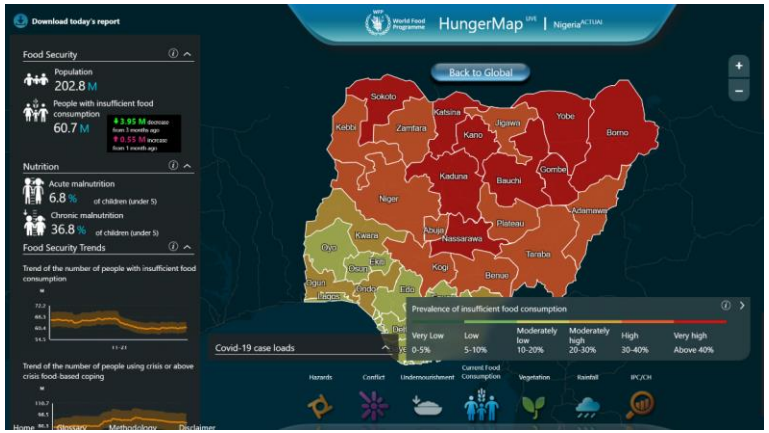
Data DENT

Data for Decisions to Expand Nutrition Transformation

A landscape of trends and opportunities in nutrition data innovations

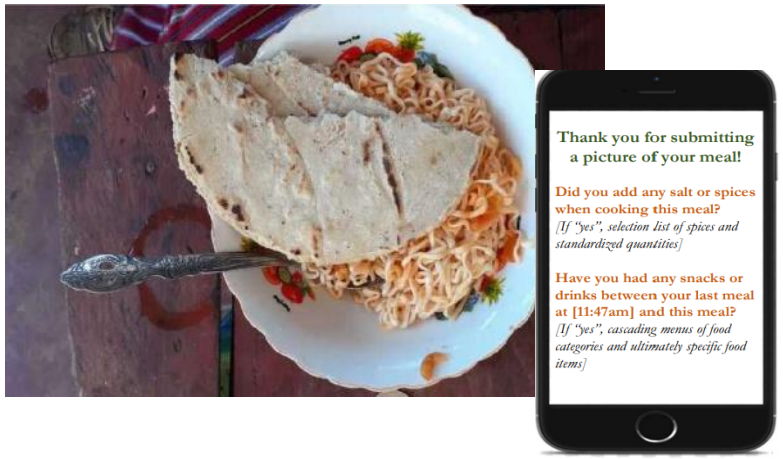
Jan 2022

Nutrition data innovations hold promise for strengthening the nutrition data value chain across low- and middle-income countries (LMICs)



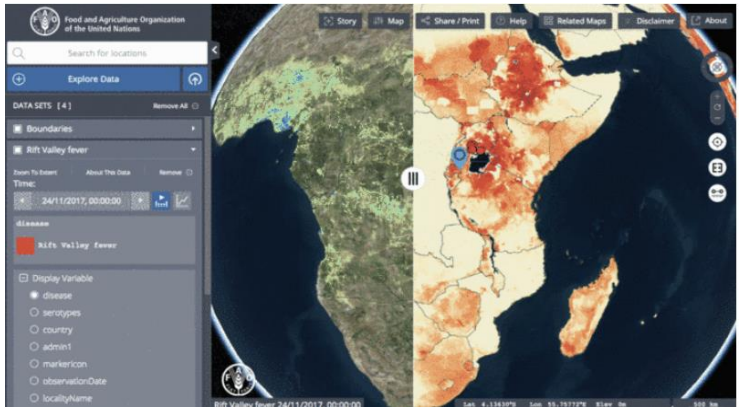
Hunger monitoring system leveraging big data & machine learning[1]

Artificial intelligence used to determine hemoglobin levels[2]



Remote dietary assessment through pictures[3]

Artificial intelligence used to detect malnutrition[4]



Geospatial platform with data on food and agriculture[5]

Digital data capture for food fortification quality assurance[6]

This work aims to conduct a landscape of trends and opportunities for nutrition data innovations

Step I: Objective

Start a conversation among donors, governments, and development partners in LMICs with stake or who invest in the nutrition DVC about emerging solutions and potential investments in data innovations

Step II: Scope Inclusion

Data innovations created in or after 2015 which use new or non-traditional data sources, methods, and partnerships to reframe issues and generate new solutions, and fall within the following nutrition data domains: nutrition status, diet, food environment, food security, food fortification, and micronutrients

Step III: Methods

Nutrition data innovations were identified through a combination of desk reviews (via internet search) and stakeholder consultations

**Please note we did not conduct a comprehensive review since the project aim was to provide a snapshot of overall trends in nutrition data innovations, not to create an inventory of all innovations*

Please refer here to review the comprehensive slide deck for this work.

To set the scene for this work, we identified 9 data innovation categories based on our scoping review

Indicator development
- ❑ De novo indicators
- ❑ Proxy indicators
- ❑ Composite indicators

Citizen-generated & open data
- ❑ Citizen-generated data
- ❑ Open data
- ❑ Crowdsourcing

Mobile solutions
- ❑ Data collection tools
- ❑ Wearable devices
- ❑ Case management apps
- ❑ Diagnostic & clinical decision support apps

Modeling & simulation tools
- ❑ Economic optimization modeling
- ❑ Health impact modeling
- ❑ Policy impact modeling

Digitalization
- ❑ Electronic health records
- ❑ Blockchain

Geospatial data & statistics
- ❑ Remote sensing
- ❑ Geospatial mapping
- ❑ Geographic information system/spatial statistics

Artificial intelligence
- ❑ Machine learning
- ❑ Deep learning
- ❑ Natural language processing
- ❑ Computer vision

Data visuals
- ❑ Scorecards
- ❑ Dashboards
- ❑ Index
- ❑ Profiles

Data collaboratives & partnerships
- ❑ Data collaboratives
- ❑ Data partnerships

Big data is often embedded within these categories. Big data (in terms of large complex datasets) may be derived from mobile solutions, geospatial data, health records, etc., and is often processed using artificial intelligence or visualized by data visuals.

These data innovation categories have the potential to influence one or more segments of the data value chain

	Prioritization	Creation & Collection	Curation	Analysis	Translation & dissemination	Decision Making
Indicator development	■	■				
Digitalization		■	■			
Citizen-generated & open data		■	■			
Geospatial data & statistics		■		■		
Mobile solutions		■	■	■	■	
Artificial intelligence		■	■	■		
Modeling & simulation tools				■		
Data visuals					■	■
Data collaboratives & partnerships	■	■	■	■	■	■

Key Findings

Key findings from our review of nutrition data innovations include:

Key Finding 1

There has been a significant number of nutrition data innovations since 2015—we found approximately 60 in the domains and sources we reviewed

Key Finding 2

The majority of nutrition data innovations found are mobile solutions, artificial intelligence, or digitalization

Key Finding 3

Nutrition data innovations have started to bring solutions to fundamental data challenges, but there is more work to do given challenges remain

Key Finding 4

Data innovations from other sectors can be leveraged to strengthen nutrition data value chains

Key Finding 5

Use of data innovations by nutrition stakeholders has accelerated during the COVID-19 pandemic in response to unique data challenges

There is a growing number of nutrition data innovations—we found approximately 60 in the domains and sources we reviewed

Nutrition Domains

- **Nutrition Status Data = 22**
- **Food Fortification Data = 4**
- **Diet Data = 21**
- **Micronutrient Data = 6**
- **Food Environment & Food Security Data = 14**

DVC Stage Influenced

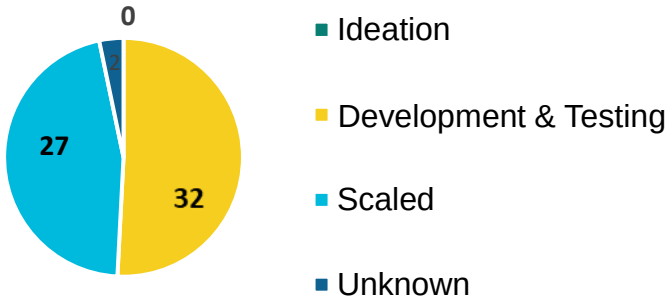
Prioritization	Creation & collection	Curation	Data analysis	Translation & Dissemination	Decision Making
6	24	22	36	29	0

Top Funders

unicef · Foreign & Commonwealth Office · USAID FROM THE AMERICAN PEOPLE · WFP · Bill & Melinda Gates foundation

*The top funders **are mostly consistent with top funders for nutrition data and information systems (ND&IS)** more broadly***

Scaling Stage*



*For details on how we define the DVC and scaling stages, please refer to the definitions list here
**For more information on donor funding for ND&IS, please refer to DataDENT's work on tracking donor financing here

A significant number nutrition data innovations found are mobile solutions, artificial intelligence, or digitalization

Mobile solutions are the use of mobile and wireless technologies for data entry and storage or to support decision-making (often when paired with other innovations on the backend)

Used to

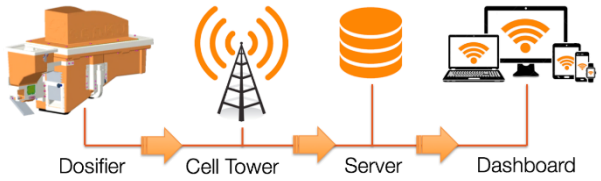
Collect and store data in **real-time** across several nutrition domains to monitor fortification processes, food security crises, etc.

Enable **remote data collection**

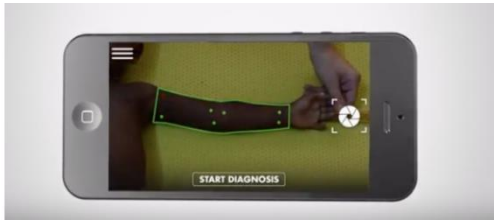
Improve the **speed and accuracy of diagnosing nutritional conditions** by using mobile apps to help with complex calculations or apps with artificial intelligence that can diagnose malnutrition from a photo

Please note successful use of mobile solutions is based on affordability and access to cellular devices and Wi-Fi connection.

Examples from different nutrition domains



Sanku Smart Dosifier Machine[7]
Technology that collects data from flour mills via cellular-connected dosifiers, granting access to real-time data via GPS & automatic curation into a central, cloud-based dataset



SAM Photo Diagnosis App[8]
Mobile app which uses a photo to automatically diagnose malnutrition in children using geometric morphometric techniques

Citizen H2D3[9]
A real-time system for monitoring dietary diversity in space and time, based on a citizen-driven spontaneous crowdsourcing approach using an interactive mobile app

For more examples of mobile solutions being used for nutrition data, please refer to the comprehensive slide deck here.

A significant number nutrition data innovations found are mobile solutions, artificial intelligence, or digitalization

Artificial intelligence is the development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, & language

Some uses include:

- Provide **predictive insights and forecasting** for malnutrition and food security early warning systems
- Analyze large amounts of data to provide **decision support**

Please note AI is not always feasible given its implementation requires specialized technical knowledge and equipment.

For Example

Nutrition Early Warning System (NEWS)[10]

Uses machine learning to aggregate and analyze satellite imagery and traditional data to provide ongoing surveillance of nutrition threats and options for nutrition interventions

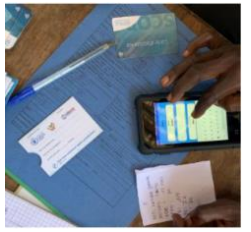
Digitalization is the use of digital technology to transform systems or processes to bring efficiency to operations & improve service delivery

Some uses include**:**

- Create **data management platforms which streamline** the process of collecting, storing, analyzing, and sharing nutrition status and diet data

Risks include data privacy, data security, & the potential of a system failure which can result in disruptions to service delivery and data capture.

For Example



SCOPE CODA[11]

A cloud-based platform to improve data management in malnutrition treatment programs by giving a digital identity to clients and tracking nutrition services using android devices and a personalized smartcard linked to an electronic database

For more examples of artificial intelligence and digitalization being used for nutrition data, please refer to the comprehensive slide deck here.

We also found some nutrition data innovations in the other data innovation categories

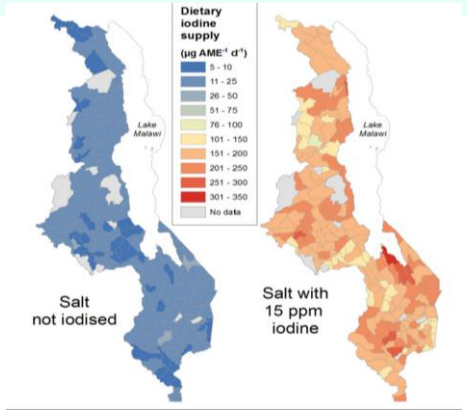
Data Innovation Category	Definition	Examples (hyperlinked)
Indicator Development	New measures and metrics that provide information on a particular topics	Composite indices of anthropometric data quality; Metrics to assess advocacy efforts
Citizen Generated & Open Data	Data sourced directly from individuals in a population through voluntary reporting; data that are freely used, shared, and aggregated together for public value	Citizen-H2D3; Show me what you eat: Assessing diets with images
Geospatial Data & Statistics	Tools which utilize geospatial data for geographic mapping and to conduct analysis	Hand in Hand Geospatial Platform; Geospatial Modelling of Nutrition Status
Modeling & Simulation Tools	Tools which analyze data to help make predictions or guide decision-making based on a specific set of conditions	Micronutrient Action Policy Support (MAPs); Optima Nutrition
Data Visuals	Visuals which provide graphical representations of data that helps people see trends, outliers, and patterns	Food Systems Dashboard; HungerMap LIVE
Data Collaboratives & Partnerships	New mechanisms or networks for bringing together different entities (e.g., research institutions, NGOs, government agencies, private companies) to support one or more aspects of the data value chain	Gallup Global Diet Quality Project; GODAN (Global Open Data for Agriculture and Nutrition)

For the full list of nutrition data innovations, please refer here: https://datadent.org/landscape-of-nutrition-data-innovations/ .

KEY FINDING 3

Nutrition data innovations have started to bring solutions to fundamental data challenges, but there is more work to do given challenges remain (Selected Example 1/2)

Nutrition Domain	Example Data Challenges	Innovations to Address Some Challenges	Some Remaining Challenges
Micronutrient Data	1. Overall **lack of new data** due to high costs and logistical constraints around data collection 2. **Incomplete & poor-quality data** due to lack of standardized protocols to assess micronutrients	**Modeling and simulation tools** are being used to provide estimates of micronutrient deficiencies where primary data is not available **For example:** Micronutrient Action Policy Support (MAPS) tool - communicate estimates of dietary micronutrient supplies & deficiency risks at national & sub-national scales in Africa	• Need to **standardize protocols** to assess micronutrient intake given current proxies used to assess deficiencies can be inadequate • Need fast, reliable, and low-cost **diagnostic tools** to collect high-quality data on micronutrient status



Maps show dietary iodine supplies in Malawi with & without iodization of salt[12]

KEY FINDING 3

Nutrition data innovations have started to bring solutions to fundamental data challenges, but there is more work to do given challenges remain (Selected Example 2/2)

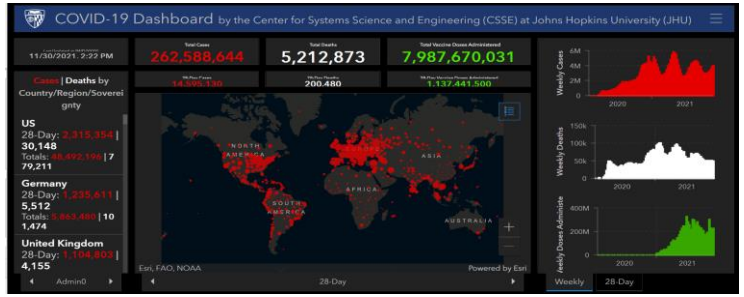
Nutrition Domain	Example Data Challenges	Innovations to Address Some Challenges	Some Remaining Challenges
 **Diet Data**	1. Overall **lack of time-relevant data** on food consumption 2. Data collection is **expensive & complex** given diets change seasonally and current methods require large amounts of data to be collected & stored 3. Not much happening around the **use and application of data** collected for decision making	• **Indicator development** efforts help to standardize the measurement of different aspects of diet (e.g., diet quality) **Ex. Gallup Global Dietary Quality Project** - a new partnership to pioneer the global measurement of diet quality by generating data and tools to enable routine, valid, and comparable diet data collection • Innovative tools to **measure food consumption** are advancing data collection efforts **Ex. Speech2Health** - voice-based mobile nutrition monitoring system that converts spoken food intake data to text and uses AI to search the food in a nutrition database and accurately compute calorie intake values • Modeling & simulation tools are used to **optimize diets** **Ex. School Meal Planner Plus** - digital solution that optimizes school meals by making them simultaneously more nutritious, cost-efficient, and locally sourced	• Overall need for **more individual-level dietary data**, however high costs and complex methods remain barriers • Need **disaggregated analysis** of dietary data by age and sex to ensure programs target at-risk populations

There is potential to further leverage data innovations and existing solutions from other sectors to strengthen the nutrition data value chain

According to a global survey of national statistical offices asking where they want to expand capacity in the next 3 years, **over 40% state the use of geospatial information as high priority & around 25% for citizen generated data***

Geospatial Data and Statistics

Promising example in health



Esri's COVID-19 ArcGIS Hub- *Gathers and shares information on the pandemic (e.g., maps, datasets, apps) critical for surveillance efforts - used in the COVID-19 Dashboard shown above*[13]

Applications to nutrition for further exploration

- Collect data **via remote sensing** (e.g., drones) and use to generate predictions when paired with artificial intelligence
- Understand nutritional disparities across settings and **spatially-linked risk factors** for & determinants of poor nutritional status

Note some geospatial tools require complex technologies and specialized technical skills and are not easy to integrate into current systems.

Citizen Generated Data

Promising example in health

Citizen Voice and Action[14] *is a social accountability approach to improve service delivery by facilitating community-level data collection to identify service gaps and advocate for solutions (e.g., more health workers in an area)*

Applications to nutrition for further exploration

- **Gather critical information directly from community members** on access to and quality of nutrition services, nutritional status, food environment, attitudes, norms, and values

Take care to ensure data is of high quality and representative since it is voluntary & often collected through unstructured methods.

There is potential to further leverage data innovations and existing solutions from other sectors to strengthen the nutrition data value chain

Artificial Intelligence

Promising example in agriculture & climate

Gro Intelligence[15]- *combines a multitude of data sources and leverages machine learning analytics to provide a unified view of climate, agriculture, and economy helping manage risks, adapt to changing conditions, and forecast with greater confidence.*

Applications to nutrition for further exploration

- Analyze large volumes of data to **provide decision support** around nutrition status, recommend interventions, etc.
- Provide **predictive forecasting** for malnutrition and food security

Please see note on feasibility on slide 10.

Data Collaboratives and Partnerships

Promising example in disaster relief

Data collaborative *where NCEL, Nepal's largest mobile operator,* ***shared anonymized phone data*** *with Flowminder, a non-profit, to* ***map the movement of people*** *caused by a 2015 earthquake* ***to assist with targeting aid*** *to the most in need.[16]*

Applications to nutrition for further exploration

- Improve the accessibility of nutrition data through **data sharing**
- Leverage **collective knowledge of experts** to solve the most pressing data gaps related to the nutrition DVC (e.g., quality concerns, standardization)

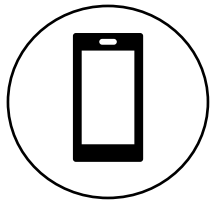
Please note the governance and limited funding of a partnership could pose a risk to the expected outcomes.

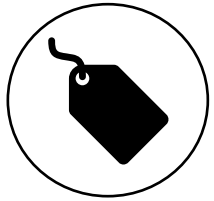
Throughout the COVID-19 pandemic, stakeholders have tapped into the potential of data innovations to address key data challenges

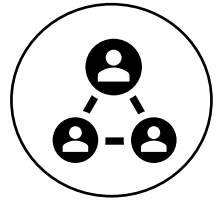
- **Innovations emerged to help address challenges primarily around nutrition status, diet, and food security/food environment data.**
- **Innovations most commonly fell within the mobile solution and data visual categories.**

As examples:

Mobile Vulnerability Analysis and Mapping (mVAM)	COVID-19 Monitoring Dashboard	Food Price Crowdsourcing in Africa (FPCA)	WFP's Global Monitoring of School Meals	Standing together for Nutrition
Technology to remotely monitor household food security and nutrition in real-time through collecting data via short mobile phone surveys and live telephone interviews*	*Dashboard on socioeconomic impacts of COVID-19 on households and individuals based on high-frequency household phone surveys (available for 64 countries)*	*Tool to crowdsource stable food price information daily directly from citizens, presenting validated data in an open-access dashboard*	*Mapping of school closures to track the number of students missing school meals as a proxy indicator for food insecurity to help decision-makers reach these children*	*A multidisciplinary consortium to assess the impact of COVID-19 on nutritional status, including modeling projected impacts and identifying recommendations*







*Note the COVID-19 pandemic reignited county government interest in routine food security surveillance systems in particular

Recommendations

Scaling innovations requires an ecosystem of actors speaking to each other including funders, adopters, end users, and innovators. Our key recommendations are tailored to these groups:

For Innovation Adopters

Identify and prioritize data gaps and challenges and then map to potential solutions—**consider leveraging both existing data sources and methods as well as innovations.**

Learn from innovations that have been scaled successfully in other contexts for key gaps identified.

For Innovation Funders

Take a more strategic approach to investments in nutrition data innovations to fill gaps in the nutrition DVC, including consideration of pathways to scale and funding plans.

Coordinate and collaborate with other stakeholders with possible co-funding of specific data challenges or types of innovations.

Identify promising innovations that have successfully scaled across several geographies to identify critical ingredients needed to scale up innovations.

For All Stakeholders

Consider **feasibility** of innovations including **costs, capacities** required to maintain and support, and **inputs** such as data required to power the innovation**.**

Consider **risks** around adopting an innovation including around **data privacy, data quality, equity** in terms of whose data are captured, and added **stress on existing systems.**

Annex

References for Images

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