Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Assessing Food System Sustainability

using a global index

Chris Béné

Senior Policy Expert

CGIAR: Consultative Group for International Agricultural Research

www.nature.com/scientificdata

SCIENTIFIC DATA

OPEN

DATA DESCRIPTOR

Global map and indicators of food system sustainability

Christophe Béné[1*], Steven D. Prager[1], Harold A. E. Achicanoy[1], Patricia Alvarez Toro[1], Lea Lamotte[1,2], Camila Bonilla[3] & Brendan R. Mapes[4]

This paper presents the first global map of food systems sustainability based on a rigorous protocol. The choice of the metric dimensions, as well as the individual indicators included in the metric, were initially identified from a thorough review of the existing literature. A rigorous inclusion/exclusion protocol was then used to refine the list and shorten it to a sub-set of 27 indicators. An aggregate sustainability score was then computed based on those 27 indicators organized into four dimensions: environment, social, food security & nutrition and economic. The paper shows how the availability of data (or lack therefore) results in an unavoidable trade-off between number of indicators and number of countries, and highlights how optimization can be used to present the most robust metric possible given the existence of this trade-offs in the data space. The process results in the computation of a global sustainability map covering 97 countries and 20 indicators. The sustainability scores obtained for each country are made available over the entire range of indicators.

Background & Summary

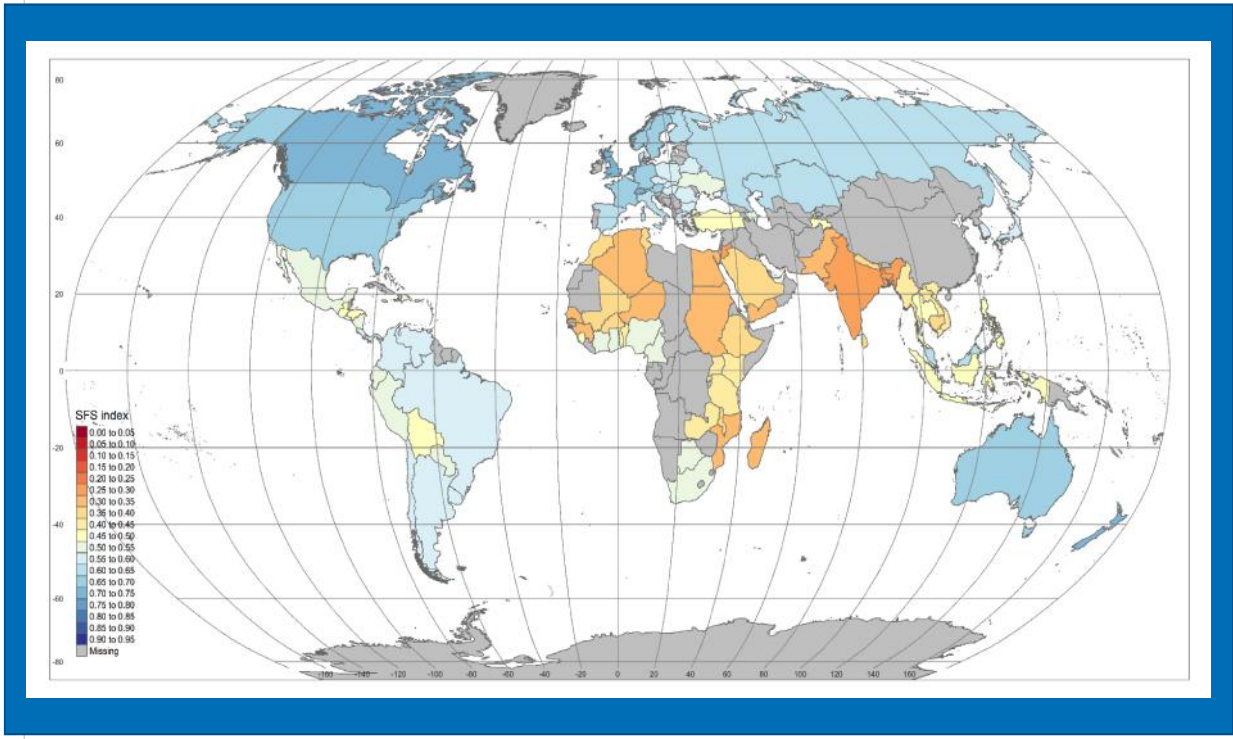
Addressing the question of the (un)sustainability of our food systems is critical as the world is bracing for hard-choice challenges and potentially massive trade-offs around issues related to food quality and food security in the coming decades[1,2]. Meeting increasing demand for nutritious food for a growing global population under climatic pressures, while mitigating associated environmental damages, is already a pressing challenge[3,4]. In 2016 the total number of chronically undernourished people was estimated to be around 815 million (more than one person out of ten)[1]. At the same time, the health consequences of the exponential increase in overweight and obese people are becoming another global burden[4,5]. Worldwide, those trends are correlated with a massive environmental 'food print' of the food production and distribution sectors[6,7], coupled with patterns of food utilization characterized by concerning levels of waste and with supply chains that are increasingly homogenous and prone to crowding-out of smaller agri-food operators[8].

While some conceptual and theoretical advances in defining food systems and their related indicators and metrics have shed light on these complex dynamics[9], researchers and analysts are still struggling with one basic question: How can we define and empirically measure food systems' *sustainability*? Attempts to address this question add insight[10,11] but several conceptual or methodological challenges limit the overall utility of those efforts:

i. **Lack of representativeness**. Generally the list of countries included in such analyses is limited and often biased towards OECD or high income countries (for which data are usually more available than for lower income countries where national statistical systems are less effective). For instance the Sustainability map proposed by ref.[10] covers only 67 countries – mainly high income countries;

ii. **Lack of conceptual clarity** on how the different dimensions of food system sustainability are constructed and delimited. While the most comprehensive of those studies do include series of indicators that cover four dimensions (social, environmental, nutrition and food security, and economy), it is not always clear how those indicators have been selected or can be rigorously measured. For instance ref.[11] proposed a "resilience" dimension which they argue should be part of the sustainability assessment of food systems. The problem is that resilience is itself a latent variable (i.e. a variable that cannot be measure directly) and there is no particular reason why the index used by ref.[11] (the ND-GAIN country index[12]) should be chosen over any other measure of resilience. In fact some even argue that there is currently no clear consensus on how to measure resilience, or whether resilience is really a dimension of (food system) sustainability[13].

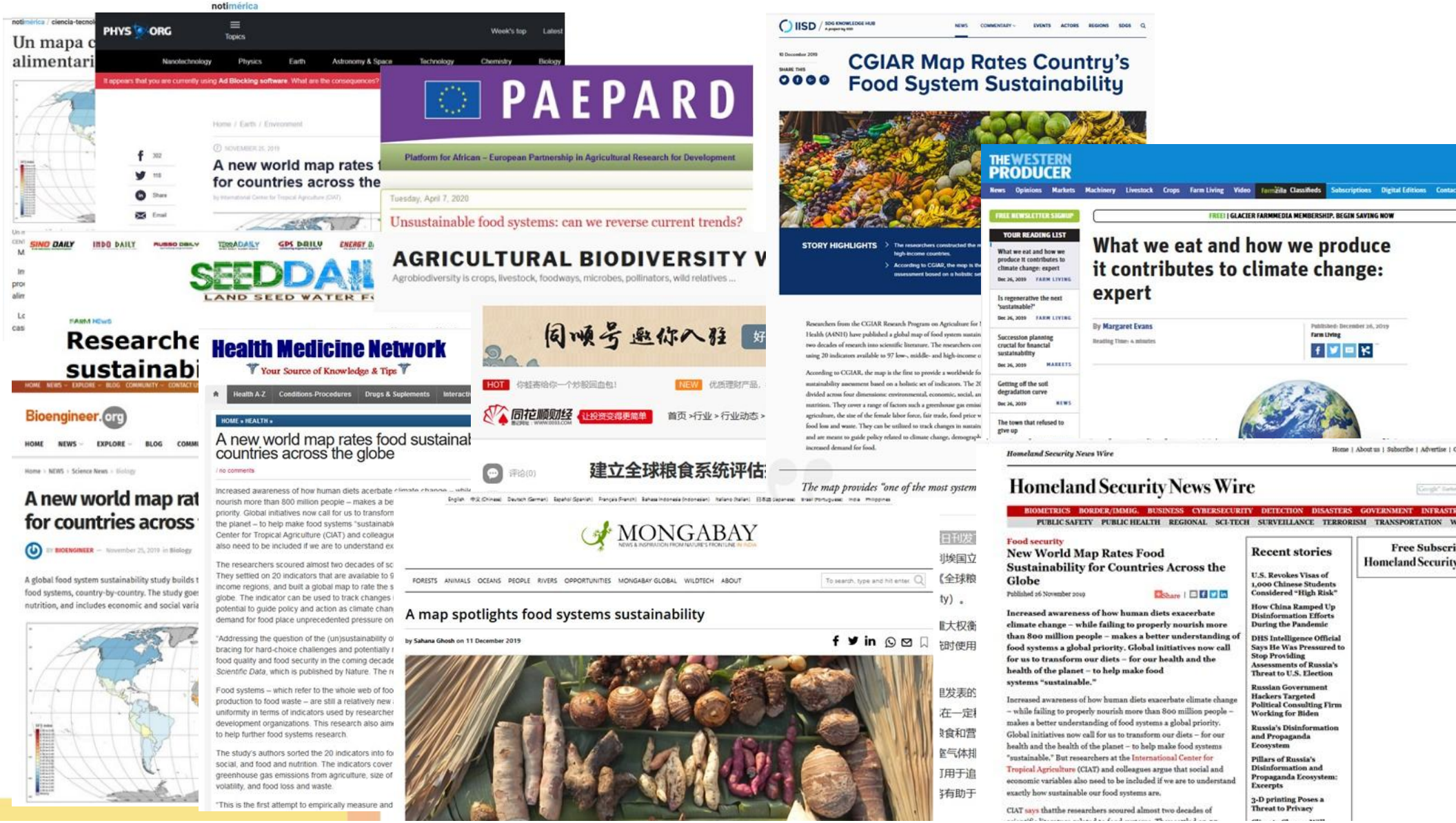
[1]Decision and Policy Analysis Program, International Center for Tropical Agriculture, Km 17 Recta Cali-Palmira, CP 763537, Cali, Colombia. [2]Supagro, 2 place Pierre Viala, 34060, Montpellier, France. [3]Department of Environmental Science and Policy, University of California, One Shields Avenue, Davis, USA. [4]Frederick S. Pardee Center for International Futures, University of Denver, 2201 South Gaylord Street, Denver, CO, 80208-0500, USA. *email: c.bene@cgiar.org



Alliance

Bioversity International

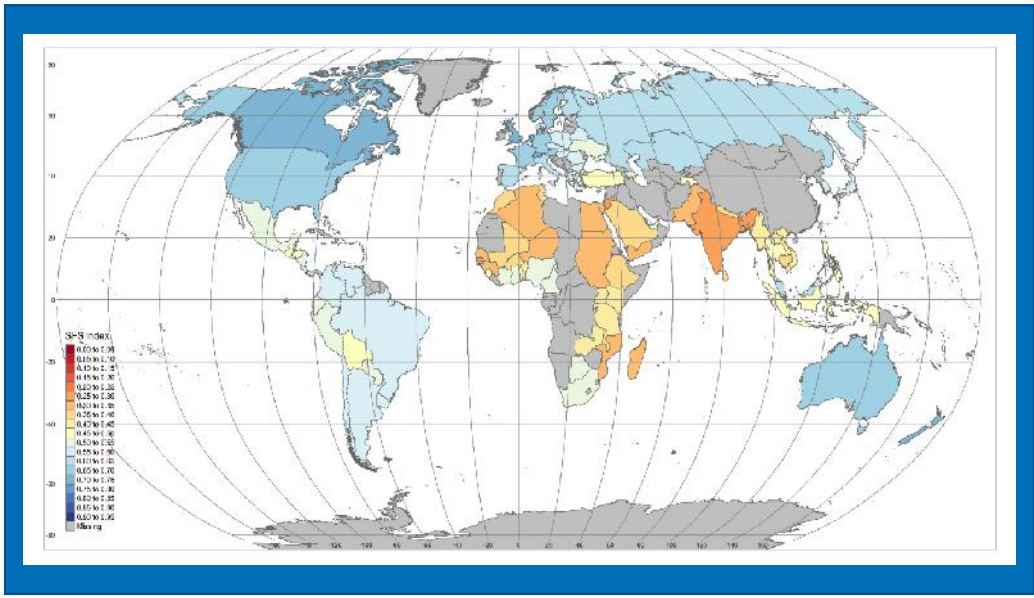
CIAT


notimérica
PHYS.ORG
PAEPARD
Platform for African – European Partnership in Agricultural Research for Development
Tuesday, April 7, 2020
Unsustainable food systems: can we reverse current trends?
IISD / SDG KNOWLEDGE HUB
CGIAR Map Rates Country's Food System Sustainability
STORY HIGHLIGHTS
THE WESTERN PRODUCER
What we eat and how we produce it contributes to climate change: expert
By Margaret Evans
AGRICULTURAL BIODIVERSITY
Agrobiodiversity is crops, livestock, foodways, microbes, pollinators, wild relatives ...
SEEDDAIL
LAND SEED WATER
Health Medicine Network
Your Source of Knowledge & Tips
Bioengineer.org
A new world map rat
for countries across
A new world map rates food sustainal
countries across the globe
同顺号 邀你入驻
建立全球粮食系统评估
MONGABAY
A map spotlights food systems sustainability
by Sahana Ghosh on 11 December 2019
Homeland Security News Wire
Food security
New World Map Rates Food Sustainability for Countries Across the Globe
Published 26 November 2019
Increased awareness of how human diets exacerbate climate change – while failing to properly nourish more than 800 million people – makes a better understanding of food systems a global priority. Global initiatives now call for us to transform our diets – for our health and the health of the planet – to help make food systems "sustainable."
Recent stories
U.S. Revokes Visas of 1,000 Chinese Students Considered "High Risk"
How China Ramped Up Disinformation Efforts During the Pandemic
DHS Intelligence Official Says He Was Pressured to Stop Providing Assessments of Russia's Threat to U.S. Election
Russian Government Hackers Targeted Political Consulting Firm Working for Biden
Russia's Disinformation and Propaganda Ecosystem
Pillars of Russia's Disinformation and Propaganda Ecosystem: Excerpts
3-D printing Poses a Threat to Privacy

Motivation

- increasing interest (and need!) to be able to measure food system sustainability

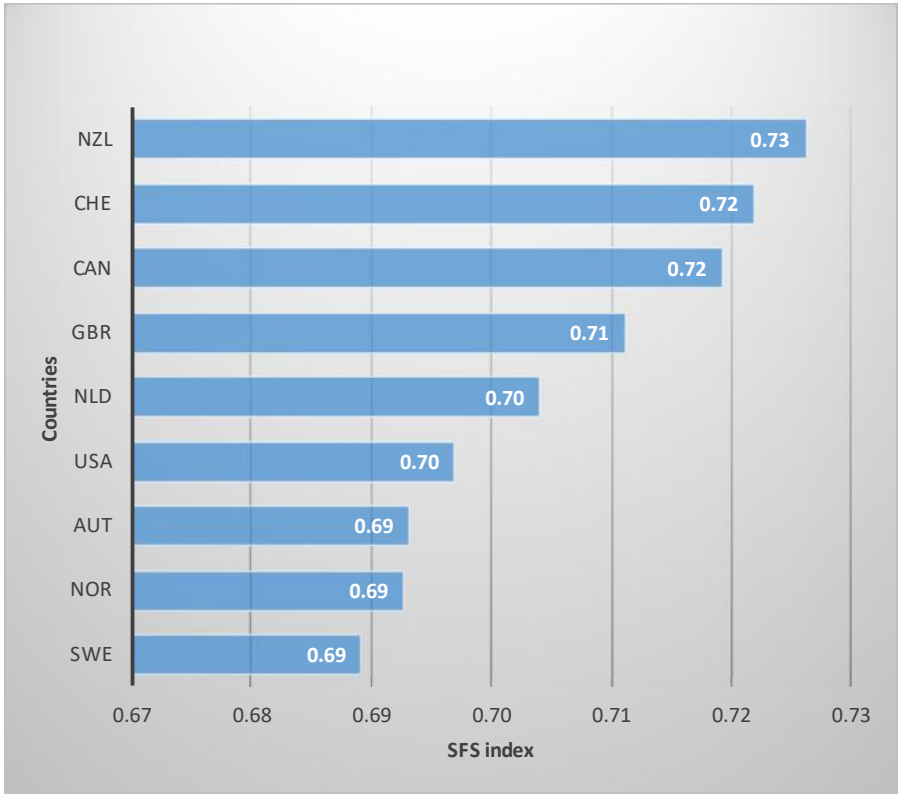
- "your measure is only as good as its accuracy"
  - ❑ bias toward 'developed' countries
    - ➢ global – incl LMICs
  - ❑ bias toward Nutrition and Environment
    - ➢ holistic – Economic and social dimensions



97 countries = from both HICs and LMICs
20 indicators – 4 dimensions of sustainability:
FoodSecu&Nutri – Envir – Econ – Social

Canada

Countries	SFS_index	Environment	Economic	Social	Food_nutr
NZL	0.73	0.62	0.85	0.68	0.77
CHE	0.72	0.62	0.73	0.68	0.88
CAN	0.72	0.62	0.84	0.66	0.78
GBR	0.71	0.66	0.75	0.60	0.85
NLD	0.70	0.57	0.84	0.61	0.84
USA	0.70	0.57	0.83	0.59	0.84
AUT	0.69	0.59	0.77	0.57	0.89
NOR	0.69	0.49	0.86	0.66	0.82
SWE	0.69	0.50	0.83	0.66	0.83



Behind the numbers…

Dimension	Sub-dimension	Category	Indicators[1]	Period	Nber countries
Environment	Air	Quality	Greenhouse gas emissions in total agriculture (gigagrams)	2000-2010	222
	Water	Use	Agricultural water withdrawal as percentage of total renewable water (%)	2000-2016	174
	Soil and land	Quality	Soil carbon content (as percentage in weight)	2008	202
		Use	Agricultural land as % of arable land	2000-2014	217
	Biodiversity	Wildlife (plants, animals)	Benefits of biodiversity index (0 = no biodiversity potential to 100 = maximum)	2008	192
			Crop diversity (Calories diversity measured by Shannon index)	2009-2011	177
Economic		Financial performance	Agriculture value-added per worker (constant 2010 US$)	2000-2015	181
Social		Gender equity	Labor force participation rate, female (% of female population ages 15+)	2000-2016	184
Food and Nutrition	Food Security	Availability	Per capita food available for human consumption (kcal/capita/day)	2016	113
		Access	Food consumption as share of total income (% of total household expenditure)	2016	113
			Estimated travel time to the nearest city of 50,000 or more people	2015	245
		Utilization	Access to improved water resource (% of total population)	2000-2014	198
			Access to electricity (%)	2000-2014	211
		Stability	Price volatility index	2011-2017	194
			Per capita food supply variability (kcal/capita/day)	2000-2011	162
	Food Safety		Burden of foodborne illness (number of cases)	2010	194
	Food waste and Use		Food loss as % of total food produced	2016	113
	Nutrition	Diet	Diet diversification	2001-2010	165
		Overweight & obesity	Prevalence of obesity (% of the population, over 18 years of age	2000-2014	191
		Hidden hunger	Serum retinol deficiency	1995-2005	193

Some reflections…

- the “tyranny of the (available) datasets”
  - bias toward production (agric) and consumption
- framed around environment and nutrition e.g. EAT Lancet report
  - little on the economic and social dimensions of food systems (epistemology + data availability)
- trade-off between specificity and comparability
- “this index does not tell the story I want, I’ll pick another one”
  - importance of (conceptual) rigour and transparency
  - importance of the holistic interpretation of ‘sustainability’

Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Thank you

Chris Béné

c.bene@cigar.org

CGIAR

Bioversity International and the International Center for Tropical Agriculture (CIAT) are CGIAR Research Centers.
CGIAR is a global research partnership for a food-secure future.