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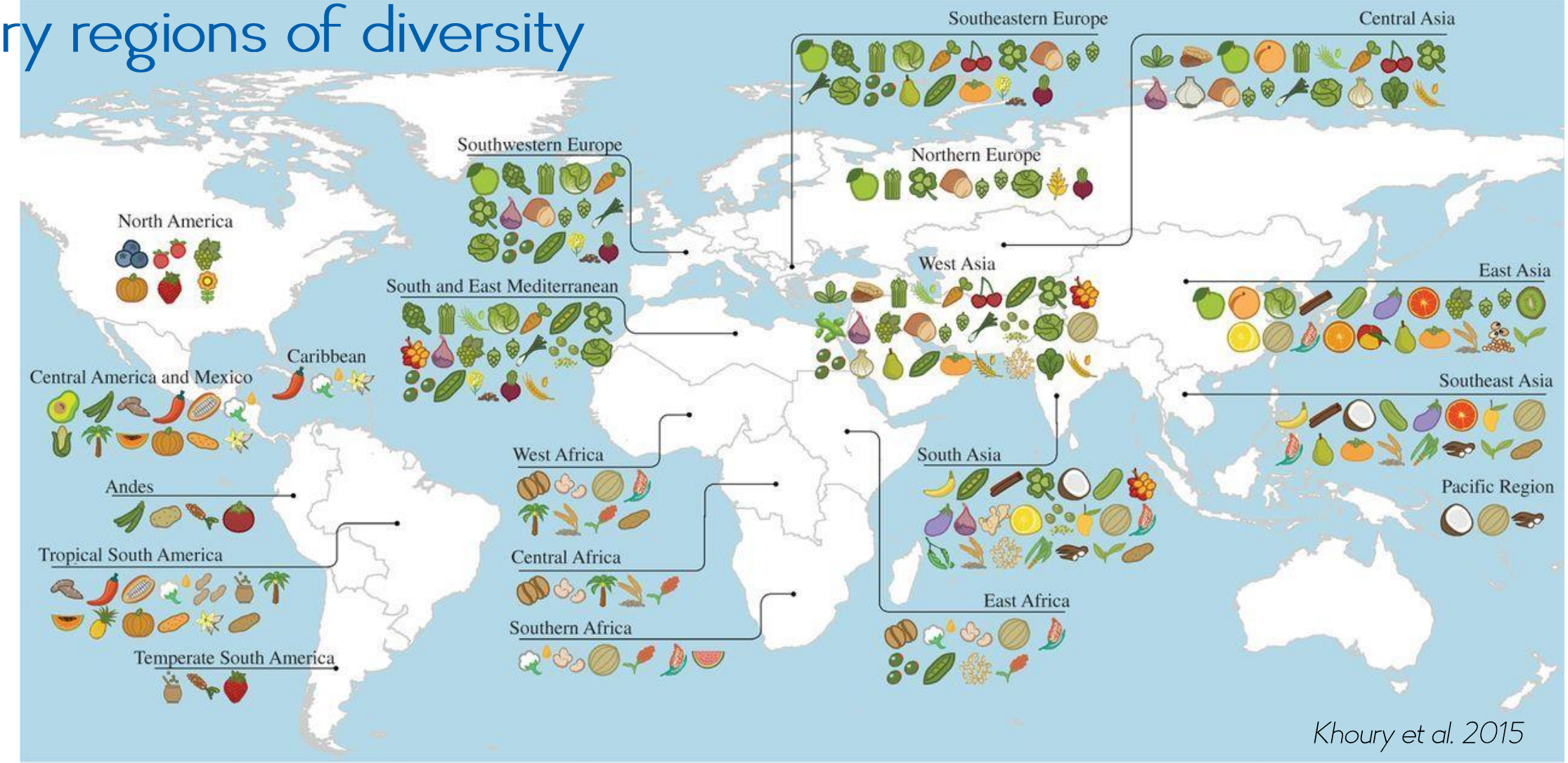
Why some crops are "orphan"?

Perception gaps in the case of taro (*Colocasia esculenta*)

Michel Edmond GHANEM *Ir. Ph.D.*
Michel.ghanem@um6p.ma

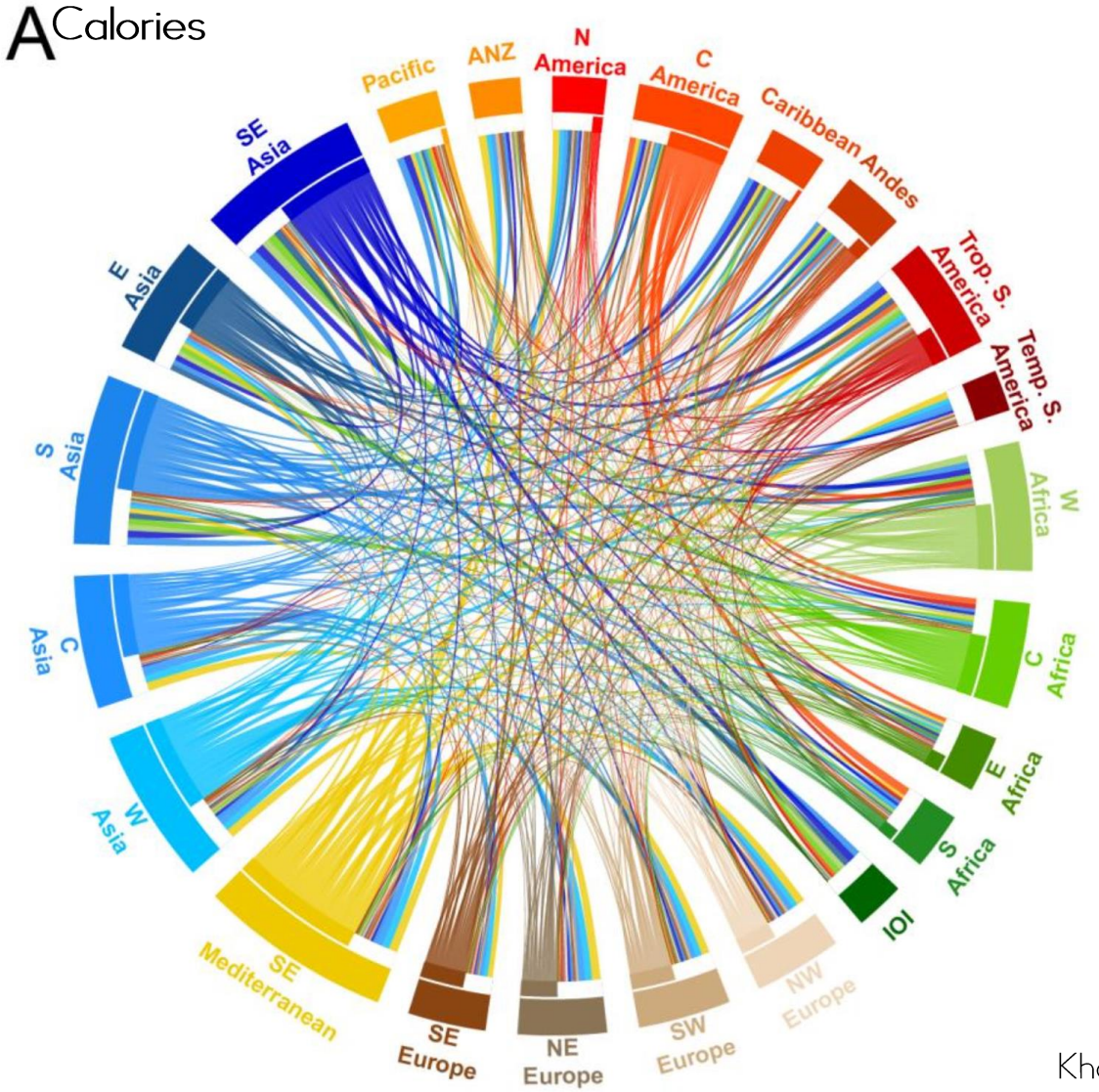
1. The crops that feed the world
2. What is an “orphan” crop ?
3. Perception gaps: the case of taro

Primary regions of diversity



alfalfa
almonds
apples
apricots
artichokes
asparagus
avocados
bananas and plantains
barley
beans
blueberries
cabbages
carrots
cassava
cherries
chickpeas
chillies and peppers
cinnamon
clover
cocoa beans
coconuts
coffee
cottonseed oil
cowpeas
cranberries
cucumbers
dates
eggplants
faba beans
figs
garlic
ginger
grapefruit
grapes
groundnut
hazelnuts
hops
kiwi
leeks
lemons and limes
lentils
lettuce
maize
mangoes
mate
melons
millets
oats
olives
onions
oranges
palm oil
papayas
peaches and nectarines
pears
peas
pigeonpeas
pineapples
plums
potatoes
pumpkins
quinoa
rape and mustard seed
rice
rye
sesame
sorghum
soyabean
spinach
strawberries
sugar beet
sugarcane
sunflower
sweet potatoes
taro
tea
tomatoes
vanilla
watermelons
wheat
yams

Food supplies: We are highly interconnected !

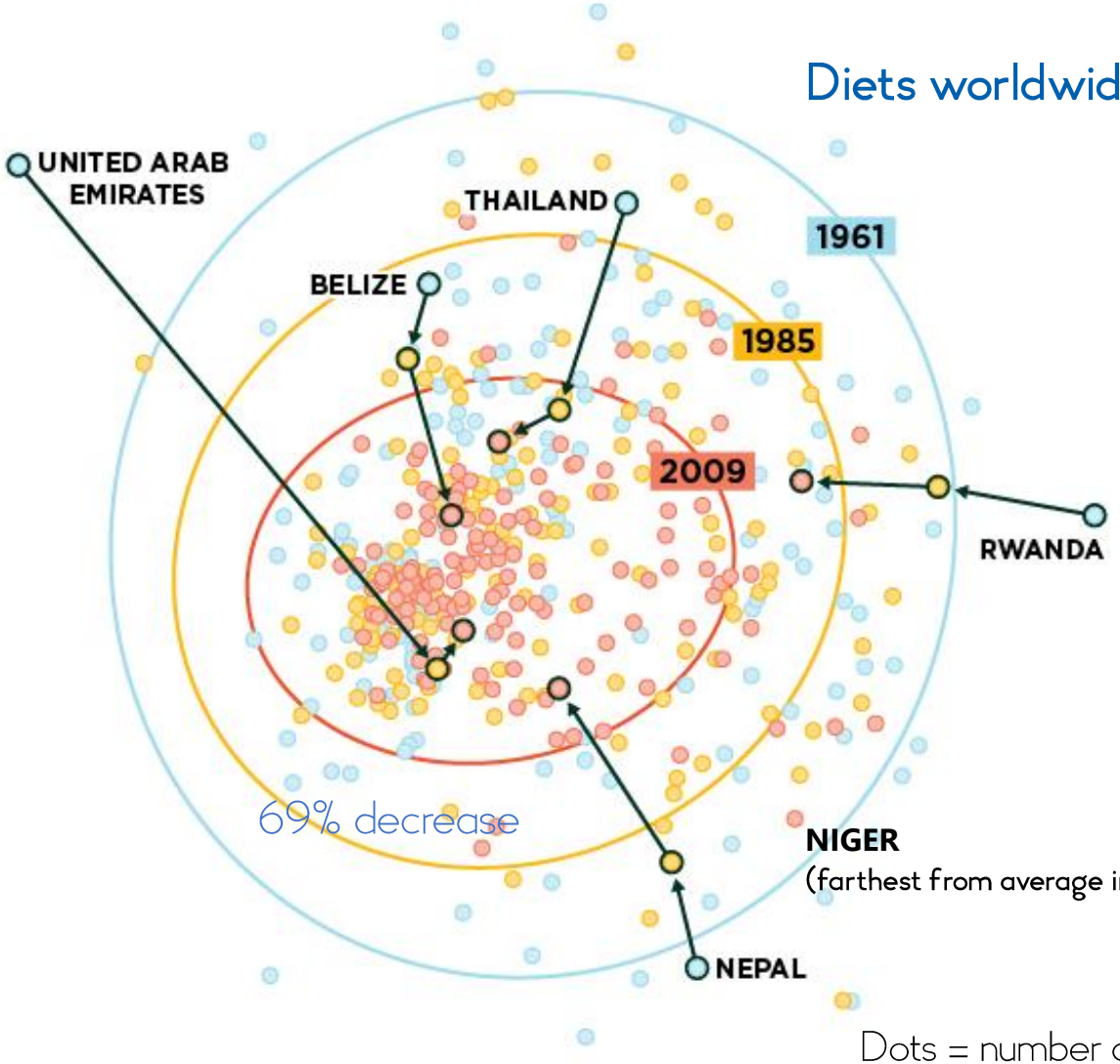


Dependence of each region of the world in terms of calories derived from crops whose primary regions of diversity are found elsewhere

Khoury et al. 2015

Diets are changing: over the last 50 years diets have become homogenized

Diets worldwide are becoming more similar*



Dots = number of different crops consumed in a country + what quantities
Ellipses = the degree of variation among countries

Khoury *et al.* (2014) *PNAS* 111

Each country's food supply composition in contribution to calories in:

1961 1985 2009

How many crops feed the world ?

How Many Plants Feed the World?

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Abstract: *FAO food supply data for 146 countries were analyzed to identify the plant commodities that account for the top 90% of each country's per capita supply of food plants by weight, calories, protein, and fat. The plant commodities were divided into two groups: species commodities, such as "cabbages," that can be attributed to particular species; and general commodities, such as "hydrogenated oils," whose species composition is not known. A total of 82 species commodities and 28 general commodities contribute 90% of national per capita supplies of food plants. The 82 species commodities consist of 103 species. Fifty-six of these commodities, comprising 75 species, individually account for 5% or more of at least one country's supply of a nutritional category (plant weight, plant calories, plant protein, plant fat). These figures are several times higher than previous findings that very few (7–30) plant species feed the world. The new figures are considered more accurate because they derive from national supply rather than global production data, and from several separate measures of the importance of a food commodity rather than one. The results suggest that (1) plant species diversity remains a significant factor for world food supply; and (2) a conservation priority is to maintain both this wider array of species and the diversity of genetic variants that comprise each species.*

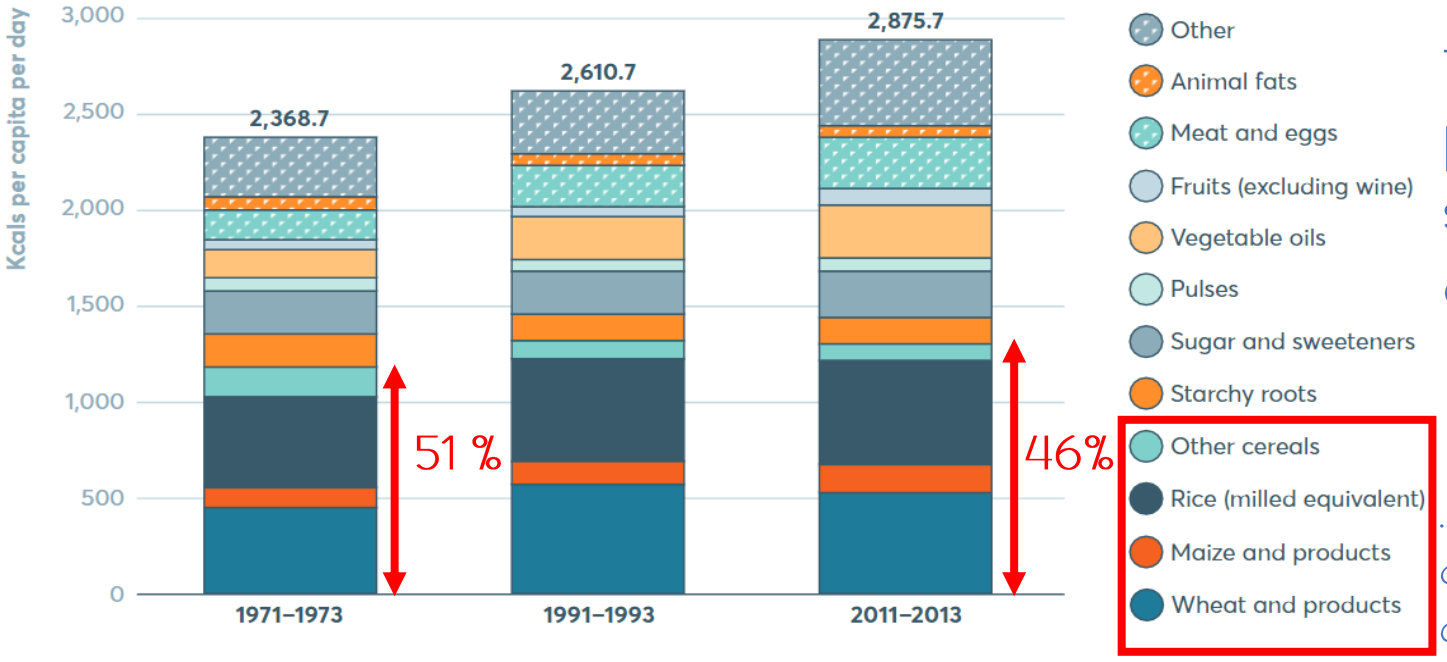
Resumen: *Los datos de la FAO sobre abastecimiento de alimentos para 146 países, fueron analizados para identificar la mercadería vegetal que comprende el 90% tope do abastecimiento per capita de alimentos vegetales en peso, calorías, proteínas y grasas. La mercadería vegetal fué dividida en dos grupos: mercadería por especie como las "coles" que pueden ubicar dentro de un taxa de planta en particular*

Prescott–Allen and Prescott–Allen, 1990

Khoury et al. 2014; 2015

A complicated answer:
Global decline in crop diversity

Diet transition:
What about non-staples crops ?



Pingali P., 2015
Pingali P.& Sunder N., 2017

2020
Global Nutrition Report
Action on equity to end malnutrition

"Agricultural policy is heavily biased towards improving staple-grain productivity, especially for the major staples …, while dietary diversity needs are not adequately addressed.

….total calorie consumption per person per day has risen over time, but the share of staple cereal calories within total calorie consumption has declined. "

The Global Nutrition Report (GNR), 2020

https://globalnutritionreport.org/reports/2020-global-nutrition-report/

Diet transition:

Does international research follow the trends ?

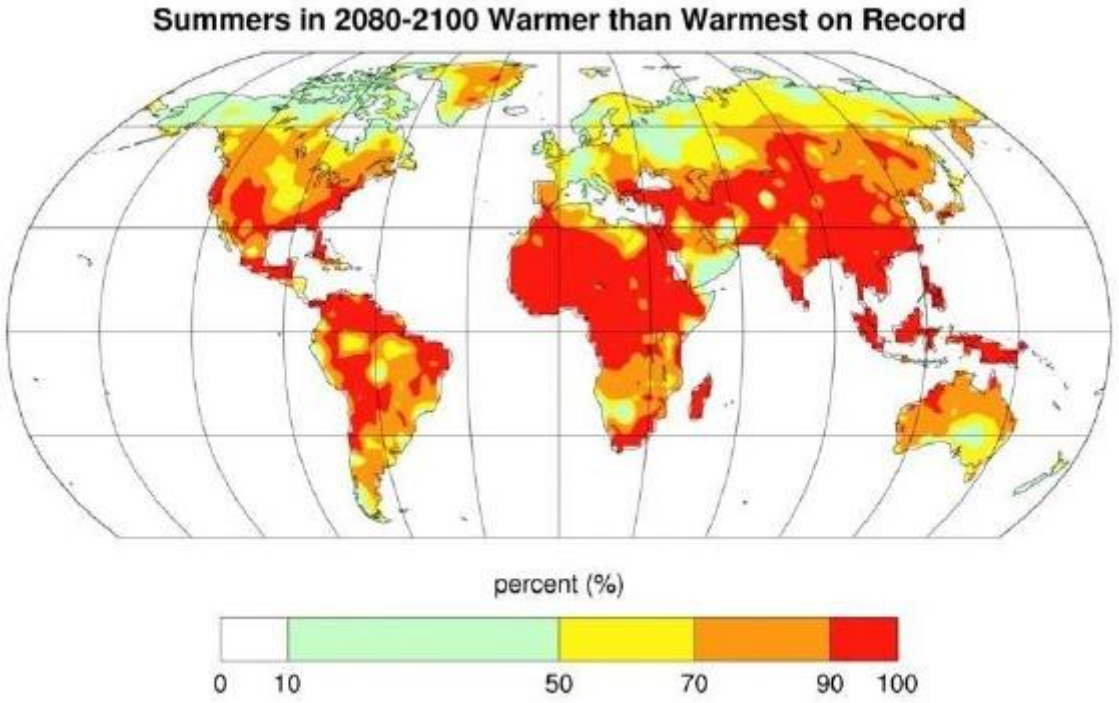
"The Consortium of International Agricultural Research Centers (CGIAR), …. has traditionally allocated most of its commodity research budget to the major staples, increasing this after the 2008 food price crisis. The balance of funding has to be shared between fifteen crops, livestock, fish and trees."

"Research and development investments should prioritise neglected staples such as sorghum, millets and tropical tubers."

The Global Nutrition Report (GNR), 2020

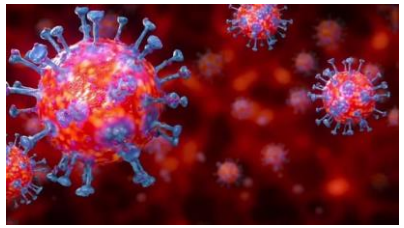
Climate change and population growth:

Hotter and drier planet



More mouths to feed

Pandemics



The New York Times

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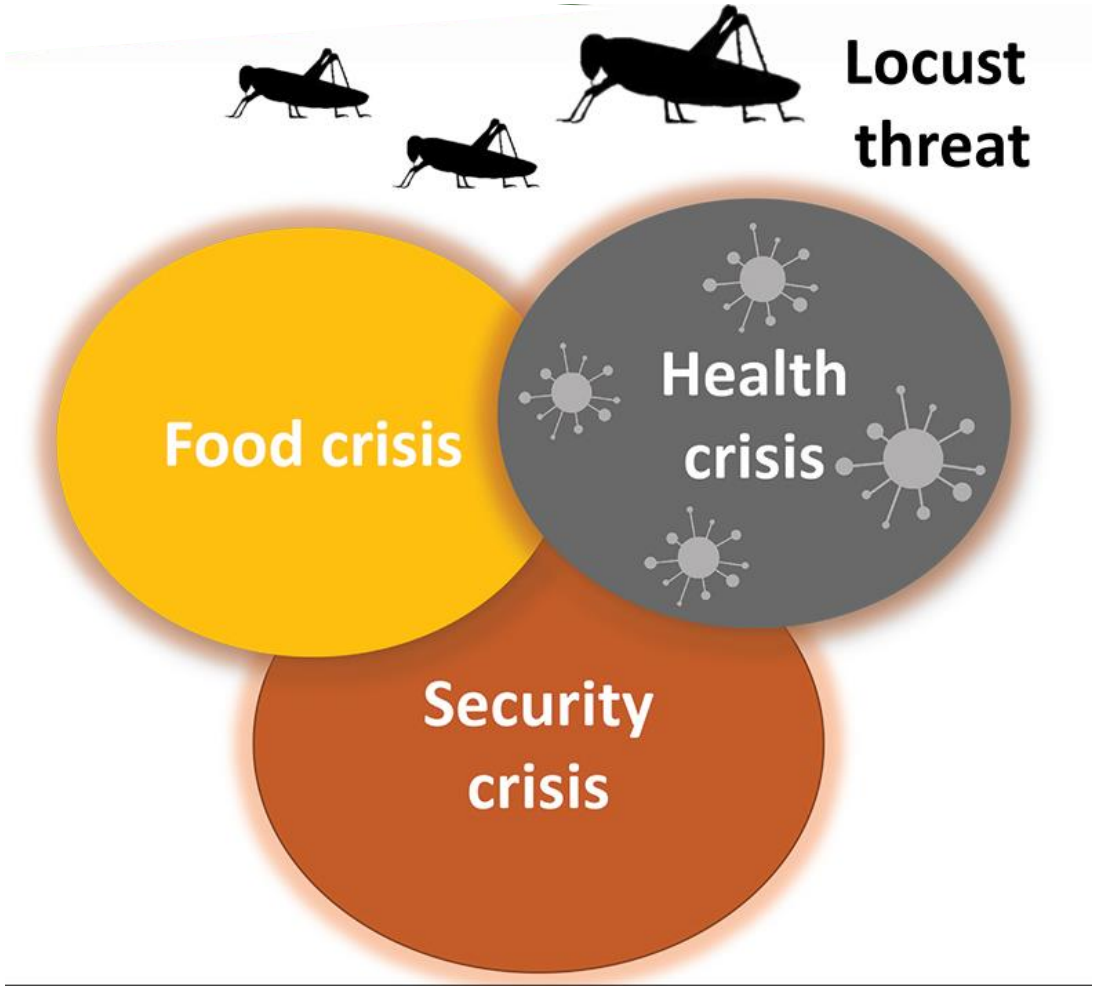
Opinion

Spoiled Milk, Rotten Vegetables and a Very Broken Food System

The coronavirus crisis demonstrates what is wrong with how the world feeds itself.



Our food systems are at risk

Today, humans look to 4 crops to ensure more than half of their calories, tapping into just 1 percent of the diversity still available to us.

A stock portfolio with just a few holdings !

Diversity to the rescue: seeing the unseen !

Underutilized or "orphan" crops

What is an orphan crop ?

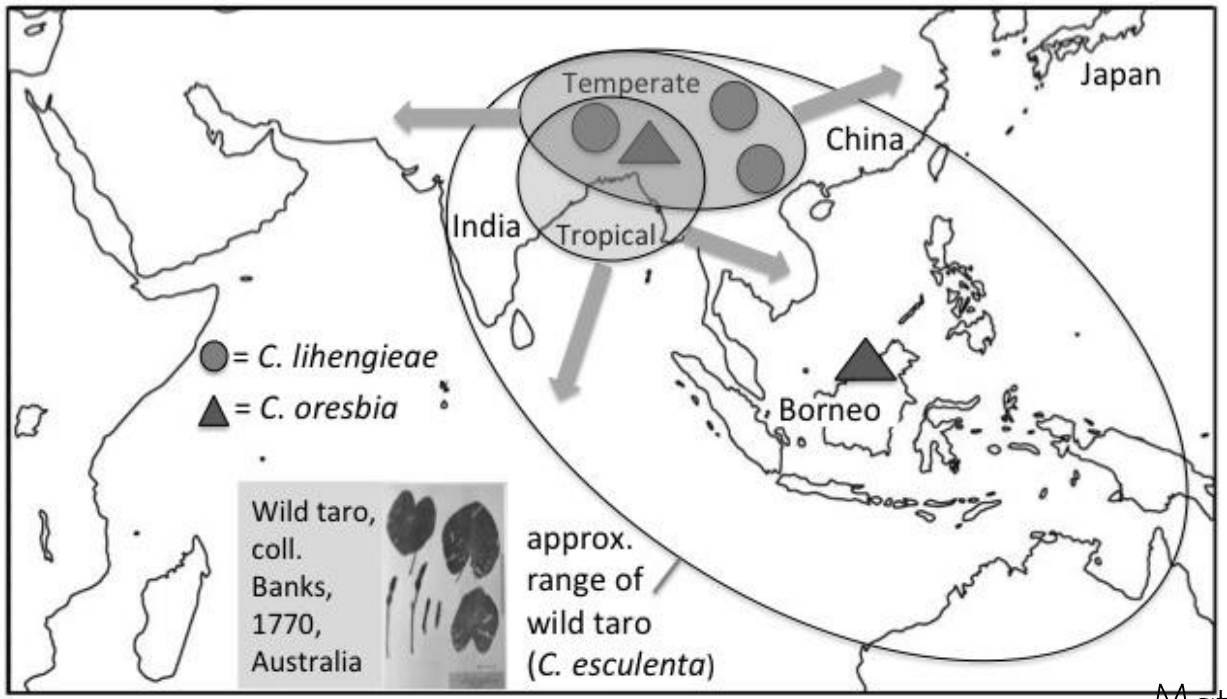
"Orphan or minor" crops as those that are: "*...typically not traded internationally but which can play an important role in regional food security. For various reasons, many of these crops have received little attention from crop breeders or other research institutions wishing to improve their productivity.*"

Falcon et al. (2017)

Taro

What is taro (*Colocasia esculenta*) ?

Araceae *2,823 species*



Matthews 2014

Is taro an "orphan" crop ?

African Orphan Crops Consortium

Healthy Africa through nutritious, diverse and local food crops

HOME ABOUT MEET THE CROPS ONGOING PROJECTS PARTNERS AND NETWORK AFRICAN PLANT BREEDING ACADE

Colocasia esculenta

March 8, 2013 / 1 min read

Common Name: Taro

Description

Colocasia esculenta is a tropical plant grown primarily for its edible corms, the root vegetables most commonly known as taro. It is believed to be one of the earliest cultivated plants. Linnaeus originally described two species which are now known as Colocasia esculenta and Colocasia antiquorum of the cultivated plants that are known by many names including eddoes, dasheen, taro, but many later botanists consider them all to be members of a single, very variable species, the correct name for which is Colocasia esculenta . . . .Read more

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Allanblackia

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Irvingia gabo

Moringa oleif

Ricinodendro

Sclerocarya

Tamarindus i

Uapaca kirki

Vitellaria par

CROP TRUST MISSION WORK ABOUT RESOURCES NEWS PRESS HOW TO HELP OTHER WEB

INFO GENEBANKS PROJECTS

Aroids

COLOCASIA XANTHOSOMA

CENTER OF ORIGIN: **PAC-T, SAS, SEA**

CONSERVED AT
CEPACT
IITA

TOP 5 PRODUCERS
NIGERIA
CHINA
CHINA
CAMEROON
GHANA

The aroids are known as one of the "orphan crops", meaning they receive minimal attention from modern plant breeding relative to their importance as a food source. The crops in this group clearly have great potential, and there is considerable diversity both within species and between them. It is estimated that there are more than 1,000 varieties of taro alone. There are

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Plants People Planet PPP Open Access

OPINION

Perception gaps that may explain the status of taro (*Colocasia esculenta*) as an "orphan crop"

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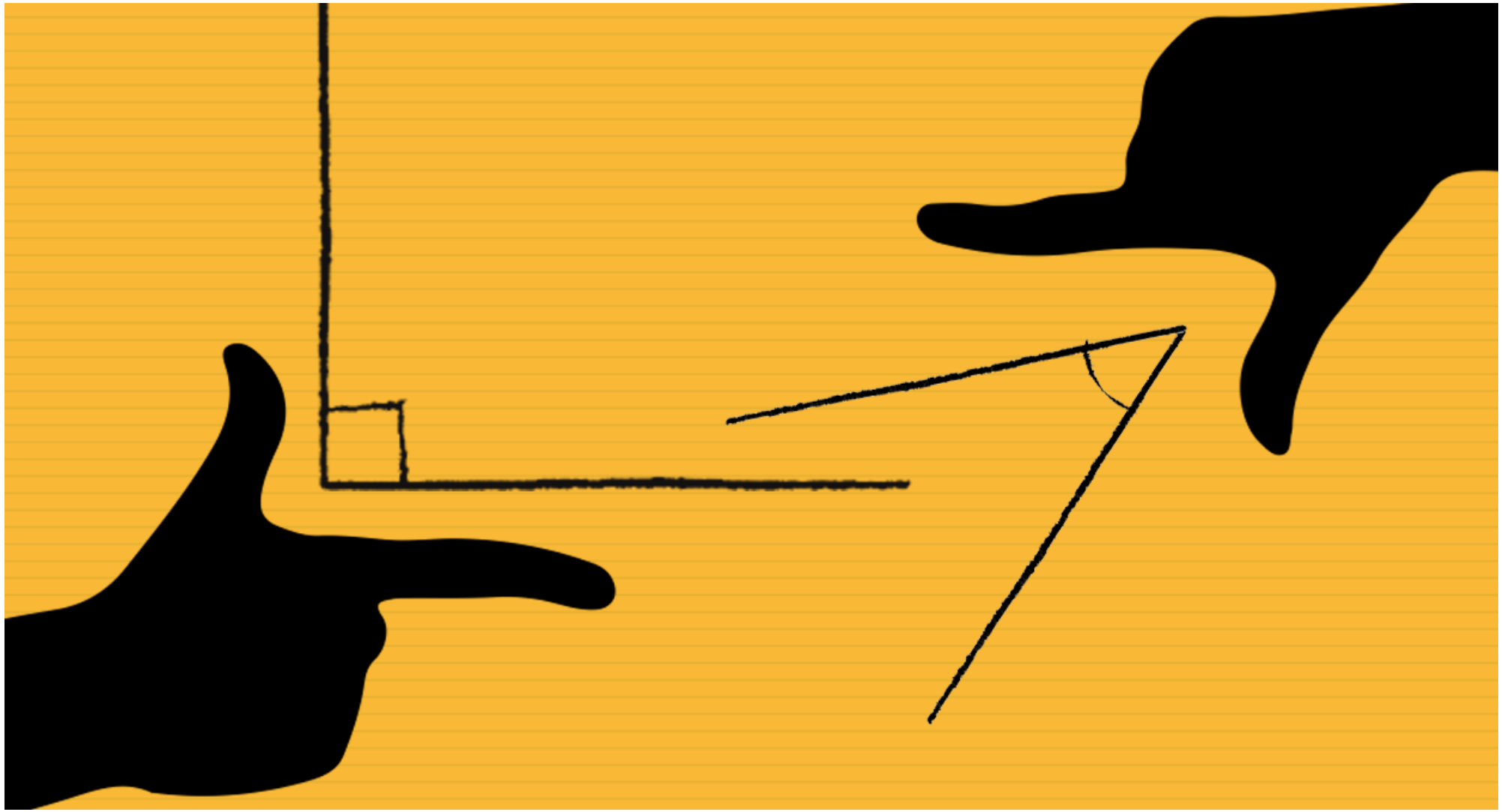
Societal Impact Statement

Using Taro (*Colocasia esculenta*) as a case study, we examine how perception gaps contribute to negative feedback loops that create or maintain the orphan status of certain crops. For students and researchers seeking uncrowded areas for study, orphan crops and crop-wild-relatives offer large open spaces, figuratively and literally. Learning how to see what has not been seen may in turn help us to reduce our global dependence on very few crops, and the risks that follow from this. The combination of climate change and variability and increasing population has painted a dark picture of future food security for many regions in the world were resources are scarce. The key to future food and nutrition security may very well lie in unlocking the untapped potential of orphan and overlooked crops.

Matthews and Ghanem (2020)(In press)

Perception gaps



Perception gaps in the case of taro

- *"Dogmatic" views*
- *Linguistic diversity and naming*
- *Social biases or a non-favorable reputation*
- *Under-research*
- *Limited physical visibility of living wild populations*
- *Poor archaeological visibility*
- *Missing numbers*
- *Distribution maps are few and sketchy*

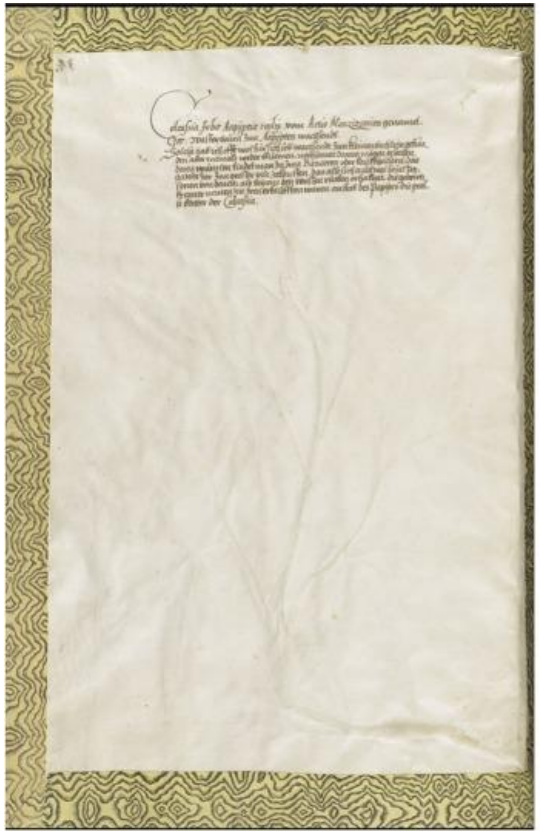
Matthews and Ghanem (2020)(In press)

"Dogma" : taro is a "tropical root crop" (it is much more!)

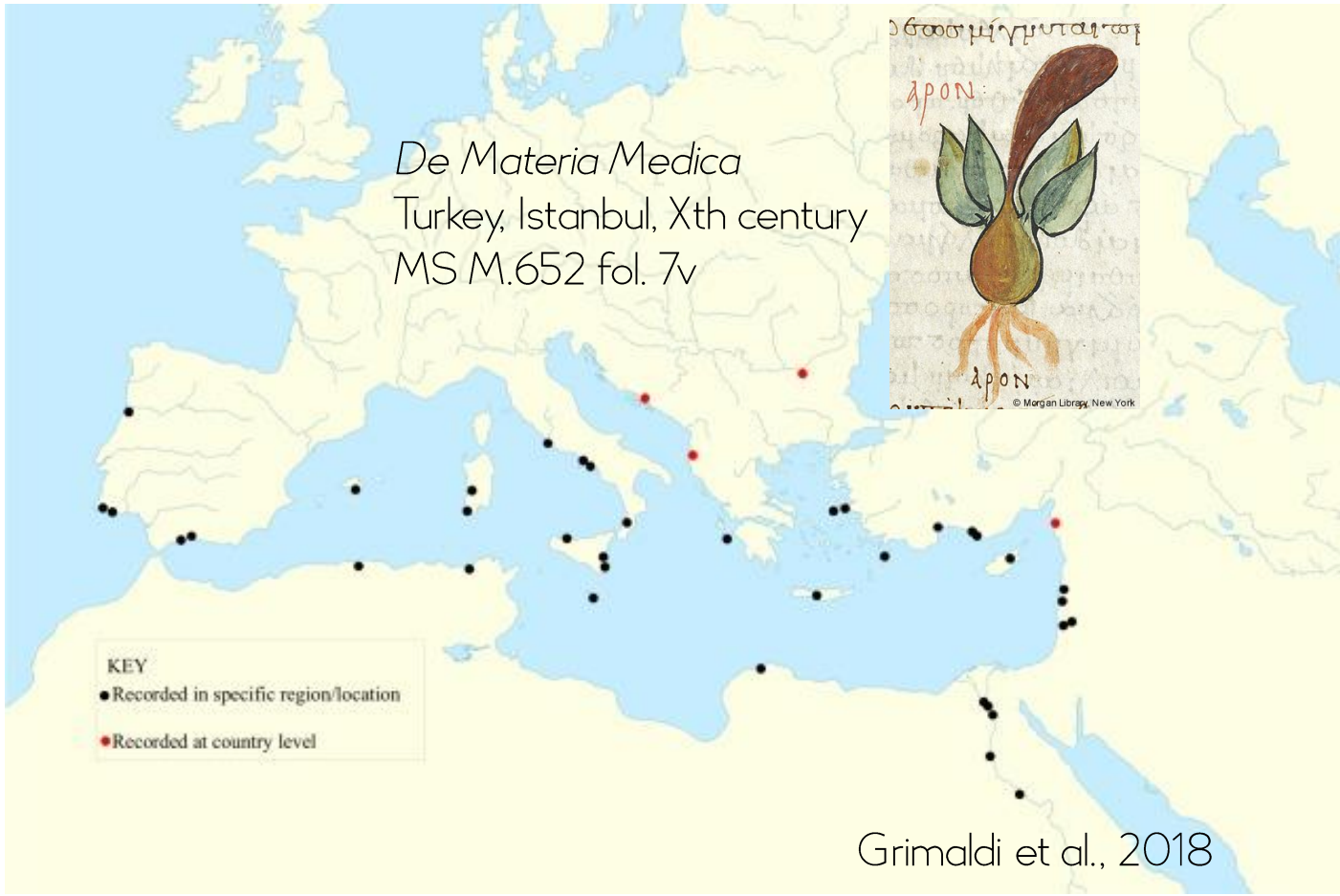
Taro is also a "temperate" crop (China, Nepal, Japan, NZ, Korea)

Andong Province, South Korea, Northern temperate zone (Photo by P.J. Matthews)

“Dogma” : taro is a “tropical root crop” (it is much more!)



Annotated text and dried sample of *C. esculenta* collected by Rauwolf in Lebanon during his journey in the Middle East. XVI century Pictures by Naturalis Biodiversity Center.



Taro is also a “temperate” crop : The Mediterranean

“Dogma” : taro is a “tropical root crop” (it is much more!)

Achu – typical paste made of mashed taro corms in Africa

Lovo preparation– typical corms cooking in the Pacific

“Dogma” : taro is a “tropical root crop” (it is much more!)

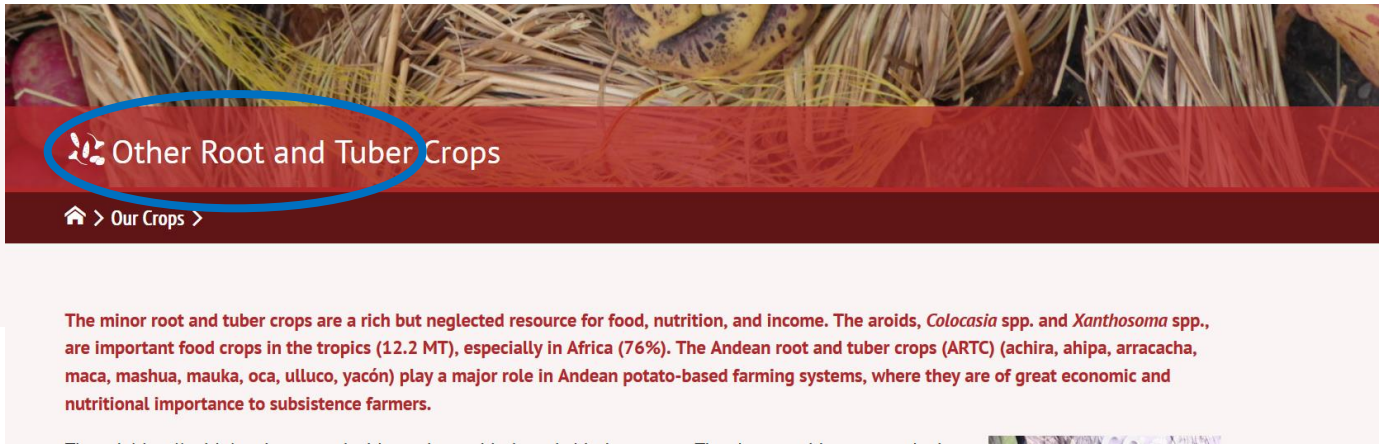
Photos by P.J. Matthews and Michel E. Ghanem

Taro is a leafy green vegetable

Taro is under-researched

RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR



	Taro	Sweet potato	Cassava	Yam	Cowpea	Sorghum
	Colocasia esculenta	*Ipomea batatas*	*Manihot esculenta*	*Dioscorea villosa*	*Vigna ungiculata*	*Sorghum bicolor*
Total number of publication (Web of Knowledge 2000–2020)	832	2023	2069	2309	3223	17223

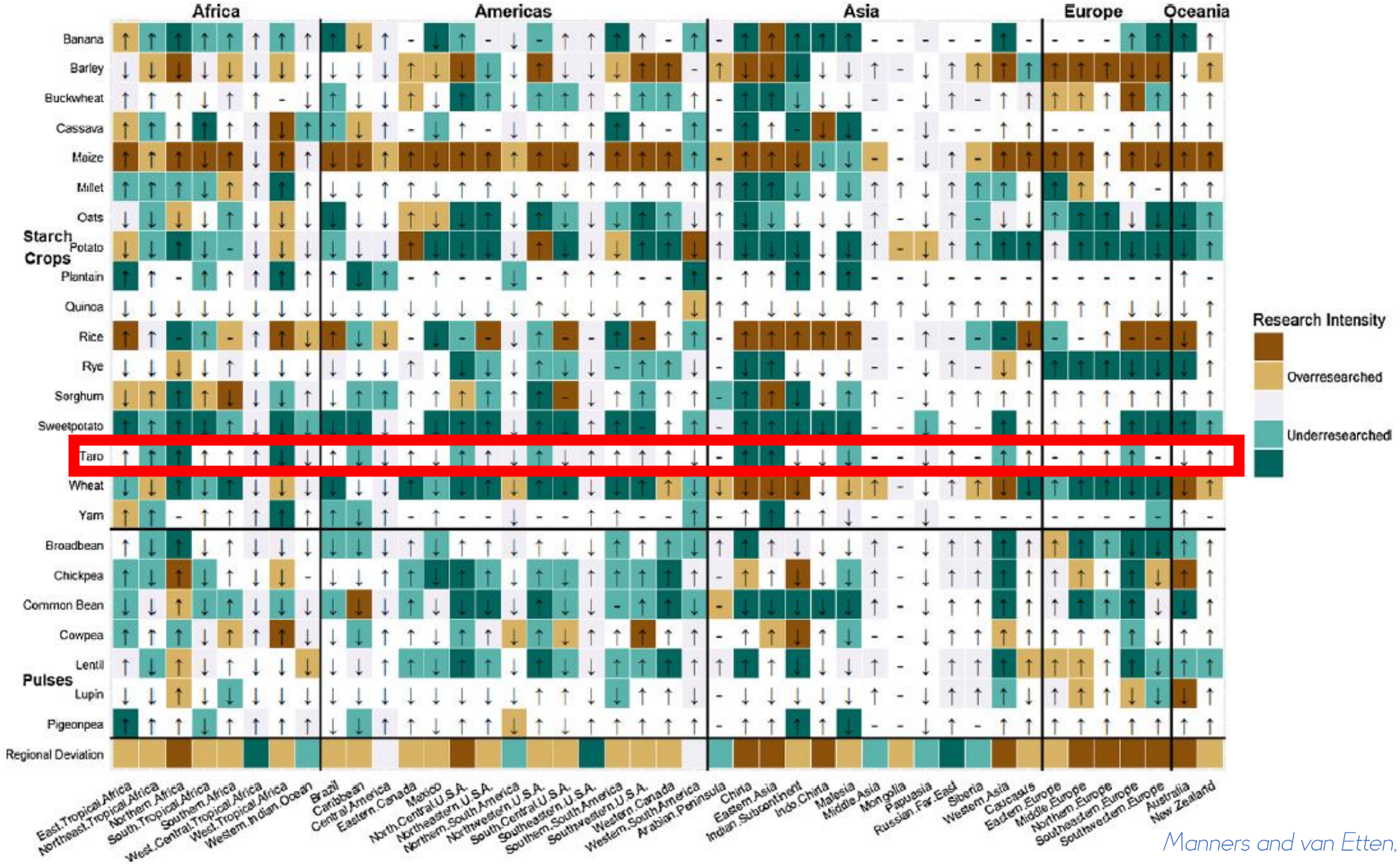
Matthews and Ghanem, (2020) in press

Pacific Community
Communauté du Pacifique

CROP TRUST

cirad
LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

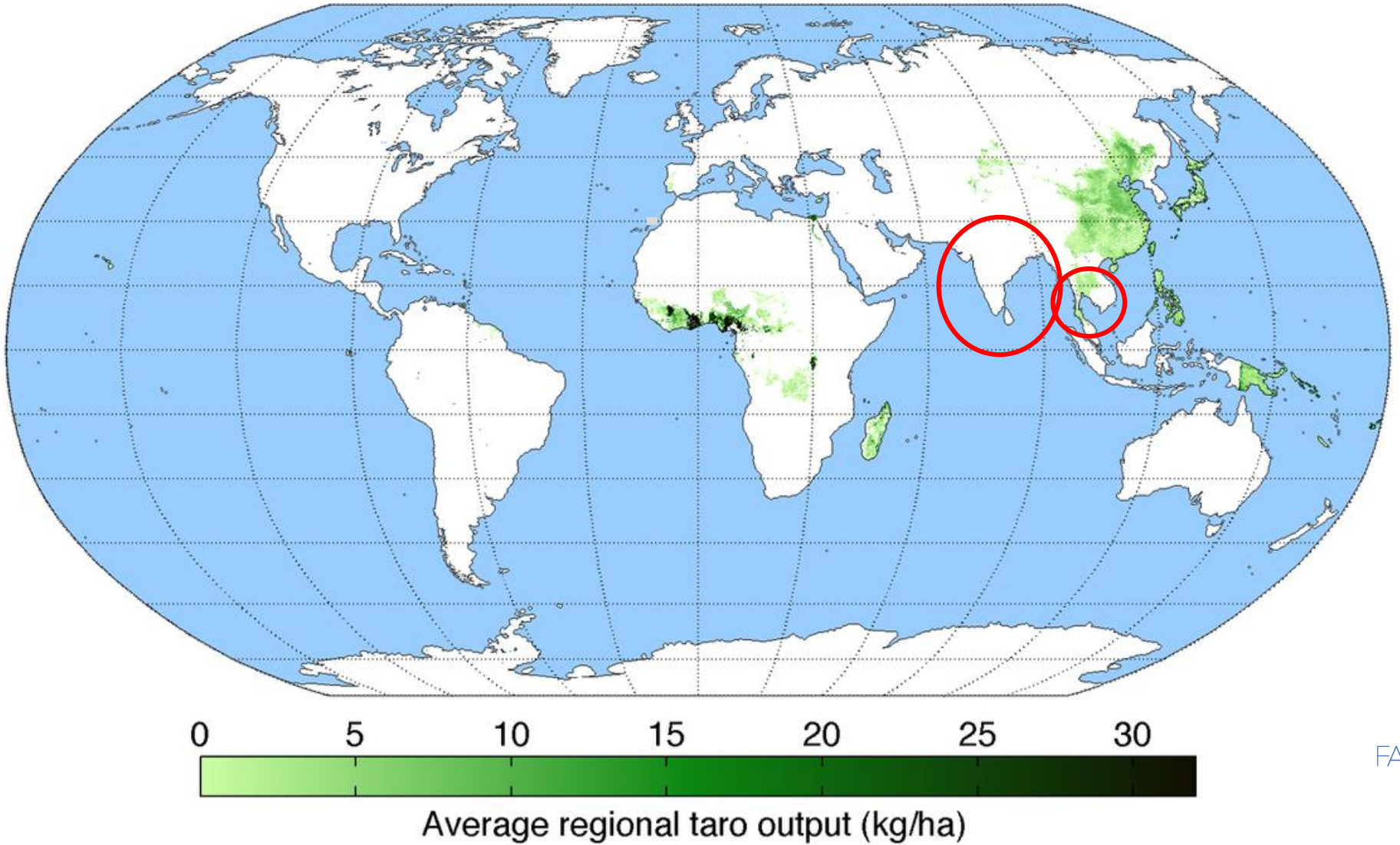
Taro is under-researched



Manners and van Etten, 2018

Missing numbers

In countries where taro is grown, corms and leaves are marketed through local distribution channels that cannot easily be measured by governments or trade organizations



FAOSTAT, 2019

Missing numbers

Production for more than 2 **billion people** who are known to consume taro – as a traditional food crop in their countries – is unaccounted for in FAO global statistics

In total, counting all the countries with missing taro production data the perception gap represents approx. 57% of taro production in Asia

Matthews and Ghanem, (2020)(in press)

	Country	Tonnes	Population	kg/capita/yr
With numbers	China (PRC)	1,800,000	1,370,350,000	1.31
	Japan	175,000	126,999,800	1.38
	Philippines	112,262	100,096,500	1.12
	Thailand	95,000	67,223,000	1.41
	Taiwan	45,000	23,433,800	1.92
	Subtotals	2,227,262	1,688,103,112	Average 1.32
Missing numbers	India*	–	1,267,400,000	–
	Indonesia	–	252,810,000	–
	Pakistan	–	185,130,000	–
	Bangladesh	–	158,510,000	–
	Vietnam	–	92,550,000	–
	Iran	–	76,500,000	–
	Myanmar	–	53,720,000	–
	South Korea	–	49,510,000	–
	Malaysia	–	30,190,000	–
	Nepal	–	28,120,740	–
	North Korea*		24,700,000	
	Sri Lanka	–	21,450,000	–
	Cambodia	–	15,410,000	–
	Six nations with <10,000,000	–	14,700,000	–
	Subtotals	–	2,270,700,00	–
		Approxi. Total taro-producing population in Asia	3,932,714,744	

Missing numbers

For taro as a green vegetable, gathered wild or from cultivation, the perception gap is close to 100%

India : the perception gap represents a failure to see approx. 32 % of likely production in the taro producing regions of Asia (East, South, and Southeast Asia combined)

Matthews and Ghanem, (2020)(in press)

Take-home messages

- *"Positive feedback loops have helped lead to humanity's present global dependence on a very small number of commodity crops, and to the erosion of genetic diversity within commodity crops*
- *High risk of current food systems*
- *Taro is an outstanding example of a crop that has been neglected as a subject of research: there is probably no other globally-distributed starch crop for which there is no internationally funded institution with a global mandate*
- *Many gaps in awareness, interest and knowledge can contribute to the neglect, underutilization or decline of orphan crops such as taro*