Big Data for food security: opportunities and challenges

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A premiss

- Food security is being growingly recognized as the result of the interaction of many elements in a ***complex system*** on outcomes at the individual level
  - Contrast with old, partial visions of food security as, say, food supply adequacy, or of food insecurity as simply just one manifestation of monetary poverty
  - It is best defined as the ability to regularly access sufficient, safe food, in socially acceptable ways

A premiss

- It is also common to refer to the many *dimensions* of food security, which, in the latest conceptualization (HLPE, 2019) include: Availability, Access, Utilization, Agency, Stability and Sustainability.
- Though Big Data can prove extremely useful in monitoring all the mentioned dimensions, I decided not to focus my presentation on detailed examples of big data applications (of how which there will likely be plenty presented and discussed during the conference)
- As I believe most opportunities are quite self-evident I will focus most of my remarks on a few fundamental challenges

A premiss

- In monitoring food security, and addressing food insecurity, attention is to be devoted to **detect *inequalities* in a highly *diverse* world**, for which it is necessary **to analyze information at the very disaggregated level**, through the lenses of models that embed diversity
  - Contrast with the highly stylized microeconomic models of consumer behaviour
- Effective data use requires strongly **integrated governance systems**, as decision making occurs at many levels, along a data informed decision making cycle, along which data and information flows in different directions

Opportunities presented by big data

(in the area of food consumption)

Need for granular information

Real-time monitoring

Emerging areas for data coverage

(Potential) broadly shared access

Current coverage of FSN data

Level	Dimensions of food security and nutrition					
	Availability	Stability	Sustainability	Access	Utilization	Agency
Macro	Natural resource base Earth Observation International food commodity stocks and trade	Global/regional food commodity stocks and reserves	Weather and other risk trends and predictions	International food commodity prices	Food composition data Food safety data	
Meso	Domestic food availability	National food stocks and reserves		National food price indices	Water & Sanitation	Market concentration shares
Micro	Local food systems	Early Warning Information Systems		Local food prices Household incomes and consumption patterns Food insecurity experiences	Household living conditions Household water access Dietary intakes	Food insecurity assessment surveys Women's Empowerment in Agriculture Rural Livelihood and Information Systems
Individual (Outcomes)	Dietary intake/diet quality; malnutrition prevalence and related health outcomes					

Critical urgent data gaps areas

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Meso	Domestic food availability	National food stocks and reserves		National food price indices	Water & Sanitation	Market concentration shares
Micro	**Local food systems**	**Early Warning Information Systems**	**?** **(Environtmental, social and economic sustainability of farming)**	**Local food prices** **Household incomes and consumption patterns** **Food insecurity experiences**	Household living conditions **Household water access** **Dietary intakes**	Food insecurity assessment surveys Women's Empowerment in Agriculture **Rural Livelihood and Information Systems**
Individual (Outcomes)	Dietary intake/diet quality; malnutrition prevalence and related health outcomes					

We need granular information

- Gender, age, education, employment status are key aspects that, depending on the local context, may heavily condition people's effective ability to access food
- This has posed an incredible challenge for food security assessments, which have been traditionally based on surveys
- Digital personal devices provide the potential to reach individuals in ways that were not conceivable just few decades ago

Real-time monitoring

- Traditional info systems presents considerable lags in making info available for policy guidance
  - FAO Food Balance Sheets updated up to t-2 or t-3
  - Household food consumption surveys only conducted every 2-5 years or more
  - Dietary intake surveys conducted even less frequently

Emerging areas for data relevant for food security

- Growing importance of “modern” forms of food consumption
  - Food prepared and consumed away from home
  - Food prepared away from home and consumed at home
- Increased recognition of the relevance of food for health
  - Attention must be given to detailed food composition and dietary quality

(Potential) broadly shared access

- Current technology allows access to virtually anything is connected to the internet, by anyone
  - Crowdsourced information from social network, catering services, restaurant etc. may already provide lots of useful, real-time information on food consumption patterns
- Information *could* flow in all directions: from people, to governments, to businesses and viceversa
  - Smart phone apps can be used to collect specific information, while providing feedback to the consumers that can help improve their food behaviors
  - This *might* be very important to promote the *agency* dimension of food security, meaning that people *could* have increased control for example on the food they chose to ea

Challenges

Digital divide and limited data literacy

Analytic capacity (data science vs. statistics)

Data governance

Digital divide and limited data literacy

- While data is pervasive in our lives, not everyone has the same ability to access available technology and capacity to use it
- There are still gaps to be filled both in developing the needed infrastructures and making them accessible to all

Analytic capacity

- The increased volume and speed of data generation and diffusion has outpaced the ability of education systems worldwide to keep up with the necessary innovation and adaptation
- We were still in the middle of a transition towards establishing sufficiently broad and deep training on statistics and on probability theory-based scientific inference, when the new field of data science has potently emerged
- Diffused high computational power has created the illusion of being able to fully substitute human intelligence with an “artificial” one, thinking with computing

Analytic capacity

- The ability to properly interpret the large flow of data and information that reaches us is still very limited, even within professional circles
  - This is inducing rent-seeking behavior by some who manage to grasp the needed competence, also favored by models of data and information governance that treats them as *excludable* assets

Data governance

- Current debates are dominated by the conflict between demands for more access to data and fears that this may lead to violations of the right to privacy of individuals
  - This is leading to attempts to strengthening *data protection* structures (both from a legal point of view, and through technical infrastructures) that end up limiting data sharing spaces
  - There are indeed important ethical aspects related to the data revolution that have not been fully explored (see, for example, Floridi and Taddeo, 2016)

Data governance

- Yet, there are a few aspects that seems to be taken as given, that – in my humble opinion – could be revisited
- Data are mostly seen as an *economic* asset, meaning that they can be governed through market-like based mechanisms, and invoking variations of Coase's theorem to expect the market to reach a socially optimal allocation
  - e.g., assigning data ownership rights, encouraging mechanisms to protect them, but then making such rights tradeable

Data governance

- Fundamentally fragmented legal jurisdictions (national or regional) are meant to be able to support and enforce such arrangements even when transactions occur (and are needed) at a global scale (e.g., the “cloud”)
- The result is that current data governance arrangements lead to outcomes that are suboptimal (too little data sharing), costly to enforce, and perceived as unfair

Data governance

- An alternative visions considers modern digitally stored data as a special kind of public good, which is inherently non-excludable and non-rival
  - By its nature, the internet relies heavily on redundancy in storing information, so that, as soon as a piece of information is stored somewhere, it is immediately copied in several places to prevent loss
  - By their nature, digital data are non-rival in the sense that use of one piece of data by someone neither prevents nor reduces the utility of use of *the same* piece of data by someone else
- Optimal levels of data sharing can only be achieved by mechanisms based on trust, by which those who generate data must be willing to *donate* them for the greater good, and those who use it must commit not to abuse or misuse them

Solutions?

- The above considerations leads to a call for truly innovative (revolutionary?) data governance arrangements
- The CFS HLPE Report #17 suggests considering the creation of a FSN data trust empowered with a mutually agreed mandate to:
  A. Decide on which data (that are relevant for food security an nutrition) should be treated as “open access”
  B. Monitor and sanction possible abuses of such data
- Even before such arrangements could materialize, there would be high payoff from investing in:
  - Statistics and data analytics capacity development, at all levels
- Mechanisms to prevent rent seeking in data generation/management and to redistribute benefits, rewarding data sharing, should be put in place

Thank you

- Questions or comments to Carlo.Cafiero@fao.org
- References:

HLPE. 2020. *Food security and nutrition: building a global narrative towards 2030.*

HLPE. 2022. *Data collection and analysis tools for food security and nutrition: towards enhancing effective, inclusive, evidence-informed, decision making.*

(Both reports by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.)

Floridi, L. & Taddeo, M. (eds) 2016. Data ethics. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2083)