasing needs for nutritious, safe, and traceable food and certification of these)
- **Need for optimized agri-food systems** – Due to factors such as climate change and demography, agri-food systems in LMICs are expected to require an increased productivity, efficiency and (urban) consumer orientation calling for innovation, including D4Ag solutions.
- **D4Ag ecosystem maturity** – The D4Ag ecosystem is also expected to naturally mature thanks to the aforementioned trends along with (i) increasing investments from both the public and the private sectors, (ii) accelerating business and operating models' innovation, (iii) expanding availability of human capital to design and develop D4Ag solutions, and (iv) developing regulations and legislations catalysing digital innovation.

As SNV becomes more active in the D4Ag ecosystem, it will be critical to both follow these developments and identify emerging trends potentially structuring the sector in order to remain relevant and maximise impact.

II.2 Existing initiatives addressing structural barriers

a. Interventions[17]

Multiple international development organisations have been leading initiatives addressing the aforementioned structural barriers (see section II.1.d). Five categories or such initiatives or interventions are distinguished including (i) thought leadership, (ii) ecosystem management, (iii) technical assistance, (iv) financing, and (v) value chain and agri-food system integration.

- THOUGHT LEADERSHIP

  Stakeholders like D4Ag experts and development organisations, with the support of agriculture service providers and policy makers, drive the thinking around priority market entry points for D4Ag interventions. They do so based on ecosystem readiness and mobilising resources around high-potential business and impact use cases of D4Ag solutions.

- STAKEHOLDER ECOSYSTEM MANAGEMENT

  International development organisations support mapping efforts of D4Ag champions and flagship use cases and acts as a third-party facilitator for ecosystem matchmaking and partnerships and learning engagements.

- TECHNICAL ASSISTANCE TO THE PUBLIC SECTOR

  Partners of the public sector can serve as technical support partners (with varying levels and areas of expertise) in developing a knowledge and skills base for the business and regulatory advancement in the D4Ag ecosystem. The technical assistance also includes the support provided to organisations such as Ministries of Agriculture or ICT in the building of the D4Ag infrastructure.

- FINANCING WITH INNOVATIVE AND INCLUSIVE FINANCE

  Stakeholders with financing capacity can catalyse grant funding for the pilot implementation of promising D4Ag business and operational models, mobilise financing for scaling, and enable public investment in the D4Ag ecosystem (e.g., through blended finance and advising governments on public spending).

- VALUE CHAIN AND AGRI-FOOD SYSTEM INTEGRATION

  Agri-food system actors at the most granular level are best positioned to translate both the thinking behind and the ecosystem strengthening D4Ag into practical solutions for implementation within agriculture ventures across different stages of growth.

Across these 5 categories, 14 different interventions are identified and characterized by their level of applicability to address the 4 structural barriers. While each intervention is considered as applicable to address at least one barrier, the more global, as opposed to local, interventions tend to be more applicable across the four barriers. It is also good to note that while these interventions are presented independently, international development organisations tend to combine multiple interventions in their D4Ag initiatives.

[17] Source: Adapted from *Data Sovereignty in Agricultural Value Chains*, by GIZ and Dalberg, 2022

Figure 13: D4Ag interventions and their applicability per structural barrier[18]

Key: Minimally applicable | Somewhat applicable | Applicable

	Categories	Interventions	Level of applicability per structural barrier: PPPs & D4Ag infra.	Public investment	Regulations	Sustainability & Scalability
GLOBAL	Thought leadership	01. Assessing D4Ag ecosystem readiness across LMICs				
		02. Articulating business & impact cases, including MEL data collection				
	Stakeholder ecosystem management	03. Mapping champions & flagship use cases				
		04. Matchmaking & partnerships facilitation, including PPPs				
		05. Facilitating knowledge transfers				
	Technical assistance to the public sector	06. Building capacity in public institutions				
		07. Supporting the creation of an integrated D4Ag infrastructure				
		08. Shaping the regulatory environment				
	Financing with innovative and inclusive finance	09. Enabling public investment in the D4Ag ecosystem				
		10. Catalysing financing for successful commercial models				
		11. Providing grants to D4Ag entrepreneurs				
LOCAL	Value chain and agri-food system integration	12. Shaping market demand for D4Ag services and products, including at the SHF level				
		13. Supporting the roll out and scale up of D4Ag services and products				
		14. Digitizing and building capacity around key agricultural operations				

b. Stakeholders

Key stakeholders supporting the D4Ag ecosystem are mapped along the 5 categories of interventions. This stakeholder mapping (i) is not exhaustive; (ii) does not include D4Ag vendors and entrepreneurs (as not directly supporting the enabling environment or D4Ag infrastructure); and (iii) present stakeholders in one category while some of them are involved across several categories of interventions.

Figure 14: Landscape of stakeholders supporting the D4Ag ecosystem in LMICs (not exhaustive)

II.3 Why a D4Ag strategy is needed

While the evolution towards an accelerated digitalization of the agri-food systems is no longer to be proven, the impact of D4Ag on communities of smallholder farmers, consumers and other VC actors is yet to be articulated and thoroughly measured at scale. That said, multiple sources highlight game-changing improvements in terms of productivity, profitability, food quality, employment, resilience to climate change, and more recently responses to extreme shocks such as pandemics.

[18] Note: Interventions are considered as "applicable" when they directly address a structural barrier and "somewhat applicable" when they can potentially address a structural barrier and/or do not directly address it. The interventions that are believed to have little to no potential to address a structural barrier are categorized as "minimally applicable". For example, "supporting the roll out and scale up of D4Ag services and products" is considered as somewhat applicable to address the lack of public investment as this intervention has the potential to influence the involvement of the public sector but only if it is articulated with the right advocacy.

Unfortunately, too often this impact remains limited in LMICs due to structural barriers including, but not restricted to, lack of appropriate regulations, public investment, scalable approaches, and partnerships to create the required D4Ag infrastructure. Next to these barriers, D4Ag also poses risks related to data governance as well as the digital divide.

In such a context, international development organisations have a twofold role to play in D4Ag: (i) supporting the development of a sustainable, equitable, and inclusive D4Ag ecosystem and (ii) building internal capacity to leverage D4Ag solutions in their own agri-food sector portfolio.

Given the fast-changing, broad, and transversal nature of D4Ag, playing this role requires SNV to strategically position itself in the D4Ag ecosystem and review its operations in light of that positioning.

III SNV'S POSITIONING

III.1 Food sector portfolio

Focusing on LMICs, SNV's food sector portfolio aims at transforming agri-food systems along three impact areas namely (i) food security and health diets; (ii) sustainable production in a healthy agri-food system; and (iii) economic participation and social inclusion. Beyond and across these three impact areas, the portfolio seeks to contribute to the universal themes of (i) climate change adaptation and mitigation and (ii) gender equality and social inclusion in the food sector.

SNV's food sector portfolio is structured around 5 products and 23 product components, each product having specific impact indicators linked to the food sector, and global impact indicators linked to one or more sustainable development goals (SDGs). Products and product components are used as building blocks to design and implement projects and programmes addressing specific development goals. While the definition of SNV's products and product components generally do not have a clear digital angle, most of them can greatly and directly benefit from digitalisation and D4Ag technologies and solutions.

Figure 15: SNV's food sector products and product components[19]

Food Sector Products	Product Components
Productive and resilient food landscapes	Integrated landscape management, sustainable land and water use and ecosystem restoration
	Sustainable intensification of agriculture and regenerative agriculture
	Sustainable intensification of pastoralism and climate -positive practices in livestock and dairy
	(Digital) Climate adaptation products and services for small -scale producer resilience
	Strong institutions and multi -stakeholder platforms
Inclusive agri-food markets and green investments	Market development of climate smart and nutrition sensitive products and services
	Social and environmental safeguards for food production and nutrition
	Scaling public and private finance to narrow the adaptation gap
	Enabling Environment for climate -smart, inclusive and nutrition-sensitive market development and investment
Youth employment and entrepreneurship	Individual and organisational capacity development (Push)
	Fund management and blended finance (Match)
	Market systems development (Pull)
	Governance/ institutional strengthening (Enable)
Healthy Diets for All	Consumption of nutritious diets
	Improved nutritious food distribution and access
	Nutritious food product development & quality assurance
	Nutrition sensitive production
	Nutrition governance for a sustainable healthy food system
Resilience of Food, Water and Energy systems in fragile and remote rural settings	Strengthened food, energy and water systems in fragile and remote settings.
	Resilient livelihoods in remote and fragile contexts
	Conflict prevention and management of land tenure and natural resources.
	Raised government accountability and a strengthened social contract
	Increased voice of economically or socially excluded groups

III.2 Relevant assets

SNV benefits from four main assets when leveraging D4Ag and contributing to the D4Ag ecosystem. Each of these assets is defined along with its relevance for the D4Ag context.

[19] Source: SNV, *Agri-food strategy*, 2022

a. Extensive and trustful network of partners with a strong experience building PPPs

ASSET

SNV benefits from an extensive and trustful network internationally as well as in-country. This network is also diverse and made of actors from the public, private, and international development sectors. With that network, SNV also gained experience setting up formal and sustainable partnerships at scale in the agriculture sector with both the public and the private sectors, including through PPPs.

RELEVANCE IN D4AG

Successfully leveraging D4Ag solutions and supporting the D4Ag ecosystem usually requires a wide range of capabilities calling for a consortium and partnership approach. This is even more the case for organisations willing to go into implementation and address structural barriers of the D4Ag ecosystem. In LMICs, a D4Ag project directly engaging and benefiting farmers, SMEs and consumers would very often require the involvement of (i) the public sector at national and sub-national levels, (ii) D4Ag vendors, (iii) infrastructure providers (e.g., telecom operator), (iv) association of farmers (e.g., cooperatives) and extension workers, and (v) key commercial agri-food system stakeholders (e.g., input providers, aggregators, processors, distributors and vendors) ready to cover part of the operating costs incurred in the D4Ag operations. Through its network and long-term experience designing and building partnerships (including PPPs), SNV is well positioned to (i) support public actors in joining forces with the private sector and (ii) complement its capabilities with the ones of its current and potential partners to successfully take part in the D4Ag ecosystem.

b. On-the-ground presence

ASSET

SNV represents more than 1300 staff across 24 countries with most of them directly interacting with the targeted smallholder farmers, consumers, and other agri-food system stakeholders. On top of its network of employees, SNV also enjoys a wide range of partners having their own teams of agents and extension officers.

RELEVANCE IN D4AG

In rural LMICs, the deployment of D4Ag solutions is facing key challenges, including but not restricted to (i) accessibility and availability of technology, (ii) digital literacy, and (iii) awareness, trust, and behaviour change. To best embrace these challenges in D4Ag initiatives, an extensive on-the-ground presence is required. Among others, agents, vendors and extension officers can help to (i) bridge the technology access gap (e.g., by delivering the D4Ag solution with own devices), (ii) build capacity among communities to help them use the D4Ag solutions, and (iii) raise awareness and create trust in the new services offered. Finally, the on-the-ground presence also plays a critical role in ensuring the customer feedback loop which is critical to monitor and improve the D4Ag solutions on a continuous basis.

c. Breadth and depth of experience in agri-food systems

ASSET

SNV has a long-standing experience working in and transforming agri-food systems in LMICs with country-specific expertise (i) across the four types of value chains (i.e., crops, livestock, fisheries, and forestry), (ii) from pre-production to consumption, and (iii) working directly with a wide range of agri-food system actors.

RELEVANCE IN D4AG

While the D4Ag sector is rapidly growing through the creation of start-ups with a strong digital technology expertise (e.g., in remote sensing, IoT, or blockchain), there is a clear gap in the D4Ag ecosystem when it comes to articulating that expertise with in-depth understanding of the diversity of agri-food systems' challenges and opportunities. Additionally, SNV's expertise – across all types of value chains from pre-production to consumption – uniquely positions the organisation to enable D4Ag solution providers to mature sustainable and scalable business and operating models which often requires a systemic approach.

d. Privileged access to Dutch D4Ag-related organisations as a way to start

ASSET

Established in the Netherlands, SNV has a privileged access to a network of Dutch organisations already active and known in the D4Ag sector in LMICs such as Netherlands Space Office, Wageningen University, and Rabo Foundation.

RELEVANCE IN D4AG

In order to quickly create trust and visibility in the D4Ag ecosystem in LMICs, SNV has the opportunity to start by building on what has already been done by organisations part of the Dutch international development community and sharing strong relationship with the Ministry of Foreign Affairs of the Netherlands (e.g., G4AW – Geodata for agriculture and water).

e. Existing experience in D4Ag

ASSET

Since 2015, SNV has gained experience in the D4Ag sector through the GARBAL digital service which was launched in Mali in 2017 (G4AW STAMP), then in Burkina Faso in 2019 (G4AW MODHEM), and scaled-up in Niger in 2022 (EKN IDAN).

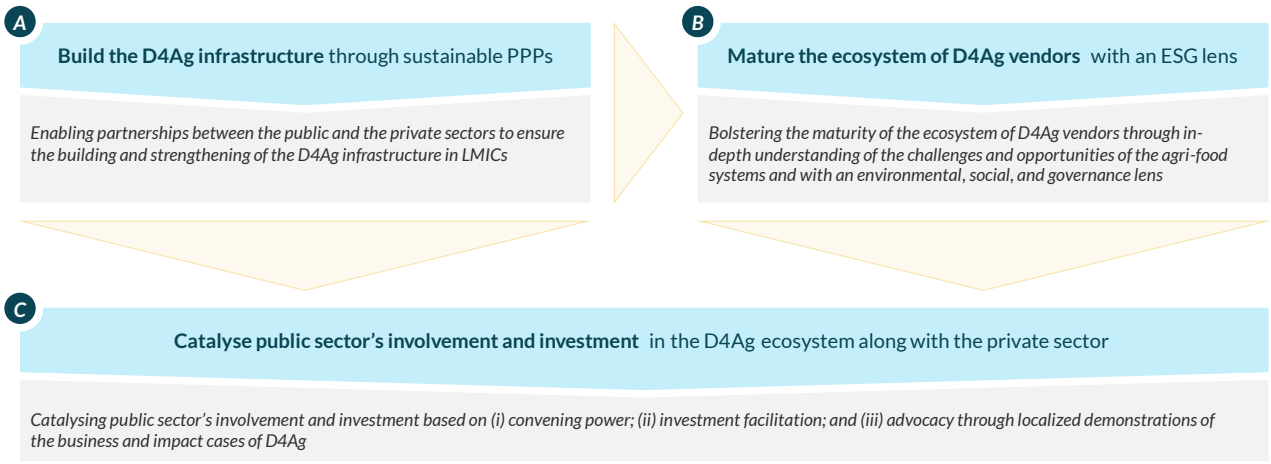
RELEVANCE IN D4AG

Through this initiative, SNV has demonstrated its ability to successfully design, develop, deploy, and scale up D4Ag solutions. Additionally, highly transferrable expertise was developed in terms of (i) partnering with telecom operators; (ii) remote sensing and geospatial data science; and (iii) digital service design, delivery, and bundling[20].

III.3 Value proposition

Three thematic areas and objectives have been identified for SNV's work in the D4Ag ecosystem based on (i) SNV's assets as well as (ii) the structural barriers in the D4Ag ecosystem identified by SNV. These objectives result in three categories of initiatives taken by SNV to strengthen the DA4g ecosystem.

Figure 16: Thematic areas and objectives for SNV's work in the D4Ag ecosystem



a. Build the D4Ag infrastructure through sustainable PPPs

Through its trusted network of international and in-country organisations as well as its long-term experience designing and building partnerships at scale with both the public and the private sectors, SNV enables public-private partnerships (PPPs) aimed at strengthening the D4Ag infrastructure in LMICs. Beyond setting up the partnership, thanks to its on-the-ground presence SNV also plays a role in the piloting and early implementation of the D4Ag infrastructure (e.g., ag data hub, market observatory, soil and water data, weather monitoring and forecasting system; land and farmer registry, livestock surveillance system, fisheries monitoring and surveillance system, crop and forestry surveillance system).

b. Mature the ecosystem of D4Ag vendors with an ESG lens

Through its in-depth understanding of the challenges and opportunities of the agri-food systems, SNV enables D4Ag vendors to identify and refine scalable and sustainable models and approaches through activities such as (i) support to knowledge transfer initiatives as well as collaboration and incubation platforms; (ii) development of knowledge materials promoting the right innovations and advocating for a shared and coordinated vision of the D4Ag ecosystem; and (iii) facilitation of partnerships with the public sector. Beyond helping the vendors mature their business and operating models, SNV leverages an Environmental, Social, and Governance (ESG) lens to maintain alignment between its work with the D4Ag vendors and its core values and objectives.

[20] Note: The GARBAL service bundled digital advisory, financial access, and market linkage services delivered to farmers and pastoralists for a modest cost via SMS, airtime, and mobile data.

Depending on the level of maturity of the local D4Ag ecosystem, before contributing to maturing of D4Ag vendors, SNV first enables the building of the D4Ag infrastructure (see section III.3.a).

c. Catalyse public sector's involvement and investment in the D4Ag ecosystem along with the private sector

Given the fragility of the context in which SNV evolves, the public sector plays a critical role in building the early foundation required to enable successful D4Ag use cases. Depending on the needs and the level of digital readiness of the context, the private sector is also engaged to complement potential capacity gaps and provide growth opportunities[21].

Based on localized demonstrations of the business and impact cases of D4Ag from its experience in building D4Ag infrastructure (see section III.3.a) and driving the maturing of D4Ag use cases (see section III.3.b), SNV convenes and partner with the public sector to create buy-in and catalyse its involvement and investment in the D4Ag ecosystem, especially at the level of the D4Ag enabling environment. Along with the local public sector, SNV also convenes key stakeholders such as (i) large donors and investors (e.g., World Bank, Bill and Melinda Gates Foundation, Acumen), (ii) private sector actors required to strengthen the D4Ag infrastructure and D4Ag enabling environment (e.g., local mobile network operator, international cloud service provider), and (iii) representatives from other countries more advanced in the building of their D4Ag Infrastructure and strengthening of their D4Ag enabling environment.

[21] Note: Refer to *IV.4.e – Adopt a readiness and fragility lens* for more details on how to operate D4Ag initiatives according to the level of maturity of the context

IV RECOMMENDATIONS

To best position itself in the D4Ag ecosystem, SNV takes a threefold approach including: (i) the delivery of its value proposition anchored on three types of initiatives, (ii) the mainstreaming of D4Ag solutions across its food sector products, and (iii) the integration of ten key principles for success in its work in leveraging D4Ag solutions and strengthening the D4Ag ecosystem.

IV.1 Evaluation of D4Ag interventions

To deliver its value proposition, mainstream D4Ag solutions in its food sector portfolio, and integrate key principles for success, SNV can combine several D4Ag interventions. Four evaluation criteria are used to surface the best set of D4Ag interventions maximising (i) additionality, (ii) financeability, (iii) impact, and (iv) alignment with SNV's food sector portfolio.

Figure 17: Intervention prioritization criteria

1	**Additionality of the intervention**	How does the intervention address D4Ag ecosystem key issues/ pain points and provide additionality relative to available solutions?
2	**Ability to secure funding and investment**	How likely is this opportunity to secure funding/ align with key funder and investor interests?
3	**Potential for sustainable impact**	Does the intervention have potential for continued impact on the D4Ag ecosystem and more broadly along the SDG even after the support period?
4	**Alignment with SNV's food sector portfolio**	How is SNV's food sector portfolio best positioned to pursue and support the intervention, given its positioning and capabilities?

The result of the evaluation shows a high potential for SNV to intervene across the five categories of interventions. The recommendations in this strategy (especially the list of *focus interventions for SNV*) are prioritizing interventions that obtained an average score between moderate and high across the four evaluation criteria. This leads to a focus on interventions evaluated as moderately or highly additional, fundable, impactful, and aligned with SNV.

Figure 18: Evaluation of the D4Ag interventions based on the prioritization criteria

Key: Low Moderate High

	Categories	Interventions	Evaluation criteria: Additionality	Fundability	Impact	Alignment
GLOBAL	Thought leadership	01. Assessing ecosystem readiness across LMICs				
		02. Articulating business & impact cases, including MEL data collection				
	Ecosystem management	03. Mapping champions & flagship use cases				
		04. Matchmaking & partnerships facilitation, including PPPs				
		05. Facilitating knowledge transfers				
	Technical assistance of the public sector	06. Building capacity in public institutions				
		07. Supporting the creation of an integrated D4Ag infrastructure				
		08. Shaping the regulatory environment				
	Financing with innovative and inclusive finance	**09. Enabling public investment in the D4Ag ecosystem**				
		10. Catalysing financing for successful commercial models				
		11. Providing grants to D4Ag entrepreneurs				
LOCAL	Value chain and food system integration	**12. Shaping market demand for D4Ag services and products, including at the SHF level**				
		13. Supporting the roll out and scale up of D4Ag services and products				
		14. Digitizing and building capacity around key agricultural operations				

IV.2 Delivery of SNV's value proposition in D4Ag

This section details how SNV can deliver its value proposition by identifying focus interventions as well as potential partners for each anchor thematic area and objective of the value proposition. A summary of the recommendations is available in the next figure.

Figure 19: Summary of interventions per category of intervention and value proposition thematic area

D4Ag intervention categories	Value proposition		
	Build the D4Ag infrastructure through sustainable PPPs	*Mature the ecosystem of D4Ag vendors with an ESG lens*	*Catalyse public sector's involvement and investment in the D4Ag ecosystem*
Thought leadership	• Advocate for the importance of building the D4Ag infrastructure with local key institutions • Build evidence on the impact and business cases of building and strengthening the local D4Ag infrastructure	• Help highlight the opportunities and demonstrate the level of readiness and maturity of the D4Ag enabling environment and D4Ag infrastructure • Generate new or disseminate existing knowledge materials for D4Ag vendors • Advocate for, among others, (i) the bundling of D4Ag use cases; (ii) the expansion of D4Ag vendors operating in neighbouring countries; and (iii) the integration of advanced technologies	• Based on SNV's experience of supporting the maturing of D4Ag use cases and development of elements of D4Ag infrastructure, demonstrate the need for and impact and cost of investing in the overall D4Ag enabling environment (beyond agriculture) and D4Ag infrastructure to the right stakeholders from the public sector

Ecosystem management	• Facilitate the partnership between local public institution(s) and infrastructure service providers
	• Connect the local public institution(s) with other public institutions having led D4Ag infrastructure projects in the region
	• Support the local public institution(s) in identifying long-term technical partners
	• Facilitate the connection between the local public institution(s) and funders active in the financing of D4Ag infrastructure
	• Ensure coordination and integration with existing D4Ag infrastructure initiatives
		• Support the public sector in mapping the existing D4Ag vendors
		• Facilitate partnerships between the public sector and D4Ag vendors to help them mature their business and operating models
		• Support the creation of national or regional incubators and accelerators coaching D4Ag vendors and young start-ups
			• Convene key representatives from the public sector with
			  ○ D4Ag vendors having successfully worked with or benefited from SNV
			  ○ Organisations having successfully worked with SNV to build D4Ag public goods and strengthen the local D4Ag infrastructure
			  ○ Donors and funders having supported SNV's work in the D4Ag ecosystem
			  ○ Representatives from other countries more advanced
			  ○ D4Ag experts to help facilitate the above interventions

Technical assistance to the public sector	• Provide guidance on what is most needed in terms of D4Ag infrastructure
	• Support the local public institution(s) in preparing for the digital transformation required to successfully design, develop, and implement the D4Ag infrastructure
	• Identify private sector actors (e.g., large agribusinesses) who would be potentially ready to co-finance the building of D4Ag public goods
		• Facilitate the capacity building of the workforce of the future who will have to increasingly engage with D4Ag vendors and technologies
		• Support the public sector in their PPPs with D4Ag vendors
		• Enable the digitalisation of the network of extension officers and field agents
			• With SNV's internal D4Ag experts and the support of external experts, provide technical assistance by
			  ○ Helping the designated public institution(s) to build internal capacity by setting up dedicated teams, recruiting talents, and securing budget which can be allocated to these teams
			  ○ Seconding or placing experts who can help the designated public institution(s) navigate the aforementioned activities[22]

Financing with innovative and inclusive finance	• Support the local public institution(s) in formulating the long-term business plan which will support the D4Ag infrastructure from design to maintenance and scale up • Help the public institution(s) in identifying avenues to co-finance the infrastructure with a funder or a group of funders • Investigate avenues to monetize part of the services eventually delivered by the D4Ag infrastructure	• Support young D4Ag vendors with high-impact models to tap into existing grant funding programs already implemented by other funders • Facilitate the connection between more mature D4Ag vendors with high-impact models to access impact investment • Help public private partnerships with D4Ag vendors to engage with donors and impact investors	• Beyond supporting the designated public institutions in reaching out to the right funders and donors, help the public sector to clearly formulate the (i) needs and challenges in terms of the overall D4Ag enabling environment and D4Ag infrastructure, (ii) the potential solutions, and (iii) their associated impact and cost • Help local D4Ag champions from the public sector to identify internal public budget which could be allocated to D4Ag interventions
Value chain and agri-food system integration	• Facilitate the adoption of the infrastructure after deployment through on-the-ground efforts • Support the local public institution(s) in measuring the adoption and impact of the D4Ag infrastructure to ensure continuous improvement	• Support the digitalisation of impactful agribusinesses and farmer organisations • Through extensive on-the-ground presence, advocate for impactful D4Ag vendors among communities of producers and consumers • Drive efforts of quantitative and qualitative data collection from smallholder farmers and consumers and other VC actors	• Support the public sector in the formulation of D4Ag laws and regulations by ensuring an integration of needs, challenges, and opportunities identified on the ground by SNV • Assist the Ministry of Agriculture (or equivalent) to build the capacity of its extension officers in D4Ag • Help the public sector demonstrate the impact of its interventions in the D4Ag ecosystem by sharing relevant data from SNV's activities

[22] Note: Interventions listed in *Technical assistance to the public sector* in the two other value proposition thematic areas are also relevant here.

a. Build the D4Ag infrastructure through sustainable PPPs

CONTEXT

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. 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, calling for public sector-led efforts to build the appropriate digital public goods. A robust D4Ag infrastructure layer includes, among other items[23]:

Ag data hub – *Centralizes and harmonizes all the crop, fisheries, livestock, nutrition, food and food safety data owned by the public sector in order to make it digitally accessible to a wide range of users including D4Ag vendors, public institutions, and value chains actors*

Market observatory – *Produces reliable and timely information on crop, fisheries, and livestock production as well as consumer insights, nutrition/diets analytics and food market prices to provide useful information to decision makers, D4Ag vendors, and value chain actors in understanding food and nutrition security, market trends, and addressing food price volatility*

Soil and water data – *Ensures availability of soil and water data with national coverage, granularity, and timeliness thanks to data collection campaigns as well as soil and water analysis laboratories*

Weather monitoring and forecasting system – *Ensures availability of timely, granular, and high-quality weather information with accurate weather forecasting including marine weather forecasting where appropriate*

Land and farmer registry – *Enables the documentation of farmland data (e.g., farmers registration, land sizes, machinery, status of land, etc.) and socio-economic data (e.g., farmer education, age, income, gender, disability, etc.) to facilitate sustainable use of land resources while maintaining the rights of smallholder farmers*

Livestock surveillance system – *Enables monitoring of livestock identities, age, movements, yields, health and safety throughout the country*

Fisheries monitoring, control, and surveillance system – *Enables the government to efficiently monitor fisheries through tracking of vessels, fishermen, as well as their catches and sales*

Crop pests and diseases surveillance system – *Enables early detection of crop diseases and pests in order to quickly respond to emerging outbreaks, stabilize food supplies, and enhance food safety and nutrition security*

These public goods immediately impact side actors and eventually benefit smallholder farmers and consumers directly. A strong, coordinated effort – rather than one-off, small-scale efforts – by multiple actors is critical to the success of such initiatives[24].

In this context, through (i) its network and expertise in building large scale PPPs as well as (ii) its on-the-ground presence and in-depth understanding of the key constraints addressable with a strengthened D4Ag infrastructure, SNV can combine some of the following focus interventions – depending on the context – to support D4Ag ecosystems.

FOCUS INTERVENTIONS FOR SNV

- **Thought leadership**
    - Advocate for the importance of building the D4Ag infrastructure with key institutions such as Ministry of Agriculture, Agriculture Transformation Agency, National Statistical Office, Ministry of ICT, or equivalents

[23] Note: Each of these items is made of a combination of data (e.g., weather data), software (e.g., weather forecasting algorithm), and hardware (e.g., meteorological station).
[24] Source: CTA and Dalberg, *The Digitalization of African Agriculture*, 2019

- Build evidence on the impact and business cases of building and strengthening the D4Ag infrastructure based on existing initiatives in the country or in the region

- **Ecosystem management**
  - Facilitate the partnership between public institution(s) supposed to host and own the infrastructure and infrastructure service providers (e.g., telecom operator, cloud provider, meteorological infrastructure vendor)
  - Connect the public institution(s) supposed to host and own the infrastructure with other public institutions having led D4Ag infrastructure projects in the region
  - Support the public institution(s) supposed to host and own the infrastructure in identifying long-term technical partners to ensure the maintenance and management of the infrastructure and establishing partnerships with them
  - Facilitate the connection between the public institution(s) supposed to host and own the infrastructure and funders active in the financing of D4Ag infrastructure (e.g., World Bank, Bill and Melinda Gates Foundation, African Development Bank)
  - Ensure coordination and integration with existing D4Ag infrastructure initiatives to avoid duplication of effort, build synergies, and prevent credibility and trust issues across the D4Ag ecosystem
- **Technical assistance to the public sector**
  - Provide guidance on what is most needed in terms of D4Ag infrastructure in the country based on grounded experience across value chains
  - Support the public institution(s) supposed to host and own the infrastructure in preparing for the digital transformation required to successfully design, develop, and implement the D4Ag infrastructure, this includes among others having (i) the right tech-savvy leaders in place as well as a clear plan to build digital capacity internally; (ii) updated operating procedures; and (iii) a new work culture with a strong emphasis on innovation through iterative and incremental cycles
  - Identify private sector actors (e.g., large agribusinesses) who would be potentially ready to co-finance the building of D4Ag public goods
- **Financing with innovative and inclusive finance**
  - Support the public institution(s) supposed to host and own the infrastructure in formulating the long-term business plan which will support the D4Ag infrastructure from design to maintenance and scale up
  - Help the public institution(s) supposed to host and own the D4Ag infrastructure in identifying avenues to co-finance the infrastructure with a funder or a group of funders
  - Investigate avenues to monetize part of the services eventually delivered by the D4Ag infrastructure
- **Value chain and agri-food system integration**
  - Facilitate the adoption of the infrastructure after deployment through on-the-ground efforts such as marketing and behaviour change campaigns and capacity building initiatives with D4Ag vendors, network of extension officers, agri-businesses, consumer organisations.
  - Support the public institution(s) supposed to host and own the infrastructure in measuring the adoption and impact of the D4Ag infrastructure to ensure continuous improvement

POTENTIAL PARTNERS

Figure 20: Examples of potential partners of SNV in the building of a D4Ag infrastructure across the 5 categories of interventions

Interventions	Partners NOT EXHAUSTIVE
Thought leadership	GODAN Global Open Data for Agriculture & Nutrition; ODI open data institute; dial Digital Impact Alliance
Ecosystem management	GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT DATA; MERCY CORPS AGRIFIN; AGRA Growing Africa's Agriculture
Technical assistance to the public sector	iSDA AFRICA; Microsoft; CLS
Financing with innovative and inclusive finance	THE WORLD BANK; syngenta foundation for sustainable agriculture; Open Capital
Value chain and food system integration	bop inc; idh Farmfit; giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

b. Mature the ecosystem of D4Ag vendors with an ESG lens

CONTEXT

While it is becoming more and more achievable to design and develop digital solutions, including in the D4Ag space, only a small proportion of D4Ag vendors have succeeded to deploy their D4Ag solutions at scale in LMICs, especially among smallholder farmer communities and bottom of the pyramid (BoP) consumers. Maturing the business and operating models of D4Ag solutions usually requires an in-depth and comprehensive understanding of the agri-food systems as well as an extensive on-the-ground presence, which few D4Ag vendors possess. In this context, SNV enables D4Ag vendors to identify and refine scalable and sustainable models and approaches through activities such as (i) support to knowledge transfer initiatives as well as collaboration and incubation platforms; (ii) development of knowledge materials promoting the right innovations and advocating for a shared and coordinated vision of the D4Ag ecosystem; and (iii) facilitation of partnerships with the public sector. Additionally, there is an opportunity for SNV to integrating an environmental, social, and governance (ESG) lens to the deployment of D4Ag solutions to help them embracing challenges of agri-food systems with equity, sustainability, and inclusivity.

Based on the level of maturity and readiness of the D4Ag ecosystem in a given country, SNV might want to consider this category of interventions only after having supported the building of the D4Ag infrastructure (see section IV.2.a.).

FOCUS INTERVENTIONS FOR SNV

- **Thought leadership**
    - Help highlight the opportunities and demonstrate the level of readiness and maturity of the D4ag enabling environment and D4Ag infrastructure in countries that have historically attracted less investments and D4Ag vendors
    - Generate new or disseminate existing knowledge materials for D4Ag vendors identifying how to (i) launch and operate a D4Ag business in a given country; (ii) mature its business and operating model depending on the country, value chain, targeted users; (ii) target less-served segments, especially women and other marginalised segments; and (iii) monitor, evaluate, and demonstrate impact among less-served communities
    - Advocate for, among others, (i) the bundling of D4Ag use cases through the establishment of super platforms led by an agribusiness, a bank, a telecom operator, or the public sector eventually linked with platforms beyond agriculture (e.g., health, water supply, sanitation, etc.); (ii) the expansion of D4Ag vendors operating in neighbouring countries; and (iii) the integration of advanced technologies (e.g., remote sensing, machine learning, blockchain)[25]
- **Ecosystem management**
    - Support the public sector in mapping the existing D4Ag vendors along with their value proposition, pricing model, outreach, and impact on urban and rural communities across the country
    - Based on a clear understanding of the D4Ag vendors operating in a given country, facilitate partnerships between the public sector and these vendors to help them mature their business and operating models
    - Support the creation of national or regional incubators and accelerators coaching D4Ag vendors and young start-ups
- **Technical assistance to the public sector**

[25] Note: Refer to *IV.4. – Ten principles for SNV's success in D4Ag* for a more exhaustive list of potential areas for advocacy with D4Ag vendors

- Facilitate the capacity building of the workforce of the future who will have to increasingly engage with D4Ag vendors and technologies
- Support the public sector in their PPPs with D4Ag vendors from the design and establishment of the partnerships to the deployment of the related D4Ag use cases, the monitoring and evaluation of the partnerships, and their potential scale up
- Enable the digitalisation of the network of extension officers and field agents from the Ministry of Agriculture (or equivalent)

- **Financing with innovative and inclusive finance**
  - Support young D4Ag vendors with high-impact models to tap into existing grant funding programs already implemented by other funders (e.g., CGIAR Inspire Challenge, GSMA AgriTech Innovation Fund, Grand Challenges)
  - Facilitate the connection between more mature D4Ag vendors with high-impact models to access impact investment (e.g., Omnivore, Root Capital, Acumen)
  - Help public private partnerships with D4Ag vendors to engage with donors and impact investors, and ensure the incorporation of impact metrics related to marginalised segments in the monitoring and evaluation of the partnership

- **Value chain and food system integration**
  - Support the digitalisation of impactful agribusinesses and farmer organisations to help them increase their reach and efficiency as well as access to D4Ag use cases
  - Through extensive on-the-ground presence, advocate for impactful D4Ag vendors among communities of producers and consumers
  - Drive efforts of quantitative and qualitative data collection from smallholder farmers and consumers and other VC actors to help understand their needs and challenges related to the D4Ag ecosystem eventually helping the D4Ag vendors to mature their business and operating models

POTENTIAL PARTNERS

Figure 21: Examples of potential partners of SNV in the maturing of the ecosystem of D4Ag vendors across the 5 categories of interventions

Interventions	Partners NOT EXHAUSTIVE
Thought leadership	Mercy Corps AGRIFIN; ISF; Principles for Digital Development
Ecosystem management	CGIAR Platform for Big Data in Agriculture; Digital Agri Hub; The World Bank
Technical assistance	bop inc; proximity;
Financing with innovative and inclusive finance	Acumen; root capital; GSMA
Value chain and food system integration	Digital Green; One Acre Fund; viamo

c. Catalyse public sector's involvement and investment in the D4Ag ecosystem along with the private sector

CONTEXT

It is clear that the D4Ag ecosystem requires a strong involvement from the public sector in order to reach its full potential while remaining inclusive, equitable, and sustainable. Concrete areas of interventions for the public sector include:

- The development of a regulatory framework promoting innovation and investment and supporting entrepreneurship, including at the intersection of digital and agriculture
- The establishment of clear laws, guidelines, social contracts, etc. to enable data protection and governance and foster data sovereignty

- The building, engaging, and relating of the overall D4Ag enabling environment beyond agriculture which often calls for the creation of public goods managed by the public sector to enable D4Ag infrastructure and use cases, especially for less-served segments

However, today only few countries in LMICs benefit from a strong involvement from the public sector in the D4Ag ecosystem. In this context, SNV can use a bottom-up approach to leverage learnings and experience from its D4Ag infrastructure interventions (see section IV.2.a.) as well as with D4Ag vendors (see section IV.2.b.) to build buy-in from the public sector and catalyse its involvement and investment in the D4Ag ecosystem.

FOCUS INTERVENTIONS FOR SNV

- **Thought leadership**
    - Based on SNV's experience of supporting the maturing of D4Ag use cases and development of elements of D4Ag infrastructure, demonstrate the need for and impact and cost of investing in the overall D4Ag enabling environment (beyond agriculture) and D4Ag infrastructure to the right stakeholders from the public sector
- **Ecosystem management**
    - Convene key representatives from the public sector with
        - D4Ag vendors having successfully worked with or benefited from SNV to help the public sector (i) better understand their model and impact and (ii) investigate potential avenues for partnership
        - Organisations having successfully worked with SNV to build D4Ag public goods and strengthen the D4Ag infrastructure to help the public sector better understand (i) how to build the D4Ag infrastructure, (ii) the role they can play in building and managing the D4Ag infrastructure, (iii) the types of partnerships and resources required
        - Donors and funders having supported SNV's work in the D4Ag ecosystem to catalyse potential funding partnership to enable the public sector to (i) take over the management of the D4Ag public goods created, (ii) continue building the rest of the D4Ag infrastructure, and (iii) develop both a conducive innovation and investment regulatory framework as well as data protection and governance laws and enforcement mechanisms
        - Representatives from other countries more advanced in the building of their D4Ag infrastructure and strengthening of their D4Ag enabling environment
        - D4Ag experts to help facilitate the above interventions by technically assisting the public sector (see below)
- **Technical assistance to the public sector**
    - With SNV's internal D4Ag experts and the support of external experts, provide technical assistance by
        - Helping the designated public institution(s) to build internal capacity by setting up dedicated teams, recruiting talents, and securing budget which can be allocated to these teams
        - Seconding or placing experts who can help the designated public institution(s) navigate the aforementioned activities
- **Financing with innovative and inclusive finance**[26]
    - Beyond supporting the designated public institutions in reaching out to the right funders and donors, help the public sector to clearly formulate the (i) needs and challenges in terms of the overall D4Ag enabling environment and D4Ag infrastructure, (ii) the potential solutions, and (iii) their associated impact and cost
    - Help D4Ag champions from the public sector to identify internal public budget which could be allocated to D4Ag interventions
- **Value chain and food system integration**
    - Support the public sector in the formulation of D4Ag laws and regulations by ensuring an integration of needs, challenges, and opportunities identified on the ground by SNV
    - Assist the Ministry of Agriculture (or equivalent) to build the capacity of its extension officers in D4Ag

[26] Note: Interventions listed in *Technical assistance to the public sector* in the two previous sections of this chapter (i.e., IV.2.a and IV.2.b) are also relevant here.

- Help the public sector demonstrate the impact of its interventions in the D4Ag ecosystem by sharing relevant data from SNV's activities in the agri-food systems

POTENTIAL PARTNERS

Figure 22: Examples of potential partners of SNV in the catalysing of public sector's involvement across the 5 categories of interventions

IV.3 Mainstreaming D4Ag interventions in SNV's food sector products[27]

While the previous section (i.e., *IV.2 – Delivery of SNV's value proposition in D4Ag*) illustrates the interventions SNV puts in place within each thematic area, this section highlights what could be the results of the intersection between a thematic area and a product. Therefore, the intersections between the products and :

- **Build the D4Ag infrastructure through sustainable PPPs** thematic area present the elements of D4Ag infrastructure to consider in each product
- **Mature the ecosystem of D4Ag vendors with an ESG lens** thematic area present the D4Ag use cases to consider in each product
- **Catalyse public sector's involvement and investment in the D4Ag ecosystem** thematic area present the elements of D4Ag enabling environment to consider in each product[28]

[27] Note: Recommendations on how to leverage D4Ag use cases in each food sector product component are provided in Annexes.
[28] Note: This thematic area also concerns the D4Ag infrastructure (as the public sector usually invests in both the D4Ag infrastructure and the D4Ag enabling environment) but only the D4Ag enabling environment was considered to avoid duplication with the first thematic area.

Figure 23: Recommendations per food sector product and value proposition thematic area

Agri-food sector products	Value proposition		
	Build the D4Ag infrastructure through sustainable PPPs	*Mature the ecosystem of D4Ag vendors with an ESG lens*	*Catalyse public sector's involvement and investment in the D4Ag ecosystem*
Productive and resilient food landscapes	Consider the following elements of D4Ag infrastructure: • Weather monitoring and forecasting system (including network of weather stations and forecasting software) • Soil and water data collected with granularity and timeliness and openly disseminated and integrated in food landscape management decision making • Ag data demonstrating the long-term business and impact cases of sustainable intensification and regenerative agriculture • Land and farmer registry that enables the documentation of farmland data (e.g., farmers registration, land sizes, machinery, status of land, etc.) and socio-economic data (e.g., farmer education, age, income, gender, disability, etc.) to facilitate sustainable use of land resources while maintaining the rights of smallholder farmers	Consider the following D4Ag use cases: • **Advisory services** such as (i) timely climate smart agriculture training, information, and advice; (ii) early warning advisory • **Financial access** such as (i) input, harvest, and climate smart credit; (ii) mobile saving as a safety-net against climate shocks; (iii) weather-based insurance; (iv) financial incentives for regenerative ag; (v) carbon market services • **Macro-agri intelligence** such as timely and granular agricultural datasets, combined with meteorological data • **Market linkage** such as (i) linking agro dealers to farmers enables farmers to have access to the right inputs at the right time; (ii) digital marketplaces linking SHFs to buyers and targeted consumers • **Supply chain management** such as (i) track and trace systems • **Smart farming** such as (i) digital farm machinery solutions; (ii) smart monitors; (iii) digital soil tests	Consider the following elements of D4Ag enabling environment: • Organisations such as Ministries of Agriculture and national statistical offices (NSO) with high quality statistics, granular and timely through combination with non-traditional data sources (e.g., telecom data, satellite images, IoT data) • National Meteorological Agency (or equivalent) that brings together key stakeholders who usually need weather information or own infrastructure useful for weather monitoring such as large agribusinesses, airports, agriculture research centres, universities, and telecom operators • Climate and nutrition-focused policies and regulatory frameworks • National landscape restoration strategy
Inclusive agri-food markets and green investments	Consider the following elements of D4Ag infrastructure: • Market observatory with granular and timely data collected on what is produced and how including data points such as (i) production volumes across crops and varieties; (ii) volumes of import and export; (iii) inputs used; (iv) commodity prices; (v) levels of income and employment from smallholder subsistence farmer to large scale producer; (vi) investments in the agriculture sector, especially investments enhancing agri-food system resilience while reducing GHG emissions	Consider the following D4Ag use cases: • **Advisory services** to raise awareness about climate smart and nutrition sensitive products and services • **Digital market linkage** platforms to facilitate access to climate smart and nutrition sensitive products and services, especially in the most rural areas and linking SHFs to buyers and targeted consumers increasing the efficiency of sales to several different markets, strengthening their resilience, and ultimately diets and income • **Financial access** to enable the purchase of expensive equipment building climate resilience (e.g., solar water pump) • **Supply chain management** to enable the adoption and deployment at scale of standards and certifications for agri-food products and consumer safety	Consider the following elements of D4Ag enabling environment: • Public financial incentives to adopt climate and nutrition-focused practices along the agricultural value chains • Market standards for good agricultural practices • Food system policies aiming at enhancing agri-food system resilience while reducing GHG emissions and other environmental externalities
Youth employment and entrepreneurship	Consider the following elements of D4Ag infrastructure: • Market observatory with a strong focus on the labour market related to the agri-food system including jobs and employment data points disaggregated by age, gender, geography, income level, level of education, etc.	Consider the following D4Ag use cases: • **Advisory services** used for capacity building in rural areas in terms of farming good practices, digital literacy, rural entrepreneurship (including the transition from subsistence to commercial farming and the formalization of a business in the agriculture sector), etc. • **Financial access** services to increase financial inclusion, especially among the less-served segments with innovative credit scoring, co-financing with the public sector, subsidy programs, etc.	Consider the following element of D4Ag enabling environment: • Public financial incentives to recruit and work with young men and women • Policies and regulations aimed at supporting young men and women in their journey in the labour market • Technical and Vocational Education and Training programs, including in the rural areas to foster employment among young men and women
Healthy Diets for All	Consider the following elements of D4Ag infrastructure: • Labs to conduct research and analysis on the nutritional properties of the food that is produced and imported • Market observatory with a strong focus on the downstream part of the agricultural value chains where the food consumption patterns can be observed including the nature and quantities of the food consumed along with its availability, access, and utilisation	Consider the following D4Ag use cases: • **Consumer advisory services** providing information and recommendations to consumers on nutrition and food consumption patterns and best practices • **Macro food and nutrition intelligence** providing support tools that integrate data on consumers as well as food and nutrition • **Digital food marketplaces** connecting consumers to producers or retailers including hyperlocal platforms facilitating direct sales between farmers and producers	Consider the following elements of D4Ag enabling environment: • Legislation, certification, and codes of conduct promoting responsible production and distribution of food (e.g., food quality and food safety standards) • Public financial incentives to produce and distribute nutrition sensitive food • Regulations for the public and private education systems to ensure healthy diets at school
Resilience of Food, Water and Energy systems in fragile and remote rural settings	Consider the following elements of D4Ag infrastructure: • Early warning system combining food and nutrition insights, weather data, and crop pest and disease data, as well as livestock surveillance data • Soil and water data combining both remote sensing and manually collected data	Consider the following D4Ag use cases: • **Advisory services** available through feature phone with USSD, SMS, or IVR-based solutions and designed for both farmers and pastoralists in local languages • **Market linkage** used by humanitarian organisations to connect with producers, distributors, and communities requiring assistance	Consider the following elements of D4Ag enabling environment: • Mobile connectivity even in the most rural areas • Land tenure and property right rules and institutions ensuring legitimacy, equity, economic efficiency, as well as environmental sustainability

IV.4 Ten key principles for SNV's success in D4Ag

In this section, key principles for SNV's success in D4Ag are presented. These principles are transversal and aim at guiding SNV on both how to deliver on its value proposition in D4Ag (see section IV.2.), as well as how to mainstream D4Ag solutions in SNV's agri-food products (see Annex VI.1).

Figure 24: Overview of key principles for SNV's success in D4Ag

a. Mainstream D4Ag across SNV's food sector portfolio

As presented in the previous section, beyond supporting the D4Ag ecosystem, SNV also has the opportunity to integrate D4Ag use cases and solutions in the delivery of its agri-food products. While such mainstreaming should directly help SNV to enhance its impact through its agri-food products (e.g., by increasing their scale and efficiency), it should also help SNV build capacity internally to improve the delivery of its value proposition in the D4Ag ecosystem. Refer to Annex IV.1 for more details on how to leverage D4Ag use cases and solutions across SNV's food sector product components.

b. Start by building on what already exists, especially in the Dutch D4Ag ecosystem

With actors such as Ministry of Foreign Affairs, Rabo Foundation, Solidaridad, Netherlands Space Office, and Wageningen University & Research, the ecosystem of Dutch actors supporting the D4Ag sector in LMICs is unique and particularly developed in the area of geographical data with projects such as G4AW (Geodata for Agriculture and Water). Given its location and tight connection with Dutch donors (Dutch Embassies and Directorate-General for International Cooperation representing about 50% of its revenue), SNV could start its journey in the D4Ag sector by building on what has already been achieved and learned by its peers and potentially playing a convening role with these actors. Beyond avoiding duplication of efforts, this approach appears to be a low hanging fruit when it comes to build credibility in the D4Ag sector, with both beneficiaries and donors.

c. Be intentional with the marketing, awareness raising, and trust building

Given the low levels of awareness and trust in new technologies, especially among underserved communities who are less exposed to the transformation of the agriculture sector, successfully deploying D4Ag solutions require heavy investments in terms of go-to-market. While marketing campaigns through radio and SMS are common in rural LMICs and benefit from a large and efficient outreach, hybrid 'digital + human' marketing approaches tend to be required, especially to launch a new service of product.

RECOMMENDATIONS

- Partner with radios and telecom operators for marketing campaigns
- Closely monitor and evaluate the campaigns to best tailor them to the local context
- Partner with actors (from the public and/or the private sectors) who manage a large field force to leverage their agents and officers for the on-the-ground promotion of new D4Ag products or services
- Design marketing campaigns in local languages

d. Leverage human-centred design and be demand driven

Thanks to its extensive on-the-ground presence and exposure to consumers, producers and SMEs, SNV has the opportunity to leverage D4Ag solutions and support the D4Ag ecosystem from the perspective of the final beneficiaries.

RECOMMENDATIONS

- Extensively engage consumers, producers and SMEs in the building of D4Ag solutions from the design to the implementation and evaluation in order to ensure alignment with their needs, challenges, opportunities, and broader context in which they live
- In the conceptualisation of D4Ag solution, map the diversity of the targeted users in terms of gender, age, income, mother tongue, access to internet and digital technologies, digital literacy, size of the farms and main crops, etc.
- Consider the following resources:
  - <Dalberg – What is human-centred design: introduction and primers>
  - <IDEO – The field guide to human-centred design>
  - <GSMA – mAgri Design Toolkit, User centred design for mobile agriculture>

e. Adopt a readiness and fragility lens

The applicability and scalability of D4Ag interventions will highly depend on multiple factors including among others (i) the availability and affordability of mobile internet, (ii) the digital literacy, (iii) the awareness of and trust in D4Ag solutions, (iv) the level of maturity of the regulatory environment, and (v) the level of organisation of the targeted value chain(s). Additionally, the types of partnership models and investments required by and suited to a country will evolve based on its digital readiness.

Figure 25: Preliminary investment typology for D4Ag [29]

	DIGITAL READINESS STAGE		
	Activate	**Accelerate**	**Amplify**
Dominant partnership models	• Public- and donor-lead programs • CSO-led initiatives	• Public-led PPPs and private-led PPPs if more advanced • CSO-led initiatives • Public- and donor-led programs	• Private sector with public oversight • Private sector coopetition
D4Ag investment examples	• Hard and soft infrastructure • Focused services • Data policy reform • Budgetary reform for D4Ag	• Piloting innovative digital solutions • Scaling digital bundled services • Venture capital investments • D4Ag start-up investments • Expansion of infrastructure	• High-tech digital solutions • Global services • D4Ag for transformative system shifts
Example SNV countries	• Niger, Mali, Burkina Faso	• Kenya, Bangladesh, Zambia,	• Indonesia

RECOMMENDATIONS

- Before engaging in the D4Ag ecosystem, start by assessing the level of readiness and fragility (see D4Ag ecosystem readiness toolkit in Annexes)
- In the most fragile contexts, consider (i) partnering with humanitarian actors, (ii) favouring D4Ag solutions available offline, (iii) working with SMEs and farmer organisations and extension officers rather than with farmers directly, (iv) focusing on building the D4Ag infrastructure rather than delivering farmer-facing services
- Consider the following resources:
  - <FAO – Status of digital agriculture in 47 sub-Saharan African countries>
  - <AfDB – Digital Agriculture Country Profiles>
  - <D4Ag ecosystem readiness toolkit (see Annexes)>

f. Clearly define KPIs and monitor and evaluate results

Monitoring, evaluation, and learning (MEL) practices are critical to both (i) improve current and future D4Ag solutions and (ii) generate public and private sectors' involvement and investment in the D4Ag ecosystem. Given the incremental nature of the impact of D4Ag, it is usually hard to measure and single out, especially in the agriculture context where the baseline conditions significantly vary over time.

[29] Source: Adapted from *A Blueprint for Digital Climate-Informed Advisory Services: Building the Resilience of 300 Million Small-Scale Producers by 2030*, by Global Commission on Adaptation, 2021

RECOMMENDATIONS

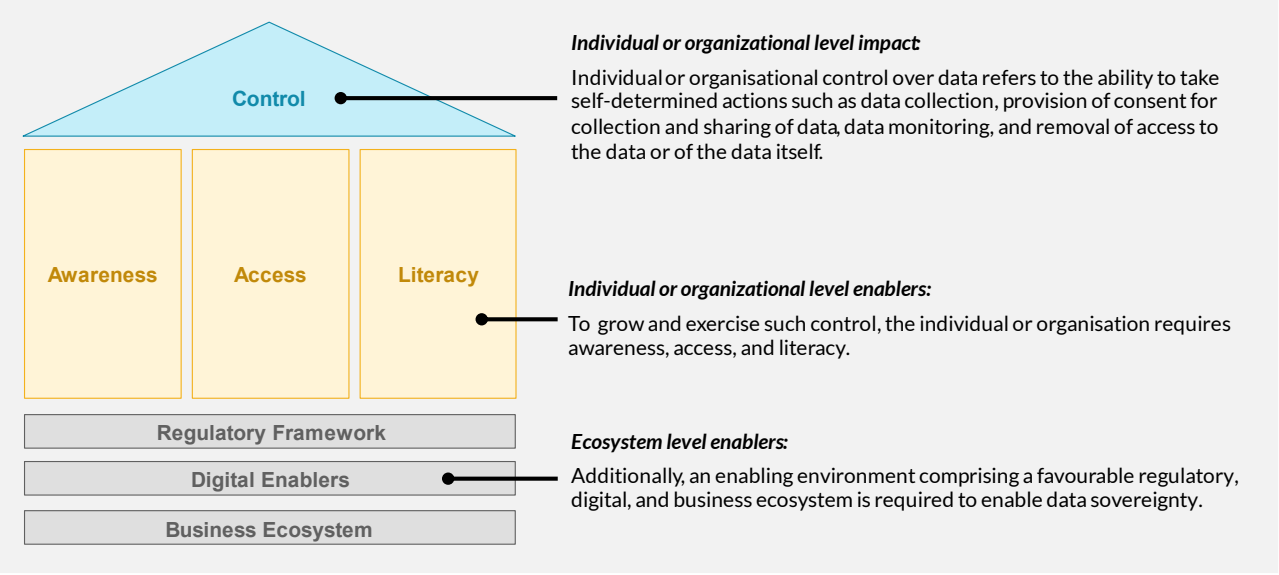
- Develop metrics and methodologies tailored for assessing the output, outcome, and impact of D4Ag solutions and interventions, including per D4Ag use case (for both the consumer-oriented as well as the SME and producer-oriented use cases)
- Closely track and report SNV's investment in D4Ag
- In each D4Ag project or intervention, clearly define the objectives, the processes and methodologies, as well as the roles and responsibilities related to the MEL activities of the project
- Ensure adapted timeline and budget at the project level dedicated to MEL activities
- Consider partnering with organisations specialized in MEL activities (e.g., Laterite, Busara Center for Behavioural Economics, ID Insight)
- Consider the following resources:
    - <Porciello et al. – A Systematic Scoping Review: How are farmers using digital services in low- and middle-income countries?>

g. Foster inclusivity and data sovereignty and reduce the digital divide

The potential impact of D4Ag solutions at the individual level depends on several factors including, but not restricted to, access to technology, awareness, and digital literacy. Given the extent to which these factors diverge across gender, age, income, (dis)ability, communities, and geographies, it is critical to take them into account when addressing challenges in the D4Ag environment in order to ensure inclusivity and avoid increasing the existing digital divide.

Additionally, these same factors influence the level of data sovereignty at the individual (e.g., producer, consumer) or organisation (e.g., cooperative, SME) level in agricultural value chains in LMICs. Data sovereignty is defined as the capability of an individual or an organisation to have control over their personal and business data. This is made possible by certain enablers at the individual and organisation level such as awareness, access, and literacy, and at the ecosystem level such as the regulatory, digital, and business environment. Consumers and smallholder farmers typically have the least amount of agency or control over this data, including their personal data; as a result, they do not sufficiently exercise their data privacy rights nor equally benefit from the value of their data.

Figure 26: Data sovereignty framework[30]



RECOMMENDATIONS

- Build internal awareness on challenge related to inclusivity and data sovereignty and reflect them in SNV's D4Ag strategy and operations
- Impose the adoption of an inclusivity lens to each project having a digital component from design to evaluation
- Develop knowledge products demonstrating levels of adoption and impact from D4Ag solutions across key dimensions (e.g., gender, age, income, geography, race)
- Promote D4Ag solutions accessible and/or having an impact on the local communities characterized by lower access to technology, awareness, and digital literacy for both consumers and producers
- Prioritize D4Ag solution providers being intentional in terms of inclusivity and data sovereignty (e.g., Digital Green)
- Support and incentivize D4Ag providers to be more inclusive and further consider data sovereignty of their users

[30] Source: GIZ & Dalberg, *Data Sovereignty in Agricultural Value Chains*, 2022

- Based on local regulations, raise smallholder farmer communities' awareness of their rights in terms of data management
- Consider the following resources:
    - <Mercy Corps AgriFin – Gender Transformative Toolkit>
    - <Open Data Institute – Data Ethics Canvas>
    - <DIAL – Principles for Digital Development>
    - <IFAD – Toolkit: Reducing rural woman's domestic workload through labour saving technologies and practices>
    - <The Human Account: Transforming financial product and policy design for the under-served>

h. Prioritize vendors with a local presence and leverage local communities

To deploy D4Ag solutions in LMICs without leaving the already underserved segments behind, an extensive on-the-ground presence is needed in order to be able to bridge the gaps in terms of digital literacy, access to technology, and awareness of and trust in D4Ag solutions. While the grounded presence can come directly from the D4Ag vendor, it can also be provided by a partner organisation such as the public sector (e.g., through extension officers) or an agribusiness (e.g., through filed agents). Finally, the local communities including cooperatives, village savings and loan associations (VSLA), and other organisations of farmers should also be considered for the deployment and scale up of D4Ag solutions in rural LMICs.

RECOMMENDATIONS

- When comparing D4Ag vendors in the context of a service provision for a D4Ag project, request for information in terms of geographical penetration across the country as well as on-the-ground presence and distribution model
- Support D4Ag vendors to partner with organisations which can help them to increase their reach such as telecom operators, large agribusinesses, banks, etc.

i. Integrate a climate smart agriculture lens

Beyond its potentials in terms of increasing food security, D4Ag can also play a critical role in helping the agri-food systems in mitigating their impact on the environment and strengthening their resilience to climate change and variability.

RECOMMENDATIONS

- Help D4Ag vendors identify opportunities when it comes to foster mitigation and adaptation in value chains
- Demonstrate the potential of D4Ag in terms of climate adaptation and mitigation to the public sector to catalyse its involvement in the ecosystem
- Support the public sector in applying a climate smart agriculture lens in its contribution to the D4Ag ecosystem
- Consider the following resources:
    - <Global Commission on Adaptation – A Blueprint for Digital Climate-Informed Advisory Services: Building the Resilience of 300 Million Small-Scale Producers by 2030>
    - <Mercy Corps AgriFin – Digital Climate Smart Agriculture Playbook>

j. Take a systemic food system approach

To maximise its impact with D4Ag, SNV takes a food system approach resulting in a stronger consideration for D4Ag solutions which:

- bundle D4Ag use cases in order to enable economies of scale and increase engagement and benefits generated for customers
- support the agri-food system across the different types of value chains, including crops, livestock, fisheries, and forestry
- deliver value to several segments of the value chains including farmers as well stakeholders having a higher readiness to pay for D4Ag (e.g., input providers, financial institutions, offtakers) usually leading to more sustainable business models

RECOMMENDATIONS

- Involve experts having a holistic understanding of agri-food systems, especially at the design phase of D4Ag projects
- Help D4Ag vendors to scale to other types of value chains and expand their service offering to businesses having a high readiness to pay for D4Ag solutions
- Support the public sector in considering fisheries and forestry value chains in its contribution to the D4Ag ecosystem

V THE WAY FORWARD

In terms of way forward to launch new D4Ag initiatives, three preliminary paths have been identified for SNV building on its experience with the GARBAL service and expanding its activities in D4Ag.

A. REPLICATE

SNV replicates the GARBAL service offering in another country (e.g., Uganda) with other partners (e.g., MTN).

Entry points:

- A relationship with a telecom operator keen to expand its service offering to increase stickiness and ARPU (average revenue per user)
- A public institution eager to launch a service similar to GARBAL
- A funder or donor ready to financially support the initiative

B. SCALE UP

SNV scales up the GARBAL service by:

- extending the service offering by adding new use cases (e.g., supply chain management)
- expanding the uptake and user base through interventions such as marketing campaigns, design and technical improvement of the solution, adaptation of the business and operating models, etc.
- deploying the service to other countries or geographies with the same technical partners (e.g., Orange)

Entry points:

- Orange accepting to scale up the GARBAL service
- A public institution convincing Orange to scale up the GARBAL service
- A funder or donor ready to financially support the initiative

C. INITIATE

SNV initiates a completely new D4Ag project with different objectives, partners, and scope than the ones from the GARBAL service. In order to efficiently initiate such new projects, SNV has the opportunity to design and conceptualise these projects based on learnings from existing agri-food sector projects. This requires providing for an assessment of the opportunities and challenges that can be addressed with D4Ag within each agri-food sector project. Such assessments can then be used to feed pieces of business development (e.g., concept note, proposal).

Entry points:

- Value proposition (a): Build the D4Ag infrastructure through sustainable PPPs
    - Funder(s), D4Ag infrastructure vendor(s), and public institution(s) eager to partner to build the D4Ag infrastructure (e.g., a market observatory)
    - A public institution and a private sector stakeholder (e.g., agribusiness, bank, telecom operator) eager to partner and co-finance the building of the D4Ag infrastructure
- Value proposition (b): Mature the ecosystem of D4Ag vendors with an ESG lens
    - An existing agri-food sector project with budget which can be allocated to interventions helping to mature the ecosystem of D4Ag vendors (e.g., the development and publication of knowledge materials based on learnings from the project and providing useful guidance to D4Ag vendors)
    - A funder or donor ready to financially support the initiative
- Value proposition (c): Catalyse public sector's involvement and investment in the D4Ag ecosystem along with the private sector
    - A successful project building the D4Ag infrastructure and/or maturing the ecosystem of D4Ag vendors to create buy-in from the public sector

VI ANNEXES

VI.1 Leveraging D4Ag use cases in non-D4Ag-specific projects

While SNV will implement D4Ag-specific projects fully dedicated to addressing structural barriers proper to the D4Ag ecosystem, the organisation will also continue implementing project which are non-D4Ag-specific, but which could benefit from D4Ag solutions. For each food sector product component, this annex (i) indicates the level of applicability of D4Ag use cases and (ii) identifies most relevant D4Ag use cases. This assessment and set of recommendations should not be considered as exhaustive but rather as a first step towards identifying the role D4Ag use cases can play across each SNV's agri-food sector products and components.

a. Productive and resilient food landscapes

INTEGRATED LANDSCAPE MANAGEMENT, SUSTAINABLE LAND AND WATER USE AND ECOSYSTEM RESTORATION

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Macro-agri intelligence for large scale monitoring of above- and underground natural resources management

SUSTAINABLE INTENSIFICATION OF AGRICULTURE AND REGENERATIVE AGRICULTURE

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Advisory services to deliver information about sustainable land-use and farming practices and agri-food choices for targeted consumers
- Financial access to help farmers covering the losses related to yield decreases the first years of adoption of practices such as regenerative agriculture

SUSTAINABLE INTENSIFICATION OF PASTORALISM AND CLIMATE-POSITIVE PRACTICES IN LIVESTOCK AND DAIRY

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Advisory services to deliver information about sustainable livestock (pastoralism and dairy) practices without land expansion but with climate resilient extensive management ensuring protein availability for (targeted) rural consumers
- Macro-agri intelligence including weather monitoring and forecasting systems as well as livestock surveillance systems

(DIGITAL) CLIMATE ADAPTATION PRODUCTS AND SERVICES FOR SMALL-SCALE PRODUCER RESILIENCE

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case[31]:

- Advisory services
  - **Timely climate smart agriculture (CSA)** training, information, and advice enable farmers to learn about CSA practices for their farms
  - **Early warning advisory** allows farmers to make choices based on evolving environment parameters such as weather conditions
  - CSA training and early warning advisory in D4Ag applications can be **customized to farmer location and production system** in order to provide farm-specific management information
- Financial access
  - **Input, harvest, and climate smart credit** enables farmers to buy the right inputs at the right time; have more choice when they sell; access financial incentives to adopt CSA

[31] Source: Adapted from *Toolkit to mainstream digital agriculture technologies*, by Dalberg, African Development Bank, FAO, and IITA, 2021

    - **Mobile saving** provides farmers with a safety-net against climate shocks and allows for re-investment in agriculture
    - **Weather based insurance** protects farmers against increasing climate variability and extremes
    - **Carbon finance** (e.g., through subsidies) incentivizes farmers to practice climate friendly agriculture
- Macro-agri intelligence
    - **Timely and granular agricultural datasets**, combined with meteorological data, can inform national CSA policy and decision making to build climate resilience, increase levels of production and income, and potentially reduce impact on the environment
- Market linkage
    - **Linking agro dealers to farmers** enables farmers to have access to the right inputs for their farm **increasing their productivity and potentially their climate resilience** (e.g., with drought resistant seeds)
    - **Digital marketplaces** linking SHFs to buyers and targeted consumers increasing the efficiency of sales to a number of different markets, **strengthening their resilience, and ultimately diets and income**
- Supply chain management
    - **Track and trace systems** link farmer and farm data to a commodity flow through the related supply chain and can **foster deployment of environmental certification**
- Smart farming
    - **Digital farm machinery solutions** such as PAYG solar water pump help farmers to access machines driving production and climate resilience increase
    - **Smart monitors** can help control water and fuel usage in farms and fisheries which increases water and fuel use efficiency
    - **Digital soil tests** make precision information more accessible enabling farmers to sustainably increase yields

STRONG INSTITUTIONS AND MULTI-STAKEHOLDER PLATFORMS

Level of applicability of D4Ag use cases: low (undirect)

b. Inclusive agri-food markets and green investments

MARKET DEVELOPMENT OF CLIMATE SMART AND NUTRITION SENSITIVE PRODUCTS AND SERVICES

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Advisory services to raise awareness about climate smart and nutrition sensitive products and services
- Digital market linkage platforms to facilitate access to climate smart and nutrition sensitive products and services, especially in the most rural areas and linking SHFs to buyers and targeted consumers increasing the efficiency of sales to several different markets, strengthening their resilience, and ultimately diets and income
- Financial access to enable the purchase of expensive equipment building climate resilience (e.g., solar water pump)
- Supply chain management to enable tracking of products along with their properties

SOCIAL AND ENVIRONMENTAL SAFEGUARDS FOR FOOD PRODUCTION AND NUTRITION

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Supply chain management solutions to enable the adoption and deployment at scale of standards and certifications for agri-food products and consumer safe ty

SCALING PUBLIC AND PRIVATE FINANCE TO NARROW THE ADAPTATION GAP

Level of applicability of D4Ag use cases: intermediate

Applicable D4Ag use case:

- Macro-agri intelligence including weather monitoring and forecasting systems as well as livestock surveillance systems to catalyse investment with data-driven evidence

ENABLING ENVIRONMENT FOR CLIMATE SMART, INCLUSIVE AND NUTRITION-SENSITIVE MARKET DEVELOPMENT AND INVESTMENT

Level of applicability of D4Ag use cases: low (undirect)

c. Youth employment and entrepreneurship

INDIVIDUAL AND ORGANISATIONAL CAPACITY DEVELOPMENT (PUSH)

Level of applicability of D4Ag use cases: intermediate

Applicable D4Ag use case:

- Advisory services used for capacity building in rural areas

FUND MANAGEMENT AND BLENDED FINANCE (MATCH)

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Financial access services to increase financial inclusion, especially among less-served segments

MARKET SYSTEMS DEVELOPMENT (PULL)

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Financial access services to increase financial inclusion, especially among less-served segments
- Advisory services delivered to MSMEs and cooperatives to help them transition from informal to formal

GOVERNANCE/ INSTITUTIONAL STRENGTHENING (ENABLE)

Level of applicability of D4Ag use cases: low (undirect)

d. Healthy Diets for All

CONSUMPTION OF NUTRITIOUS DIETS

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Consumer advisory services providing information and recommendations to consumers on nutrition and food consumption patterns and best practices and digitally enabling social behaviour change interventions (SBCI)
- Macro food and nutrition intelligence providing support tools that integrate data on consumers as well as food and nutrition

IMPROVED NUTRITIOUS DISTRIBUTION AND ACCESS

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Digital food marketplaces connecting consumers to producers or retailers including hyperlocal platforms facilitating direct sales between farmers and producers

NUTRITIOUS FOOD PRODUCT DEVELOPMENT AND QUALITY ASSURANCE

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Supply chain management services to enable tagging and tracking of quality standards and measurements
- Macro food and nutrition intelligence providing support tools that integrate data on the quality of the food production

NUTRITIOUS SENSITIVE PRODUCTION

Level of applicability of D4Ag use cases: high

Applicable D4Ag use case:

- Financial access to deliver financial incentives to producers and retailers to grow, produce, and distribute nutrition sensitive food

NUTRITION GOVERNANCE FOR A SUSTAINABLE HEALTHY FOOD SYSTEM

Level of applicability of D4Ag use cases: intermediate

Applicable D4Ag use case:

- Macro food and nutrition intelligence providing support tools that integrate data on the quality of the food production, consumer patterns, health and nutrition outcomes, etc.

e. Resilience of Food, Water and Energy systems in fragile and remote rural settings[32]

Level of applicability of D4Ag use cases: intermediate

Applicable D4Ag use case:

- Offline advisory services available through feature phones with SMS, USSD, or IVR-based solutions
- Other D4Ag solutions which can operate offline and are brought to farmers by extension officers who can then synchronise data and content when they have access to internet
- Macro agri-intelligence solutions leveraging data which has still been collected partly manually and disseminate insights through accessible media such as static reports, automated email, SMS, etc.

VI.2 D4Ag ecosystem readiness toolkit[33]

This annex is designed to help assess the level of maturity and readiness of a country, region, value chain, or agri-food system when it comes to D4Ag. It follows the structure of the D4Ag ecosystem framework (see Figure 2) and provides a non-exhaustive list of pointer questions at the level of the D4Ag (a) use cases, (b) enabling environment, and (c) infrastructure.

a. Mapping agriculture constraints addressable with D4Ag use cases

CROP VALUE CHAINS

PRE-PRODUCTION

- What are the uptake (%) of inputs, such as seeds, fertilizers and agrochemicals?
- Where are the channels farmers purchase inputs (e.g., cooperatives, agrovets)?
- Where do they get information about agricultural input?
- What are key challenges farmer face about inputs (e.g., quality, availability)?

PRODUCTION

- How accessible extension services are for farmers? What are quality of extension services?
- Do farmers have access to weather and pest/disease information? Market information? Where do they get it now? How actionable are they?
- Do farmers have access to information or training on how to manage water and soil fertility?
- What percentage of farmers use mechanized services and/or infrastructure (e.g., mechanical irrigation, tractor)?
- What services – such as soil testing – could enhance farmer productivity?

SUPPLY CHAIN

- Where do farmers sell their produce? Middlemen, cooperatives, or etc?
- What affects farmgate price – e.g., type of off-taker/trader, volume, timing of sales, etc? And how much?
- How do farmers access information about markets and how do they connect with other stakeholders active along the value chain?
- How are they paid for their produce – mode of payment and term of payment (cash vs digital, and spot vs in xx weeks)
- What is the level of post-harvest loss?

ACCESS TO FINANCE

- How do farmers currently pay for farm inputs and machineries? Cash, loans, savings? If loans, where do they get loans from?
- What are the key financing needs of farmers? For buying input and machineries/irrigations, hiring labour, or other?
- Do farmers have mobile money (or other form of digital finance) account?
- Do farmers have agri-insurance?

CONSUMPTION/OFF-TAKING

- How do the consumers access information on markets (e.g., prices, availabilities)?

[32] Note: Given that the definition of the product components of this product is not available yet, recommendations have been grouped at the product level.
[33] Adapted from *Toolkit to mainstream digital agriculture technologies*, by Dalberg, African Development Bank, FAO, and IITA, 2021

- Do consumers have means to check quality, safety, and provenance of the products (especially for the exported commodities)?
- Do consumers (or off-takers) have appetite to pay premium price for higher quality, more consistent supply, and/or more sustainable production? Or which market have such appetite?

LIVESTOCK VALUE CHAINS

PRE-PRODUCTION

- What is the uptake of AI and where do farmers access them?
- Where do farmers source feed?
- Is access to water a challenge for livestock farmers or pastoralists? What is the average weekly distance travelled by pastoralists to water and graze their livestock?

PRODUCTION

- What is the uptake of veterinary services and where do farmers access them?
- Do livestock keepers have access to pest and disease, as well as weather information? or water availability information?
- What percentage of livestock affected by pests and diseases annually?
- Do farmers track cycle of livestock production including calving, vaccination, and medication, and if so, how? Are there challenges in doing so?
- Do livestock keepers have a digital ID? Are their farms and animals registered?

SUPPLY CHAIN

- Where do farmers sell their livestock? Open market, middlemen, etc.?
- What affects livestock price – e.g., size, season, type of market?
- How do farmers access information about markets and how do they connect with other stakeholders active along the value chain?
- How are they paid for their produce – mode of payment and term of payment?

ACCESS TO FINANCE

- How do farmers currently pay for feed, AI, and veterinary services? Cash, loans, savings? If loans, where do they get loans from?
- What are the key financing needs of farmers? For buying feed, AI, vaccinations or other services?
- Do farmers have mobile money (or other form of digital finance) account?
- Do farmers have livestock insurance?

CONSUMPTION

- How do consumers access information on produce markets (e.g., prices, availabilities)?
- What is the average travel time for consumers to market in rural areas?
- Do consumers have means to check quality, safety, and provenance of the products (especially for the exported commodities)?
- Do consumers (or off-takers) have appetite to pay premium price for higher quality, more consistent supply, and/or more sustainable production? Or which market have such appetite?
- How do consumers pay for their produce?

FISHERIES VALUE CHAINS

PRE-PRODUCTION

- Do fishermen have access to working and growth capital (for example to buy fishing gears)?
- What existing systems map fishermen, fishing vessels, as well as fish resources?
- What is the regulatory body overseeing fishing activities and what are the policies in place governing the sector?
- How is fishery regulated? Do fishermen register for licences? Is that license digitized?

PRODUCTION

- What is the trend of fishing stock/harvests over the last years?
- Do the fishermen have access to market and marine weather information? Do they use other digital services?
- How do fishermen decide where to fish?
- What percentage of vessels use an automatic identification system?

SUPPLY CHAIN

- What percentage of fishermen have a direct access to a market or auction hall without middlemen?
- Do fishermen face high post-harvest losses? What percentage of fishermen use cold storage facilities?
- How do fishermen access information about markets and auction malls?
- How do fishermen connect with other stakeholders active along the value chain?

ACCESS TO FINANCE

- How do fishermen currently pay for fishing equipment? Cash, loans, savings? If loans, where do they get loans from?
- What are the key financing needs of fishermen?
- Do fishermen have mobile money (or other form of digital finance) account?
- Do fishermen have insurance for their equipment?

CONSUMPTION

- How do consumers access information on markets (e.g., prices, availabilities)?
- Do consumers have means to check quality, safety, and provenance of the products (especially for the exported commodities)?

- Would consumers pay a premium price for high quality, traceable, and well-preserved fish products?

b. Mapping D4Ag enabling environment constraints

CONNECTIVITY

- Is there a domestic cloud or data centre in the country?
- If so, are the local D4Ag vendors using that domestic cloud?
- What is the mobile network penetration in the country?
- What is the penetration in the most rural areas for both smartphones and feature phones?
- What percentage of the population has access to internet and electricity?
- What is the level of access to internet and electricity (including off-grid) in the most rural areas?

DIGITAL ENABLERS

DIGITAL PAYMENT

- What proportion(%) of population have mobile money / digital finance, and by segment (rural vs urban and gender / age)?
- What proportion of population have mobile money agent in proximity?
- Is there interoperability across multiple mobile money network operators?
- What are the fees for mobile money transactions?
- Are there rural Pay As You Go (PAYG) services in the country or region such as solar panels or water pumps?

DIGITAL ID

- Is there a national identification authority (or equivalent) in the country?
- Is birth registration mandatory and free of charge in the country? Is there a births and deaths registry in the country?
- Is there a national ID or unique personal identifier in the country? Is it biometric? If so, what percentage of the population is covered?
- Is the digital ID agenda in the current national action plan (or equivalent)?

DIGITAL LITERACY/ ACCESSIBILITY

- What is the level of digital literacy among population and by segment? What are farmers comfortable operating on mobile device?
- What is the penetration of internet in the country or region?
- What is the penetration of mobile phone (feature phone vs. smart phone) in the country?
- What is the total number of websites per 1000 people in the country?
- What is the cost of 1GB of mobile data (% of average income)?

DIGITAL, DATA, AND INNOVATION POLICIES

- Are there digital taxes in the country?
- Is there one or several of the following legislations in the country: (i) electronic transactions; (ii) consumer protection; (iii) privacy and data protection; (iv) cybercrime; (v) patent protection?
  - Is there clear guidance and how to comply with those legislations (e.g., how to respect data privacy and manage farmer's personal data)?
- Is there a national digital agriculture strategy (or equivalent)? If not, is the digital agenda considered in the national agricultural sector development strategy (or equivalent)?

BUSINESS ECOSYSTEM

HUMAN CAPITAL

- How many web developers, software developers, and data scientist are working in the country or region?
- How many local universities are offering curriculums in computer science, data science, software development, and web development?
- Are the local university curriculums in agricultural and environmental sciences include classes focusing on innovation and or data and digital technologies?
- What is the percentage of university students taking classes in agricultural and/or environmental sciences?
- Are there local schools, study accelerators, or TVETs focusing on computer science, data science, web development, and software development?
- Are there AI and Machine Learning initiatives operated in the local banks and telecom operators? If so, are the talents local?
- Do local universities run programs (e.g., applied research) in partnership with the agriculture industry?

DOING BUSINESS ENVIRONMENT

- What is the country's score in the World Bank's Doing Business ranking? More specifically, what are the scores for the following sub-indicators: "Starting a Businesses", "Paying Taxes", "Getting Credit", and "Resolving Insolvency"?
- What is the number of registered companies per 1000 habitants in the country?
- How many D4Ag vendors are registered in the country?

INCUBATION ECOSYSTEM

- Are there any local technology incubator and accelerator hubs which support entrepreneurs in launching new projects or scaling young start-ups?

- Are there any local initiatives run by the GAFAM (Google, Amazon, Facebook, Apple, Microsoft, etc.)?
- Are there conferences related to investment and/or innovation in agriculture in the country?

INVESTMENT AND FINANCE ECOSYSTEM

- What are the main source of capital for D4Ag vendors and start-ups in the country or region (for example, personal funds, funds from friends and family, angel investment, venture capital, private equity, debt, equity)?
- What is the estimated funding flow and deal activity in D4Ag in the country?
- Does the government have specific investment promotion strategies to attract investors into D4Ag innovations? Has the government committed funding for D4Ag innovations at the regional or national level?
- Do the local central bank and/or development bank (or equivalents) run D4Ag-specific programs (e.g., low-interest-rate loan programs)?

c. Mapping D4Ag infrastructure constraints

D4AG DATA

- Are the following agriculture datasets available in the country or region: (i) weather data; (ii) soil data; (iii) land data; (iv) markets data; (v) water data; (vi) crop, livestock, and fishery data; (vii) agronomic content?
- Are those datasets available in a digital and machine-readable format? Are the datasets already integrated in user facing D4Ag solutions?
- Is it a public institution managing the datasets? Are they publicly and freely available?
- Are there clear data standards for those datasets? Who define and manage those data standards?
- Is the data quality of those datasets measured and monitored?
- What is the granularity, coverage, and timeliness of those datasets? When is the last time they have been updated?
- Are there agriculture primary data collection enterprises operating in the country?

D4AG HARDWARE

- Is there a network of physical weather stations in the country or region? If so, how many are operational and how is the data made available?
- Is there a network of ground stations for automatic identification system (AIS) of vessels in the country or region?
- Are there publicly owned soil analysis laboratories in the country or region?
- Are the regional offices of the local Ministry of Agriculture, Livestock, and Fisheries (or equivalent) equipped with laptops, mobile devices, and internet connectivity?
- Does the local Ministry of Agriculture, Livestock, and Fisheries (or equivalent) owns sensors such as drones; soil, pest, and crop diagnostics equipment; or field sensors?

D4AG SOFTWARE

- What are the key D4Ag public goods available in the country?
  - Is there a national weather forecasting service in the country?
  - Is there a national pests and diseases monitoring system in the country?
  - Is there a national market observatory monitoring market prices and volumes for crop, livestock, and fish in the country?
  - Is there a national livestock surveillance system in the country?
  - Is there a national fisheries and vessels monitoring system in the country?
  - Is there a food and nutrition security early warning system implemented in the country?
- Do the officials from the Ministry of Agriculture, Livestock, and Fisheries (or equivalent) use data management technologies to gather, store and centralize, analyze, and disseminate ag data?
- Do the officials from the Ministry of Agriculture, Livestock, and Fisheries (or equivalent) use data governance technologies to manage quality, usage, and security of the ag data?

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World Bank Group, *What's Cooking: Digital Transformation of the Agri-food System*, 2021

World Economic Forum, Synergy, Mercy Corps, Consumers International, Dalberg, Food Systems Summit – Digital Marketplace Playbook, 2021

VI.4 Suggested reading

Title	Institution and Date	Value chain	Geography	Case Studies	Bundled service	Gender	Youth	Climate
<Digitalization of African Agriculture Report>	CTA – Dalberg, 2019	Crop and Livestock	Sub Saharan Africa	Yes	Yes	Yes	Yes	Yes
<E-agriculture strategy development guide>	FAO, 2019	All	Global	No	No	No	No	No
<Digital Agriculture maps, 2020 State of the Sector in Low- and Middle-Income Countries>	GSMA, 2020	All	Global	Yes	Yes	Yes	No	Yes
<mAgri Design Toolkit, User centered design for mobile agriculture>	GSMA, 2018	All	Global	Yes	No	Yes	No	No
<GSMA toolkit for digitalization of agriculture value chains>	GSMA, 2020	All	Global	Yes	No	No	No	Yes
<ICT Toolbox for Contract farming professionals>	GiZ, 2017	All	Global	Yes	Yes	No	No	No
<Fintech and Financial Inclusions>	CGAP, 2019	Crop	Global	Yes	Yes	No	No	NMo
<Byte by Byte>	MaMo Panel, 2019	Crop and Livestock	Africa	Yes	No	Yes	Yes	Yes
<Digital Ag Profiles>	AfDB-CGIAR-FAO, 2021	Crop	Africa	Yes	No	No	No	Yes
<Why Invest in ICTs for Agriculture>	CTA, 2018	Crop	Global	Yes	No	No	No	No
<Introducing the Digital Agriculture Platform Blueprint	Mercy Corp - Dalberg	Crop	Nigeria, Kenya	Yes	Yes	Yes	No	Yes
<e agriculture in action, Drones for Agriculture>	FAO, 2016	All	Global	Yes	No	No	Yes	Yes

<e agriculture in action: blockchain for agriculture>	FAO, 2019	All	Global	Yes	No	No	No	Yes
<Toolkit: Reducing rural woman's domestic workload through labor saving technologies and practices>	IFAD, 2016	All	Africa	Yes	No	Yes	No	Yes
<Compendium of rural women's technologies and innovation>	IFAD, 2016	Crop and Livestock	Africa	Yes	No	Yes	No	Yes
<Agricultural Platforms in a Digital Era: Defining the landscape>	ISF/RAFLL, 2021	All	Global	Yes	Yes	Yes	Yes	No
<Digital Delivery: A digitalization guidebook>	Argidius /ANDE/Dalberg, 2021	All	Global	Yes	No	Yes	No	No
<Scaling Up Disruptive Agricultural Technologies in Africa>	World Bank (WB), 2020	All	Africa	Yes	Yes	Yes	Yes	Yes
<The role of digital tech in livestock traceability and trade>	FAO, 2020	Livestock	Global	No	No	No	No	No
<An inventory of new technologies in fisheries>	OECD, 2017	Fisheries	Global	No	No	No	No	No
<Information and communication technologies for small-scale Fisheries>	FAO, 2020	Fisheries	Global	Yes	No	Yes	No	Yes
<Platforms in agricultural value chains>	Supporting Economic Transformation (SET), 2020	All	Africa	Yes	No	Yes	Yes	No
Gender Impact Study: Cross -cutting Final Report	MercyCorp - Dalberg	Crop	Africa	Yes	No	Yes	No	No
<What's Cooking : Digital Transformation of the Agri-food System>	WB, 2021	All	Global	Yes	Yes	Yes	Yes	Yes

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