

EXPERTS' RECOMMENDATIONS TO BOOST SUSTAINABLE DIGITALISATION OF AGRICULTURE, FORESTRY AND RURAL AREAS BY 2040

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1. INTRODUCTION

Between October 2020 and January 2021, the DESIRA H2020-funded project worked on a contribution to the debate on the 'Long-term vision for rural areas' (LTVRA). This contribution was developed under the scope of the experts' Working Groups of the European Rural Digitalisation Forum (RDF). The RDF is an open EU-wide community of stakeholders with a common interest to work, learn and share knowledge about digitalisation in three domains: agriculture, forestry and rural areas. It offers a multi-actor research and innovation perspective and evidence. This contribution took the form of three documents that capitalised on the knowledge already developed in the project and of the views of members of the RDF and other relevant stakeholders, ranging from other H2020 projects, academics, local developers, SMEs, etc. There has been a response from 53 experts from 16 EU Member States and 3 non-EU countries.

The three documents focused on presenting the key digital game changers that will shape the future of agriculture, forestry and rural areas by 2040. In this respect, this document complements the above mentioned contributions, summarising the main messages, lessons and recommendations presented in the three documents.

Given their potential game-changing nature, digital technologies can be a relevant object of discussion in relation to the development of plausible and desirable futures for rural areas. Hence, the central question becomes:

Will digital technologies contribute to build desirable futures in rural areas, or will they get us further away from the desired ambitions?

The potential of digital technologies to lead rural areas as well as the agriculture and forestry sectors to a desirable situation cannot be taken for granted, nor can the futures of these sectors be solely reliant on the processes of digitalisation.

DESIRA shows that a thorough and well-conceived analysis of the concerns, threats, benefits and opportunities raised around the use of digital tools and technologies is absolutely necessary to achieve the desirable futures of rural areas through digitalisation. From a starting point that considers digitalisation as the means to an end rather than the end in itself, rural areas can create 'innovation environments' that stimulate researchers, developers, agricultural extensionists, farmers and other rural actors to identify, design and develop technological solutions that help them go in the desired direction.

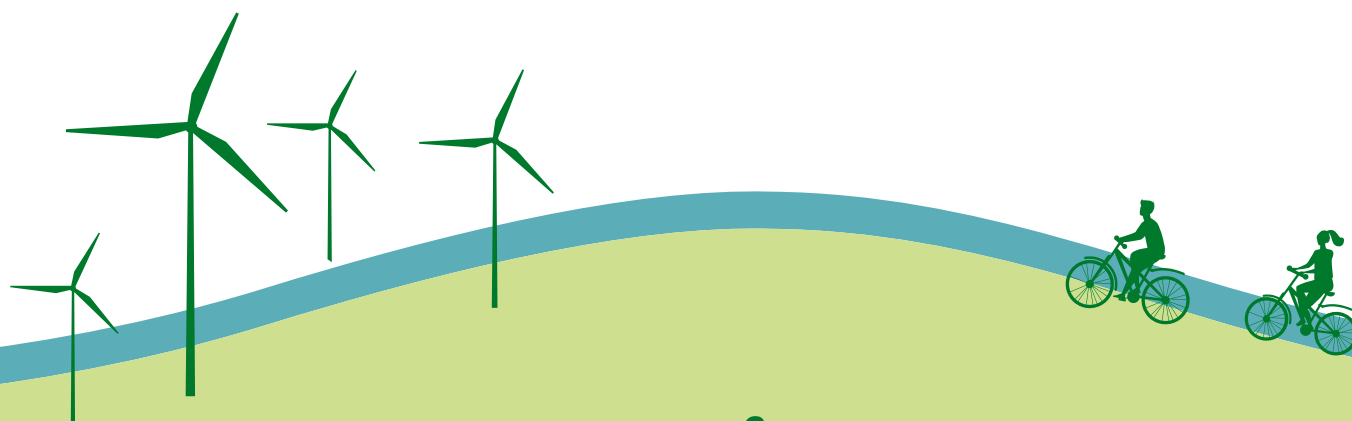
2. MAIN PROMISING SOLUTIONS

When thinking about digital game changers, it is important to note that there is a close link between digital technologies - and tools using these technologies - and so-called application scenarios. An application scenario can be defined as the

Table 1. Potentiality of game-changing digital technologies for DESIRA RDF domains

Technology	Agriculture	Forestry	Rural areas
Social Media and social networks	Access to online services and connection with the market		Access to information, knowledge exchange
Websites and online platforms			
Cloud	Provision of remotely deployed services; better support to real-time sensitive scenarios	Provision of remotely deployed services	Provision of remotely deployed services to be accessed through web or mobile apps
Local and remote sensing (sensors), drones and/or satellite imagery	Advanced monitoring capabilities applied to crops and livestock to increase production, assess health status, and other	Advanced monitoring capabilities applied to trees to monitor physiological parameters, growth, and other	Wearables have a large potential in e-health scenarios; sensing can prevent and reduce the impact of natural hazards
Blockchain or other certification / traceability services	Traceability and smart contracts; insurances		Trust dependant services and applications (digital identity, education, health, insurance, energy)
Data and analytics (Big data)	Information from sensed data to support decision making		Supporting decision making at different levels in communities
Augmented reality/ virtual reality	Educational purposes; easily accessible visual information		
3D printing	Design and printing of custom parts and small equipment		Empowered local production
Artificial intelligence	Decision support and management system; planning and simulation		
Autonomous systems	Semi and fully autonomous systems for agricultural practices	Semi and fully autonomous systems for forestry (cutting, loading, harvesting, yarding)	Semi and fully autonomous systems for forestry (cutting, loading, harvesting, yarding)

Source: Adapted from Bacco *et al.* 2020



context in which a given goal can be accomplished by using digital tools. In DESIRA, application scenarios have been built by grouping digital tools according to the function they serve. In the Synthesis Report on the Inventory and Taxonomy of Digital Game Changers (Bacco *et al.*, 2020) an overview is given of technologies which are considered as potentially game changing for agriculture, forestry and rural areas (see Table 1).

In addition, a total of 53 acknowledged experts in agriculture, forestry and rural life were asked to provide their views about which digital technologies will have the most influence on the future of rural areas, and in different rural development domains. The experts consulted highlighted some technologies with potential to bring change and contribute to build desirable futures in rural areas in 2040. In this respect, the four most prominent technologies mentioned are (in order of relevance): i) data and analytics (Big data); ii) artificial intelligence; iii) local and remote sensing; and iv) websites and online platforms (see Figure 1).

As mentioned before, the relevance of the different technologies depends on the specific scenario in which they are applied. In this respect, the 53 experts also provided their perceptions

regarding the relevance of the technologies according to seven thematic domains. The Table 2 shows the most relevant technologies that could shape the future of rural areas in 2040 representing the votes or number of times chosen from the 53 possible responses.

Table 2 shows that the use of Social Media and social networks could have a strong effect (positive or negative) in facilitating social inclusion and vitality. It also highlights that Websites and online platforms will be particularly relevant for three of the development domains: Infrastructure/services; Digital technology (availability, affordability, quality), and Income/work/jobs.

In the domain of Infrastructure and services (health, education, housing, transport), the influence of a wider variety of technologies is observed, such as Blockchain or other certification/traceability services; Augmented Reality / Virtual Reality (AR/VR); 3D printing; Artificial intelligence (AI); and Autonomous Systems.

In relation to influencing the availability, affordability and quality of digital technologies, the results outline technologies such as Websites and online platforms together with Cloud, Blockchain

Figure 1: Most relevant technologies that could shape the future of rural areas in 2040 (share of mentions N=53)

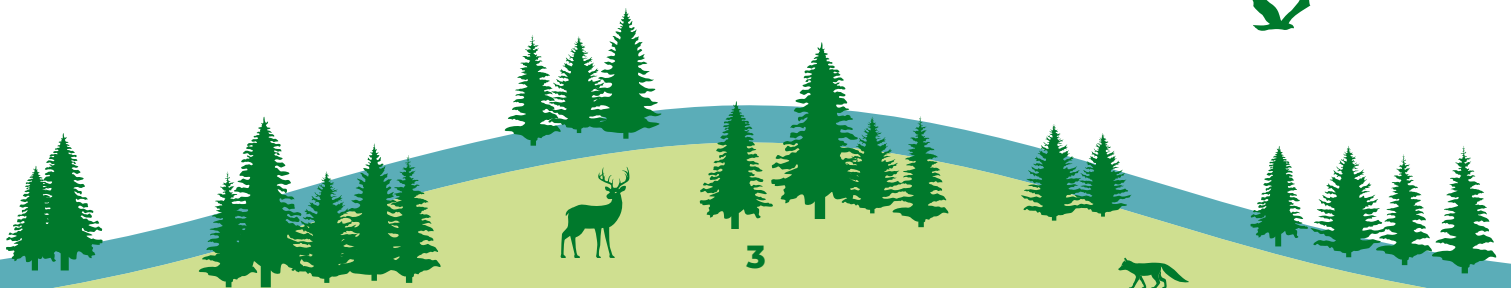
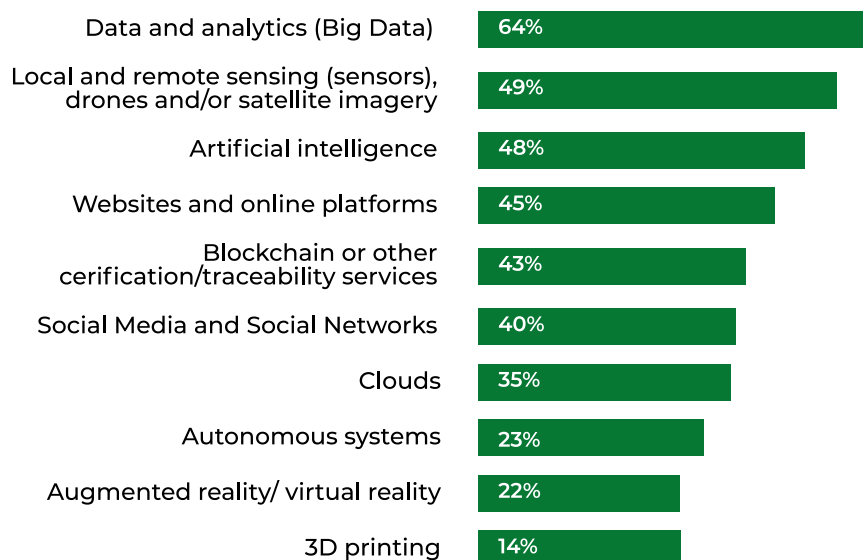
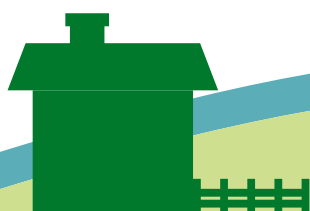


Table 2. Most relevant technologies to shape the future of rural areas, agriculture and forestry (N=53)

Thematic areas/ development domains	Social Media and social networks	Websites and online platforms	Cloud	Local and remote sensing (sensors), drones and/or satellite imagery	Blockchain or other certification/ traceability services	Data and analytics (Big data)	Augmented reality/ virtual reality	3D printing	Artificial intelligence (AI)	Autonomous systems
1. Infrastructure/ services (health, education, housing, transport)	14	32	20	18	24	33	24	23	32	25
2. Digital technology (availability, affordability, quality)	15	28	38	23	23	33	20	19	32	19
3. Income/work/jobs (availability, quality, pay)	24	28	21	12	17	25	14	19	26	22
4. Social inclusion/ vitality (governance, demography, diversity, security, tradition, culture)	46	22	16	5	11	26	19	9	21	15
5. Basic goods: food/ energy (availability, affordability, quality)	9	19	12	17	20	22	9	9	20	21
6. Climate change (impact ON & OF territory)	10	14	16	41	17	40	13	5	30	18
7. Environment (biodiversity, pollution, water availability)	11	15	17	46	18	40	15	5	31	19



and Artificial intelligence (AI) as the ones with most potential to influence this domain.

Finally, experts identified technologies such as Data and analytics (Big data), Local and remote sensing and Artificial intelligence (AI) as those most likely to change the game in relation to Climate change and Environment.

3. SET OF PRINCIPLES TO GUIDE DIGITALISATION PROCESSES TOWARD DESIRED FUTURES

This section provides a set of principles that should be considered to guide and support the future development and implementation of digitalisation processes in agriculture, forestry and rural areas. These are developed on the basis of the main conclusions drawn from key research outcomes from the DESIRA project and from the three contributions developed by the RDF on digital game changers that will shape the future of agriculture, forestry and rural areas by 2040.

Creating the basic conditions for digitalisation

There are three basic conditions for a successful digitalisation strategy in rural areas: technological infrastructure, human capital, and economic gains. The first condition is that all rural areas in Europe need to have access to high-quality digital and internet infrastructure. Access to internet has become a basic need, and a rights-based approach should be adopted to promote it. Market failures should be quickly detected and public intervention should replace private initiative when necessary.

Human capital is the second basic condition. Digitalisation will only take place if local stakeholders recognise their usefulness and have the skills and competences to apply them. Investment in digital infrastructure will be wasted if there are no sufficient digital skills in rural areas. Rural areas need to plan their skills pathways to ensure competences for accessing existing or planned digital infrastructure, understand and use the resulting services, and contribute to the co-design of new services and actions. Gender parity in digitalisation should also be promoted.

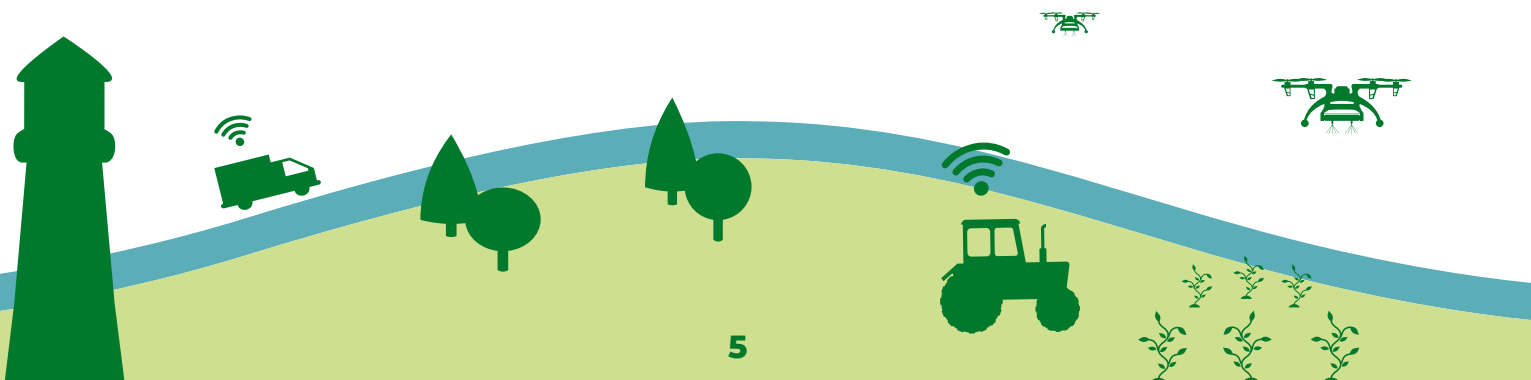
The third condition is that rural areas and their sectors have the capacity to exploit economically their access to broadband and technologies, while the value created remains in local communities. Rural areas must have access to intermediaries, digitalisation brokers and 'spaces' to support digitalisation. Digital hubs, fab labs, co-working spaces, living labs and other intermediate bodies can help to develop local capacity to innovate, create and contribute to new smart products and services.

Anchoring digitalisation to sustainable development

Digitalisation can be a driver of sustainable development, provided that digitalisation processes and strategies are aligned with Sustainable Development Goals (SDGs). Digitalisation can improve the territorial capital of rural areas and their sectors, and digital solutions can address the needs and expectations of rural communities and businesses while addressing European societal challenges. Digitalisation should help connect rural and urban areas, reduce the vulnerability of fragile environments, improve the capacity of local communities to anticipate environmental shocks and stresses, support the creation of new services to give competitiveness to rural economies, and improve access to market for rural products and services. In agriculture, forestry and rural areas there is a strong need for digital technologies and tools tailored to the characteristics of various typologies of farms and farming systems, rural areas and needs, as well forests and related industries, and not just for standard tech solution for large-scale actors and uses or intensive systems.

Adapting digitalisation to different contexts

Many of the issues addressed in the discussion about digitalisation are multi-factorial, and need to be considered from a multi-level and multi-actor perspective. For example, in some contexts robotisation can save farming from declining in areas where farmers' average age is growing and there is a shortage of labour, while in others it may lead to farm concentration and unemployment. Communities with different problems and different endowments of human capital and of digital skills may respond differently to incentives to digitalisation. Participatory



and place-based approaches in rural digitalisation are to be strengthened to ensure that digital solutions are adapted to, and address the needs of, local people and territories.

Engaging with rural stakeholders and conducting a careful analysis of social, historical, institutional, political, environmental, and other factors before introducing digital and technological solutions in a particular geographical location, community or aspect (health, education, jobs, etc.) would augment positive impacts of digitalisation and limit negative ones. Whenever available, digital expertise from and for rural areas by regionally-based digital experts or knowledge centres should be sought. The role of the brokers/advisors/connectors becomes essential to link up the needs of the local actors with innovation and digital centres, so as to acquire the knowledge and skills needed to identify, design and implement the digital and technological solutions.

Favouring digital inclusion

Even in a level playing field, digitalisation can generate uneven development, as early adoption may lead some to accumulate competitive advantage with respect to late adopters. To prevent this from leading to marginalisation and polarisation, and to ensure equal access to the possibilities created by digitalisation, active policies should be put in place to avoid digital exclusion and to ensure that no one is left behind. All the rural social and economic groups, particularly more vulnerable and disadvantaged ones, need to be heard and involved.

Developing digital ecosystems

The contribution of digitalisation to development depends on the integration of actors, infrastructures, digital application systems, data and services. Gaps in one of these aspects may hamper the success of digitalisation strategies. The development of conducive digitalisation ecosystems is related to 'connectors', individuals and agencies that support digital coordination of local actors, selecting the best technologies, and promoting data sharing and interoperability. Digital hubs,

fab labs, co-working spaces, living labs, Local Action Groups and other intermediate bodies can provide the umbrella under which the ecosystem could be created. Support for animation, facilitation and brokerage, and project preparation activities are of capital importance to boost digitalisation processes in rural areas.

Developing adaptive governance models

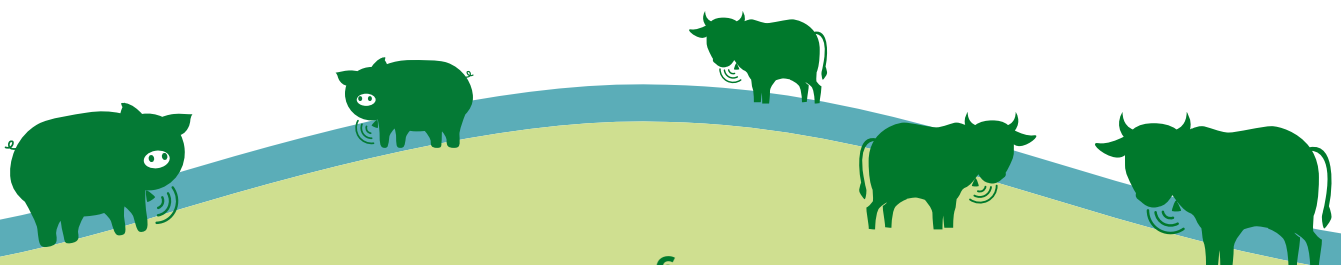
An important principle for achieving the desired digital future is that there is a clear need to change current governance models, and develop ones that address local issues such as infrastructure, skills, data, innovation, and digital inclusion in a coherent and consistent way. To achieve this, governance models will need to shift from reactive to proactive models.

New multi-actor governance models should be considered, which integrate and engage science and innovation with policy-makers, civil society and citizens, in the co-creation process for digitalisation, in a way that balances power. In-depth local knowledge about stakeholders and their role in the local society, business chances/threats, ways of communication, etc., is needed to fully understand the truth behind the stories. This knowledge will enable the design and implementation of sustainable digital development pathways that are adapted to the local reality.

Designing policy tools for sustainable digitalisation

Sustainable digitalisation is an ambitious programme of social transformation, as it looks at how digital technologies can trigger the reconfiguration of social and economic relations. For this reason, the whole set of policies that affect rural areas, agriculture and forestry should be revised and designed in the light of the opportunities and of the threats that digitalisation poses to them.

The effort needed to foster sustainable digitalisation requires dedicated bodies with the right competences. At regional level,



Regional Digitalisation Agencies or specific offices of Regional Development Agencies should be set up to support local communities in developing and implementing digitalisation actions plans, monitoring progress, sharing best practices, and coordinate with Agriculture and Rural Knowledge and Innovation Systems (ARKIS) to foster digitalisation and cooperate with Digital Innovation Hubs to support SMEs in developing and applying suitable digital technologies. At European level, the future CAP Network should strengthen its capacity to support EU Member States towards digitalisation and monitor the progress made.

4. RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE GUIDING PRINCIPLES

The previously mentioned guiding principles for the digitalisation of agriculture, forestry and rural areas can be put into practice with the implementation of actions in four key rural development domains, namely: i) Human capital; ii) Innovation; iii) Investments; and iv) Governance. Table 3 provides ideas of actions with the ambition to serve as inspiration for actors working in digitalisation of agriculture, forestry and rural areas.

Table 3. Ideas of actions to operationalise the guiding principles for digitalisation of agriculture, forestry and rural life

Guiding principles for digitalisation	Key rural development domains			
	Human capital	Innovation	Investments	Governance
Creating the basic conditions for digitalisation	Education & training for basic digital skills	Encouraging peer-to-peer networking	Public support to infrastructures	Monitoring Digital Economy and Society Index (DESI) indicators progress
Anchoring digitalisation to sustainable development	Raising awareness; Education & training for above basic-level skills; Training of ARKIS agents.	Digitalise ARKIS and aligning it with Responsible Research Innovation (RRI)	Linking investments & projects to sustainability goals	Monitoring the sustainability performance of digitalisation projects
Adapting digitalisation to different contexts	Profiling digitalisation users according to skills and needs	Encourage interactive innovation	Align support to investments with local strategies	Community based approaches to digitalisation strategies
Favouring digital inclusion	Mapping vulnerable groups	Encouraging peer-to-peer networking	Support to vulnerable groups	Monitoring DESI indicators progress
Developing digital ecosystems	Training and digitalisation brokers	Encourage Living Lab approaches. Peer learning among digitalisation brokers (within ARKIS) and align them to RRI	Prioritise support based on cooperation and multi-actor projects	Encourage the development of Smart Villages and Local Digital Innovation Hubs
Developing adaptive governance models	Planning, coordination and networking among rural digitalisation agencies, Smart Villages, Digital Innovation Hubs, Fab labs, etc.			
Designing policy tools for sustainable digitalisation	Develop fast and flexible supporting mechanism or policy instruments to support local/regional multi-actor cooperation processes for digitalisation. Support should be provided for all preparatory work around digitalisation such as animating stakeholders, facilitating engagement processes, feasibility assessments, prototype and project development, etc.			

REFERENCES

Bacco, M., Paolo, B., Brunori, G., Debruyne, L., Ferrari, A., Gotta, A., Koltsida, P., Lepore, F., Orsini, A., Rolandi, S., Scotti, I., Toli, E. (2020). Synthesis Report on the Taxonomy and Inventory of Digital Game Changers. <http://desira2020.eu/wp-content/uploads/2020/11/D1.3-Taxonomyinventory-Digital-Game-Changers.pdf>

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