Land, a critical resource for the water, energy and food nexus

Jean-François Soussana and Olivier Barreteau

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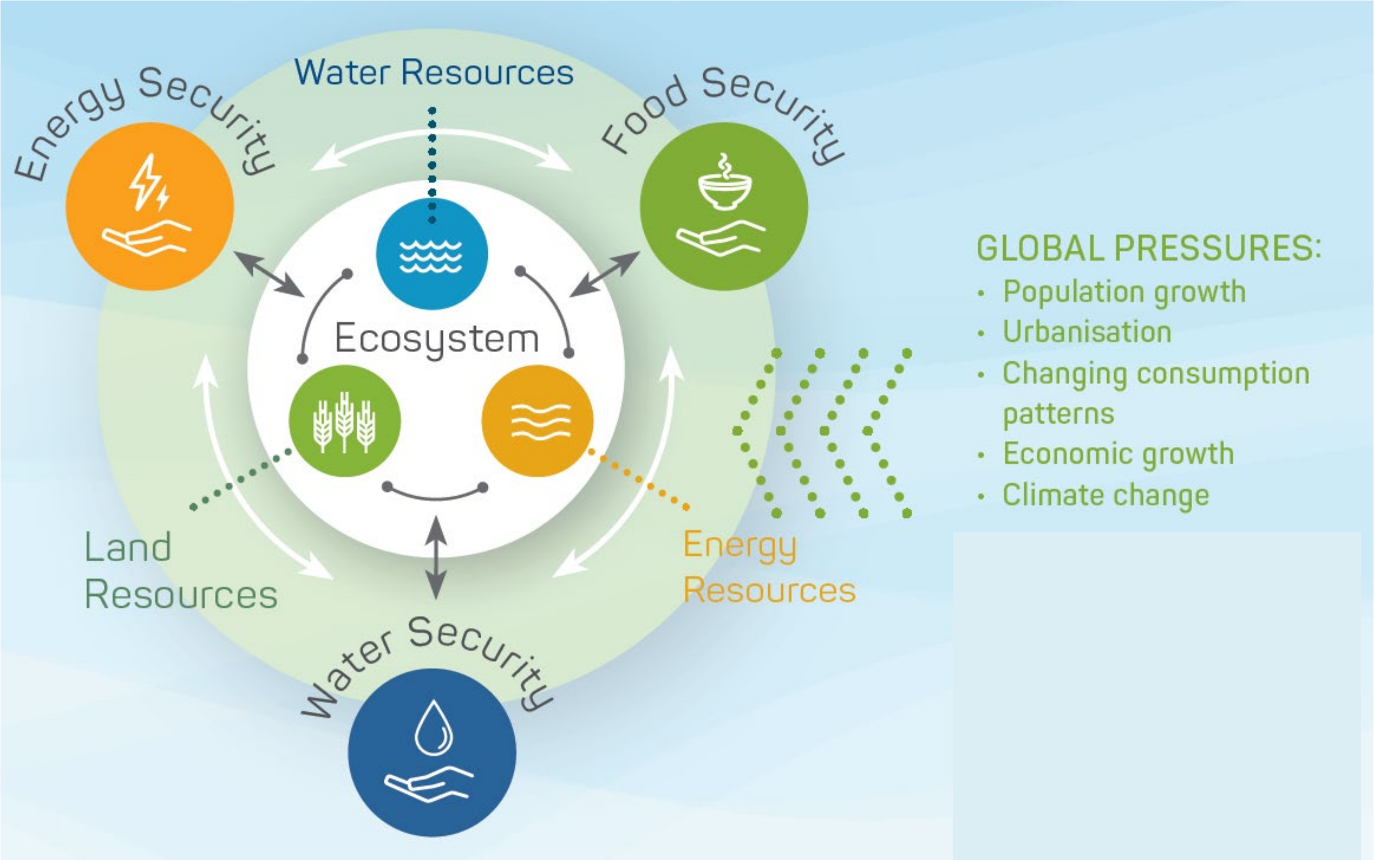
The WEF nexus concept



Source: BMZ Nexus interlinkage strategy

The WEF nexus in perspective

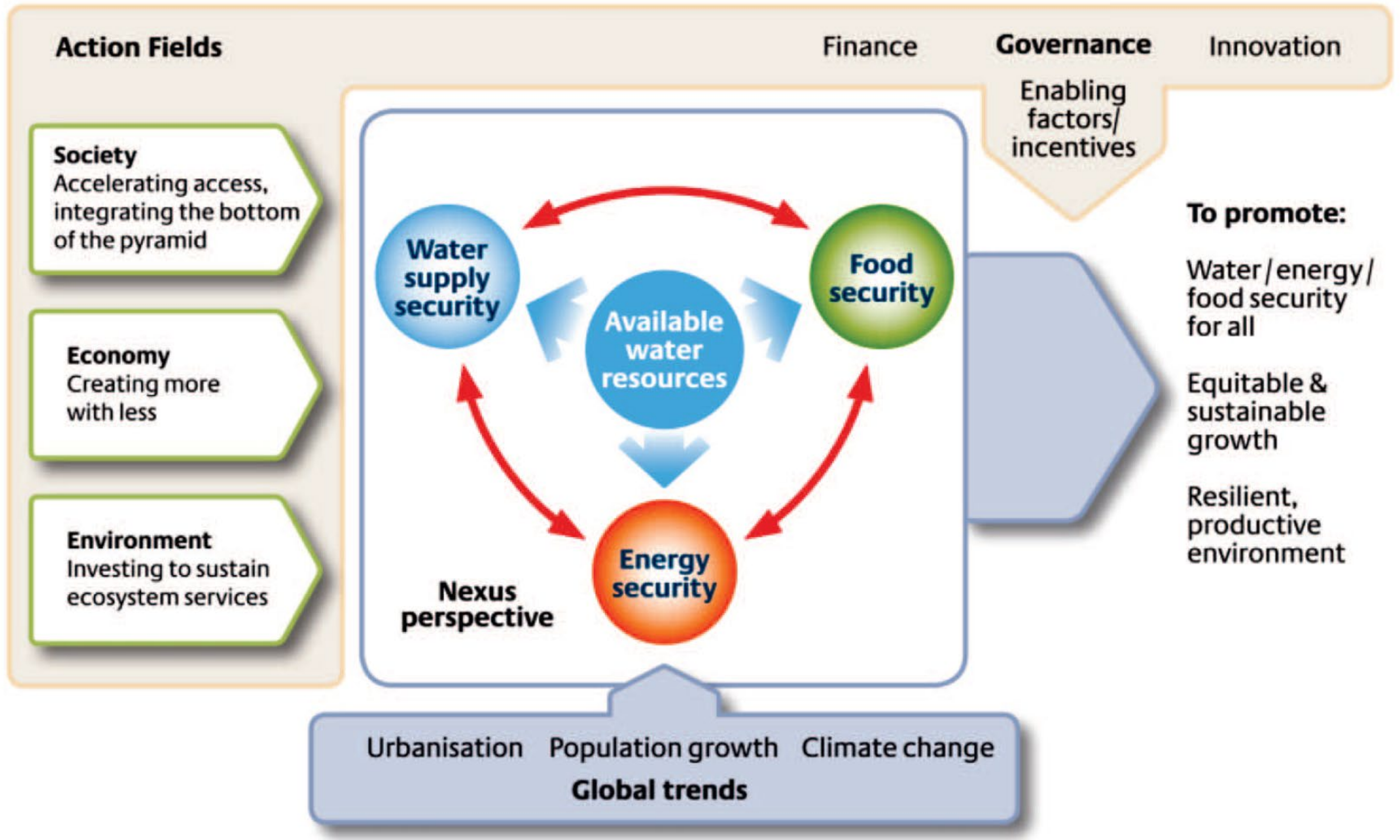


Figure 1. Water-Energy-Food Security Nexus from Hoff (2011). Source: Understanding the Nexus: Background paper for the Bonn 2011 Nexus Conference, Stockholm Environment Institute 2011. Reprinted with permission.

Tamee R Albrecht *et al* 2018 *Environ. Res. Lett.* **13** 043002

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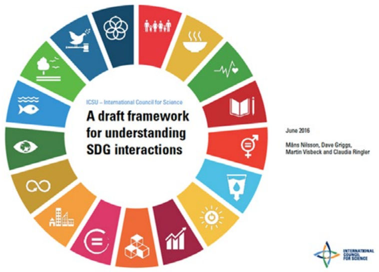
The WEF nexus and the SDGs

WEF nexus

Reconnecting
SDGs 2, 6 and 7

Going from human-environment
to transforming our world
and to leaving no one behind

Source: ICSU, 2018



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Risks from failures in WEF governance

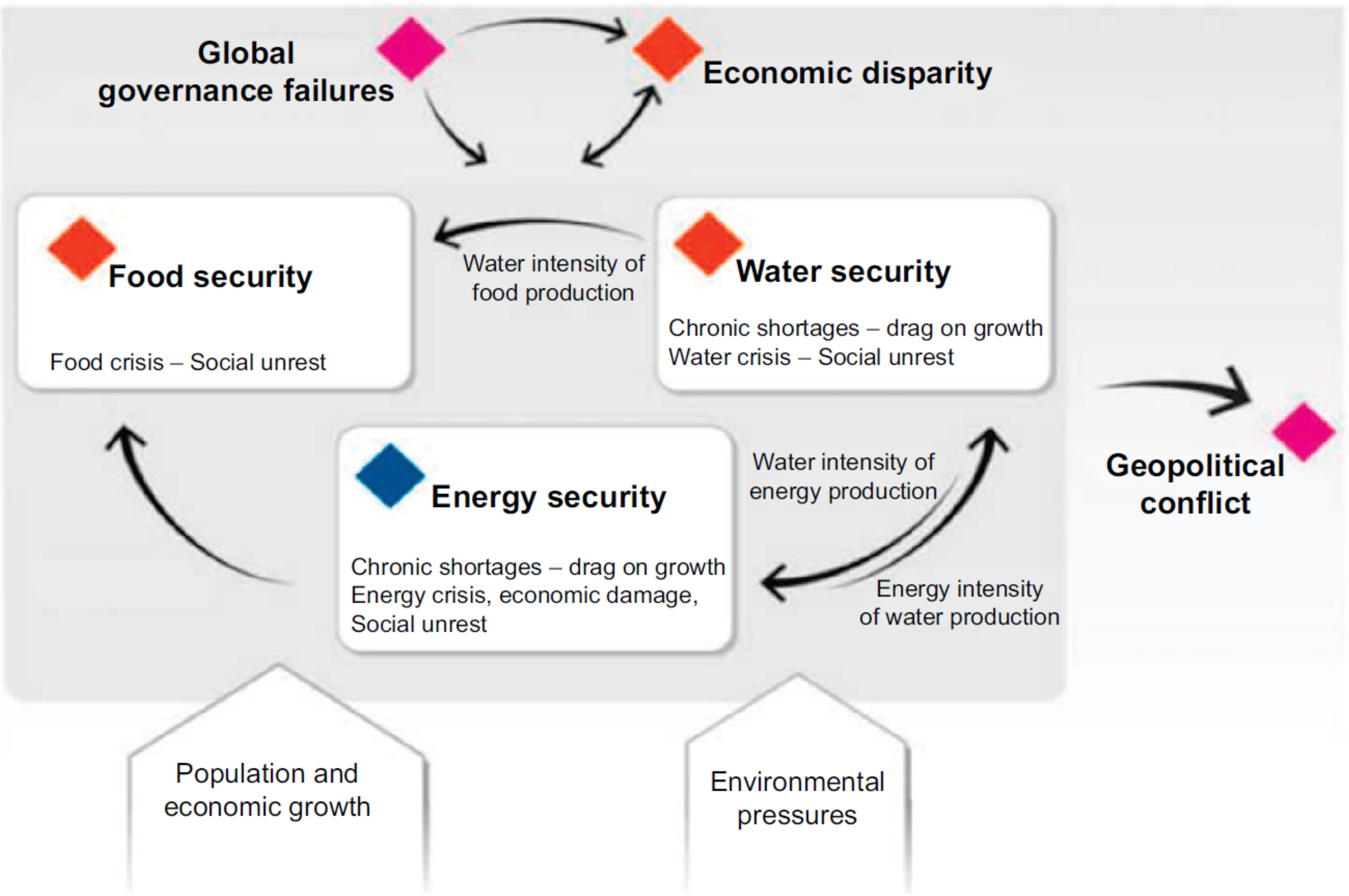

Figure 2. Water-Energy-Food Security Nexus from World Economic Forum. Source: Global Risks 2011 (Sixth Edition), World Economic Forum, Switzerland, 2011. Reprinted with permission.

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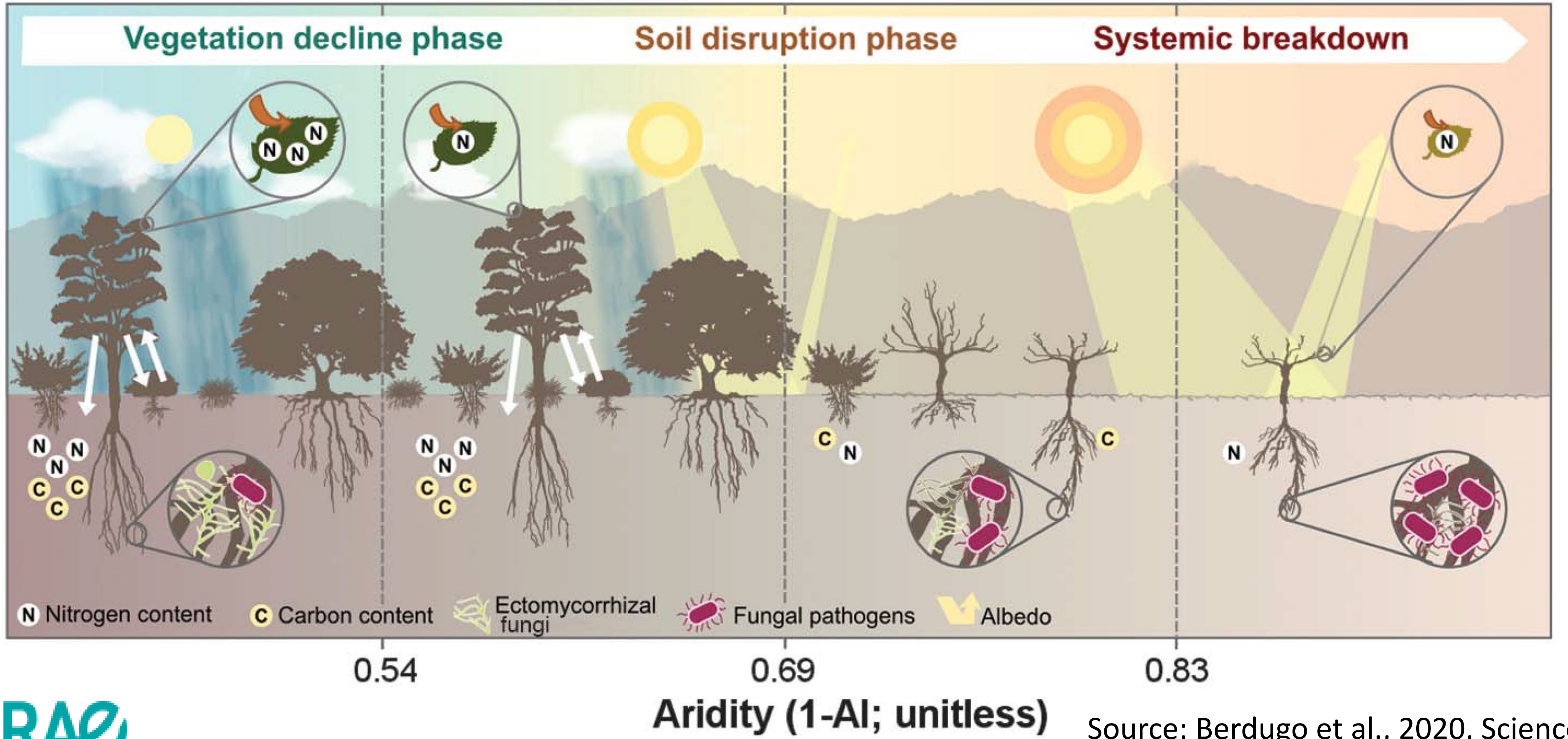
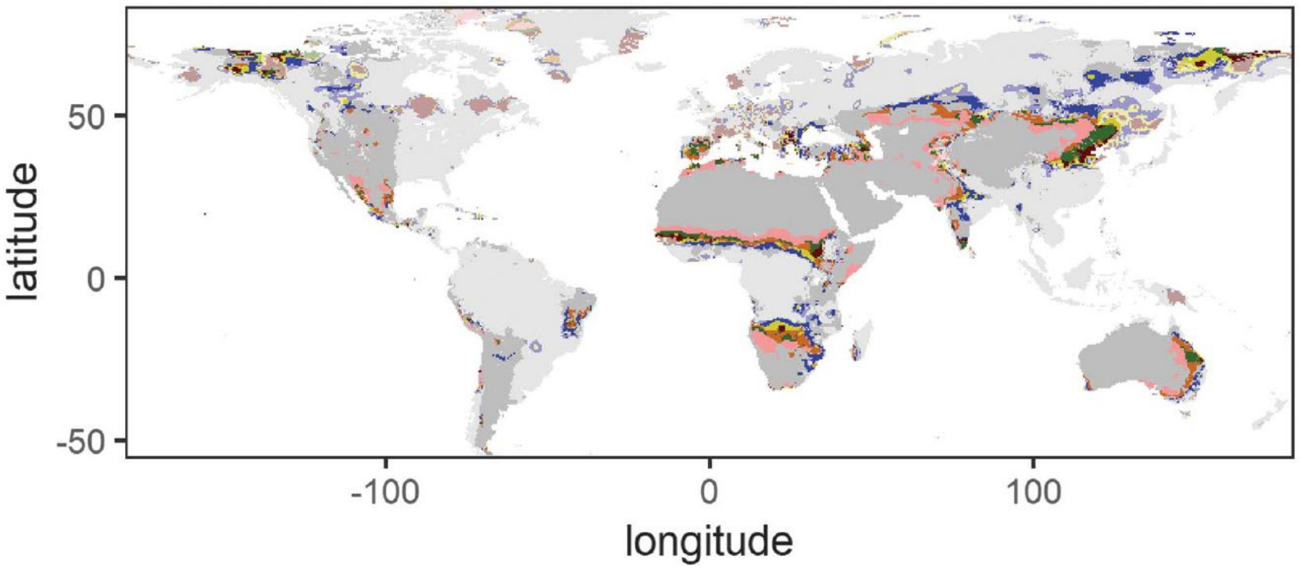
Ecosystem breakdown with increasing aridity



Source: Berdugo et al., 2020, Science

Climate change vulnerability of global drylands



Legend	Threshold crossed	% emerged lands affected	% drylands affected
	0.54	7.5 %	7.7 %
	0.54 & 0.69	3.3 %	3.1 %
	0.54, 0.69 & 0.83	3.2 %	1.7 %
	0.69	2.5 %	5.1 %
	0.69 & 0.83	1.8 %	3.3 %
	0.83	3.7 %	7.7 %

Fig. 3. Map of climate change vulnerability in global drylands. This map includes areas that will cross each (or several) of the thresholds described according to the aridity predicted for 2100 by the IPCC RCP8.5 scenario (i.e., under the assumption of sustained increase in CO_2 emissions). Transparent areas are outside of the range used for the data in this study [i.e., areas that are not drylands today; see (*16*) for further details].

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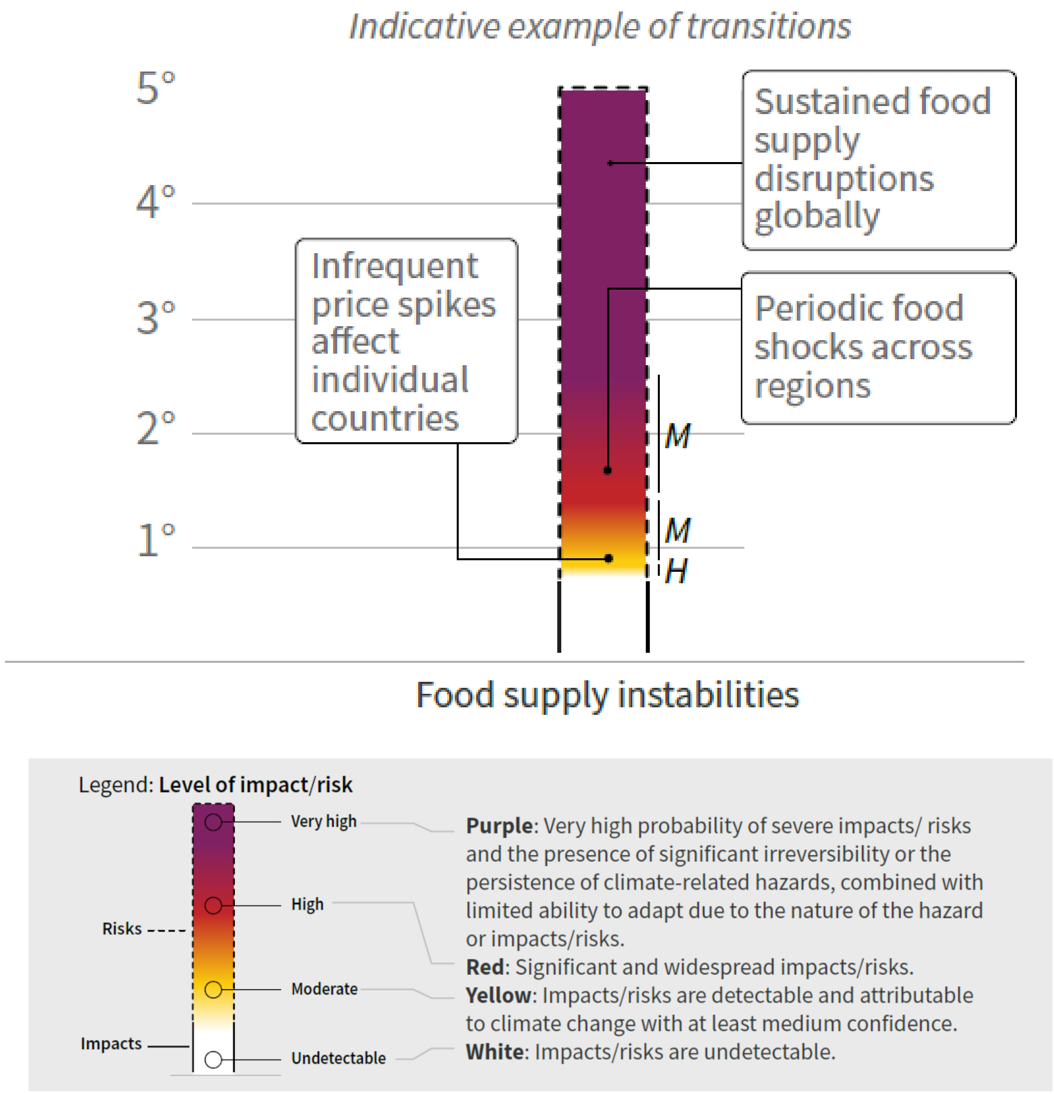
Source: Berdugo et al., 2020, Science

Risks to food supply stability as a result of climate change



The stability of food supply is projected to decrease as the magnitude and frequency of extreme weather events that disrupt food chains increases

Increased atmospheric CO_2 levels can also lower the nutritional quality of crops

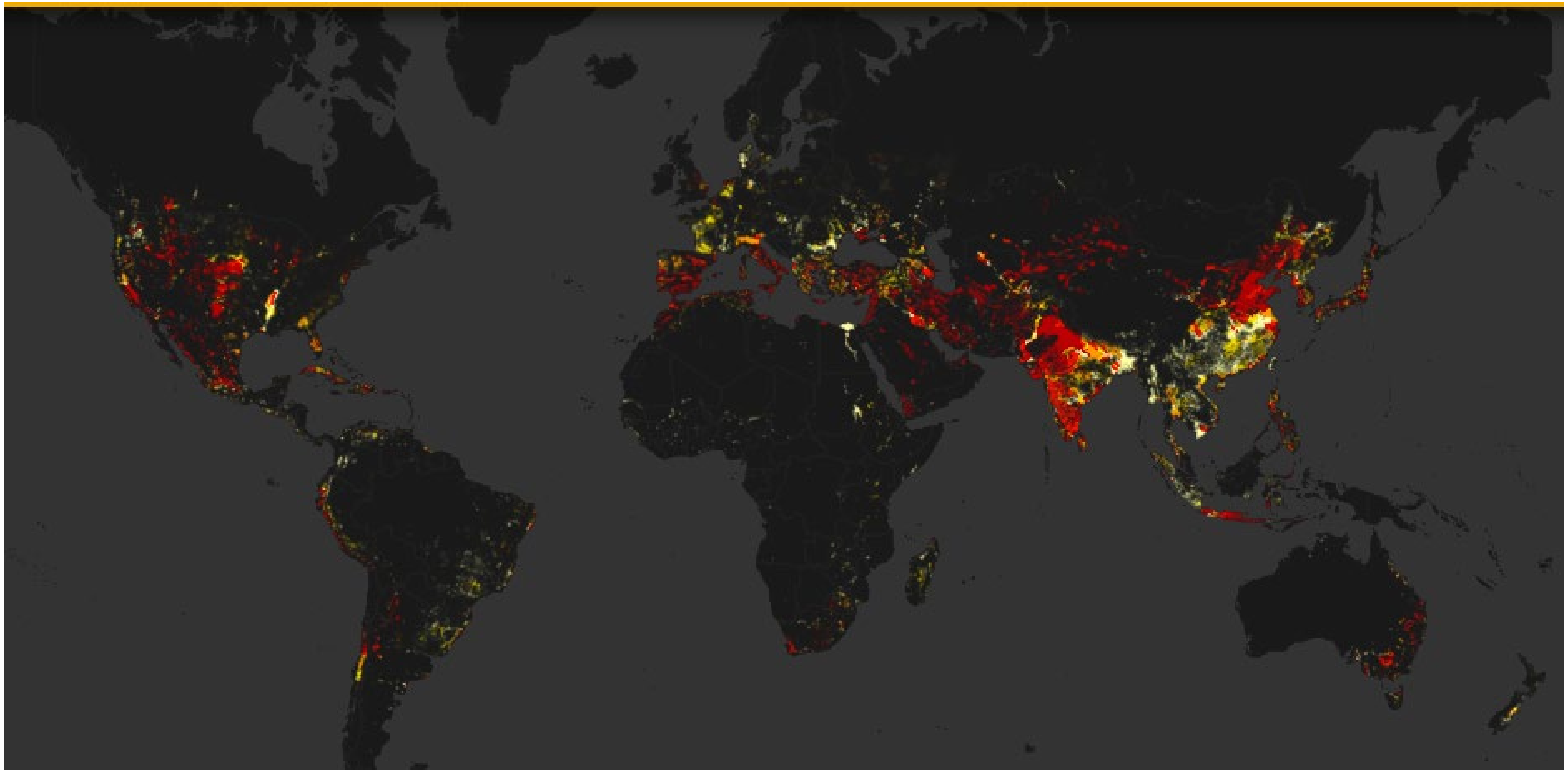
Median economic models project a 7 % increase in food prices due to climate change by 2050 leading to increased risks of food insecurity

The most vulnerable people will be more severely affected

Increased warming may amplify migration both within countries and across borders

IPCC, SR CCL, SPM, 2019

Over-abstraction of water through irrigation



Source: World Resources Institute
http://www.wri.org/applications/maps/agriculturemap/#x=-162.42&y=17.61&l=2&v=home&d=gmia

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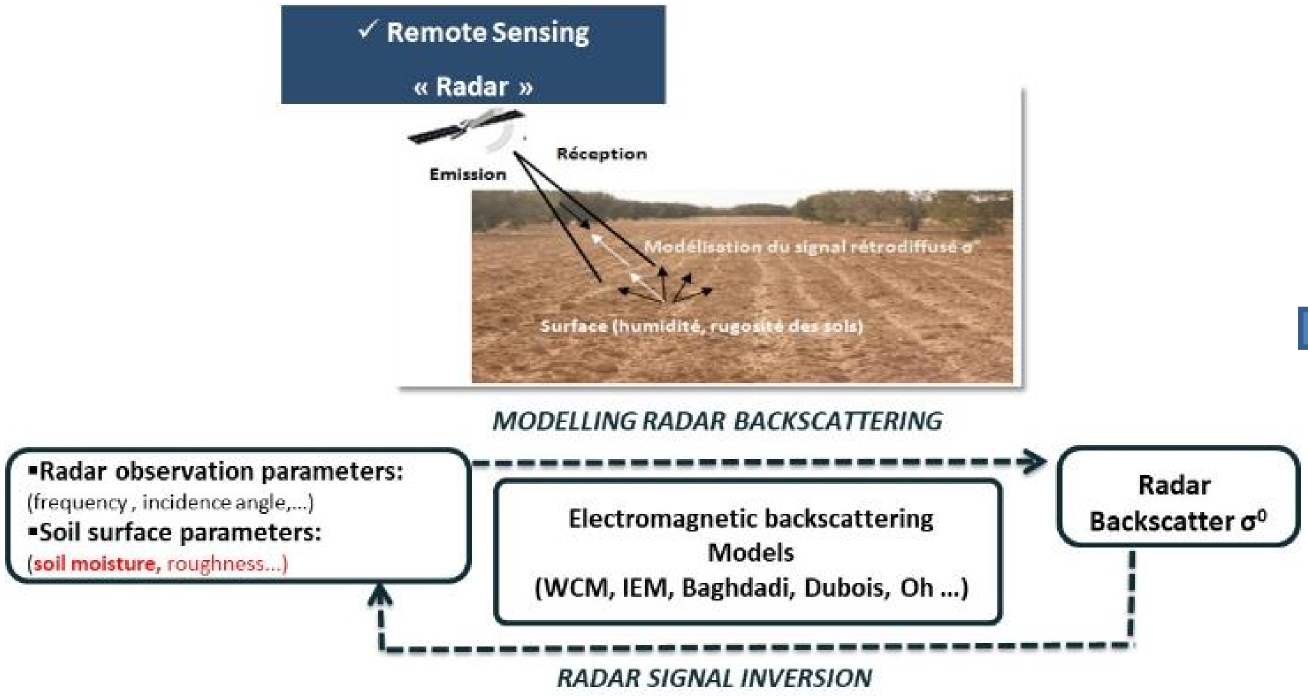
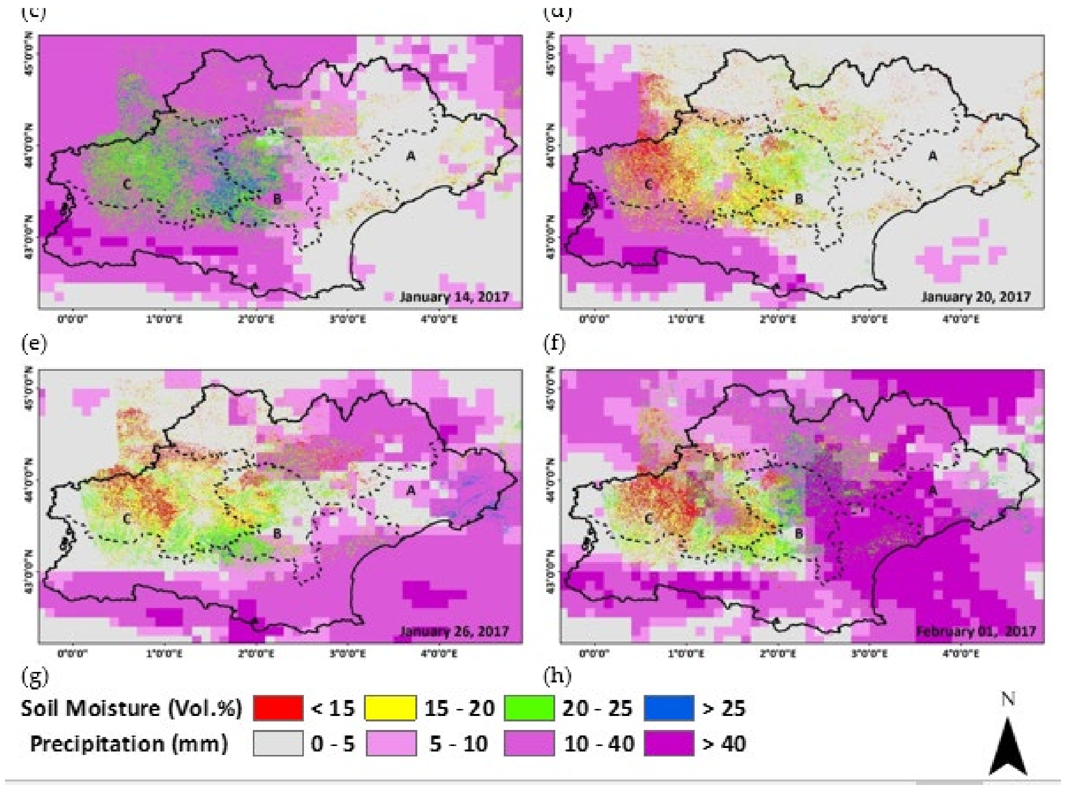
Mapping of soil moisture in agricultural environments: application to monitoring irrigation

Soil moisture mapping with very high spatial and temporal resolution:
Innovative product: precision (5 vol.%) and scale (plot)
Relevant product for irrigation monitoring
No global equivalent

➔ Operational and available, see Theia: http://www.theia-land.fr/





Increasing challenges from global changes

- Climate, Urbanization
- New demand for food, energy…
  - Quantity, quality
- Technical changes
  - Practices, varieties
- Change in access to resources
  - Interconnections, treated waste water reuse
- New information availability
  - Big data, connected objects
- Exploring new institutional tools
  - Insurance systems

⇒ **What are the consequences beyond their frame?**

Innovation in drip irrigation in Maghreb

- Strong expectations for water saving
  - Lower consumption to avoid groundwater depletion
  - Issue of efficiency: farmers and their objectives & practices
  - Suitability of outscaling from the lab to the agricultural region

- No conclusive evidence of benefits
  - Use of surplus water for intensification, continued decline of water tables
  - Water saving at field level, not at regional level
  - Allocation of « saved » water to be handled

Van der Kooij S., Zwarteveen M., Boesveld H., Kuper M., 2013: The efficiency of drip irrigation unpacked. Agricultural Water Management, 123, 103-110

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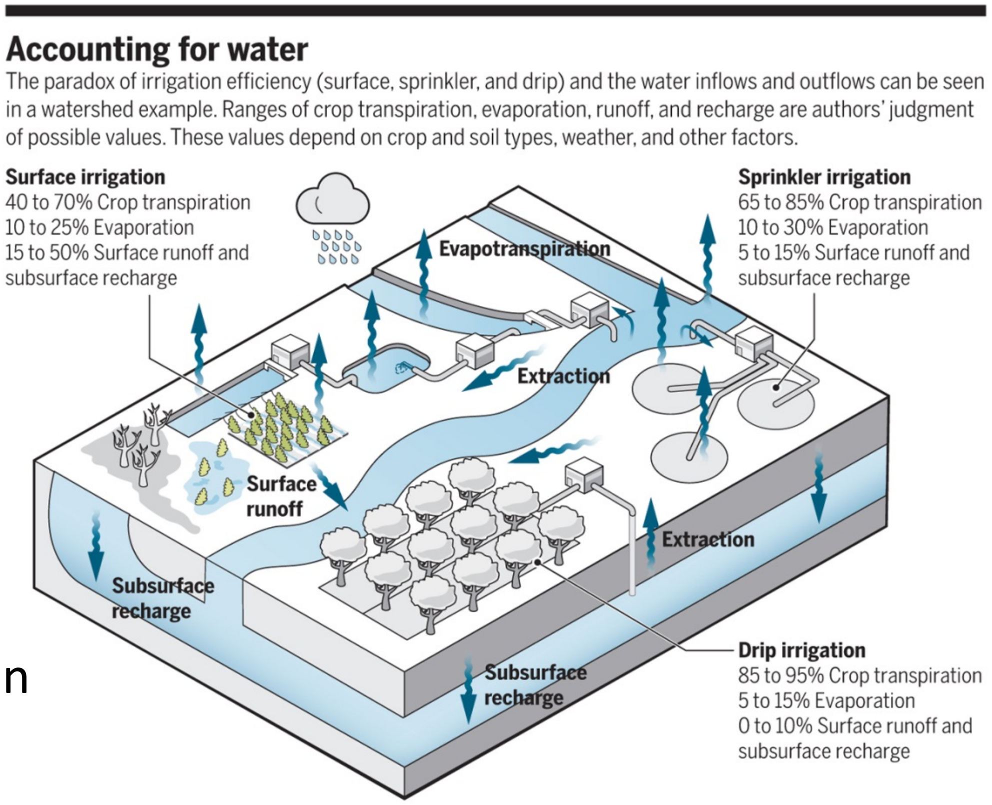
Transfering farm vulnerability to basin vulnerability:
Taking in account return flows

- Egypt *(Perry et al. 2017)*
  - All return flows contribute to resource
  - Increase of on farm irrigation efficiency does not mean water saving
  - Need to adress destination of excess flows

- Australia *(Perry et al. 2017)*
  - Assumption of zero return flows in Murray Darling
  - Subsidies for on-farm water savings
  - Increase of on-farm water consumption



R. Q. Grafton et al. 2018

Science AAAS

Grafton R. Q. et al. 2018. The paradox of irrigation efficiency. Science, 361 (6404): 748-750
Perry C.J. et al. 2017. Does improved irrigation technology save water. A review of the evidence. FAO, Cairo, 42p.

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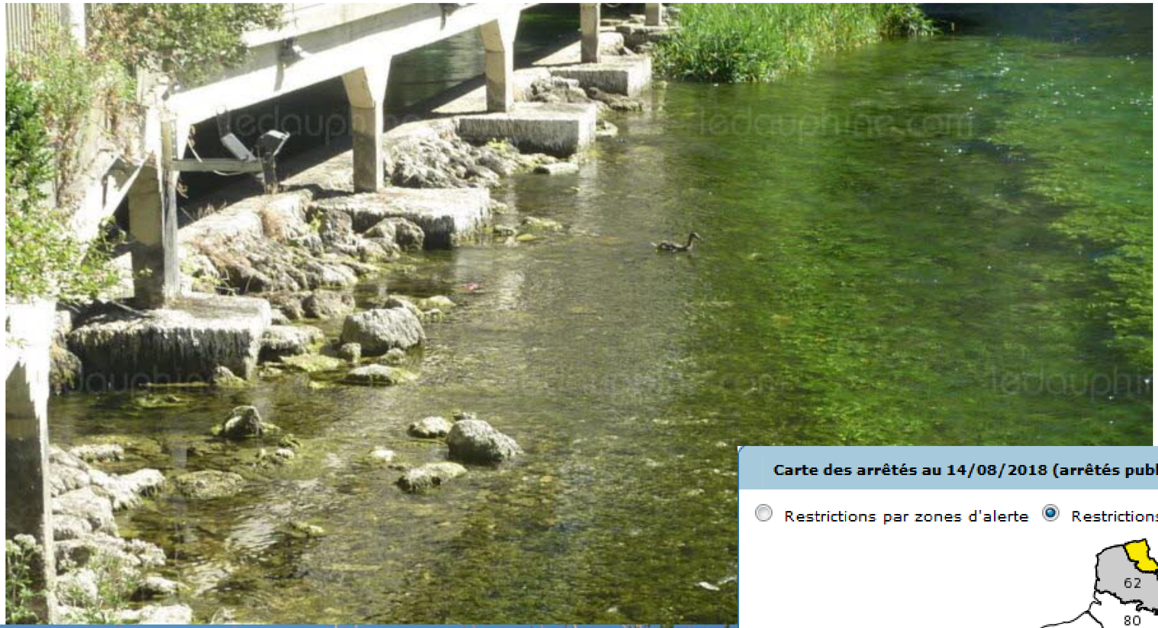
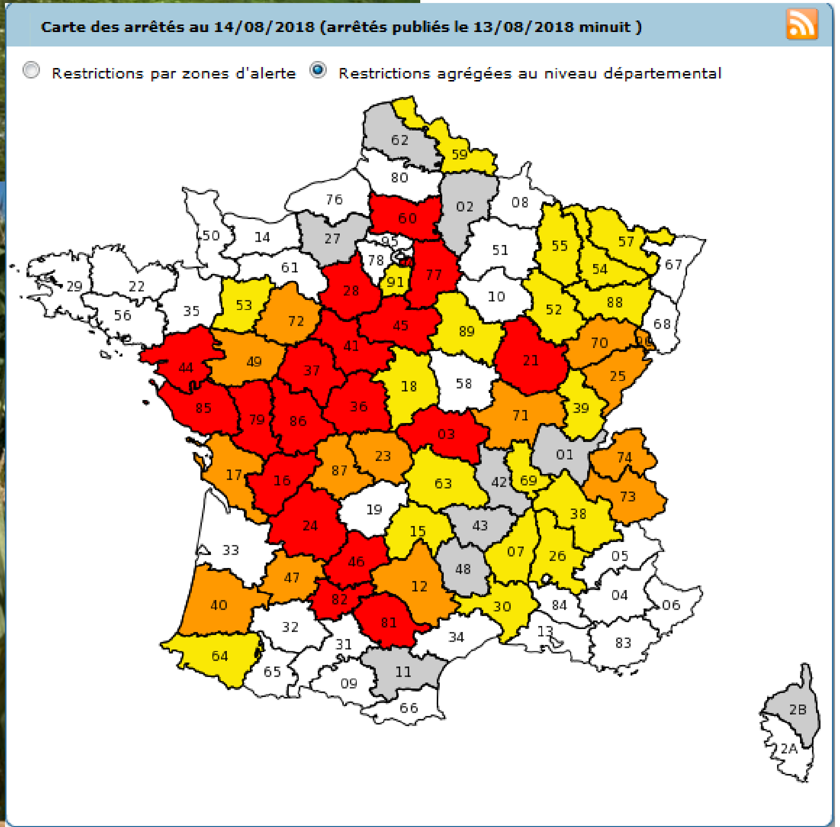
Adaptation to drought in France





Land degradation neutrality

United Nations
Convention to Combat Desertification

Sub -Indicators
UNCCD (CBD, UNFCCC)
Reporting Mechanisms

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Combating desertification and land degradation: co-benefits for the climate

The fight against land degradation has immediate and long-term co-benefits for adaptation and mitigation (high confidence)

Many activities to combat desertification can contribute to climate change adaptation and reduce biodiversity loss with positive spin-offs for sustainable development

Avoiding, limiting and reversing desertification would improve soil fertility, increase carbon storage in soils and biomass, while promoting agricultural productivity and food security (high confidence)

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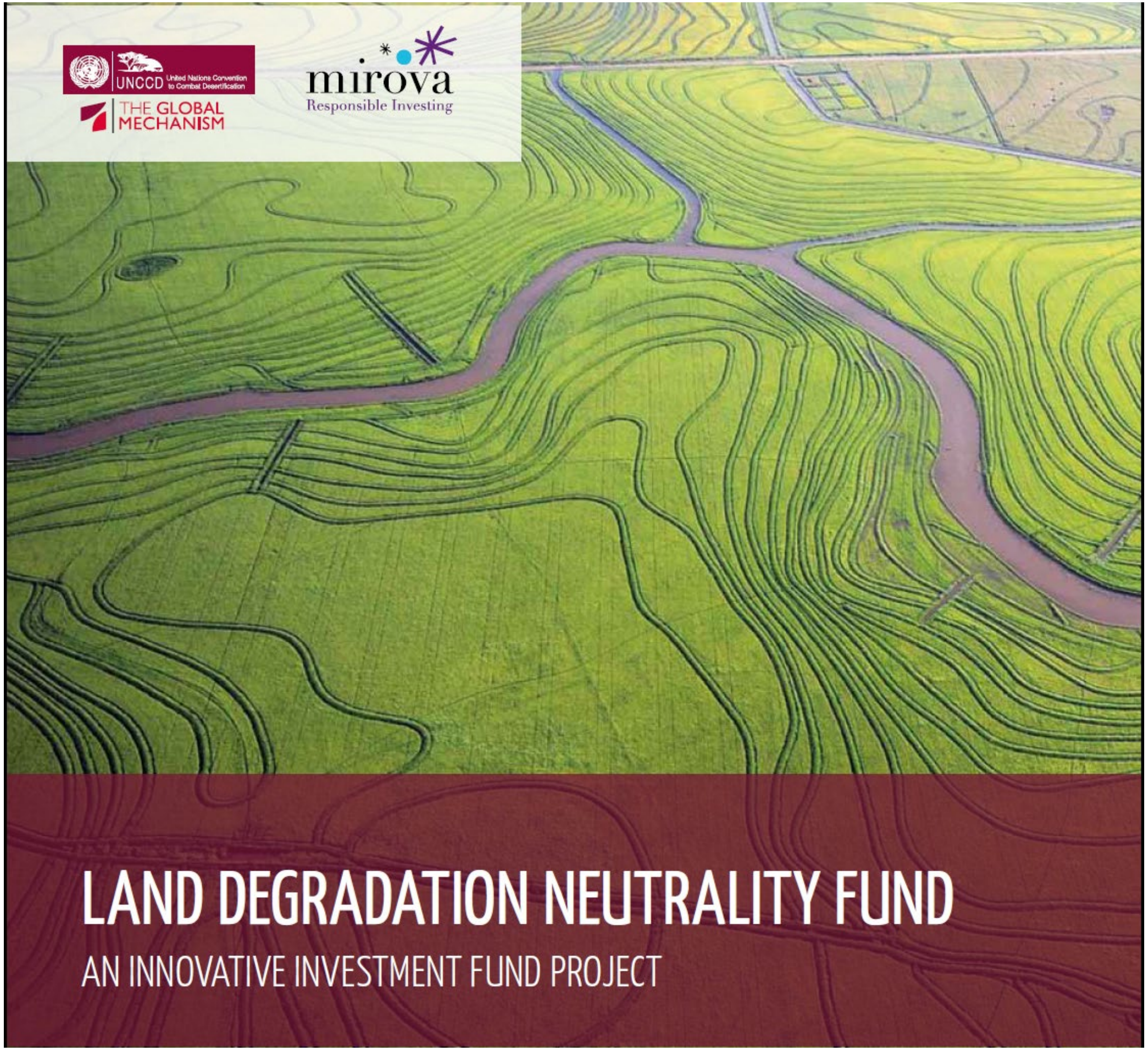
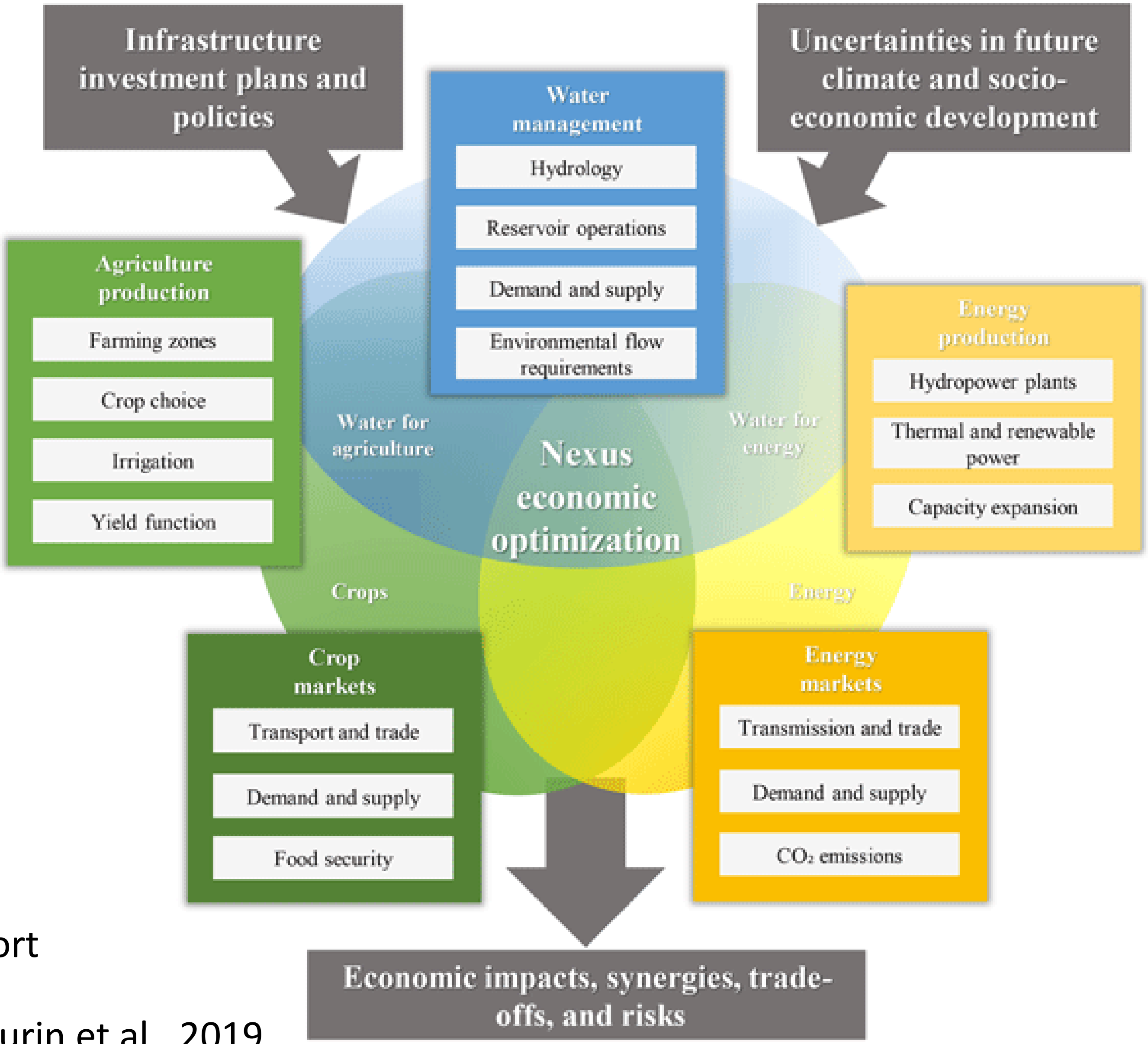

UNCCD United Nations Convention to Combat Desertification
THE GLOBAL MECHANISM
mirova
Responsible Investing
LAND DEGRADATION NEUTRALITY FUND
AN INNOVATIVE INVESTMENT FUND PROJECT

Planning infrastructures



Decision support

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Source: Payet-Burin et al., 2019

International network of partnerships

from French research on natural resources (land, water, bioenergy)

Institut de Recherche pour le Développement FRANCE

INRAE la science pour la vie, l'humain, la terre

cirad LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

G20
SAUDI ARABIA 2020

Thank you for your attention!

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