DRG4 FOOD

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DRG4FOOD Digital Responsibility Roadmap

D3.3 DRG4Food Roadmap to Digital Responsibility

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Abbreviations

SDGs	Sustainable Development Goals
EC	European Commission
EU	European Union
PII	Personal Identifiable Information
CO_2	Carbon Dioxide
PETs	Privacy Enhancing Technologies
GDPR	General Data Protection Regulation
IoT	Internet of Things
AES	Advanced Encryption Standard
SMEs	Small and Medium sized Enterprises
AI	Artificial Intelligence
R&I	Research and Innovation
NGOs	Non-Governmental Organizations

1 Executive summary

In a world where digital technologies increasingly shape the global food system, ensuring trust, fairness, and accountability in how data is used has become essential. The **EU-funded DRG4FOOD project** responds to this need by promoting a digitally responsible food system that places citizen at the centre of innovation. Guided by the **Digital Responsibility Goals (DRGs)**, the project supports the development of inclusive, transparent, and ethically designed digital tools across key areas such as **food traceability, personalised nutrition, and consumer empowerment.**

In this context, a **DRG4FOOD Strategic Roadmap** was developed to identify key action areas that support the responsible digital transformation of the European food system. The roadmap provides a comprehensive framework to align research, innovation, and policy with DRGs, aiming to foster fairness, transparency, and trust in data-driven food environments.

This roadmap highlights major knowledge gaps, technological barriers, and governance challenges that hinder the development of ethical and trustworthy digital tools. Drawing on insights from **Foresight and Map & Gap analysis, as well as stakeholder engagement**, the roadmap outlines a practical pathway to bridge these gaps and align future activities across the food sector in Europe**. It serves as a strategic tool to guide inclusive, human-centred digital innovation in line with European policy goals.**

Grounded in co-creation and continuous stakeholder engagement, the roadmap builds on the contributions of experts, citizens, industry, and policymakers. Its development aligns with EU strategies such as **the Farm-to-Fork Strategy, the European Data Strategy,** and contributes to global agendas like **the UN Sustainable Development Goals**. It promotes a future where digital technologies not only optimise the food system, but also safeguard individuals' rights, empower communities, and support sustainability.

To guide this transformation, two strategic areas have been identified:

1. **Transparent, Inclusive and Sustainable Food System** – valid for all use cases, comprising five sub-areas:
    - Building Transparency, Trust and Awareness in Data Usage
    - Enhancing Education
    - Establishing Adaptive and Robust Legal Frameworks
    - Creating market-driven incentives for better digital technology
    - Fostering Multi-Stakeholder Collaboration and Accountability
2. **Food Traceability for Transparent and Sustainable Agrifood System** – a targeted strategic area supporting traceability use cases through responsible technologies that enhance transparency, accountability, and environmental performance in the food supply chain.

The findings of this roadmap indicate the need for stronger **transdisciplinary collaboration** and long-term political commitment. Implementing this vision requires coordinated efforts across sectors, investment in digital infrastructure and education, and mechanisms for meaningful citizen participation.

The **DRG4FOOD roadmap** ultimately provides a structured approach to ensure that the digital transformation of the food system remains human-centred, fair, and aligned with European values. It calls for a future in which citizens are not passive data providers, but active agents of change, **shaping a food system that is not only efficient and innovative, but also inclusive, and resilient.**

2 Introduction

2.1 Vision & Mission of DRG4FOOD In the Food System

The global food system increasingly relies on digital technologies. However, a lack of trustworthy, transparent, and inclusive digital solutions has led to challenges in ensuring fairness, consumer trust, and responsible innovation. While sustainability and environmental protection remain critical, these outcomes depend on embedding trustworthiness and accountability into digital food technologies. Given the vital role of food in health, well-being, and economic prosperity, addressing these challenges requires a profound transformation of the food system. Bringing the **Digital Responsibility Goals (DRGs)** into the food system is not only a technological consideration, but also has social implications, reflecting the growing need to align digital innovation with societal values. As the digitalization of agriculture, nutrition, and food consumption accelerates, embedding fairness, transparency, and data sovereignty into these systems becomes essential for building trust and ensuring sustainable outcomes.

The DRG4Food strategic roadmap **envisions transforming the food system by leveraging data-driven technologies guided by DRGs** that prioritize openness, sovereignty, fairness, and trust. By aligning technological advancements with the diverse needs of food system actors, the roadmap aims to pave the way for **a more equitable and sustainable future**.

This roadmap was developed by **the DRG4FOOD consortium** in collaboration **with European and global organisations,** as well as **a wide array of stakeholders** from academia and industry sectors relevant to the project. Its development was enriched through comprehensive activities, including **consultations, workshops, and collaborative discussions**, ensuring its relevance to the food and data management communities. The roadmap builds upon the foundation of key project deliverables, including Map & Gap Analysis (D3.1), the Foresight Analysis (D3.2) and the Roadmap for implementing Digital Responsibility (D4.1), which have provided essential insights and direction for its development.

2.2 Roadmap Direction and Key Focus Areas

2.2.1 Scope

The **DRG4Food strategic roadmap addresses critical challenges** in the food system **by integrating Digital Responsibility Goals** and offering a comprehensive framework for evaluating and improving data rights, management practices, and technological applications.

With **a multi-actor approach**, the roadmap focuses on ensuring **equitable data access** to food data, **advancing climate and environmental objectives** through resource-efficient and circular practices, and **driving responsible innovation** through implementing a governance concept for digital responsibility as defined in Governance concept for project regarding Digital Responsibility deliverable (D4.2) in the data-driven food system. It highlights the importance of **empowering communities** with tools, data, and resources to support localized, inclusive solutions that promote economic growth and ensure data fairness. Furthermore, it emphasizes the need to provide the public with **transparent information about their data**, comprehensive education on its potential uses, and awareness of their rights.

Emerging from **an in-depth analysis** of the current state of **data rights, trends, and challenges** within the food system, the roadmap identifies and addresses the diverse needs of

stakeholders. It prioritizes actions that align the food system with the needs of **primary target groups** such as citizens and consumers, particularly young people, while also supporting **secondary target groups** like producers, retailers, and food waste management entities.
By aligning its goals with the **EU's Farm-to-Fork Strategy** and the **EU's climate ambition for 2030,** the roadmap aims to contribute to a healthier and more sustainable future for all, ensuring the **transformation of the food system benefits both people and the planet**.

2.2.2 Main Goals

This roadmap aims to provide clear guidance for sustainable and responsible data management within the food system by achieving the core goals:

- **providing citizens and consumers with access to accurate, secure, and actionable data** to make informed choices, while educating them about data usage, their rights, and ethical practices to foster transparency and trust,
- **enabling businesses and producers to adopt data-driven practices** that reduce waste, optimize resource use, and promote sustainable environmental management,
- **promoting cross-sector partnerships** to develop innovative solutions that align with nutritional and environmental goals, fostering shared accountability,
- **ensuring digital tools and practices prioritize fairness and sovereignty**, creating a food system that is inclusive, resilient, and adaptable to diverse needs.

2.2.3 Target Audience

The roadmap is aimed towards **the European Commission (EC), EU member states, policymakers**, and other **industry funders** to foster fair management of personal data, while prioritizing consumers' needs and protecting their rights. The roadmap is also targeted to **individuals or organisations** interested in general concepts of digital responsibility and who want to know in which directions Personal Identifiable Information (PII) should develop. In particular, it seeks to support decision-makers in aligning data strategies with responsible digital innovation across the food value chain, while ensuring that both citizens and businesses are empowered to actively participate in this transition.

The roadmap and its actions are user-inclusive which means that all genders, age groups, ethnical groups, marginalised communities etc are considered and where necessary, certain user groups are specially addressed in the actions.

2.3 Digital Responsibility Goals (DRGs)

The **Digital Responsibility Goals (DRGs)** serve as guiding principles for fostering a trustworthy and ethical digital ecosystem that prioritizes human identity, social cohesion, and trust. Developed through a multistakeholder approach involving experts from diverse fields, the DRGs simplify the complexities of digital responsibility and provide a framework for making responsible digital behaviour visible, comparable, and comprehensible.

Similar to the UN Sustainable Development Goals (SDGs), which establish a shared agenda for a sustainable planet, the DRGs promote the development of digital technologies grounded in universal rights and values. By embedding these principles into the design, development,

and operation of digital services, the DRGs ensure "**trustworthiness by design**" and align technology with the fundamental needs and rights of individuals.

The **7 DRGs** were developed to address critical aspects of digital technology that require improvement to foster a more trustworthy and responsible digital world. They adopt **a citizen-centric approach** by supporting decentralized and self-sovereign identity frameworks, **empowering end-users**, and **promoting user-focused business models**. By offering a comprehensive framework of responsible digital practices, the DRGs create a solid foundation for a trustworthy and ethical digital economy.

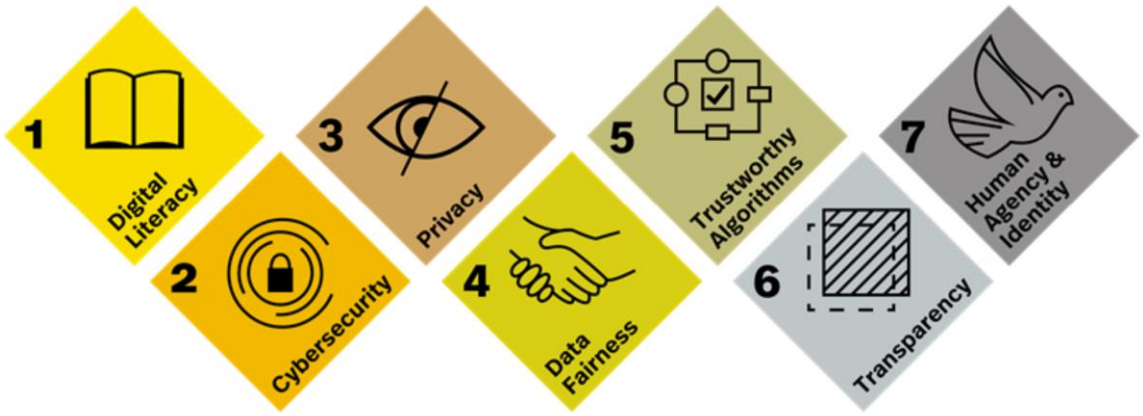


Figure 1: The Digital Responsibility Goals (DRGs).

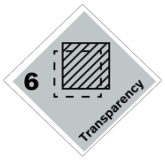
Digital Literacy and unrestricted as well as competent access to digital services and infrastructure are prerequisites for the sovereign and self-determined use of digital technologies.

Cybersecurity protects systems against compromise and manipulation by unauthorized personsand ensures the protection of users and their data: the basis for secure technologies.

Privacy is part of human dignity. Privacy protection - with consistent purpose limitation and data minimization beyond current regulation - allows users to act with confidence in the digital world.

Data Fairness means that even non-personal data must be protected and treated carefully, transparently according to their value, to ensure balanced and fair collaboration between all actors in the dataecosystem

Trustworthy Algorithms ensure that data is processed on the basis of fundamental principles such as explainability, robustness, and fairness: The pre-condition for trustworthy artificial intelligence.



Transparency is an important building block for building trust. In the digital space, it is importantto proactively create transparency for users and all other stakeholders.

Especially in the digital space, we must protect our identity and preserve **human responsibility**. The resulting digital products, services, and processes are human-centred, inclusive, and ethically sensitive, maintaining human agency at all times.

2.4 DRG4FOOD Use Cases

The use cases developed within the framework of the DRG4FOOD project focused on three key areas:

Food Tracking:

This use case focuses on food traceability technologies, encompassing the entire food system from farm to fork. The proposed technological solutions should consider both environmental impacts (e.g., CO_2 emissions, waste generation, water, and land use) and societal aspects (e.g., fair income distribution for farmers). These solutions should be designed to prevent food fraud, verify authenticity based on geographical indications or botanical/zoological origin, and ensure that the information provided on food labels is accurate and verifiable for consumers.

Targeted nutrition:

This use case focuses on developing solutions that enable personalized nutrition recommendations, supporting individuals in adopting healthier diet habits. By incorporating personal variables, these solutions aim to tailor nutrition advice based on behavioural and emotional factors, dietary preferences and restrictions, and lifestyle choices. These factors may also be influenced by personal beliefs, religious practices, weight management goals, and environmental sustainability considerations. The proposed solutions should help individuals improve their diets while ensuring nutritional adequacy, such as maintaining a balanced intake of food groups and essential micronutrients. Additionally, they should contribute to preventing or reducing the risk of non-communicable diseases and promoting sustainable healthy lifestyles. Furthermore, these solutions must uphold scientific accuracy, ensuring that the nutrition recommendations provided are evidence based and reliable, while also considering affordability and practical feasibility for users.

Consumers' food choices:

This use case focuses on enhancing consumer literacy and awareness regarding the health, environmental, and economic impacts of their food choices. By equipping individuals with actionable knowledge, these solutions empower consumers to make healthier, more sustainable, and affordable dietary decisions without compromising on taste. Thanks to this, these solutions aim to positively influence dietary habits and overall health, while promoting a transition towards more sustainable diets. The proposed solutions may be directly accessible to consumers or facilitated through practitioners such as dietitians and nutritionists.

Additionally, they could be utilized by other stakeholders in the food system, such as producers and retailers, to further support informed decision-making. Ultimately, the primary beneficiaries of these solutions remain the consumers themselves.

3 Roadmap to Digital Responsibility

3.1. Methodology

The work leading to this roadmap has been organised to provide **meaningful insights** and **recommendations** for various stakeholders in the food system and digital responsibility domains. These include public and private funders, policymakers, and individuals or organisations interested in the development of trustworthy, data-driven food systems in Europe.

The roadmap's development followed a structural and agile methodology to extract valuable insight from multiple sources while ensuring close collaboration with stakeholders and alignment with European Commission initiatives.

The process involved three main steps:

1. **Map & Gap Analysis:** existing and emerging solutions were analysed through desktop research and open discussions, evaluating their strengths and weaknesses to create a comprehensive map of approaches and tools for food & nutrition. Gaps and opportunities were further identified to ensure that innovations are trustworthy by default and aligned with the Digital Responsibility Goals.
2. **Foresight Analysis:** micro- and macro-scenarios were developed to demonstrate how future solutions can support the European Data Strategy. During collaborative workshops, the impact of citizens' data sharing rights and their willingness to share data on the future food system was examined, aiming to provide a structured framework for shaping technological, societal, and regulatory dynamics.
3. **Roadmap development:** insights from the Map & Gap and Foresight analyses were combined with input from project partners and stakeholders through iterative feedback loops, including three online workshops organized to validate the roadmap.

For more details, refer to the deliverables: the Map & Gap Analysis (D3.1) and the Foresight Analysis (D3.2).
The methodological process adopted for the roadmap development is summarised in Figure 2, highlighting the core analytical phases and the iterative, participatory nature of the approach.

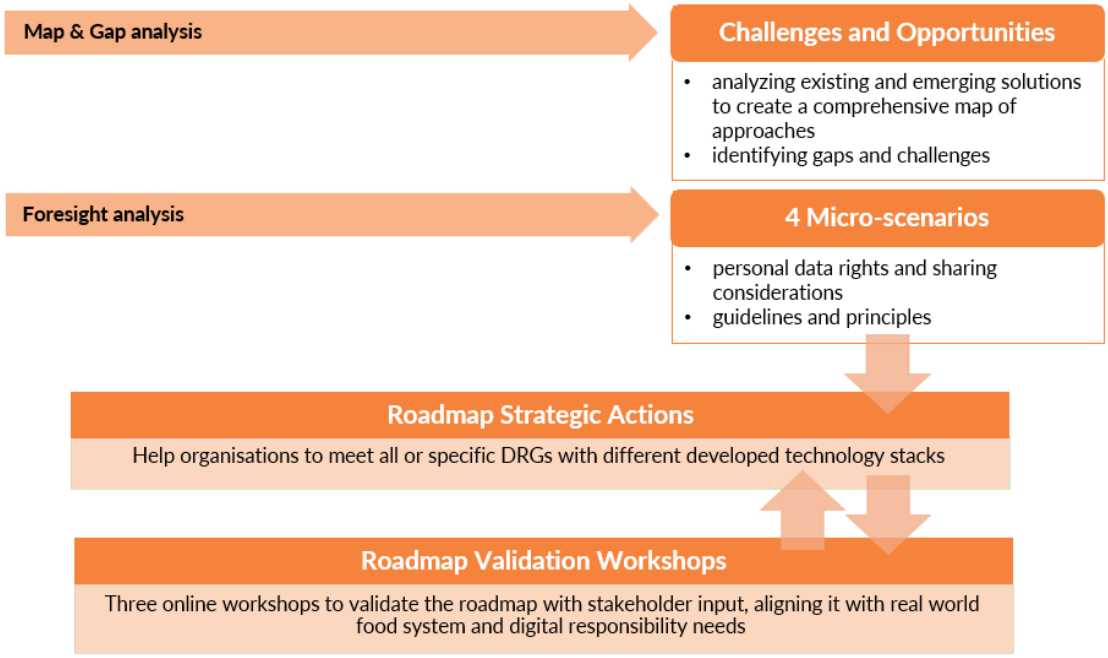


Figure 2. *Overview of the DRG4FOOD roadmap development process, combining Map & Gap analysis, foresight exploration, and co-creation with stakeholders.*

3.1.1 Stakeholder engagement

The roadmap integrates contributions from diverse sources, enriched by stakeholder engagement and iterative consultations. These efforts integrated insights from desktop research, collaborative sessions, and discussions with diverse experts, ensuring the roadmap is inclusive and aligned with domain experts and covers societal needs. Key inputs were gathered from **workshops** and **collaborative exchanges**, alongside **iterative feedback loops with project partners and stakeholders,** and have been thoroughly integrated into this document.

3.1.1.1 Stakeholder Workshops

Workshops played a vital role in shaping the roadmap, creating a platform for collaboration among diverse stakeholders, including policymakers, industry representatives, researchers, and community organisations. These sessions focused on gathering a broad range of perspectives to identify challenges, opportunities, and priorities within the food system and digital responsibility domains.

Interactive engagement methods, such as **interactive discussion and the "Back FROM the Future" methodology**, were used to encourage participation and facilitate the collection of actionable insights. These approaches ensured that stakeholder contributions were directly incorporated into the scenario analysis and roadmap development process, enhancing its relevance and applicability. These workshops are further described in **D3.1 and D3.2**.

3.1.1.2 Feedback Loops

In addition to workshops, **iterative feedback loops** (e.g., **the Focus Group**) allowed for continuous revision of the roadmap. Through targeted sessions, stakeholders reviewed findings from the Map & Gap Analysis, Foresight Analysis and Roadmap Development, providing valuable input for optimization. This iterative process ensured that the roadmap remained aligned with stakeholder priorities while addressing identified challenges and opportunities effectively.

3.2 Findings from Map & Gap Analysis

3.2.1 Map Analysis

The map analysis identified **key technologies, protocols, procedures, implementation concepts, and guidelines** for building digitally responsible systems. The collected resources were grouped into four categories:

- structured and semi-structured repositories such as datasets and unstructured repositories such as Wikis,
- software tools and frameworks for managing, storing, processing, visualising, and transferring data,
- abstract concepts such as data encryption, with concrete instances like the Advanced Encryption Standards (AES) algorithm or Java security packages,
- guidelines, best practices, and standards for implementing digital data sources or applications.

The result of this analysis is the recognition that data storage and software applications must be designed with privacy and trust in mind **(privacy-by-design and trust-by-design)**. This highlights the importance of **Privacy-Enhancing Technologies (PETs),** which provide solutions for data encryption, data exchange or secure data storage.

Additionally, the study identifies **technical and organizational measures (TOMs)** as essential components for compliance with data protection regulations, such as GDPR. These measures include:

- access control measures to secure both physical and virtual environments,
- data lifecycle management to ensure secure storage, processing, and data deletion,
- cybersecurity protocols to prevent unauthorized access and data breaches,
- transparent user information policies to uphold digital responsibility principles.

For further details, the Map & Gap Analysis (D3.1)deliverable provides a complete list of data sources, implementation concepts, and guidelines referenced in this analysis.

3.2.2 Gap Analysis

The Gap Analysis was structured around 3 DRG4FOOD use cases, evaluating them from several aspects, including key enabling technologies, open technological challenges, regulatory and governance aspects, and benefits and risks for users. The following gaps and challenges were identified:

Food Tracking:

- Lack of comprehensive and real time food system data across the supply chain, from production to consumption, including food waste and side streams.

◆ Challenges in integrating diverse technologies (IoT, blockchain, Artificial Intelligence, digital labels) to ensure traceability.
◆ Limited interoperability and data standardization, making it difficult to harmonize tracking data across different platforms.
◆ High costs and resource requirements for small and medium sized enterprises (SMEs) to implement traceability solutions.
◆ Unclear regulatory frameworks for blockchain based food tracking applications.
◆ Data reliability and accuracy concerns, requiring dynamic and regularly updated datasets.
◆ Consumer trust issues due to complex technological solutions, making implementation challenging.

Targeted Nutrition:
◆ Lack of integrated and validated nutrition databases, leading to fragmented data sources (e.g. food composition, genetic, cultural data).
◆ Challenges in ensuring data reliability and developing standardized food ontologies.
◆ Limited consumer trust in AI-driven nutrition recommendations due to a lack of transparency in how advice is generated.
◆ Challenges in data collection, with user concerns about privacy, cyber risks, data tampering, and the limited application of zero-knowledge proof technologies.
◆ Difficulties in motivating user engagement, highlighting the need for better education and improved usability for consumers.
◆ Limited availability of peer-to-peer interactions, making it difficult for users to take an active role in managing their nutrition data.
◆ Uncertainty regarding data ownership and control, as users may hesitate to share personal health data with private entities.
◆ Scientific validation challenges, as AI driven dietary recommendations require evidence-based verification, and the necessary knowledge base is not yet fully developed.

Consumers' Food Choices:
◆ Lack of real time consumer centred tools to provide information on food choices during decision making (e.g., AI-driven apps, QR code traceability).
◆ Difficulty in integrating psychological and behavioural factors into food recommendation systems, making it hard to influence consumer decisions effectively.
◆ Challenges in balancing information provision with consumer autonomy, avoiding information manipulation.
◆ Privacy concerns over tracking food purchases and consumption behaviours.
◆ Risk of misinformation or inaccurate recommendations, as food choice algorithms may be influenced by commercial interests.
◆ Limited food literacy among consumers, leading to a gap between available data and actual behavioural change.
◆ Difficulty in maintaining updated and reliable food choice data, considering dynamic factors such as changing supply chains, nutrition science, and consumer preferences.

3.3 Findings from Foresight Analysis

In foresight analysis, each DRG4FOOD use case was broken down into **four micro-scenarios, representing potential future situations.** These were based on variations in technological innovation, citizen awareness, and public investment, leading to the following four micro-scenarios:

1. **Conservative:** incremental technological advancements, minimal improvements, and stagnant consumer awareness.
2. **Radical Tech Innovation:** rapid technological transformation, combined with a lagging regulatory system and low user awareness of the benefits and risks of emerging technologies.
3. **Citizens' High Level of Attention:** increased consumer concern influenced by both accurate information and misinformation campaigns, creating pressure for policymakers to act.
4. **High Investments in R&I:** significant public investment in the food traceability system, driving innovation and aligning with broader EU development goals.

A series of workshops were conducted with stakeholders, including policymakers, researchers, industry representatives, and NGOs, to evaluate the potential impact of the micro-scenarios. The discussions focused on identifying actionable outcomes for shaping a responsible food system. Key findings include:

◆ **The Potential of Digital Food Systems.**

Emerging technologies like blockchain for food traceability, AI-driven nutrition recommendations, and real time consumer tools could transform the food system. These innovations bring greater transparency, efficiency, and personalization, empowering both consumers and industry stakeholders. However, their success depends on trust, accessibility, and responsible governance.

◆ **Consumer Trust and Data Governance as Key Enablers.**

The willingness of consumers to share data is an essential factor. Many workshops' participants emphasized the need for clear, fair, and transparent data governance to ensure privacy, security, and user control. Without robust policies, the implementation of digital food solutions may face resistance, particularly due to fears of data misuse and commercial exploitation.

◆ **The Need for Inclusive and Fair Access.**

Technology should not widen existing gaps. Socioeconomic disparities and digital literacy remain barriers to the widespread adoption of food data solutions. Ensuring affordable, user friendly, and widely accessible tools is essential to prevent exclusion, particularly for SMEs, marginalised communities, and vulnerable populations.

◆ **Regulatory Uncertainty and Ethical Risks.**

Unclear AI and data protection regulations could hinder progress, while misinformation and commercial influence pose risks to food choice systems. Many participants highlighted the need for stronger EU standards and independent oversight to prevent manipulation and ensure ethical norms.

◆ **Strengthening Public and Private Collaboration.**

Addressing these challenges requires coordinated efforts between governments, businesses, researchers, and consumers. Private and public collaboration can accelerate sustainable and responsible digital food ecosystems.

The insights gained from these discussions, serve as the foundation for the actionable strategies outlined in the next section. These strategies aim to foster an innovative, responsible, and resilient food system, supporting broader EU policy objectives, **the European Green Deal**, **EU Declaration on Digital Rights and Principles** and **the UN Sustainable Development Goals.**

The roadmap emerging from this foresight process provides a strategic tool to anticipate risks, guide responsible innovation, and inform inclusive policymaking. It highlights the need to

ensure that emerging technologies serve the public interest, remain trustworthy, and actively reduce inequalities in the digital food ecosystem.

3.4 Roadmap Strategic Actions

The strategic vision of the DRG4FOOD roadmap is structured around two key strategic areas, where the first area is generally valid for all use cases and contains 5 sub-areas. The second strategic area represents the food tracking use cases. Each area as well as sub-area is addressing a critical dimension of digital responsibility in the food system. These areas are illustrated in Figure 3 below. For each action developed within these strategic areas, prioritization was determined based on the authors' expertise and then validated in three workshops.

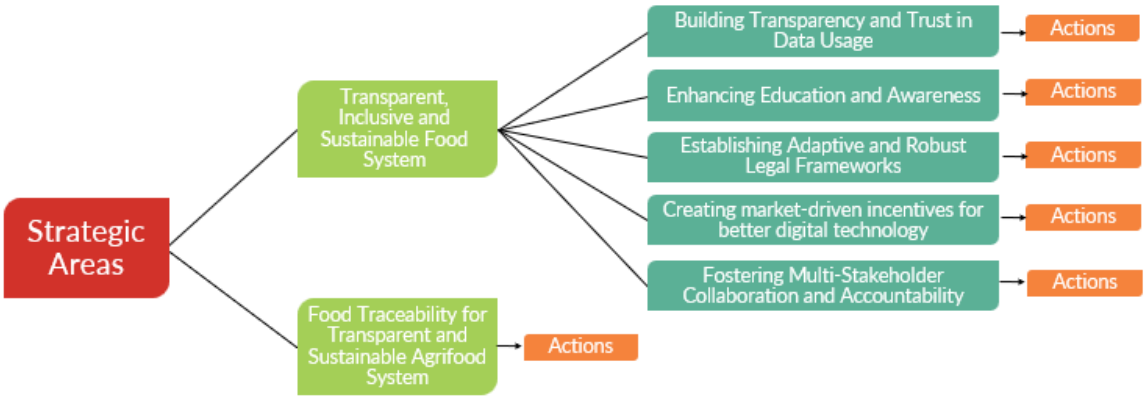


Figure 3. *Core strategic areas of the DRG4FOOD roadmap, guiding the transformation towards a fair, transparent, and inclusive digital food ecosystem.*

3.4.1 Strategic Approaches for a Transparent, Inclusive, and Sustainable Food System.

Strategic Sub-Area 1: Building Transparency, Trust and Awareness in Data Usage

As data becomes increasingly central to food production, distribution and consumption, concerns about privacy, misuse, and inequitable access to its benefits have grown. These challenges undermine trust among stakeholders, limit consumer engagement, and limit the adoption of innovative solutions. Public awareness and understanding of data use in the food system remain limited, particularly regarding the benefits and risks associated with data sharing. To bridge this gap, consumer-focused communication strategies should be developed to explain the benefits and risks of data use in simple, accessible terms, highlight the role of the data in driving sustainability and innovation, and help consumers recognize the value their data holds. In parallel, broad public awareness campaigns should be launched to reach wider audiences beyond formal education settings. These campaigns should use accessible messaging, mass media, and storytelling to improve general awareness of data's role in everyday life and build public trust. As organisations across the public and private sectors grapple with rapidly evolving data ethics and regulatory landscapes, there's an urgent need

for a centralised European resource that makes human-centered, transparent practices both accessible and actionable. This resource would support coherent communication, empower consumers, and reinforce trust across the entire food data ecosystem.

Action 1

Implement targeted communication strategies and public awareness campaigns to enhance consumer understanding of data use and the value of their data in food system using accessible messaging and divers media to reach a broad audience.
Priority: High

Action 2

Create a one-stop-shop for transparent and human-centered data practices for both public and private entities.
Priority: Medium

Many individuals lack the tools and resources necessary to control and manage their personal data effectively. Without these tools, people often feel disconnected or excluded from data-driven systems. Standardized, user-friendly, and inclusive tools, based on e.g. the European Digital Identity (EUDI) framework, should be developed to allow all people, regardless of socio-economic status or digital literacy, to access and manage their data effectively.

Action 3

Implement standardised and transparent tools that allow all individuals to access, manage, and control their personal data and clearly inform them of their rights and how to exercise them.
Priority: High

Strategic Sub-Area 2: Enhancing Education

Many people lack a clear understanding of the connection between data, food, health, and nutrition. This knowledge gap limits informed decision-making and prevents communities from fully engaging with and benefiting from technological advancements in the food system. To improve public understanding, knowledge transfer should be prioritised through practical and accessible learning opportunities, including workshops, community seminars, and online resources, to engage individuals across diverse demographics. Importantly, digital tools should be complemented by personal, hands-on experience and excursions to create more tangible and relatable learning.

Action 1

Launch comprehensive educational programs to improve public understanding of the connections between data, food, nutrition, and health.
Priority: Medium

Additionally, socio-economic disparities and digital literacy barriers intensify inequalities, leaving underserved populations unable to access or utilize digital tools effectively. Without

comprehensive education initiatives and targeted outreach campaigns, these barriers will persist, limiting the potential for systemic innovation and sustainability. Efforts should be made to reach schools, local communities, and digitally underserved populations through targeted campaigns that promote awareness and understanding of data use in the food system. Educational initiatives should also cover topics such as nutrition, food sourcing, sustainability, and responsible digital engagement with food information and services. By equipping individuals with these essential skills, this action will empower informed decision-making, promote healthier eating habits, and strengthen consumer resilience in an increasingly digital food landscape.

These campaigns should emphasize inclusivity, ensuring that vulnerable groups are actively engaged and supported in comprehending the role of data in their daily lives. These efforts should also focus on providing funding for training programs, access to digital devices, and improved internet connectivity in underserved areas. Actions in these areas could be linked to initiatives around the European Declaration on Digital Rights and Principles and funded by programmes such as Digital Europe.

Action 2	Expand outreach to schools, local communities and digitally underserved populations through targeted campaigns and incorporate food and digital literacy into school curricula and community programs. **Priority:** High
Action 3	Develop policies and initiatives to bridge socio-economic and digital literacy gaps, building on existing frameworks such as the European Declaration on Digital Rights and Principles. **Priority:** Medium

Finally, professional education across the food sector should be strengthened to equip workers, food business operators, and supply chain actors with essential digital and data knowledge. This includes tailored training for farmers and postgraduate programs for data users and professionals working in the fields of food, nutrition, and sustainability.

Action 4	Enhance professional education in the food sector through tailored training for farmers, workforce upskilling, and postgraduate programs for food and sustainability professionals. **Priority:** Medium

Strategic Sub-Area 3: Establishing Adaptive and Robust Legal Frameworks

A simplification and integration of current legal frameworks governing data collection, data sharing and data usage would create more certainty for businesses and citizens alike. A simplified user-friendly framework should build upon existing regimes such as the GDPR, EU AI Act or Data Act while addressing current limitations or overlap of these regulations. A support system for strengthening competencies in relation to digital rights and regulations

should be established for addressing questions of businesses and citizens alike. The appropriate governance levels at which these frameworks and support systems should be implemented (e.g., local, regional, national, or EU level) contain political aspects and can vary from country to country and from region to region. It is therefore not covered here but left to the policy makers to decide.

Action 1	Simplify and tighten legislation that protects data rights, supports sustainable food practices, and ensures ethical corporate behavior. **Priority:** High

Since technology innovation rapidly reshapes the food system, existing legal frameworks often struggle to stay aligned, leaving critical gaps in protection and governance. Outdated regulations face difficulties to address emerging challenges, such as the ethical use of AI in food production or the privacy implications of advanced data analytics. To ensure fairness and adaptability, legal frameworks must be dynamic and inclusive.

Action 2	Regularly update legal frameworks in a timely manner to align with technological advancement. **Priority:** High

Additionally, marginalized communities can face barriers in accessing and benefiting from data-driven innovations, either due to a lack of infrastructure (broadband access) or basic digital competencies. Without explicit legal provisions to address their needs, these groups are often excluded from the opportunities presented by technological advancements. Prioritizing inclusion through participatory processes ensures that marginalized communities are not left behind. Establishing policies that explicitly promote equity, guaranteeing that all groups benefit from data-driven advancements.

Action 3	Ensure inclusive legal frameworks for marginalized communities. **Priority:** Medium

Additionally, consumers are increasingly demanding transparency regarding the origins, production methods, and environmental impacts of the food they consume. Although producers put already information on the labels, the lack of accessible and clear information, partly caused by the limited space on food labels, undermine their ability to make informed choices. This gap weakens trust in the food system and slows the implementation of sustainable practices. Providing detailed information in both digital (e.g. QR codes or mobile applications) and non-digital formats (e.g. labels, in-store displays), will empower consumers, increase demand for ethical and sustainable products, and foster greater engagement with the agrifood system. A step toward this goal would be the introduction of a digital product passport for food products, enabling standardized, transparent, and easily accessible information along the entire supply chain. In addition, EU-wide legislation should be enhanced

on food information transparency, including front-of-pack labelling and stricter controls should be enhanced on digital food marketing targeting vulnerable groups.

Action 4

Motivate food producers and distributors to provide consumers with detailed information on food origins, production processes, and environmental impacts through both digital (e.g. QR codes, mobile apps) and non-digital formats while stricter controls are enhanced to protect vulnerable groups.
Priority: Medium

Strategic Sub-Area 4: Creating market-driven incentives for better digital technology

The lack of clear and consistent criteria defining "responsible" digital technology creates confusion in the food system. Without a standardized evaluation framework, stakeholders, including businesses, governments, and consumers, struggle to assess the ethical, sustainable, and inclusive impact of digital technologies. Developing a unified framework with measurable criteria ensures that all stakeholders have a shared understanding of what "responsible" means, enabling better decision-making and fostering alignment across the industry.

Action 1

Develop and desseminate a standardized evaluation framework and common measurement criteria for responsible digital technologies.
Priority: High

Without market-driven incentives, many organisations are reluctant to invest in digitally responsible solutions, fearing uncertain returns or competitive disadvantages. Encouraging voluntary adoption through recognition, certification, and access to resources creates a supportive environment where responsible practices are rewarded. At the same time, while innovation is essential for improving food security, efficiency, and safety, the introduction of modern technologies without adequate evaluation can lead to unintended social, economic, and environmental consequences.

To build a consumer-centric and responsible digital food system, it is crucial to make social impact assessments a standard practice. This ensures that new food technologies are aligned with public interests and contribute meaningfully to a more inclusive and sustainable future. Demonstrating the economic benefits of adopting these technologies, such as increased efficiency, consumer trust, and risk mitigation, enhances their value and motivates broader adoption across the food sector.

Action 2

Promote implementation of responsible digital technologies through market-driven incentives, by aligning e.g. public procurement schemes with DRG compliance criteria. Provide targeted subsidies for SMEs meeting digital responsibility benchmarks.
Priority: Medium

Action 3	Invest in research to demonstrate the economic benefits of responsible digital technology. **Priority:** Medium

Additionally, a standardized public rating system for nutrition apps should be introduced to evaluate and highlight evidence-based, reliable solutions. Publicly displaying these ratings will empower consumers to make informed choices and encourage app developers to meet higher standards of credibility and ethical data practices. By fostering responsible innovation, food technologies can play a pivotal role in reducing food waste, lowering carbon emissions, and promoting resource efficiency, while also strengthening consumer confidence and equitable participation in the food system. Establishing clear policies that support sustainable and socially responsible advancements will create a resilient and fair food system where innovation is a force for positive and inclusive transformation.

Action 4	Establish a public rating system for nutrition apps to ensure transparency and reliability. **Priority:** Low

Action 5	Encourage the development of technologies and innovations that prioritize sustainability, transparency, and equity. **Priority:** High

Strategic Sub-Area 5: Fostering Multi-Stakeholder Collaboration and Accountability

The complexity of the food system requires collaboration among diverse stakeholders across the food system. However, fragmented efforts and unclear roles often lead to inefficiencies, duplication, or gaps in addressing critical challenges such as sustainability, waste reduction, and resource efficiency. Without a coordinated approach, stakeholders may struggle to align their efforts with shared goals, resulting in missed opportunities for innovation and progress. Establishing multi-stakeholder partnerships provides a platform for alignment, enabling better coordination, clear role definition, and collective action toward a transparent and sustainable food system.

Action 1	Create a platform for stakeholder to exchange and which provides guidance to clarify responsibilities and track progress across the product lifecycle. **Priority:** Medium

Action 2	Develop a secure and collaborative food data space in the EU to integrate and share data across the food system, ensuring accessibility, security, and alignment with privacy and ethical standards. The data space should also support interoperability with other data spaces and initiatives, such as European Open Science Cloud or Common European Agricultural Data Space (CEADS). **Priority:** Medium

At the same time, the development of more sustainable practices, particularly in packaging and by-product management, requires access to reliable, high-quality data. Current practices often prioritize cost over sustainability, due to the lack of data-driven insights into environmental impacts and resource use. By encouraging sustainable solutions and promoting transparency, collaborative efforts can align with environmental goals and gain public trust.

Action 3	Incentivize sustainable practices through funding programs, public recognition, and targeted regulations that reward innovation in packaging and by-product management. **Priority:** Medium

3.4.2 Strengthening Food Traceability for a Transparent and Sustainable Agrifood System

Traceability ensures accountability, enhances food safety, and provides consumers with detailed information on food origins, production methods, and environmental impacts. Current systems face challenges such as inconsistent communication protocols, limited standardization, and unequal access to technologies, particularly for small and medium-sized enterprises (SMEs). By adopting modern technologies and implementing uniform communication standards, the food supply chain can become more reliable, efficient, and transparent. This will not only build trust among stakeholders but also facilitate seamless data sharing and decision-making across the agrifood system. Unified standards developed through partnerships between public and private entities can further enhance accountability and consistency.

Action 1	Establish standardized communication protocols and common data standards for data exchange. **Priority:** Medium

Small and medium-sized enterprises (SMEs), often experience significant limitations, such as limited financial resources, insufficient technical expertise, and reduced access to advanced technologies. These difficulties exclude them from participating in sustainable and efficient supply chains, deepening the gap between small and large stakeholders. To create a fair and inclusive agrifood system, it is essential to develop technologies that are affordable, user-friendly, and accessible to all. Providing financial incentives and open-source tools will enable

smaller actors to integrate traceability systems into their operations with minimal effort, fostering equitable participation and improving overall supply chain sustainability.

Action 2	Promote the development of low-cost, user-friendly traceability technologies accessible to small-scale actors, through support of open-source communities and targeted financial incentives. **Priority:** High

Equity in supply chains is closely related to preventing larger stakeholders from monopolizing data and technology. Without appropriate regulatory frameworks and empowered public authorities, smaller actors often lack access to or fail to benefit from traceability innovations. Public authorities play a significant role in auditing compliance, enforcing fair practices, and ensuring that technologies are accessible and affordable for all supply chain participants. Clear regulations and oversight mechanisms are necessary to foster equitable access to technology, protect smaller actors, and create fair competition in the agrifood system.

Action 3	Empower public authorities to ensure equitable access to traceability systems such as provenance platforms, QR code labelling, or databases tracking environmental and social impact, prevent data monopolisation, and enforce compliance with legislation. **Priority:** High

3.5 Conclusions

The DRG4FOOD roadmap represents a concrete step towards a more transparent, inclusive, and digitally responsible food system in Europe. By aligning with the DRGs and embracing a multi-stakeholder, human-centred approach, this strategy offers actionable guidance for governments, industries, researchers, and civil society.

It brings forward a shared vision of a future where digital technologies not only enhance food system efficiency and innovation, but also safeguard individual rights, promote equity, and build collective trust. Through its strategic areas and practical recommendations, the roadmap outlines how fairness, transparency, and accountability can become cornerstones of digital transformation across the entire food value chain.

The successful implementation of the roadmap will require long-term political commitment, cross-sectoral alignment, and sustained investment in education, digital infrastructure, regulatory innovation, and community engagement. This means building stronger bridges between policymakers and citizens, ensuring that both institutional and civil society voices shape the direction of data-driven innovation.

Most importantly, the roadmap calls for placing citizens at the heart of digital food innovation, not just as data sources or end-users, but as empowered actors with rights, responsibilities, and agency. It envisions a food system where technological progress serves both people and the planet, contributing to public good while actively reducing inequalities and strengthening democratic control over digital tools.

As digitalisation continues to shape the future of food, the DRG4FOOD roadmap offers more than a path forward, but a framework for ensuring that this transformation remains ethical, inclusive, and sustainable, in line with European values and global sustainability goals.