



# Digital Transformation for More Nutritious Food Systems

How Digital Tools Can Be Used to Scale and Commercialize Nutrient-Enriched Staple Crops



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Digital Innovation

# How can HarvestPlus improve the nutrition of a billion farmers and consumers by 2030?

Increased adoption of technology and digital tools can create incentives to switch to nutrient-enriched varieties, strengthen supply chains, and empower low-income and potentially vulnerable food producers.



HarvestPlus is implemented by teams across the CGIAR and their partners. Over 70 million people in farm households, and millions more in the marketplace, are benefitting from biofortification delivery programs. In our experience, it takes a full range of support to bring biofortified seeds, grains, and foods to farmers and consumers. Digital technologies allow us to take this approach even further.

Developing economies increasingly have strong mobile networks, and more people are starting to use smart- or mobile-phones each day. The environment is primed to implement technologies that increase productivity, food safety, and value for farmers and commercial value chain actors in [all countries HarvestPlus operates in](#).

HarvestPlus is committed to the investigation, adoption, and research of new technology including digital tools to scale out nutrient-enriched crops. Our work in this area began in 2017 and was rapidly accelerated during the COVID-19 pandemic. Digital technologies proved essential to continue implementation activities in a non-contact environment, such as agricultural extension services and linking farmers to seed and grain markets. HarvestPlus discovered that they are more cost-effective and efficient to reach new people and our beneficiaries, stakeholders, and value chain actors in all countries are highly receptive and willing to work with new tools and technologies.

In this approach, digital tools are implemented at each point of commercial supply chains. This is done to enable stakeholders to build sustainable, commercially independent food supply chains that bring healthier foods to beneficiaries on the farm and in both formal and informal markets, and connect these users with policymakers, investors, and institutions.

This paper explains the need for digital tools and how they enable commercialization and scale, the impact on users, and the risks and benefits with examples of projects and partners along the value chain. This approach is being applied across all HarvestPlus activities and digital projects are researched and reported as part of the CGIAR Digital Innovation Initiative.





HarvestPlus has initiated digital platforms for farmers in seven countries, with four different private sector service providers.

If digitization is a conversion of data and processes, **digitalization is a transformation.** More than just making existing data digital, digitalization embraces the ability of digital technology to collect data, establish trends, and make better business decisions.

### HarvestPlus Digital Objectives

- Provide tailored training and support for male and female farmers to make use of digital technologies, especially low-income and vulnerable groups
- Improve farmers' access to markets for biofortified foods
- Create future-proofed, sustainable, and independent biofortified food supply chains
- Attract youth to biofortified farming
- Build an array of tech services providers
- Bring in new investors, sponsors, and donors
- Deliver certified, traceable healthy foods to consumers



# Seven Ways that Technology Can Build Nutritious Food Systems

## 1. Digitization

Paper-based processes and services can be made electronic. For example, biofortified seed production and sales in Nigeria can be more efficiently managed in spreadsheets and stored in cloud services.

## 2. Digitalization

New services can be created and existing ones can be transformed by technology. For example, in Pakistan there is little traceability in food supply chains, which would be transformed by implementing a digital system. When paper-based systems are digitized, finding new uses for this data is considered digitalization.

## 3. Technology

New tools, machines, or objects both tangible or intangible (e.g., software) can be introduced to improve existing processes or procedures. An example in biofortification is the use of drones or satellite images to monitor crop growth rates and yields. Another is using a new food processing process to protect the beta-carotene content of a food.

## 4. Traceability

Digital technologies can be used to follow and document the journey of a seed or ingredient along the supply chain, and this traceability is increasingly a legal requirement. Digitalization of the supply chain reduces food safety incidents and fraud while opening up more sustainable, commercial markets. It also makes it possible to trace nutritional value from seed to food, or other aspects such as carbon footprint.

## 5. Certification

In the case of biofortified crops, this is proving or certifying to each value chain member that the seed, grain, or food is derived from a genuine biofortified source which conforms to a particular standard, in most case this standard is the [Publicly Available Specification](#). Certification is easier when a supply chain is monitored and controlled with digital processes. Digital databases of suppliers and users allow for faster connectivity to audit, manage, document, and then provide certification. Using QR codes on packaging buyers, customers and consumers can view the supply chain and certification process themselves.

## 6. Blockchain

Also known as Distributed Ledger Technology (DLT), this provides a decentralized record stored in the cloud. As blockchain does not require a central authority to manage, own or collate the data, blockchain can be a low-cost solution even where institutional support for traceability is limited. Read more: [www.harvestplus.org/can-blockchain-bolster-biofortification-value-chains/](http://www.harvestplus.org/can-blockchain-bolster-biofortification-value-chains/)

## 7. Artificial Intelligence (AI)

AI can provide timely predictions from large amounts of digitized data. This can be used to monitor changes in food systems due to the introduction of biofortification and other nutritional interventions and map out the associated benefits on health, disease outcomes and DALYs (disability adjusted life years), for example.





# How Digitalization Can Scale Biofortification

Digitalization has generalized benefits for food systems, creating efficiencies between producers, processors, and markets, enabling traceability and access to markets. Biofortification is largely “hidden” trait in food crops: customers must be able to trust food systems and be aware of the benefits of more nutritional food for the market to exist.

Digitalization of the biofortified supply chain creates visibility and traceability from seed to food, and provides information for policymakers, institutions, and enterprise to invest in the health benefits and value of biofortification. Introducing these technologies in parallel will increase the impact of biofortification efforts.

Data sharing between stakeholders will catalyze change and accelerate the transformation of the agriculture sector, serving low-income farming families and women farmers while informing policy design and delivery at the local, regional, and national levels. At food production level, businesses adopting digital tools can become more efficient, producing safer foods making them more competitive and attractive businesses to customers and consumers.

Digital projects are required at each step of the value chain, building connections throughout and collecting digitized data for reporting, publications and future modeling.

HarvestPlus has developed the [Biofortification Priority Index \(BPI\)](#), which is a digital tool that ranks 128 low- and middle-income countries according to their impact potential for investment in each of the 13 biofortified staple food crops. The tool enables stakeholders and investors to identify needs and opportunities to benefit the local population. The BPI is being improved to include predictive modelling of impact and interactions with other nutritional interventions.

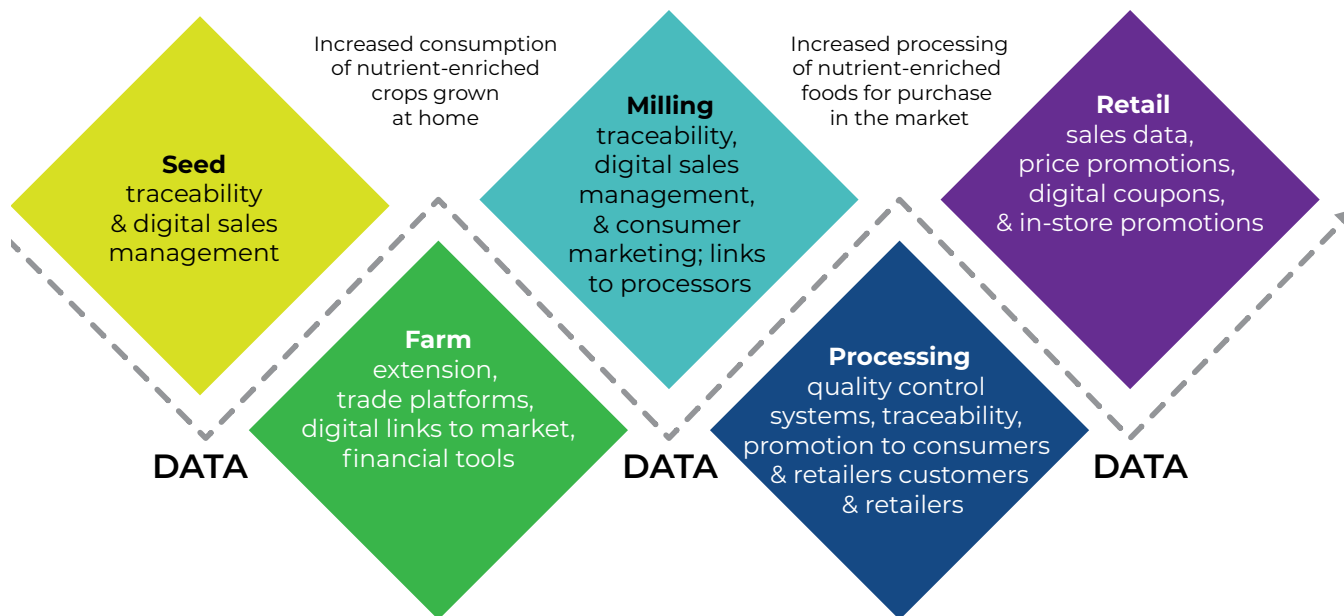


**Digital technologies, with their rapid development and deployment, can overcome long-standing market and policy failures and accelerate food system transformation if an enabling environment and complementary investments are put in place.”**

— The World Bank. *What's Cooking: Digital Transformation of the Agrifood System*

# How Does Digitization Lead to Scale In the Biofortified Supply Chain?

## The Impact Pathway



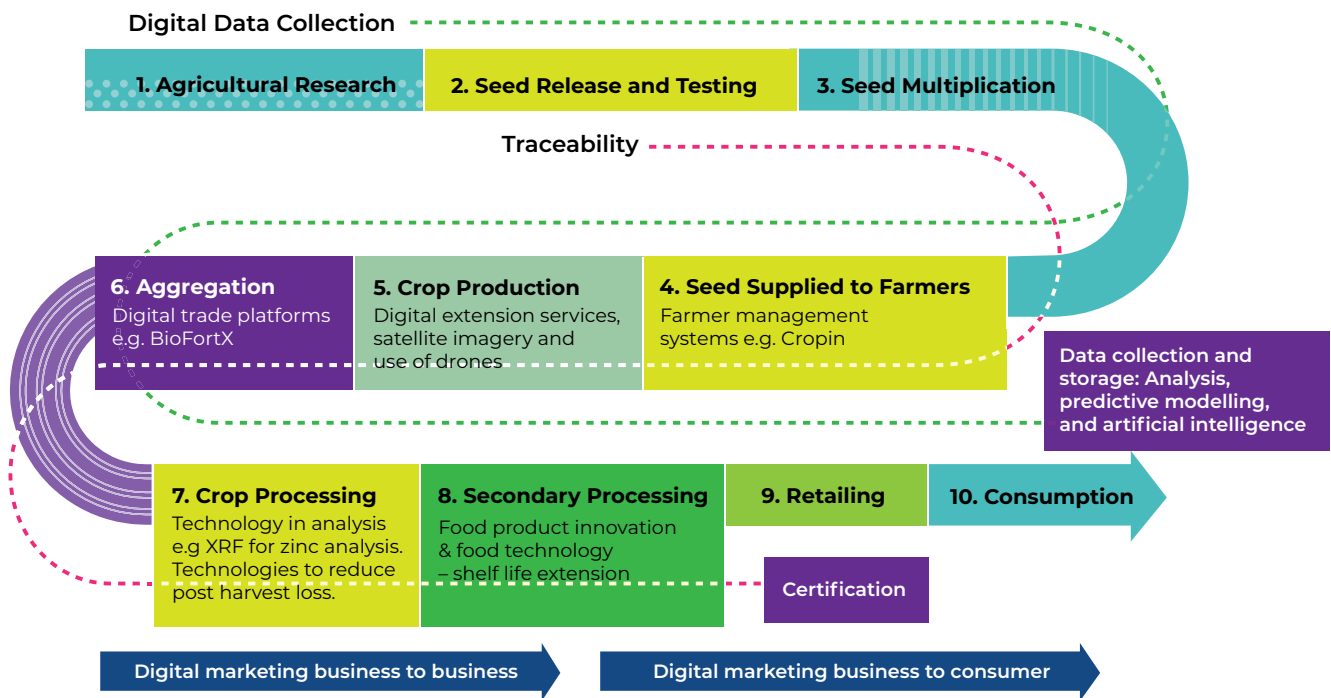
## Digital Projects Across the Value Chain

### New digitalization projects at HarvestPlus include:

- Seed, grain and food market analysis.** Baseline assessment of markets, critical entry points to promote biofortified foods to businesses and consumers, consumer purchasing behavior, and future trends.
- Predictive modeling.** A tool to understand the nutrition quality of staple food systems and predict the impact of nutrient fortification and biofortification, as well as on gender in the workforce, social inclusion, market access, livelihoods, climate, conflict, and disease outcomes. Examples include the BPI and planned work to build a predictive model.
- Seed system digitization.** Includes QA/QC, traceability, and digital sales management. HarvestPlus works with several service providers to establish routes to digitize seed sales, monitor purchases using QR codes, and link buyers of biofortified seeds to digital extension services.
- Farmer support platforms and digital extension.** HarvestPlus has initiated digital platforms for farmers in seven countries, with four different private sector service providers. In 2021, a successful project used digital extension to improve yields and incomes for [100,000 farmers in Pakistan](#). This approach can be applied to all HarvestPlus programs to include digitization of agricultural advisory services and agronomic training. Other [projects](#) support technologies such as geotagging, satellite imagery, and drones to monitor crop production.

- **Farmer trade platforms.** Linking seed producers, farmers, aggregators, and processors so they can trade their goods on a digital platform. The best examples of this are found in Nigeria with the BiofortX platform.
- **Food quality management.** HarvestPlus has three traceability partners and is currently piloting schemes in several markets, for example through work with Food Portal to pilot digital quality management systems in Pakistan. All businesses who work with HarvestPlus are encouraged to adopt paper-based traceability operations that can be digitized.
- **Digital marketing.** HarvestPlus works with retailers to obtain sales data and partners such as Euromonitor to collect market data that can be used to identify opportunities or stimulate demand through in-store promotions and coupons.
- **Digital promotion and demand creation.** It is essential to create demand for biofortified seeds, grains, and foods at multiple points along the value chain, which can be done via digital media. Pakistan [provides](#) the best example of HarvestPlus' digital communication activities across the value chain.
- **Digital data collection.** All the above interventions produce data that can be used for reporting and prediction.

## Digital Projects Across the Value Chain



*Digital projects are required at each step of the value chain. It is also necessary to build connections throughout the chain and collect digitized data for reporting, publications, and future modeling.*

# Monitoring, Evaluation, Learning and Risk Management

An additional benefit of digital technology is that it creates data that can revolutionize current methodologies for monitoring, evaluation, and learning (MEL). Automated and live data collection through cloud based and integrated information systems creates a more cost-effective means for earlier reporting, communication, and donor reporting. This data can also be used for predictive impact assessment of food systems and the outcome of nutrition interventions.

## Risks and Risk Management

Risk	Mitigation
<p><b>Digital divide:</b> The risk of excluding low-income consumers and businesses who already are disadvantaged by poor access to education and services.</p>	<ul style="list-style-type: none"> <li>• Target beneficiaries of the HarvestPlus program are those most at risk of digital exclusion. HarvestPlus is in a unique position to take technology to low-income consumers and small businesses.</li> <li>• As part of One CGIAR, we can simultaneously research target beneficiary needs and barriers to adoption, and provide sustainable solutions.</li> </ul>
<p><b>Sustainability:</b> How will new technologies and services survive beyond the lifespan of donor supported projects?</p>	<ul style="list-style-type: none"> <li>• Ensure there is a demonstrable return on investment that the user sees so they will make their own digital investments in the future. The majority of biofortified supply chains already exist in a commercial, demand-driven ecosystem that incentivizes partners to provide high quality products and services to the customers reached through the HarvestPlus program.</li> <li>• Early calculations predict increases in production, yields and revenue from the use of technology. Users that benefit from technologies will continue to pay for services from increased revenue.</li> </ul>
<p><b>Data governance:</b> How to ensure user data is protected, users can opt out, personal data is not shared and international laws and regulations are followed?</p>	<ul style="list-style-type: none"> <li>• Establish in-house expertise on data governance and legislation. Work with service providers to ensure clear divisions of data ownership and protection.</li> <li>• Work with the beneficiaries and recipients of the tools to ensure they understand and are aware of their individual rights and control of their own data.</li> <li>• Provide recipients with the ability to opt out whenever they wish.</li> <li>• Never share datasets or personal information with anyone — without explicit and informed consent.</li> </ul>
<p><b>Competition:</b> How to can we avoid HarvestPlus partners developing monopolies?</p>	<ul style="list-style-type: none"> <li>• Operate through open, competitive procurement.</li> <li>• Ensure the best prices from our partners, work with multiple partners and ensure the users know their options.</li> <li>• Working with multiple partners even in the same country and project fosters competition and drives prices down.</li> <li>• Establish long-term arrangements and business plans with partners.</li> </ul>
<p><b>Gender:</b> Women are at greater risk of exclusion from technology and digital tools due to less access to mobile phones and the internet.</p>	<ul style="list-style-type: none"> <li>• Understand current barriers for women and establish ways to break them down.</li> <li>• Use non-digital tools to initially reach women.</li> <li>• Make women the primary target of projects.</li> <li>• Establish targets and indicators at the project outset to disaggregate all data collection by gender and equal or proportionate reach of women.</li> <li>• Train men on the importance of inclusion.</li> </ul>



# Digital technologies have proven potential to empower poor populations with new communication tools, to facilitate connectivity along the value chain and to equip farmers with knowledge on key challenges and opportunities.

## Working within CGIAR

HarvestPlus is working with the CGIAR Digital Innovation Initiative, contributing to the evidence base for [how digital technologies can contribute to agricultural transformation](#), and benefiting from the community of expertise and collaboration across CGIAR.

## Our Vision for the Future

HarvestPlus will implement technologies and digital-based solutions at each step of the value chain in all supply chains supported with delivery and scaling in the countries where we work. Digitalization is both a key driver to scale but also imperative for sustainability of biofortified food supply chains which should be both nutritionally superior to standard crops and certified higher quality. We can support our beneficiaries with nutritionally enhanced foods and new skills that enable their business to grow, from the smallholder farmer to the retailer. With the expertise and current reach of the HarvestPlus team at each step of the value chain, HarvestPlus is uniquely positioned to improve food supply chains through nutrition and technology. All delivery, scaling, and commercialization projects going forward will be designed with digitization and technology as key tools for implementation.

## Sustainability

The HarvestPlus objective in technology and digitization is to kick-start or initiate projects by linking farmers and value chain players with service providers. Through donor or sponsor investment HarvestPlus can reduce the risk of investment in technology by supporting the initial fees for software or other investments. The longer-term sustainability

of projects depends on the impact and benefits that the technology provides the user — before starting a project, cost benefit, and risk analysis is carried out to ensure that the user will see a benefit through regulatory compliance, efficiencies, cost savings or increased profits; this additional income for the user will be used to sustain the investment and continue progress. It is essential to foster commercial and private sector involvement as service providers — this ensures a competitive and open marketplace for users to have choice, keeps running costs low, and avoids monopolies.

## Return on Investment

For each digital investment, a return-on-investment calculation is developed. For example, the average rice farmer in Indonesia can produce two tons paddy per harvest (based on the average of 0.3 ha per individual farmer). The average price of paddy is Rp 5,000/kg, so each farmer will get Rp 10,000,000/harvest or Rp 20,000,000/year. If a farmer is required to pay a license fee for software of USD \$10 (approx. RP 150,000/farmer/ two planting seasons or two harvests per year, so the license fee will be about 0.75% of the farmer income. This can be paid by the farmer group and/or by other stakeholders such as input companies, insurance companies, aggregators, or rice traders. In Pakistan, farmers who received digital extension services saw up to 30% increase in yield and or profits, part of which can fund extension services in future. Discussions are underway with several government extension services on methods to provide revenue generation through advertising and promotion from the private sector, if moderated and regulated properly this would be a much more sustainable way to service farmers.



## Our Partners

HarvestPlus works with multiple service providers including academic organizations and partners within One CGIAR, as well as with private sector service partners who provide commercial products and services. It is essential to partner with commercial organizations who will maintain digital services after the initial catalyzation and establishment phase with HarvestPlus.

While HarvestPlus has built implementation intelligence with trusted partners, we will always operate through a system of fair competitive procurement. Please visit our website for existing opportunities to partner with us: [ifpri.org/workwithus](http://ifpri.org/workwithus).

For more information on scaling, commercialization, and digital implementation at HarvestPlus please contact [harvestplus@cgiar.org](mailto:harvestplus@cgiar.org) or watch our webinar, “[Harnessing Tech in Nutrition-Smart Agriculture](#)”.

The [CGIAR Digital Innovation Initiative](#) accelerates the transformation towards sustainable and inclusive agrifood systems by generating research-based evidence and innovative digital solutions. It is one of 32 initiatives of CGIAR, a global research partnership for a food-secure future, dedicated to transforming food, land, and water systems in a climate crisis.

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