Guide to Digitalisation in Agricultural and Food systems

giz

List of abbreviations

AI	Artificial intelligence
AU	African Union
BMZ	German Federal Ministry for Economic Cooperation and Development
COVID-19	Coronavirus 19
DIAL	Digital Impact Alliance
DIASCA	Digital Integration of Agricultural Supply Chains Alliance
DPI	Digital public infrastructure
D4Ag	Digitalisation for Agriculture
DC	Development cooperation
EU	European Union
FAIR	FAIR Forward – Artificial Intelligence for All
FAO	Food and Agriculture Organization of the United Nations
FBS	Farmer Business Schools
GDPR	European General Data Protection Regulation
GIC	Global programme Green Innovation Centres for the Agriculture and Food Sector
GIS	Geoinformation systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GPS	Global positioning system
ICT	Information and communication technology
ID	Identification
iDPPs	Integrated development partnerships
IoT	Internet of things
IT	Information technology
ITU	International Telecommunications Union
MSMEs	Micro, small and medium-sized enterprises
NGOs	Non-governmental organisations
OECD	Organisation for Economic Co-operation and Development
PDDs	Principles for Digital Development
QR code	Quick-response code
SAIS	Scaling digital Agriculture Innovations through Start-ups
SASI	Sustainable Agricultural Supply Chains Initiative
SMS	Short message service
STA	Strategic alliances
UN	United Nations
3Rs	Resources, representation, rights

Contents

1 | Introduction

Over five billion people – more than 66 per cent of the world's total population – use the internet,[1] 4.6 billion of them on mobile devices.[2] In recent years the figure has increased by several hundred million every year. Mobile internet use is one of the most important drivers of this growth. Although there are very large regional differences, internet coverage is increasing all the time. Today there are only 350 million people living without any access to mobile internet, and almost half of them are in sub-Saharan Africa.[3]

In today's globalised world, the digital transformation is exerting an increasing influence on people's everyday lives, both in the private sphere and at work. The agricultural and food sector is also changing and exploiting the new opportunities, recording huge quantities of data electronically that are used to make agriculture more efficient and productive.

In many partner countries of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, agriculture is among the most important economic sectors. Large parts of the land are used for agricultural production, which provides the main source of income for most people in rural areas. At the same time, yields of important staple foods are diminishing due to altered precipitation patterns and extreme weather events resulting from climate change. Biodiversity is being lost and soils are losing their nutrients. Ensuring food security over the long term and combating poverty and inequality will require a transformation of the agricultural and food systems. Digitalisation is an important component in this process.

1 DataReportal – Digital 2024 Global Overview Report
2 GSMA, The State of Mobile Internet Connectivity 2024, p. 6
3 Ibid. pp. 11,12; Another 3.1 billion people live in areas with mobile broadband network but do not use mobile internet services.

Digital technologies can be applied along all value chains; they can simplify processes and enable innovations. Digital services and information and communication technologies (ICT) can help producers and micro, small and medium-sized enterprises (MSMEs) to gain better access to markets and to (financial) services. Agricultural extension services are being expanded to include digital applications that provide information on agricultural practices, the weather and market prices. This enables farmers to increase their incomes.

By combining the Internet of things (IoT) with artificial intelligence (AI), for example, digital applications help farmers to recognise weeds and gauge the availability of nutrients and water, and to apply inputs such as pesticides and fertilisers according to need. In this way farmers can save resources and avoid damage to the environment.

Digital information, analysis and extension services can improve productivity and quality, both in cultivation and in processing. They can reduce harvest and post-harvest losses and promote climate resilience and climate protection.[4] However, these potential benefits are by no means automatic. Digitalisation must be made sustainable. Its potentials should be utilised while the risks – such as digital divides, hidden extra costs and dependencies, and the misuse and loss of data – must be mitigated. Other threats include misinformation and the additional CO_2 emissions caused by digitalisation itself.

The opportunities that digitalisation offers to agriculture are great, but they are not equally accessible to everyone. On the contrary, digital gaps are growing between the genders, between generations, between different players along agricultural supply chains, between rural and urban areas, and between the industrialised countries and those of the Global South.

This guide prepared by GIZ provides an overview of digitalisation in agricultural and food systems. As an implementing organisation, GIZ runs many projects in partner countries, for instance on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The experience gained from these projects and compiled in this guide can serve BMZ and other relevant partners as the basis for a better understanding of the potentials and challenges of digitalisation, and for deriving guiding principles.

The principles presented here do not claim to be exhaustive and should not be used as the sole basis for making decisions about how to handle digitalisation. The technical information is intended to illustrate how digital training can help people in rural areas to participate in society, make their work more productive, and improve their living conditions. This document describes examples from actual practice that illustrate how policy advice can increase the opportunities that digitalisation creates for agricultural and food systems, while minimising the risks of a digital divide.

The authors wish to thank all their colleagues who helped to create this document.

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4 Analyses by Dalberg from 2019 show examples from West Africa in which digital agricultural extension services resulted in 46 per cent higher yields and 70 per cent higher incomes. Cf. The Technical Centre for Agricultural and Rural Cooperation (CTA), 2019.

2 | Guiding principles

GIZ bases all its digital activities on fundamental guiding principles. This makes it possible to protect the rights of the farming population, prevent misuse of their digital data, and pursue equal involvement and digital participation in society. The following principles serve as an initial orientation for handling digitalisation and identifying its place in the agricultural and food systems.

Guiding principles

Human rights

Digital development

Personal rights

Social and environmental sustainability

Implementation in partnership and cooperation

2.1 Principles for successful digital transformation

Recent years have seen growing demand and need for principles to guide the successful creation of digital tools and applications in development cooperation (DC), also at international level.

GIZ therefore follows the **Principles for Digital Development** (PDDs)[5] when creating and promoting digital technologies. The Principles for Digital Development Forum was launched together with the presentation of the Principles for Digital Development in 2017. These are based on the Innovation Principles (2009) of the United Nations agency for children (UNICEF), the British Digital Service Design Principles (2012) and other documents. All German implementing organisations and currently 314 international organisations have signed up to the PDDs, which contain nine general guidelines (see Figure 1) intended to ensure fair, efficient and sustainable technology development.

In 2024, the PDDs were updated to recognise and strengthen local accountability and inclusion. The updated objectives take account of problems that can arise from the creation and use of digital data. They make it clear that open innovation approaches can support adherence to the PDDs.

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5 As an implementing organisation of German development cooperation, GIZ committed itself to the PDDs in February 2018.

Principles for Digital Development

1 | Understand the existing ecosystem

Well-conceived initiatives and digital applications take account of the particular structures and needs that exist in countries, regions and communities.

2 | Share, reuse and improve

This principle advocates reusing existing resources and approaches to avoid unnecessary innovation, fragmentation or duplication of work, and ultimately to save time and money.

3 | Design with people

Designing with people means that those who will use a digital solution or a system, or who will be affected by it, are involved in the design process.

4 | Design for inclusion

Designing for inclusion means giving consideration to human beings in all their diversity and eliminating existing inequalities.

5 | Build for sustainability

Creating sustainable digital solutions avoids project interruptions for financial, operational and ecological reasons and ensures long-term results.

6 | Establish people-first data practices

Data practices that put people first focus on transparency, consent and legal assistance, and enable individuals and communities to keep control of their data and reap the resulting benefits.

7 | Create open and transparent practices

Effective digital initiatives create trust and good decision-making structures by applying measures that promote open innovation and cooperation.

8 | Anticipate and mitigate harms

Damage can occur whenever technology is involved. To avoid negative impacts, one should prepare for the worst and simultaneously work to achieve the best results, especially for marginalised groups.

9 | Use evidence to improve outcomes

Evidence is crucial to achieving impact. Feedback should be continuously collected, analysed and used.

Before implementing its projects, GIZ assesses whether it makes sense to use digital tools and methods, in line with the principle of '**digital by default**' All the projects realised by GIZ under its mandate should systematically examine digital solutions and reach well informed, project-specific decisions about which digital approaches could be applied in each case.

Regarding data management and administration, GIZ follows the GO FAIR Initiative's[6] **FAIR Principles**[7] which encourage the sustainable reusability of data, which ensure that data are findable, accessible, interoperable and reusable.

2.2 Economic, environmental and social sustainability

When digital solutions are devised and scaled up, one focus is on economic sustainability. Digital applications and activities should be built to last for as long as possible and have a stable financial basis. It is very important to have a well-thought-out business model for the digital application, especially if development cooperation projects are limited in terms of time and funding. Cooperation with private and public partners can often secure the future for such digital innovations beyond the project term.

Digital technologies and infrastructure, especially software and AI-based applications, consume huge quantities of natural resources and energy. The more powerful the technologies become, the more electricity is consumed by the devices and computer centres they require[8]. People around the world are particularly hard hit by the environmental impacts of mining for raw materials, and by the environmental pollution generated in part by the manufacture and use of innovative digital products. Environmentally sustainable digitalisation should aspire to produce digital applications and devices that cause as little environmental damage as possible, and that use recyclable components. In line with the principles mentioned above, human rights and environmental standards must therefore be applied along the entire value chain, including green computer centres[9] and the recycling of e-waste, and where such standards are missing, they must be developed.

These standards also feed into the advice given to partner countries and the promotion of digital solutions for agriculture. International agreements that can help in upholding the rights of rural population groups and in preserving more biodiversity are also taken into consideration. One example would be the United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas, which was adopted by the Human Rights Council in 2018.[10]

6 GO FAIR – Initiative
7 GO FAIR – Principles
8 Sachstand Energieverbrauch Rechenzentren (Status of energy consumption by computer centres), Deutscher Bundestag, 2021, p. 1
9 Green data centers: towards a sustainable digital transformation – A practitioner's guide (itu.int)
10 Declaration on the Rights of Peasants and Other People Working in Rural Areas, UN, 2018

2.3 Feminist development policy

The digital gender gap is huge. Poor literacy, expensive hardware and a lack of access to technical devices or experience in their use, have resulted in around 235 million fewer women than men using mobile internet worldwide. Without equitable access to technology and the internet, women and girls cannot participate in our ever more digitalised society. Systematic consideration of the gender perspective helps combat existing inequalities regarding access to and participation in digital solutions. Feminist development policy therefore encompasses the full implementation of women's and girls' rights, greater representation of women in decision-making processes at all levels and in all areas, and the resources necessary for realising rights and representation (3 Rs).[11]

In keeping with BMZ's Gender Equality Strategy and feminist development policy, GIZ works to make digital skills available to everyone irrespective of their gender.[12,13] **Gender-specific approaches** are essential for eliminating obstacles to access, knowledge and digital skills. If the full potential of such approaches is to be leveraged, they must be accompanied by measures that **address the underlying social norms**. That is the only way to strengthen women's voices, enhance their decision-making powers and promote their participation in 'the last mile'.[14] If this does not happen, the gender-specific inequalities will not only persist but also keep growing.

Access to mobile internet

40%

63%

37%

Digital gender gap on the African continent
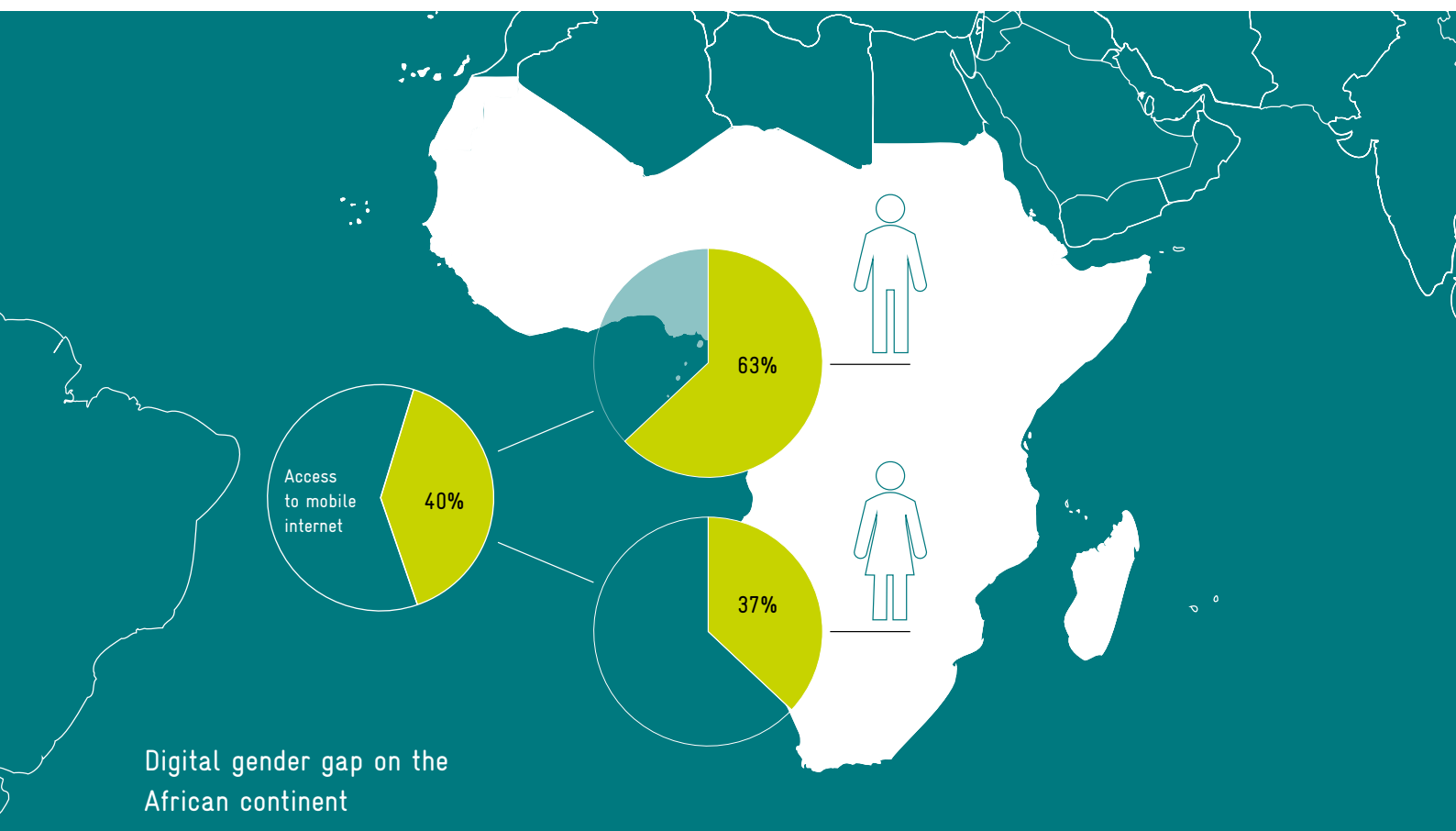
Source:
GSMA, The Mobile Economy Sub–Saharan Africa 2022; GSMA The Mobile Gender Gap Report 2022.
The data refer to access to mobile internet services in sub–Saharan Africa: 40% of the adult population has access to mobile internet services; of this group, 37% are female and 63% are male.

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11 BMZ – Feminist Development Policy 2023
12 BMZ – Frauenrechte und Gender (Women's rights and gender)
13 BMZ – Feminist Development Policy 2023
14 Note: In the context of supply chains, the 'last mile' refers to the network of relationships and transactions between buyers,
   e.g. agricultural companies, cooperatives, dealers and smallholder farmers. (GSMA, 2022)

200 million women in sub-Saharan Africa are offline

A huge digital gender gap exists in GIZ's partner countries. According to the Mobile Gender Gap Report, there are still more than 400 million women in developing countries who do not own a mobile phone. 63% of women in these countries now use mobile internet. In 2024 50 million women started using the mobile internet. In 2023, the figure was 120 million.[15] Closing the digital gender gap in low and middle-income countries would make a considerable contribution to sustainable development.

2.4 Human rights and the digital transformation

All of GIZ's activities are based on the Human Rights Strategy[16] and the Safeguards+Gender management system introduced in 2016, which defines measures for ensuring that projects are environmentally and socially compatible. During the project design phase, the system checks for possible negative project impacts in six areas: human rights; gender; the environment; climate action; adaptation to climate change; and conflict and context. It also develops measures for avoiding such impacts. In line with the 2030 Agenda,[17] GIZ concentrates on leaving no one behind.[18] Accordingly, when promoting and developing digital solutions it pays attention to inclusion, such that disadvantaged social groups can participate equally. As set out in the Africa Strategy (2023), for example, young people benefit from targeted support and education about disinformation and online violence, and about the misuse of personal data by the state.[19]

15 GSMA (2025). The Mobile Gender Gap Report 2025.
16 In May 2011 BMZ presented the strategy paper 'Human Rights in German Development Policy', which sets out binding requirements for shaping official development policy and formulates precise requirements for implementing the obligation to examine impacts on and risks to human rights. https://www.bmz.de/de/themen/menschenrechte-und-entwicklung
17 BMZ – 2030 Agenda
18 German Federal Government – global partnerships
19 BMZ – Shaping the future with Africa (2023) p.26
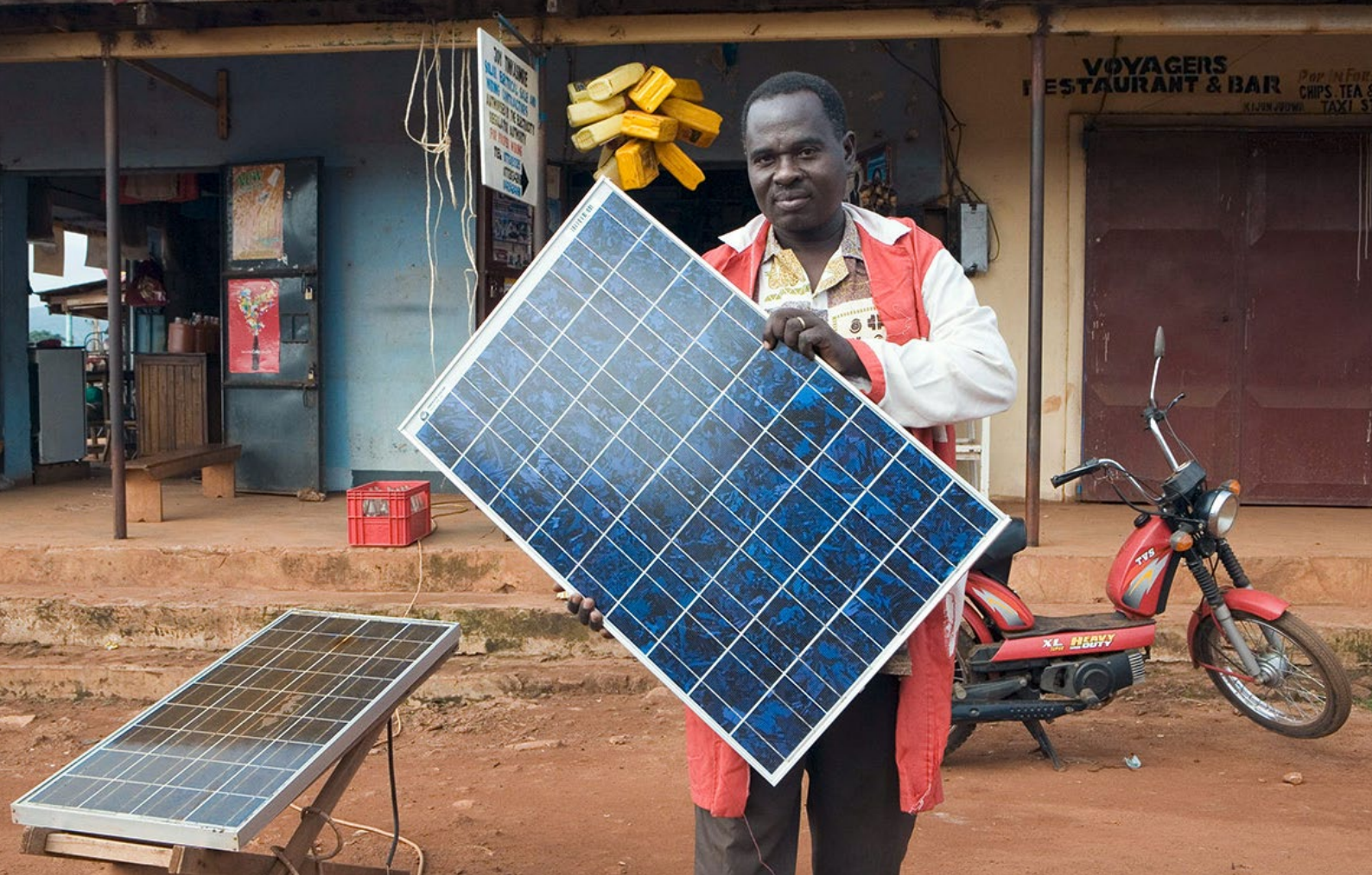
3 | Our objectives

GIZ wishes to enhance the digital participation of rural people in its partner countries. It helps them to access and use new digital technologies. At the same time, it works with partners from politics, business and society to elaborate the necessary framework conditions and solutions.

In keeping with the German Government's national Digital Strategy, GIZ supports a sustainable digital transformation in its partner countries while acting on behalf of BMZ. However, GIZ does not encourage digitalisation for its own sake. It promotes a social and environmental digital transformation that minimises the consumption of resources, addresses hunger and poverty, prevents pandemics and explicitly supports women. This objective is also visible in the BMZ core area strategy 'Transformation of Agricultural and Food Systems' (published in 2022), the strategic realignment of BMZ's digital policy,[20] the goals of the 2030 Agenda, the Africa Strategy[21] and the strategy for a Feminist Development Policy.[22]

GIZ sees digitalisation as a promising means of responding to the complex challenges and multiple crises in agricultural and food systems. It supports smallholder farmers in particular, as the most vulnerable players in the agri-food sector, in using digital technologies safely and confidently.

Four strategic objectives can help to foster digitalisation in rural areas. They are achieved mainly through measures in financial, technical and personnel cooperation at bilateral level.

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20 Strategic realignment of BMZ's digital policy
21 BMZ – Shaping the future with Africa. The Africa Strategy of the BMZ (2023)
22 BMZ – Feminist development policy – for just and strong societies worldwide (2023)

> **Strategic objectives**
>
> 1 | The rural population and relevant partners, such as farmers' organisations and enterprises, possess essential digital skills.
>
> 2 | The rural population and relevant partners can easily access and use digital devices and data, services and applications.
>
> 3 | Legal frameworks and governance promote the development of digitalisation in agricultural systems and protect the farming population from digital risks.
>
> 4 | The digital ecosystem is strengthened at all levels, and fosters innovation and employment.

3.1 Digital literacy

To take advantage of digital tools and solutions, farmers and other relevant players in business, politics and civil society need enough appropriate digital competences and solid knowledge of information and communication technologies. Basic **digital literacy**, and the **e-skills** that build on it, are necessary for people to participate in digital life. Without these skills, smallholder farmers will be excluded from the opportunities presented by digitalisation. The goal should be to support citizens, companies and public institutions, enabling them to take independent action and decisions in the digital sphere (**digital sovereignty**).

Digital literacy programmes provide farmers, agricultural entrepreneurs and trainers with important basic skills for the autonomous use of computers or smartphones. They learn to navigate the internet safely and to use and/or create digital products such as documents or tables. With this kind of basic expertise, agricultural stakeholders can make direct work processes in the agri-food context more effective, efficient and sustainable, and can also improve other aspects of

life such as general education. One of the most important digital skills is the ability to estimate and evaluate the costs, benefits, potentials and risks associated with digital services. This involves basic knowledge of users' rights, data protection, property rights and copyrights which enables people in the agricultural sector to assess opportunities and risks when choosing digital services, and to take informed business decisions.[23]

Building on digital literacy, **e-skills** can be promoted which go beyond the basics, enabling people, for example, to use more complex software, to expand the way they deploy hardware and software options, and to use digital solutions more efficiently. Relevant e-skills begin with digital multimedia learning and greater knowledge of software applications, and extend to programming and analytical skills that support the use of tools such as geoinformation systems (GIS) and the active evaluation of agricultural data.

For the economic development of the agricultural sector, it is essential that agricultural MSMEs and start-ups obtain the skills they need to exploit the opportunities of the digital transformation and to deal with the risks. As intermediaries they are among the most important partners in development cooperation, alongside relevant ministries and authorities, governmental organisations, farmers' associations, local non-governmental organisations (NGOs), trade unions, financial service providers and larger commercial companies in the agriculture and food sector. If they have sufficient digital user-skills, the agricultural sector in partner countries can become more competitive and sustainable in the digital age. Much more extensive digital skills are needed by political decision-makers, public servants and employees with tasks relating to the sector, so that they can make good decisions about the regulatory framework for digitalisation in the agricultural sector, and promote digital sovereignty.

» **How can the promotion of smallholder farmers digital skills be improved?**
> See section 4.1

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23 Promoting these skills is also part of the German Government's implementation strategy 'Shaping digitalization' for German consumers. In Germany these skills are promoted by projects such as those of the Federal Ministry of Justice (BMJ), particularly also in rural areas. Cf. Shaping digitalization, German Federal Government, 2021, p. 31.

3.2 Low-threshold access to devices (hardware) and to data, services and applications (software)

In addition to digital skills, the rural farming population needs low-threshold access to devices, data, services and applications.

For people, public administrations and companies in rural areas to benefit from digital solutions, they first need an effective and affordable digital infrastructure, including (broadband) **internet access** (through Wi-Fi or mobile data services). There must also be a reliable and stable **energy supply** to smallholder farmers homes (last mile). Apart from this, potential users require **internet-compatible**, **user-friendly** and **affordable hardware**, such as computers, smartphones or tablets. Beyond that, more modern devices exist, such as internet-connected soil sensors, solar panels and irrigation systems with computer-controlled switching. In rural areas, devices that are not directly connected to the electricity grid need a **long battery life**, as well as some degree of water and impact resistance so they remain useable for longer.

Digital services and applications (software) must have barrier-free functionality wherever possible, and should suit the skills of the rural target group. This is achieved with intuitive or simple user interfaces, or through solutions for population groups with low literacy levels, based on speech control, read-aloud features, voice assistants (cf. FAIR Forward info box), and audio and video content in local and national languages. The Principles for Digital Development can help in the creation of such services and applications (see section 2.1).

Provided data are available and easily accessible, the rural population can use digital solutions in various areas of application within the agri-food sector (see section 3.4). The public sector can provide **open data** free of charge, such as geoinformation, weather and satellite data, as well as data on abiotic resources, such as water, and biotic factors, such as living organisms. Access to data of this kind and to (**open source**) applications enables companies to develop and scale up digital applications such as e-commerce platforms and digital financial services also for smallholder farmers. At the same time, innovative approaches can assist local authorities and decision-makers to use targeted measures to improve, for instance, food security. This type of local innovation and value creation is possible only if the active companies and the population are given access to the locally collected data, and receive support in using them. This is especially important because it is often the rural population that collects data relevant to agriculture.

EU Regulation on Deforestation-free Products – forest monitoring

Freely available satellite data can help establish and monitor deforestation-free supply chains. They support the surveillance of forests and foster greater transparency and control in agricultural value chains. The goal is to ensure that the production of agricultural raw materials does not lead to the destruction of forests or other ecosystems that should be protected. Digital applications and technologies also help in identifying the origins of raw materials, for example through digital tracing systems. When such systems are combined with digital mapping and satellite-based monitoring instruments, forests requiring a high level of protection can be identified and possible deforestation can be traced along global agricultural supply chains. Digital platforms also facilitate the involvement and cooperation of stakeholders. Digital applications are becoming increasingly important with regard to the EU Deforestation Regulation, which stipulates that products such as palm oil, coffee, cocoa and soy may be imported into the EU only if they are not associated with deforestation after 2020.

https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en

>> How can low-threshold access to hardware and software for smallholder farmers be improved?
> See section 4.2

3.3 Governance and legal frameworks

To support the development of digitalisation in the agricultural and food systems both sustainably and reliably, there is a need to establish or shape fair legal frameworks. This demands a knowledge of regulation, as well as political engagement that motivates the relevant stakeholders and reinforces their activities (cf. box on SADA).

Many countries and contexts lack regulations and laws on **data protection**. The various types of data and the often significant lack of clarity as to how data can be used, who has access to and control over them, and where they are saved, represent major challenges. For smallholder farmers in particular, such guidelines are important for protecting them against the misuse of data. As such, there is a need to promote digital skills relating to user rights and data protection. Introducing human rights-compliant legal frameworks can protect **personal rights**, **copyrights** and **property rights** connected to operational agricultural data. Furthermore, basic ethical principles should be firmly embedded in the development of technologies such as artificial intelligence (AI), which is finding increased application in the agricultural sector, for example in combination with robotics and drones.[24]

To ensure full protection of users' privacy rights, **data-protection** and **data-security standards** must be enshrined in law and made technologically feasible, and the regulations must be explained to the users. It is essential that rural stakeholders are aware of such laws and guidelines and understand why their consent to data collection is important. To ensure farmers' digital self-determination, there is a need either to draw up binding guidelines or to adapt them to national norms. They should be aligned with existing voluntary codes of conduct[25] and regulations, such as the European General Data Protection Regulation (GDPR), and regional frameworks such as the African Union's AU Data Policy Framework.[26] In addition to that, questions about **data sovereignty** and **data security** must also be addressed to ensure appropriate limits on the use and sharing of people's data. Agricultural data are of great economic interest around the world and should increasingly be seen as a commodity.

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24 Cf. Impacts of the digital economy on the food chain and the CAP, Research for AGRI Committee, 2019.
25 Cf. EU Code of conduct on agricultural data sharing by contractual agreement, EU, 2019. See also: opinion of the European Economic and Social Committee.
26 AU Data Policy Framework | African Union; see also info box in section 4.2.

If the use of and sovereignty over digitally generated agricultural data are not regulated in a way that benefits the rural population, this may lead to new inequalities and dependencies.[27] Similar dangers may exist if data formats are not standardised.[28] **Competition law** must also be addressed. Firms in the agricultural and digital sectors should not develop market monopolies.[29]

Political players can create an environment that favours competitive digital markets and digital services in the agricultural sector. It should be based on **transparent national regulatory frameworks**[30] which create a **level playing field** for market participants and telecommunications companies, while safeguarding investments.

Greater deregulation of the telecommunications sector can boost expansion of the internet. Simpler licensing frameworks for allocation of radio frequencies with low introduction costs for mobile telephony providers could **incentivise investments to expand mobile broadband** in rural areas. That would make it easier for farmers to access digital solutions.[31] Where the per capita costs of providing connections are still very high in sparsely populated regions, public funding should be made available.[32]

At the same time, questions should be asked about **price regulation** by the state and about **consumer protection**, in order to keep **internet access** affordable. The more people there are in rural areas who access the internet, the more attractive this market will be to developers and the providers of digital **applications** and **services for agriculture**.

Governments can introduce policy frameworks that promote the availability of **open source software** and **open data**. Interoperable data interfaces can be used to connect different systems with one another and to standardise them. In this way, governments can stimulate the development of digital applications and make both access to and the usability of data more transparent. That will benefit local stakeholders in particular, who can then view weather, market and climate information and act in innovative ways, thereby increasing their own value creation.[33] In addition, the open data allows them greater participation as citizens in political developments. If governments themselves provide data on the development of e-agriculture services, these effects can potentiate one another.[34]

The promotion of digital skills for experts, politicians, civil servants and decision-makers can form the basis for better institutional framework conditions (see also section 4.1). Moreover, strengthening policy formulation and regulation processes is an important prerequisite for supporting unified data standards and the establishment and expansion of digital public infrastructure, which will then make users more confident and more resilient.

>> How is it possible to support legal frameworks and political engagement that encourage digital participation by smallholder farmers?
> See section 4.2

3.4 Promoting the digital ecosystem

Promoting the digital ecosystem also makes sense when it comes to expanding digital activities in the agricultural and food sector. The Digitalisation for Agriculture (D4Ag) ecosystem (see Figure 2) consists of three main components: (i) favourable general conditions, (ii) the infrastructure and (iii) the areas of application derived from these. Most solutions relate to one or more of five areas of application for digitalisation in agricultural systems: extension services and information, market access, supply-chain management, financial services, and monitoring and macro data analysis.[35]

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27 Digital Agriculture, German Agricultural Society (DLG e.V.), 2018, p. 11
28 FAO, 2019.
29 Regulations in competition law should prevent manufacturers of agricultural machinery from joining forces with data analysis and seed supply companies in order to make farmers dependent on a few 'one-stop shops'. Cf. Position paper on agriculture 4.0, INKOTA-netzwerk e.V, 2020
30 Datenmonopole brechen (Breaking up data monopolies)| BMZ Digital.Global (bmz-digital.global)
31 FAO, 2019. Briefing Paper Digital Technologies in Agriculture and Rural Areas
32 Cf. German Federal Ministry of Food and Agriculture (BMEL) – Universal broadband coverage – also in rural areas
33 One of the aims here is to give citizens more control over data, while another is to give companies access to anonymised public data for their business ideas and models.
34 Some countries have already integrated the agri-food sector as a key focus within national digital strategies. In developing countries, most e-agriculture services are embedded in e-government or ICT strategies where the main objective is to provide basic e-agriculture services such as early alert notifications (weather) and general information, FAO 2019.
35 CTA, 2019. The Digitalisation of African Agriculture Report 2018–2019, p. 34.

Favourable conditions include digital structures and innovations that can also be adapted to the D4Ag ecosystem. With digital identification details (digital ID), farmers can add their farms and products to farm registries in order to make this information either publicly available, or available only to certain official or civil-society bodies. Digital payment systems make it easier for the rural population to access markets and agricultural finance and insurance schemes.

Building on these conditions, more specific infrastructural elements exist for digitalising agricultural and food systems, which are distinguished by agricultural data systems and developments in software and hardware. Examples would be digital smallholder registries for sharing data on locations and products, weather data, monitoring data on plant and animal pests, soil data, payment data and market information, plus software and hardware such as blockchains, AI, the IoT, drones, sensors and weather stations.

Agricultural extension and information applications enable the sharing of good agricultural practices and more efficient farm management. With digital applications for market integration, farmers can tap into new

markets and engage in e-commerce, for example. Supply-chain management applications facilitate product tracing. In the field of financial services, using digital applications it is easier for farmers to apply for loans and other financing options, and to obtain insurance. In addition, monitoring and macro data analyses can help the rural population to follow political and legal developments, and observe changes in the climate and crop growing generally.

The first three strategic goals are already reflected in the D4Ag ecosystem. However, if farmers are to participate themselves in the digital transformation of the agricultural and food systems, it is important to observe and support the ecosystem as comprehensively as possible. This will necessitate cooperation and coordination between various stakeholders both within and outside the immediate agricultural context, such as education ministries, infrastructure and transport ministries, the private sector, scientific institutions, NGOs and others. This should be supported by all parties involved.

>> **How can the digital ecosystem for smallholder farmers be promoted?** › See section 4.3

D4Ag ecosystem

Areas of application for D4Ag solutions

- Extension and information services
- Financial services
- Market integration
- Monitoring and macro data analyse
- Supply chain management

D4AG infrastructure

Ag data (e.g. farmer registry, transactions, soil, weather, remote sensing)

D4Ag software and analysis

D4Ag hardware (e.g. diagnostic instruments, sensors)

Favourable conditions

Business ecosystem

Financing and investment ecosystems

Incubation ecosystem

Active business environment

Human capital

Digital promoters

Digital payment systems

Digital ID

Digital literacy

Digital and data guidelines

Connectivity

Connectivity networks, access devices, Cloud, etc.

4 | Areas of action

GIZ promotes the digitalisation of agricultural and food systems through several areas of action: training, sharing information, development and extension services, initiatives and innovations all serve to advance and consolidate the strategic objectives in particular, but also other objectives that build on these.

Here the needs, interests and national strategies of the partner countries must be taken into consideration. A useful division of tasks with other donors is required, along with support for solutions that have already been developed locally.

The activities mentioned in the areas of action are aimed both directly and indirectly at the farming population. Direct support involves the development of digital applications and training courses, plus advice on their application (digital literacy). Furthermore, GIZ supports key stakeholders in improving the overall political and economic conditions for the target group. That includes, for example, ministries and authorities, farmers' associations, local NGOs, trade unions and businesses in the agriculture and food sector.

In the following sections a distinction is made between actors from policy, business, civil society and academia.

4.1 How can digital literacy be promoted more effectively among smallholder farmers?

Training programmes

Through capacity development,[36] people and organisations in rural areas can accumulate more knowledge, enabling them to develop and strengthen their digital expertise and skills. Capacity building for partners from politics, business and society forms the basis for digital development that benefits the farmers. All the beneficiaries together provide the driving force behind the requisite institutional reforms to facilitate digital approaches to agriculture and the protection of farmers' rights and interests.

Capacity development should preferably take place at the regional and local levels, both directly and indirectly. Training in applications must include enough time

and space for the necessary skills development, and must be repeated at regular intervals. Options should be identified in advance that are appropriate to the context and are tailored to the relevant crops, stages of value creation and income opportunities of the local population groups. The skills are imparted in training courses that accompany the use of digital solutions, for instance as blended learning approaches, designed to raise productivity, improve market access and enhance climate resilience.

Digital learning for agriculture: atingi.org

The digital learning platform atingi aims to facilitate digital access to knowledge for everyone. atingi was commissioned in 2019 by the BMZ and will receive funding from BMZ until the end of 2025. Thereafter, the platform will be transferred to GIZ's regular operations and from 2026 will be available to GIZ projects as an integrated standard product for digital learning. atingi exploits the potentials of digitalisation and gives projects a way of implementing e-learning courses that is faster, compliant with data protection regulations, efficient and economical, while scaling up their reach and their impacts. By providing high-quality learning activities free of charge, atingi contributes directly to achieving the Sustainable Development Goals and works actively to ensure that more young people, including those in rural areas, can use innovative e-learning to improve their chances of finding employment. Educational content for occupations in demand is created locally in the partner countries and can be downloaded for a broad impact. The multilingual learning activities focus on training programmes directed at groups such as school leavers and farmers.

For example, as part of their 'supraregional learning' activities, the GIZ projects Green Innovation Centres for the Agriculture and Food Sector (GIC) and the Agribusiness Facility for Africa provide self-guided courses on relevant topics using the digital learning platform. At present atingi offers 95 publicly available courses on agriculture in several languages.

https://www.agribusiness-facility.org, https://www.atingi.org/

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36 BBMZ – Capacity development. Capacity development describes a process whereby individuals, organisations and societies mobilise and continuously expand and adapt their skills. This enables them to permanently shape their own development and adapt to changing framework conditions. That includes recognising obstacles to development, designing appropriate strategies and successfully implementing them.

To foster digital literacy, GIZ works with partners to develop needs-based regional and global learning platforms, South-South cooperation arrangements and knowledge networks. Capacity development can also take place in development partnerships with the private sector, and as part of the promotion for start-ups and innovations in partner countries.[37] Cooperation arrangements and partnerships play a major role in the digitalisation of agricultural systems, which may involve data-sharing platforms, digital ecosystems and/or yardsticks for evaluating the useful and sustainable deployment of digital technologies, services and applications. In this context GIZ sees itself principally in an advisory and coordinating role, promoting cooperation schemes and forging contacts between partners.

Global partnerships also foster synergy effects, for instance through the Global Donor Platform for Rural Development,[38] a network of 40 bilateral and multilateral international cooperation organisations in agriculture and rural development. It offers the donors a way of coordinating their activities on digitalisation in agriculture.[39]

One example of successful cooperation with the private sector is the Strategic Partnership Technology in Africa,[40] which brings together businesses and development cooperation actors to pilot joint projects in partner countries.

On behalf of BMZ, GIZ operates an overarching platform for multi-stakeholder partnerships, for instance for the Sustainable Agricultural Supply Chains Initiative (SASI)[41] or for implementing the 2030 Agenda.[42] This advises governments, civil society, businesses and academia on how they can work together more effectively in the face of global challenges such as climate change, providing health care and creating decent jobs. This amalgamated platform can also be used for digitalisation in agriculture, e.g. by supporting cooperation on data and the construction of data platforms.

COVID-19 accelerated digital trainings

FBSInnova

Farmer business schools (FBS) are a proven instrument in GIZ's global programme Green Innovation Centres for the Agriculture and Food Sector (GIC) commissioned by BMZ. This training programme aims to improve management and cultivation methods by giving smallholder farmers entrepreneurial expertise and supporting them on the path to higher yields and incomes. Since it was founded in 2010, over 1.7 million smallholder farmers in 20 African countries have completed an FBS training course.

FBS Innova, developed by the Ghanaian start-up Agro-Innova, is a digital version of the successful training programme and is available as a mobile Android application. It covers the most important FBS tools from the analogue programme, such as those for registering plots of land, planning, harvest calendars, recording expenses, sales revenues and profit-and-loss accounts.

https://fbsinnova.com/

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37 See the example of 'South-South-exchange between Green Innovation Centres for the Agriculture and Food Sector (Tech)'
38 Global Donor Platform for Rural Development.
39 There is a wide range of relevant donors. CTA, 2019, p. 144 names a series of important bilateral, multilateral and private donors supporting digitalisation in agriculture. The major donors in the field of digitalisation in agriculture include the EU, BMGF, the World Bank, the Master-card Foundation, the Islamic Development Bank, FAO, IFAD, AfSB, ADB, AU, AGRA, the World Food Programme, the Rockefeller Foundation, UKAID/DFID, USAID, SIDA, NORAD, and the Netherlands Ministry of Foreign Affairs.
40 Strategic Partnership Technology in Africa.
41 Sustainable Agricultural Supply Chains Initiative (SASI).
42 Partnerships 2030.

Policy

GIZ promotes digital literacy in the **policymaking offices** relevant to regulating and developing the agricultural and digital sectors. The authorities initiate educational programmes as part of public-sector agricultural extension services, or they build systems to establish user skills in rural areas. By providing training, GIZ supports partner governments either in using relevant data and solutions to develop the agricultural sector, or in delivering e-agricultural services themselves. In addition, GIZ promotes **digital evaluation skills**[43] at policy institutions on aspects of IT security, for instance in relation to smallholder farmers' personal or business data. Local and national systems that process such data and share them with other systems must be protected against access by unauthorised or unqualified persons.

Business

In the future, digital solutions should be available to firms in the agri-food sector that wish to cooperate with other players in agricultural value chains. Only qualified private-sector players (in particular agricultural MSMEs and start-ups) are in a position to cooperate in this way to ensure the competitiveness of the sector and involve the farmers. They, too, should know about users' rights so that these rights are respected when sensitive data are stored and processed. In its partner countries GIZ also strengthens the competences of start-ups and companies in the digital sector to enable them to develop agriculturally useful services and applications that suit the needs and user skills of the rural population. Cooperatives and producer communities offer their members educational measures, and private companies train farmers as part of development partnerships.[44]

Smart Africa Digital Academy (SADA)

The Smart Africa Digital Academy (SADA) is a project run jointly by GIZ and the local partner Smart Africa. Its goal is to build the digital skills that politicians and policymakers need in order to set up the policy and regulatory frameworks for a fair, sustainable, secure and inclusive digital transformation. A range of activities, both analogue and virtual, is available to the target group so they can complete training courses on various topics of digital transformation and share their experiences. Around 15,000 people have already benefited from the learning content. Scaling up of the project both in Africa and in other regions is currently being discussed with the World Bank as a partner organisation.

https://sada.atingi.org/

Civil society

NGOs and farmers' organisations act as interest groups and advocate for educational measures at the political level. Sometimes they also offer relevant educational formats for smallholder farmers themselves.[45] Support for these partners can also help advance the interests of the target group when dealings with official bodies, service providers and market partners, and assert the legal framework conditions in the agricultural sector to the benefit of the farmers. GIZ advises the interest groups to this end and supports their training activities, including for digital skills.

As emphasised in section 2c, the digital gender gap is particularly significant. It is therefore important to provide support specifically for women and girls, which must be appropriate to their individual levels of knowledge. Suitable incentives should motivate women and girls and empower them to play an active part in digitalisation.

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43 This Guide to Digitalisation in Agricultural and Food Systems aims to ensure that the rural farming population is able to exploit the opportunities of digitalisation in commercial trade, evaluation skills should be seen more in the entrepreneurial context than in the civic context. In this guide, the entrepreneurs are first and foremost smallholder producers and their households.
44 BMZ – Food security
45 Instruments of development cooperation | BMZ Digital.Global (bmz-digital.global)

Digitalisation can help GIZ's measures in partner countries to achieve results more quickly and effectively. However, digital applications should not be developed and supported for their own sake. Each capacity development measure requires a careful analysis of the existing needs and skills. This is essential if GIZ is to develop precisely those skills that each target group needs in order to use the planned digital applications.

Reaching people in rural areas with interactive broadcasting

Radio programmes are often a good way of reaching people in remote regions. This format is almost universally accessible and does not depend on digital education or literacy. During the COVID-19 pandemic, the GIZ global programme Green Innovation Centres for the Agriculture and Food Sector (GIC), initiated by BMZ, worked with the NGO Farm Radio International to launch the project Quality Interactive Radio Supporting Farmers during the COVID-19 Pandemic (RECOVER). They reached an audience of 17.8 million.

Tailored to the local needs of the target group, the interactive radio programmes reached smallholder farmers in Côte d'Ivoire, Ethiopia, Malawi, Mali, Mozambique, Togo and Zambia between November 2020 and April 2022. It delivered information on good agricultural and commercial practices along selected agricultural value chains.
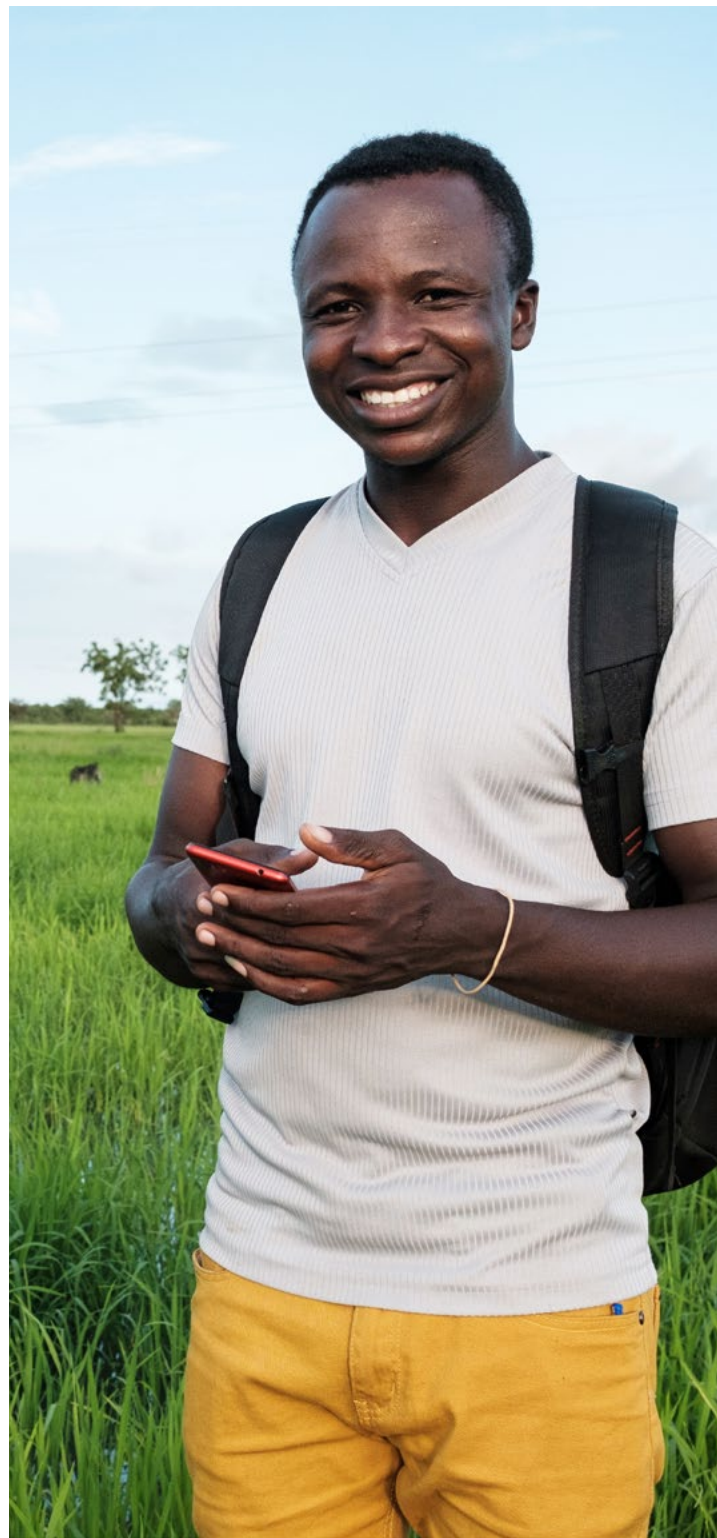
4.2 How can low-threshold access to hardware and software for smallholder farmers be promoted? What support can be given to legal frameworks and political engagement that encourage the digital participation of smallholder?

Development and advice

GIZ supports the development and dissemination of digital solutions for extension services, information services, market access, supply chain management, financial services, monitoring and macro data analysis[46] on the basis of the Principles for Digital Development (see section 2a). The aim is to give farmers the best possible low-threshold access to all functions of each software. Digital participation and the resulting improvements in productivity and market access enable farmers to do business in a way that is economically and environmentally more sustainable, while increasing their incomes, protecting their resources, strengthening their rights and creating jobs for people in rural areas. GIZ runs pilot projects that apply AI technologies, such as for automated image recognition for plant diseases, which can generate significant added value for the farmers. Furthermore, GIZ supports sustainability concepts for farming regions and examines potential solutions for their actual usability and the needs of the

INATrace – the tracing tool for sustainable supply chains

On behalf of BMZ, GIZ has been working with users to develop an open source, expandable and transferable digital solution for tracing produce in agricultural supply chains. The application aims to render the supply chain transparent from production to the consumers. INATrace is already being used in several coffee supply chains in Rwanda and Honduras. It is being transferred to other agricultural products and countries in new scaling-up projects. The application is also expected to record GPS data from fields or field boundaries. With a view to the European Regulation on Deforestation-free Products, this can enable products to be traced right back to their origin.

In the case of the coffee supply chain from Rwanda, women's cooperatives are involved, which market the already roasted and packaged coffee through a trader in Germany. With the aid of software-specific training and hardware for the cooperatives, the data are stored in a blockchain-based database. Consumers can scan a QR code to call up information on the origin, quality, production processes, certificates and prices paid. This solution creates transparency along the entire supply chain, helps in meeting corporate due diligence requirements, and opens up new markets for the producers. In the best case, this also leads to higher incomes for the coffee producers, who also have access to their data.

Open interfaces make it possible to link additional important services to INATrace, such as digital marketplaces, financial services and advice. One example here is the interface to the digital coffee market platform Beyco, through which the coffee recorded in INATrace can be offered directly for sale, and contracts can be concluded with buyers.

46 Cf. CTA 2019, pp. 32 et seq.

rural population. It scales up successful pilot projects in follow-on phases in consultation with BMZ as the client. Alongside measures to develop and promote software, where necessary, in cooperation with its partners, it also provides suitable hardware for the training courses, such as tablets and laptops.

The most important reform processes for the digital transformation in agricultural and food systems relate to **education**,[47] the **energy supply** and **broadband expansion** in rural areas. They should also promote **digital entrepreneurship**, **environmental conservation** and **climate action**.

More and more countries are introducing national e-government[48] or ICT strategies and offering e-agriculture services themselves.[49] GIZ advises its partners on how they can mainstream the agricultural sector in such strategies and expand their e-services. Strengthening these areas – including at the policy level – also encourages digital participation by the farming population.[50]

Digital public infrastructure with open source components (AgStack and GovStack)

AgStack offers a digital public infrastructure (DPI) independent of providers, which has various components for deployment in agriculture, such as registries, data transmission lines and databases. One component is a global registry that can record every geographical field boundary in the world and can provide evidence of deforestation-free agricultural production. Pre-competitive cost-free digital services such as AgStack can be offered as DPI to both public and private stakeholders, as a basis for establishing certain products and services for the end users. DPI avoids the need for each stakeholder to create their own infrastructure, and enables interoperability by realising a single standardised approach.

https://agstack.org/

DPI extends beyond the agricultural sector and comprises solutions and systems that allow the effective provision of key public and private-sector functions and services across society. The GovStack initiative, a multi-stakeholder partnership between the Digital Impact Alliance (DIAL), Estonia, Germany (BMZ and GIZ) and ITU, helps countries to implement this approach as they digitalise government services. The GovStack initiative offers technical specifications for ICT components – interoperable and reusable technical components for functions such as payments and exchanging data.

https://www.bmz-digital.global/initiativen-im-ueberblick/govstack/

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47 The FAO regards education as the most critical success factor for accelerating innovation and digital transformation in agricultural and food systems. It recommends governments to take a tripartite approach to promote research and development (R&D), innovation and education: investment in and support for (domestic) R&D and cooperation with a broad coalition of partners. Cf. DIGITAL TECHNOLOGIES IN AGRICULTURE AND RURAL AREAS, FAO 2019.

48 E-government means electronic administration (by states, municipalities or other official institutions) using digital information and communication technologies (ICT).

49 E-Agriculture services are electronic agricultural services delivered and disseminated via the internet or related technologies, such as agricultural information and extension services concerning market prices and good agricultural practices; cf.: FAO – e-Agriculture and CCAFS-e-Agriculture.

50 Those countries that do prioritize the use of ICT in agriculture also generally have a better business environment and policy and regulation framework for agribusiness. It is possible this is linked to the use of ICT as it does not seem to be related to levels of education, literacy or agricultural contribution to GDP in a country … In developing countries, most of the e-Agriculture services are embedded in e-government or ICT strategies where the main objective is to provide basic e-Agriculture services such as early alert notifications and general information.' FAO 2019, p. 6.

GIZ advises political stakeholders in all of these areas, and supports agenda setting, reform processes and their implementation.

The state can create conducive conditions to make the agricultural sector more attractive and stimulate business engagement and civil-society activities. This would include clear and binding property and (data) use rights, a fair competition policy, stable finance systems and regulatory structures, for instance in the form of tax laws or business courts. Regulations that guarantee network neutrality[51] help to ensure that the services provided by small enterprises and tech start-ups can compete on the market with large international corporations. Without network neutrality, there is a risk that internet providers will prioritise the data traffic of certain services against payment, thereby distorting competition and creating dependency on large providers.

Legal requirements for data protection and personal rights

In most African countries, digital services providers can see their users' data – data protection laws do not exist everywhere. In 2014 the African Union (AU) adopted its Convention on Cyber Security and Personal Data Protection, but so far it has been signed by only 18 Member States and ratified by 14.[52] In addition, laws are not always consistently enforced, as several African countries have yet to establish a data protection authority or appoint a data protection officer. In 2022, the African Union passed the AU Data Policy Framework,[53] a document setting out guidelines for governance of the African data market. It helps the Member States to manage complex regulatory issues, protect fundamental rights and strike an appropriate balance between innovation and privacy. In the Team Europe initiative Digital for Development (D4D Hub), whose implementation GIZ supports on behalf of BMZ, the policy framework is to be applied in 10 to 15 African partner countries so that a conducive environment for a fair data economy can be developed.

When handling its own project partners' personal data in digital contexts, GIZ complies with current national requirements and the guidelines of the **European General Data Protections Regulation (GDPR)**, as most partner countries lack their own legal regulations protecting such data.

To this end, GIZ applies the Responsible Data Guidelines. Whenever personal data are collected and stored in GIZ projects, the standards of GIZ's data protection management apply, which are aligned with the GDPR. The Responsible Data Guidelines are especially relevant when personal data are held by partner institutions that are not bound by the GDPR. In these cases, GIZ recommends not only application the local law, but also compliance with the Responsible Data Guidelines, which are based on internationally recognised general data protection principles. If there is no local legal framework, GIZ recommends applying the highest possible data protection standards on the basis of the Responsible Data Guidelines.

51 Communo network freedom, cf. the current state of research and discussion, 'Menschenrechte im digitalen Zeitalter' (Human rights in the digital age), Deutscher Bundestag, 2018.
52 African Union (2023): African Union Convention on Cyber Security and Personal Data Protection (Status List).
53 AU Data Policy Framework | African Union

Regulation and the creation of a political framework for digitalising the agricultural sector in the partner countries require interministerial consultation and cooperation involving many other policy areas, such as structural, economic, trade, environmental and social policies, and consumer protection. GIZ and the various implementing organisations and projects create synergies for mutual support.

Shaping policies with data – Data4Policy

Data4Policy

Recent years have seen rapid developments in the quantity and quality of the data collected worldwide. As a result, predictions about human behaviour, social, economic or environmental developments and future trends are becoming better all the time. These can be used to design policies tailored to social challenges and needs. For example, the BMZ Data4Policy initiative applies data for adaption to the consequences of climate change in Kenya, which is causing recurrent droughts and an unreliable water supply in regions of arid and semi-arid land (ASAL), and depriving the population of important bases for their livelihoods. The initiative works with communities and governmental partners in the context of the 'Accelerator Labs' Collective Intelligence Design Studio' to prepare a collaborative map of the water resources in Tana River County and improve water planning. In cooperation with the Kenya Institute for Public Policy Research and Analysis (KIPPRA), data for water planning and additional geodata are used to formulate policies for economic growth in the ASAL regions.

https://www.bmz-digital.global/initiativen-im-ueberblick/data4policy/

It is strongly recommended that the effectiveness of policy advice should be bolstered with flanking measures which strengthen the institutions involved. To this end, it is necessary to take existing capacities in the partner institutions into consideration during planning and implementation. Otherwise they will only be able to achieve results very slowly. The policy initiative Data4Policy cooperates with local stakeholders to develop use cases for feeding relevant data into policy measures and decisions.

4.3 How can the digital ecosystem for smallholder farmers be encouraged?

Sharing, initiatives and innovations
GIZ supports several parts of the digital ecosystem, for instance through the examples already mentioned above, but also through cooperation with established companies in the fields of software management and financial technology (fintechs). When deciding whether to bring in large firms to strengthen local ecosystems in the partner countries of development cooperation, GIZ applies the Principles for Digital Development and weighs up the benefits and risks of cooperation. That includes aspects like reinforcing an existing market concentration or monopolies. GIZ and its client accordingly decide together in each individual case.[54]

In addition, to assist the ongoing development and strengthening of the D4Ag ecosystem, GIZ also supports **digital, interoperable platforms** that can offer a variety of services. These include platforms that process data on business models, proofs of impact and ways of applying ICT in agriculture for various target groups. They are aimed at users, decision-makers and smallholder farmers. Ideally this takes place in South-South cooperation arrangements and in partnerships with scientific institutions.

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54 Cf. Blocking the Chain, ETC Group, 2019

Technologies that will be especially important in defining the ecosystem in the next few years have already been integrated in some projects and are now being applied more and more frequently. Blockchain technology, for example, can bring positive developments, particularly when it comes to securing incomes for smallholder farmers. Sales contracts can be stored in a blockchain as 'smart contracts', representing an additional form of income security for producers. Another source of income for smallholder farmers is the trade in carbon credits, which compensates for CO_2-saving agricultural production methods.

By recording a certificate digitally, they can document its unique value and thus prevent its resale (tokenisation). This can help increase income opportunities and generate additional environmentally-friendly impacts.[55]

To create synergies between individual digital solutions and enhance their reach and impact, GIZ promotes initiatives that ensure the interoperability and connectivity of digital applications and data, and as such foster good data ecosystems. Information and data standards make a considerable contribution to guaranteeing the efficiency of the sharing, provision and broad use of relevant data. GIZ and its partners are involved in devising and disseminating common standards and data models.

Data standards for digital tracing: the Digital Integration of Agricultural Supply Chains Alliance (DIASCA)

Digital standards for tracing products along the supply chains can considerably raise efficiency and facilitate the exchange of information within supply chains. These standards form the basis for exchanging data and for the reliable documentation of corporate due diligence. The objective of the global multi-stakeholder initiative Digital Integration of Agricultural Supply Chains Alliance (DIASCA), which was commissioned by BMZ and is being implemented by GIZ, is to reach agreement on common open standards to support **interoperability** between traceability systems. Moreover, current or planned regulatory requirements regarding deforestation monitoring are to be implemented with a particular focus on the European Regulation on Deforestation-free Products.

The initiative also elaborates international best-practice recommendations, primarily for the exchange of data between traceability applications. At the DIASCA Round Table meetings, relevant stakeholders discuss the definition and application of global, open, cross-sectoral standards. The stakeholders include IT providers, NGOs, governments and experts in supply chains and traceability. An interoperable digital ecosystem improves digital participation by smallholder farmers.

http://diasca.org

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55 Konrad Adenauer Foundation (2023). Climate protection with the web3 (p.3)., FAO (2021).
   Impact tokenization and innovative financial models for responsible agri-food supply chains.

GIZ also supports projects and partnerships that wish to expand the infrastructure in rural areas. It encourages alternative ways of connecting the farming population to the internet. Many farmers have neither an electricity supply nor mobile internet access. Successful digitalisation of agricultural and food systems will therefore depend on investment in hardware and network expansion.

BMZ's 22 Digital Transformation Centers promote all the stakeholders in the digital ecosystem at local level – governments, businesses and civil society.[56] GIZ also supports local and regional ecosystems, such as impact hubs and data labs, as partners for incubation programmes in the agricultural sector (see Figure 2, Favourable conditions). This is intended to encourage local developments and foster diversity within the sector. GIZ can act as an intermediary, initiating private partnerships between firms and start-ups in the field of digital entrepreneurship in agriculture. Examples of such activities are the **Make-IT in Africa** initiative and the virtual incubation programme **StartupWave**. Make-IT in Africa specifically assists start-ups in establishing their business models and forming regional and international partnerships. The initiative likewise promotes policy level approaches that should also find application in several countries.[57]

One GIZ project that specifically targets agriculture is **Scaling digital Agriculture Innovations through Start-ups (SAIS)**. This aims to help selected start-ups in the African agri-food sector to become more attractive to partners and investors, and thereby acquire more capital for growth. Besides technical expertise, capital is the biggest requirement if start-ups are to improve their products and offer them to more customers. To qualify for support through SAIS, start-ups' products have to exert a positive effect on users' incomes.

KwikBasket – kitchens, not compost

The Kenyan start-up KwikBasket, which benefited from the support of GIZ's SAIS project in 2022, connects farmers with restaurants and commercial kitchens. This enables producers to access markets regularly and obtain good prices. In 2023, 5,500 farmers registered with KwikBasket. Nearly 80 kitchens in and around Nairobi, Mombasa and Maasai Mara ordered fruit, vegetables and meat, using the platform on a daily basis, which enabled the farmers to expand their range at fair prices for their customers. During the investment readiness programme, KwikBasket itself acquired USD 1 million in capital for further growth to scale up its services. After the programme ended in July 2023, KwikBasket was taken over by the company Kyosk, making KwikBasket the first start-up in the SAIS project to achieve a successful exit.

56 Digitale Ökosysteme gemeinsam stärken (Strengthening digital ecosystems together)| BMZ Digital.Global (bmz-digital.global)
57 Make-IT in Africa II

GIZ also supports the D4Ag ecosystem through various formats for cooperation with businesses. These include development partnerships with the private sector (develoPPP), integrated development partnerships with the private sector (iDPPs), strategic alliances (STA), cofinancing and multi-stakeholder partnerships.[58]

FAIR Forward

On behalf of BMZ, the project **FAIR Forward – Artificial Intelligence for All** supports the local, open and ethically responsible development and use of AI and the associated knowledge transfer. The initiative promotes access to training data sets, supports knowledge transfer to AI, connects local partners from the private sphere and civil society, and brings political partners together with global players and research establishments.

FAIR Forward promotes the provision of open and non-discriminatory data and AI models in order to support partners in developing local solutions, particularly in the field of agriculture and climate resilience. The project places a special focus on language data in African and Asian languages and geodata for AI applications. Geodata can help, for example, in predicting harvest yields and reducing the effects of climate change in agriculture and on forests. AI applications can be used to predict changes in the climate, recognise plant diseases, and offer advice by telephone in local languages using language assistants. This benefits smallholder farmers because the improved access to information enables them to manage their harvests better and to increase their yields.

In addition, FAIR Forward is a good example of a multi-stakeholder partnership. The initiative works with organisations such as the Rockefeller Foundation, Google, the Bill & Melinda Gates Foundation and the Mozilla Foundation to encourage AI innovations in key sectors in the partner countries.

https://www.bmz-digital.global/initiativen-im-ueberblick/fair-forward/

The develoPPP.de programme makes it possible promote sustainable corporate initiatives in partner countries. Its aims are to pilot innovative technologies or demonstration systems, and to raise standards in the supply chains. This includes traceability projects in agricultural supply chains, which contribute directly to the objectives of digitalisation in agricultural and food systems while supporting farmers. Among the selection criteria for participation in the programme, projects must contribute to the 2030 Agenda[59] and achieve a long-term impact that benefits the target group. The Sustainable Agricultural Supply Chains Initiative (SASI) also promotes cooperation between several stakeholders that cuts across different raw materials. This entails holistic approaches that always include aspects of digitalisation.[61]

GIZ also cooperates with private companies in bilateral projects in the form of integrated development partnerships. This kind of cooperation is especially suitable for expanding infrastructure in the partner countries with the aid of private-sector investment.[61] Here GIZ examines cooperation arrangements with national and international mobile telephony providers so that rural areas can be supplied with broadband. In cases where the digital infrastructure is limited, for instance when smartphones are unavailable or network connections are too slow, the programme supports alternative last-mile solutions, such as SMS-based systems and mobile service points with internet access.

58 Gemeinsam für eine nachhaltige Entwicklung (Together for sustainable development) , Agency for Business and Economic Development, 2021 (see page 15)
59 BMZ – Die fünf Kernbotschaften der Agenda 2030 (The five core messages of the 2030 Agenda)
60 More information about the Sustainable Agricultural Supply Chains Initiative (SASI) and model projects is available here.
61 The World Bank makes its Private Participation in Infrastructure Project Database available, a database that contains information about private participation in infrastructure projects in developing countries and emerging economies.