

# Global effects of local food-production crises: a virtual water perspective

Stefania Tamea<sup>1,\*</sup>, Francesco Laio<sup>1</sup>, and Luca Ridolfi<sup>1</sup>

Politecnico di Torino, Dept. of Environment, Land and Infrastructure Engineering, Turin, Italy

(\*) stefania.tamea@polito.it

## SUPPLEMENTARY INFORMATION

All figures are authors' elaborations with Matlab<sup>®</sup> R14 software and maps are created with the Mapping Toolbox, v.2.0.3 (<http://uk.mathworks.com/products/mapping/>).

### Temporal trends of virtual water in Argentina

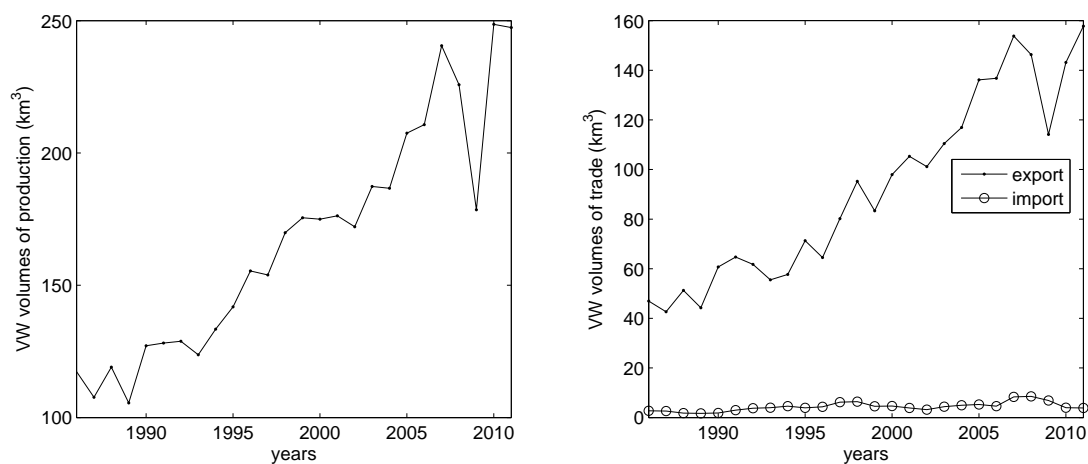


Figure S1: Virtual water volumes embedded in agricultural primary production (left) and in trade (right) of Argentina in different years (data are expressed in km<sup>3</sup>).

## Identification of high-consuming and low-consuming countries in 2011

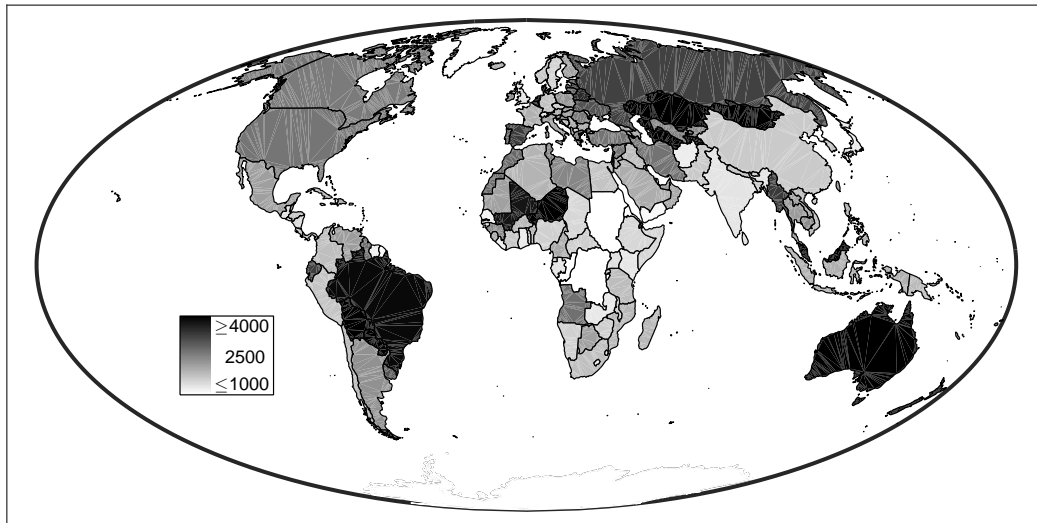


Figure S2: Per capita volume of virtual water associated to the internal availability of food (food supply + stock) in each country in 2011 (in  $\text{m}^3/\text{person}$ ).

## Impact versus vulnerability as a function of countries' wealth

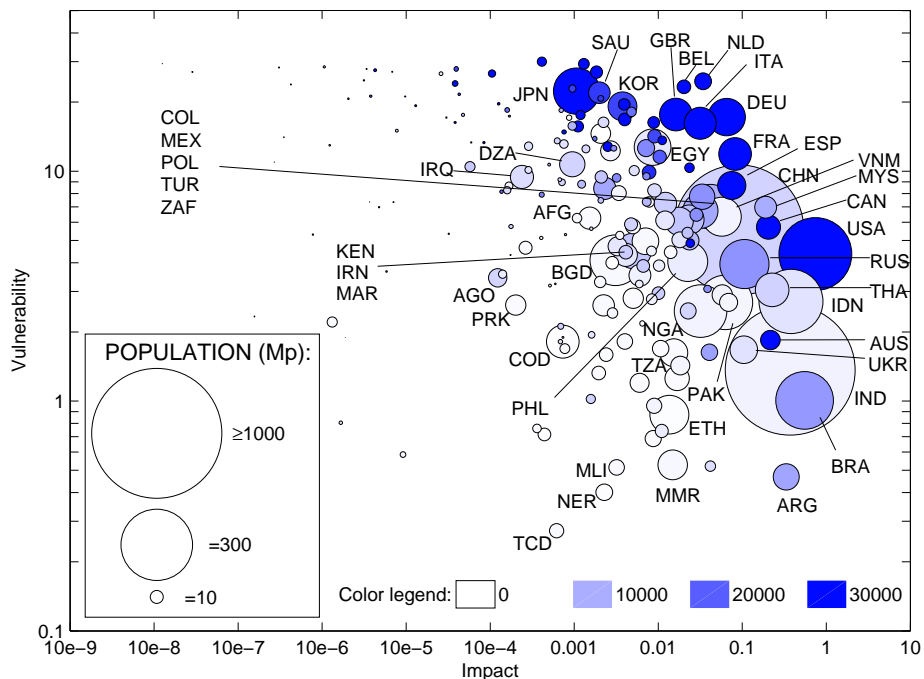


Figure S3: Absolute impact versus vulnerability of world countries with circle sizes indicating country populations (in million people) and colors scaled according to the per-capita GDP of countries (in US dollars/person/year).

## Temporal variation of indexes by country

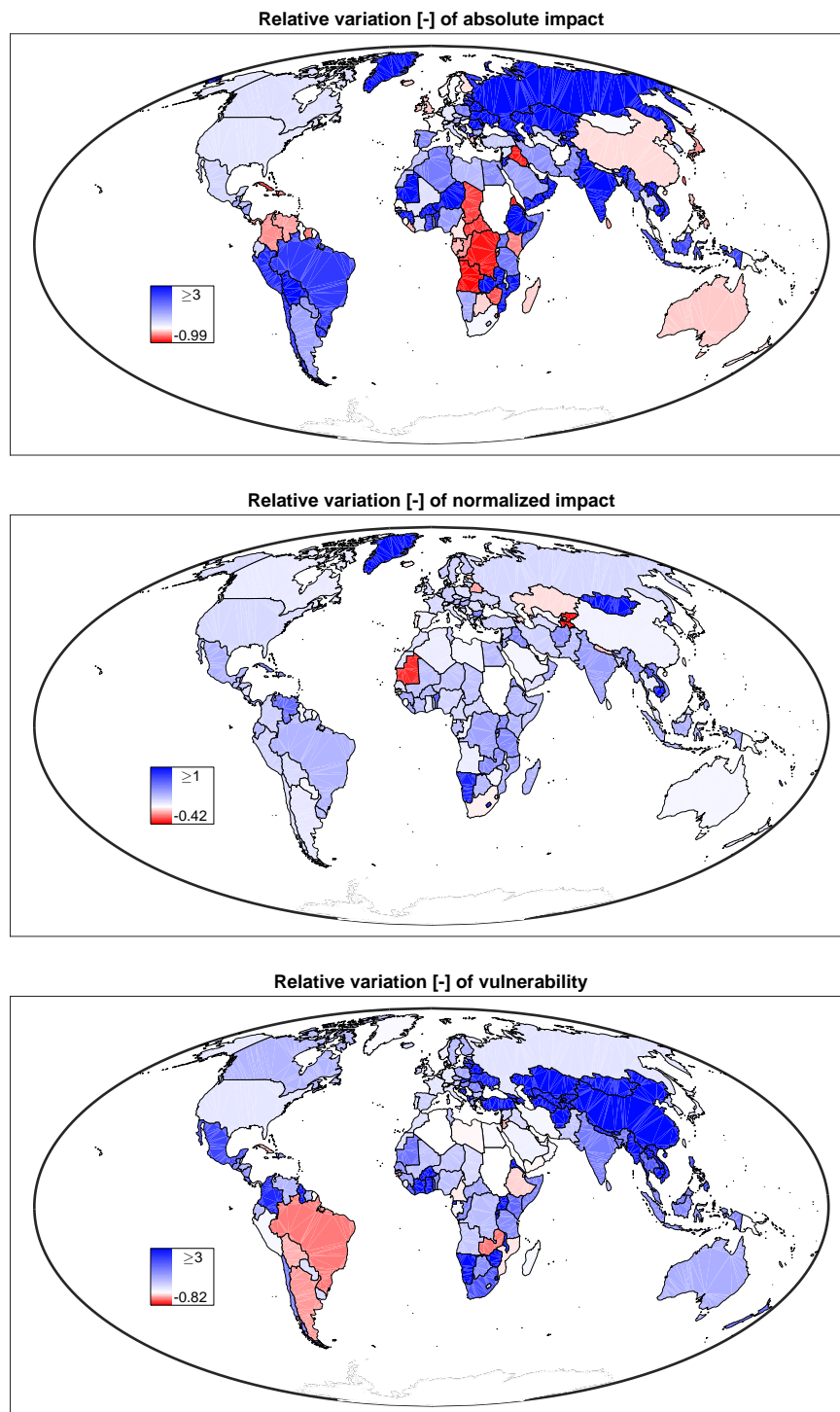


Figure S4: Relative variation of absolute impact (above), normalized impact (middle) and vulnerability (below) by country, from 1986 (or the first year of country activity) to 2011.

## Impact and vulnerability of countries

Table S1: Values of absolute impact,  $I_a$ , normalized impact,  $I_n$ , and vulnerability  $V$  of all countries in 2011.

Country	Country code	$I_a$	$I_n$	$V$
Afghanistan	AFG	1.53e-003	1.037	6.05
Albania	ALB	1.59e-004	0.914	8.17
Algeria	DZA	9.50e-004	0.846	10.32
American Samoa	ASM	7.08e-006	1.247	7.32
Angola	AGO	1.23e-004	0.694	3.34
Antigua and Barbuda	ATG	9.74e-006	1.062	21.09
Argentina	ARG	3.35e-001	0.954	0.45
Armenia	ARM	2.85e-004	0.891	10.02
Australia	AUS	2.17e-001	1.088	1.79
Austria	AUT	8.87e-003	0.961	16.01
Azerbaijan	AZE	2.10e-003	0.690	9.26
Bahamas	BHS	3.79e-006	0.992	21.12
Bahrain	BHR	3.95e-005	1.082	27.68
Bangladesh	BGD	3.11e-003	1.310	3.80
Barbados	BRB	1.69e-004	1.461	17.30
Belarus	BLR	6.63e-003	0.647	3.80
Belgium	BEL	2.02e-002	0.957	22.82
Belize	BLZ	7.89e-004	1.138	5.28
Benin	BEN	1.41e-002	1.367	4.36
Bermuda	BMU	3.38e-006	1.132	27.79
Bhutan	BTN	1.67e-006	0.940	0.80
Bolivia	BOL	1.11e-002	0.953	0.73
Bosnia and Herzegovina	BIH	1.38e-003	0.943	12.36
Botswana	BWA	2.08e-003	1.163	7.41
Brazil	BRA	5.52e-001	0.969	0.92
Brunei Darussalam	BRN	1.26e-004	1.125	19.57
Bulgaria	BGR	2.24e-002	0.821	5.30
Burkina Faso	BFA	1.07e-002	1.058	1.65
Burundi	BDI	4.42e-004	1.063	0.70
Cambodia	KHM	4.02e-003	0.990	1.77
Cameroon	CMR	1.83e-002	0.851	1.39
Canada	CAN	2.06e-001	1.002	5.51
Cape Verde	CPV	7.74e-006	1.214	14.95
Cayman Islands	CYM	3.07e-007	0.812	28.24
CAR	CAF	3.62e-004	1.003	0.75
Chad	TCD	6.19e-004	1.002	0.27
Chile	CHL	7.18e-003	0.952	12.29
Hong Kong	HKG	1.31e-003	1.083	28.83
Macao	MAC	4.29e-006	1.165	27.38
China (mainland)	CHN	9.15e-002	1.120	4.57
Taiwan	TWN	2.08e-003	1.096	14.15
Colombia	COL	1.78e-002	0.965	5.81
Comoros	COM	4.05e-004	0.989	5.10
... (continue) ...				

Country	Country code	$I_a$	$I_n$	$V$
... (continue) ...				
Congo	COG	2.87e-004	0.842	12.69
Congo DR	COD	7.34e-004	1.075	1.73
Cook Islands	COK	3.51e-007	1.267	14.06
Costa Rica	CRI	7.32e-003	0.980	7.26
Cote d'Ivoire	CIV	6.91e-002	0.948	2.62
Croatia	HRV	3.20e-003	0.981	9.24
Cuba	CUB	4.13e-003	1.038	4.35
Cyprus	CYP	7.58e-004	0.846	14.71
Czech Republic	CZE	1.04e-002	0.938	11.32
Denmark	DNK	2.36e-002	1.048	10.20
Djibouti	DJI	2.60e-005	1.018	26.44
Dominica	DMA	1.75e-004	1.417	4.31
Dominican Republic	DOM	4.77e-003	0.875	5.76
Ecuador	ECU	2.28e-002	0.910	2.41
Egypt	EGY	8.58e-003	1.032	12.04
El Salvador	SLV	5.19e-003	1.026	9.91
Equatorial Guinea	GNQ	1.36e-004	0.669	8.10
Eritrea	ERI	1.32e-006	1.626	2.18
Estonia	EST	1.76e-003	0.798	13.76
Ethiopia	ETH	1.36e-002	1.036	0.82
Falkland Islands	FLK	1.18e-005	1.191	8.91
Faroe Islands	FRO	2.86e-008	0.910	26.99
Fiji	FJI	6.74e-004	1.121	9.14
Finland	FIN	2.52e-003	0.889	12.60
France	FRA	8.26e-002	0.925	11.31
French Polynesia	PYF	3.83e-005	0.949	16.24
Gabon	GAB	4.12e-004	0.857	7.85
Gambia	GMB	8.71e-004	1.367	16.97
Georgia	GEO	7.57e-004	0.772	12.97
Germany	DEU	6.55e-002	0.897	16.26
Ghana	GHA	5.81e-002	0.966	2.81
Greece	GRC	7.81e-003	0.929	9.70
Greenland	GRL	6.83e-006	1.245	27.05
Grenada	GRD	3.02e-005	0.938	17.10
Guam	GUM	1.23e-006	0.859	12.94
Guatemala	GTM	1.81e-002	0.997	4.91
Guinea	GIN	1.97e-003	1.046	1.30
Guinea-Bissau	GNB	6.47e-003	1.366	2.16
Guyana	GUY	1.60e-003	1.079	5.59
Haiti	HTI	2.65e-004	0.858	4.56
Honduras	HND	1.03e-002	1.010	3.82
Hungary	HUN	2.86e-002	0.902	6.34
Iceland	ISL	8.43e-005	0.969	13.26
India	IND	3.74e-001	1.136	1.12
Indonesia	IDN	3.81e-001	1.033	2.47
Iran	IRN	5.07e-003	0.991	4.27
Iraq	IRQ	2.39e-004	1.204	9.12
... (continue) ...				

Country	Country code	$I_a$	$I_n$	$V$
... (continue) ...				
Ireland	IRL	1.12e-002	1.164	13.44
Israel	ISR	1.11e-003	0.920	15.40
Italy	ITA	3.17e-002	0.967	15.42
Jamaica	JAM	7.19e-004	1.120	8.85
Japan	JPN	1.07e-003	1.049	20.81
Jordan	JOR	2.23e-003	1.073	16.06
Kazakhstan	KAZ	4.08e-002	0.830	1.59
Kenya	KEN	7.07e-003	1.119	4.76
Kiribati	KIR	3.22e-005	0.817	5.33
Korea DPR	PRK	2.03e-004	1.183	2.53
Korea R	KOR	3.76e-003	1.201	18.37
Kuwait	KWT	1.05e-004	1.008	26.34
Kyrgyzstan	KGZ	1.08e-003	0.696	6.16
Laos	LAO	2.87e-003	1.116	2.38
Latvia	LVA	2.96e-003	0.800	12.47
Lebanon	LBN	9.52e-004	0.992	15.53
Lesotho	LSO	9.20e-006	1.391	0.58
Liberia	LBR	3.49e-003	0.953	5.19
Libya	LYB	5.76e-005	0.855	10.32
Lithuania	LTU	7.24e-003	0.793	9.40
Macedonia	MKD	6.29e-004	0.923	13.44
Madagascar	MDG	6.01e-003	1.019	1.17
Malawi	MWI	8.72e-003	1.203	0.67
Malaysia	MYS	1.90e-001	1.049	6.75
Maldives	MDV	1.06e-006	1.417	28.33
Mali	MLI	3.20e-003	1.101	0.50
Malta	MLT	4.29e-005	0.992	21.53
Marshall Islands	MHL	1.57e-007	0.805	2.33
Mauritania	MRT	1.67e-004	0.763	8.53
Mauritius	MUS	7.02e-004	1.003	18.29
Mayotte	MYT	0.00e+000	NaN	30.00
Mexico	MEX	4.20e-002	0.891	6.55
Micronesia	FSM	7.76e-007	0.655	5.29
Moldova	MDA	5.96e-003	0.802	3.19
Mongolia	MNG	1.62e-003	0.885	1.92
Montenegro	MNE	4.75e-005	0.976	17.51
Montserrat	MSR	1.89e-006	0.899	1.89
Morocco	MAR	4.13e-003	0.898	4.17
Mozambique	MOZ	5.07e-003	1.054	2.72
Myanmar	MMR	1.49e-002	1.145	0.50
Namibia	NAM	6.94e-004	1.133	2.10
Nauru	NRU	2.71e-007	1.028	10.94
Nepal	NPL	2.24e-003	1.326	2.53
Netherlands	NLD	3.43e-002	0.987	24.00
Netherlands Antilles	ANT	-2.03e-007	1.200	30.11
New Caledonia	NCL	1.30e-005	1.195	19.20
New Zealand	NZL	2.42e-002	0.997	4.80
... (continue) ...				

Country	Country code	$I_a$	$I_n$	$V$
... (continue) ...				
Nicaragua	NIC	8.34e-003	1.001	4.42
Niger	NER	2.28e-003	1.149	0.39
Nigeria	NGA	3.20e-002	0.997	2.28
Niue	NIU	2.63e-007	0.781	0.57
Norway	NOR	1.19e-003	1.032	17.33
Palestine	PSE	1.41e-004	0.962	3.52
Oman	OMN	9.58e-004	1.099	22.65
Pakistan	PAK	6.31e-002	1.185	2.48
Palau	PLW	0.00e+000	NaN	30.00
Panama	PAN	1.23e-003	0.944	8.68
Papua New Guinea	PNG	8.39e-003	0.900	2.73
Paraguay	PRY	4.19e-002	0.859	0.51
Peru	PER	1.22e-002	0.950	7.00
Philippines	PHL	2.25e-002	1.013	3.81
Poland	POL	3.33e-002	0.940	7.46
Portugal	PRT	9.06e-003	0.784	13.91
Qatar	QAT	3.83e-005	1.228	23.90
Romania	ROU	2.36e-002	0.876	4.85
Russian Federation	RUS	1.06e-001	0.890	3.66
Rwanda	RWA	2.41e-003	1.490	1.56
Saint Helena	SHN	0.00e+000	NaN	30.00
Saint Kitts and Nevis	KNA	4.24e-007	1.127	23.81
Saint Lucia	LCA	2.06e-006	1.020	20.62
Saint Pierre and Miquelon	SPM	1.26e-008	0.973	29.42
Saint Vincent and the Grenadines	VCT	5.97e-005	1.080	13.32
Samoa	WSM	5.87e-006	0.805	3.65
Sao Tome and Principe	STP	5.98e-004	0.769	3.23
Saudi Arabia	SAU	2.00e-003	1.122	21.26
Senegal	SEN	3.40e-003	0.914	7.85
Serbia	SRB	1.01e-002	0.928	2.89
Seychelles	SYC	3.14e-006	0.835	24.81
Sierra Leone	SLE	7.76e-004	0.813	1.66
Singapore	SGP	4.14e-004	1.034	29.52
Slovakia	SVK	4.83e-003	0.954	17.87
Slovenia	SVN	2.07e-003	0.913	20.54
Solomon Islands	SLB	5.17e-004	0.854	3.16
Somalia	SOM	2.84e-003	1.055	3.92
South Africa	ZAF	2.35e-002	1.054	5.88
Spain	ESP	7.51e-002	0.919	8.31
Sri Lanka	LKA	1.21e-002	0.964	5.94
Suriname	SUR	5.05e-004	0.899	10.64
Swaziland	SWZ	6.86e-004	0.869	1.80
Sweden	SWE	4.00e-003	0.900	16.50
Switzerland	CHE	3.94e-003	0.869	19.19
Syria	SYR	3.29e-003	0.973	4.58
Tajikistan	TJK	2.04e-003	0.508	3.24
Tanzania	TZA	1.54e-002	1.286	1.56
... (continue) ...				

<b>Country</b>	<b>Country code</b>	$I_a$	$I_n$	$V$
... (continue) ...				
Thailand	THA	2.27e-001	1.071	2.90
Timor-Leste	TLS	1.77e-004	1.021	5.71
Togo	TGO	7.80e-003	0.930	7.23
Tonga	TON	4.76e-006	0.893	6.96
Trinidad and Tobago	TTO	1.59e-004	1.013	18.36
Tunisia	TUN	9.03e-003	0.850	8.08
Turkey	TUR	3.19e-002	0.994	6.38
Turkmenistan	TKM	1.58e-003	0.883	1.01
Tuvalu	TUV	3.68e-006	1.261	7.34
Uganda	UGA	1.68e-002	1.166	1.21
Ukraine	UKR	1.05e-001	0.864	1.60
UAE	ARE	1.85e-003	1.040	26.50
UK	GBR	1.62e-002	0.896	16.81
USA	USA	7.45e-001	1.066	3.91
Uruguay	URY	3.86e-002	0.992	3.04
Uzbekistan	UZB	6.06e-003	0.830	3.41
Vanuatu	VUT	7.38e-004	0.782	1.89
Venezuela	VEN	2.32e-003	1.164	8.14
Vietnam	VNM	5.72e-002	0.993	5.99
Yemen	YEM	2.71e-003	1.057	11.91
Zambia	ZMB	8.94e-003	1.502	0.93
Zimbabwe	ZWE	5.01e-003	1.047	5.62