Solar irrigation: a shining light for river basins?

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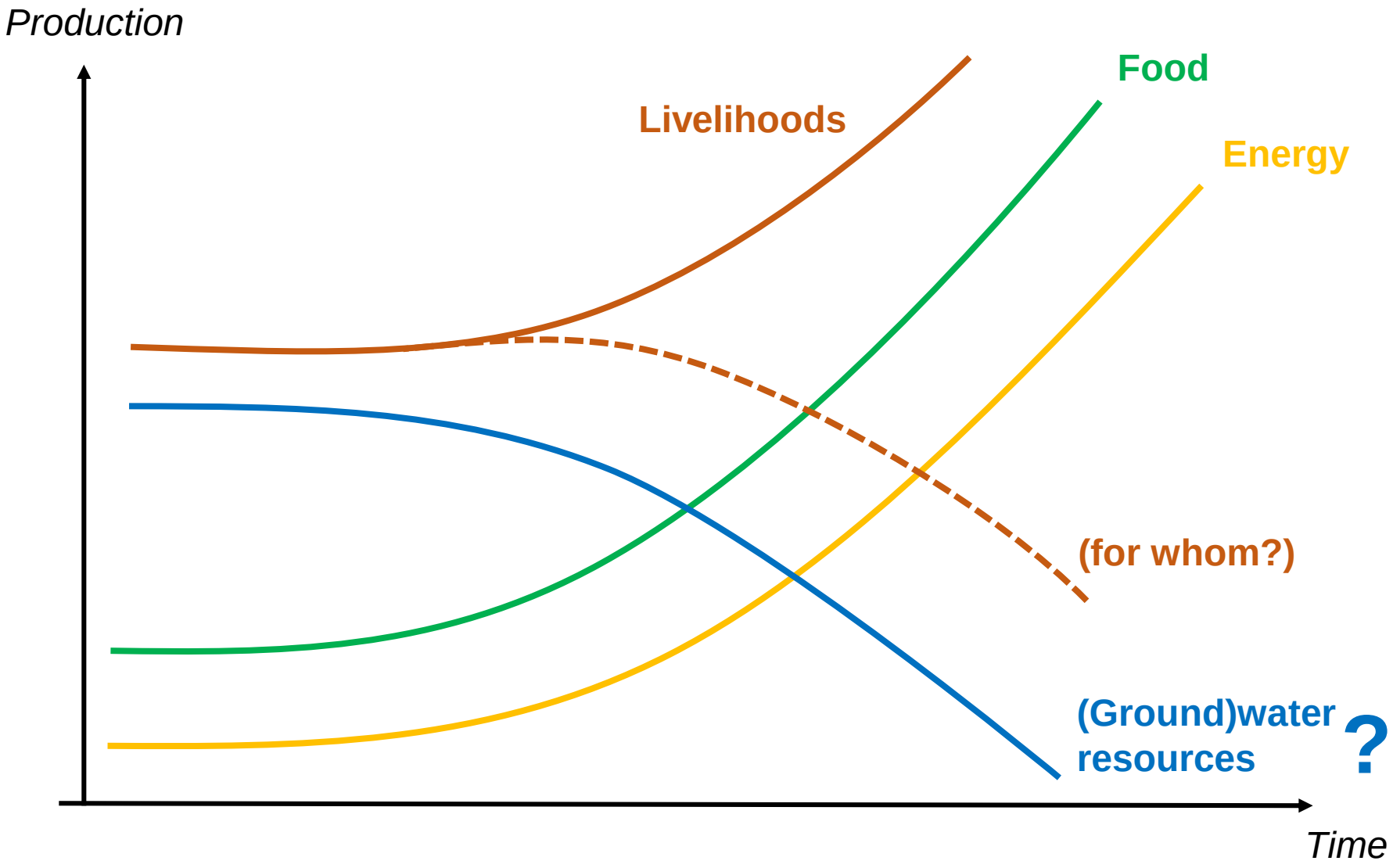
Something new under the sun? The promise of solar irrigation

- Help reduce fuel-based carbon emissions
- A cost-effective and sustainable energy source to secure food production and sustain livelihoods
- Help achieve the SDGs, pushing governments to increase energy security and electrification through use of renewable energy
- Increasingly affordable for farmers (with lowering technology costs)
- Silver bullet to fulfil the water-energy-food nexus?

Risk: the exhaustion of a common resource?



Potential issues at river basin scale

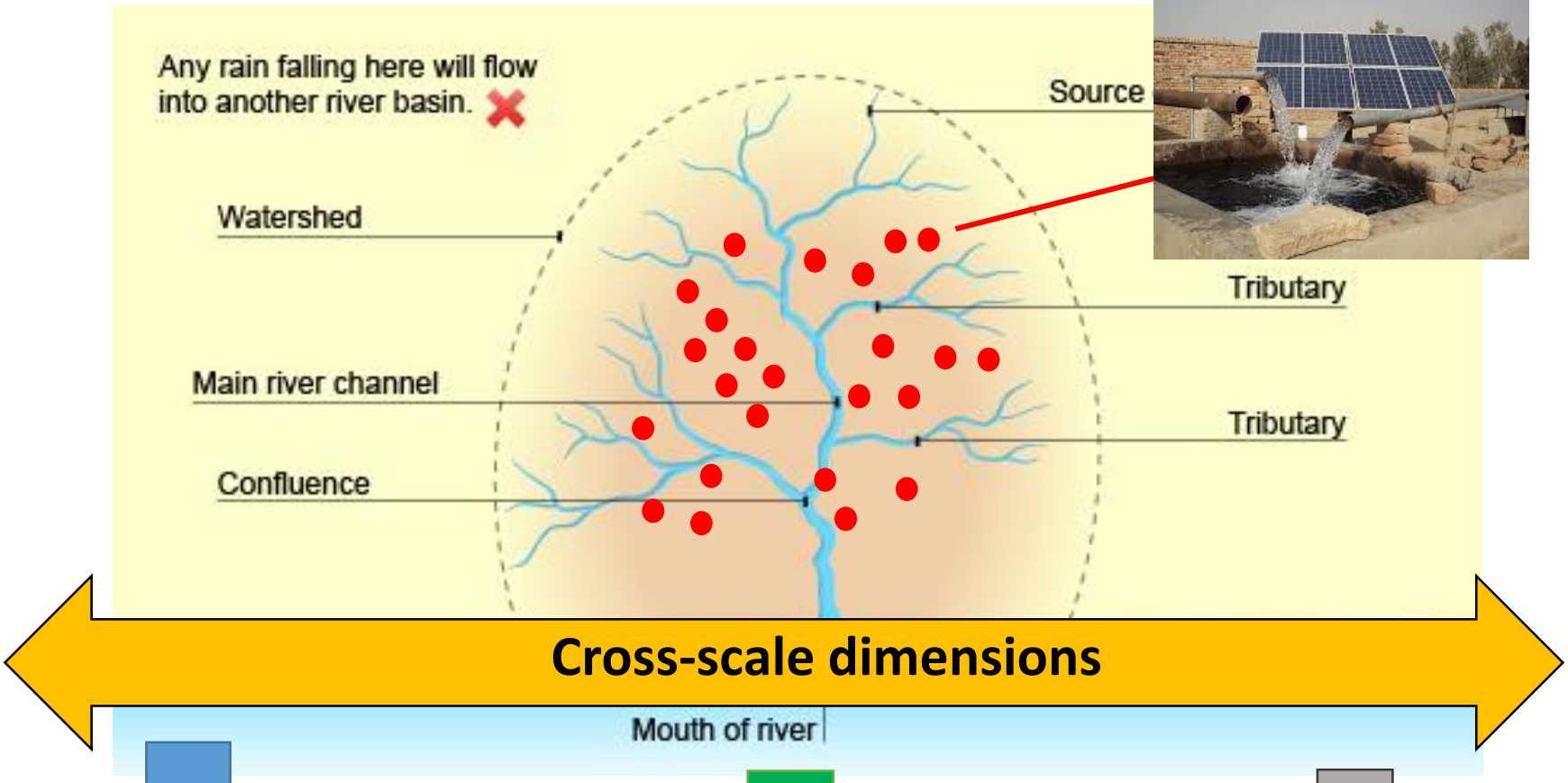
1. Limiting factors of solar technology
2. Disruptions in flows
   - Water
   - Capital
   - Power
3. Accentuation of inequalities and resource co-optation
   - Land prices
   - Groundwater overdraft
   - Accumulation of wealth
   - Poor management and rule enforcement

Some limiting factors to (solar) groundwater pumping at scale:

1. Technical (e.g. irradiation, pump pressure head)
2. Natural resource:
    1. groundwater (availability, quantity, quality) depletion?;
    2. land (access, availability) security vs. insecurity
3. Capital (investment, finance, credit)
4. Market (import for inputs, food demand, access to intermediaries, supply of parts)
5. Energy (license, connection, fees, subsidies, infrastructure)
6. Rules, control and enforcement (+/-)

Solar technology removes one component, not all of them

Flows within a river basin system



Water

runoff, stream flows, ecosystems, baseflows, dam operation, irrigation, recharge, water supply…

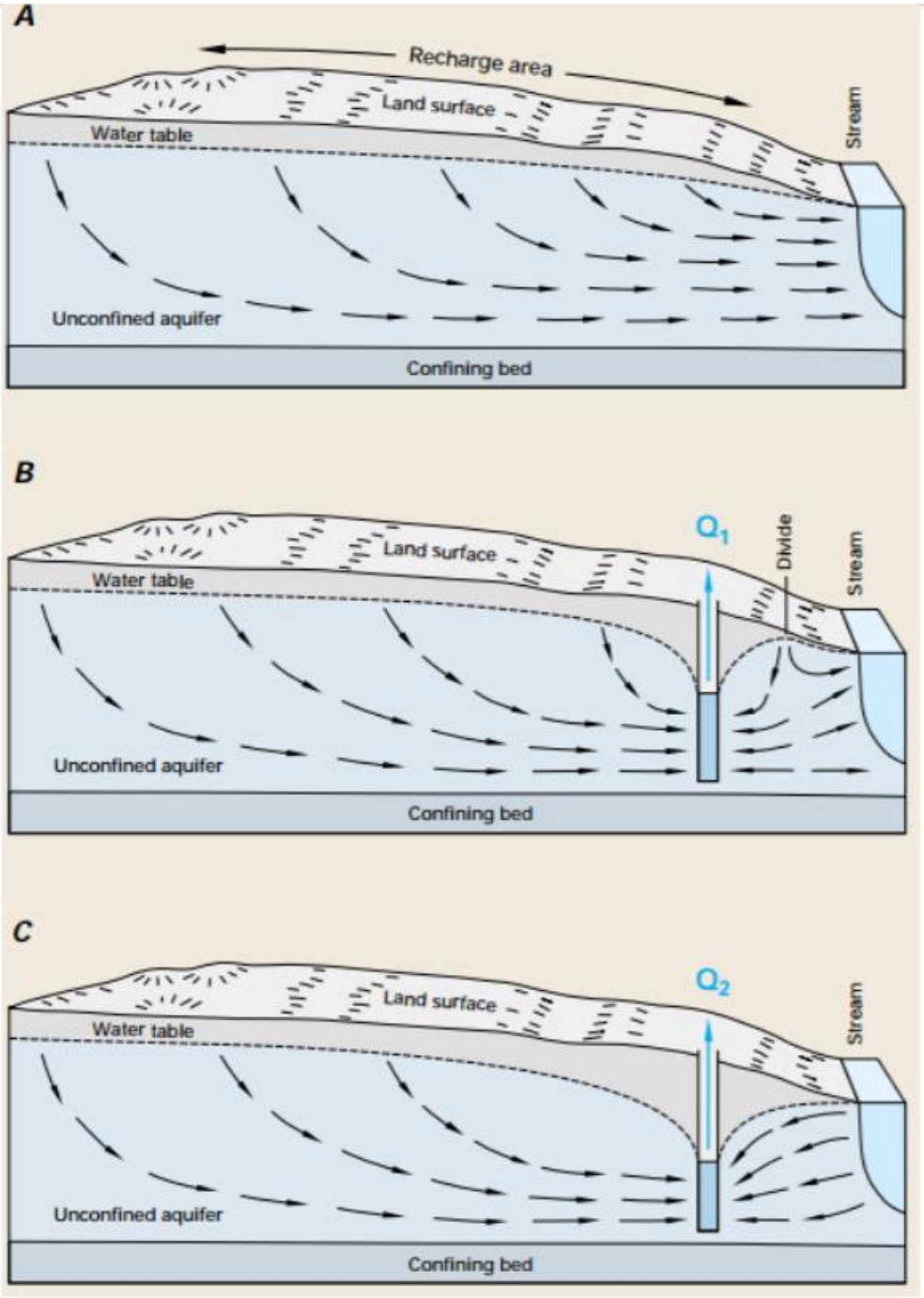
Capital

investment, markets, agri-business, agriculture expansion…

Power

influence, corruption, votes, decision-making, representation…

Flows – Surface water-groundwater interactions



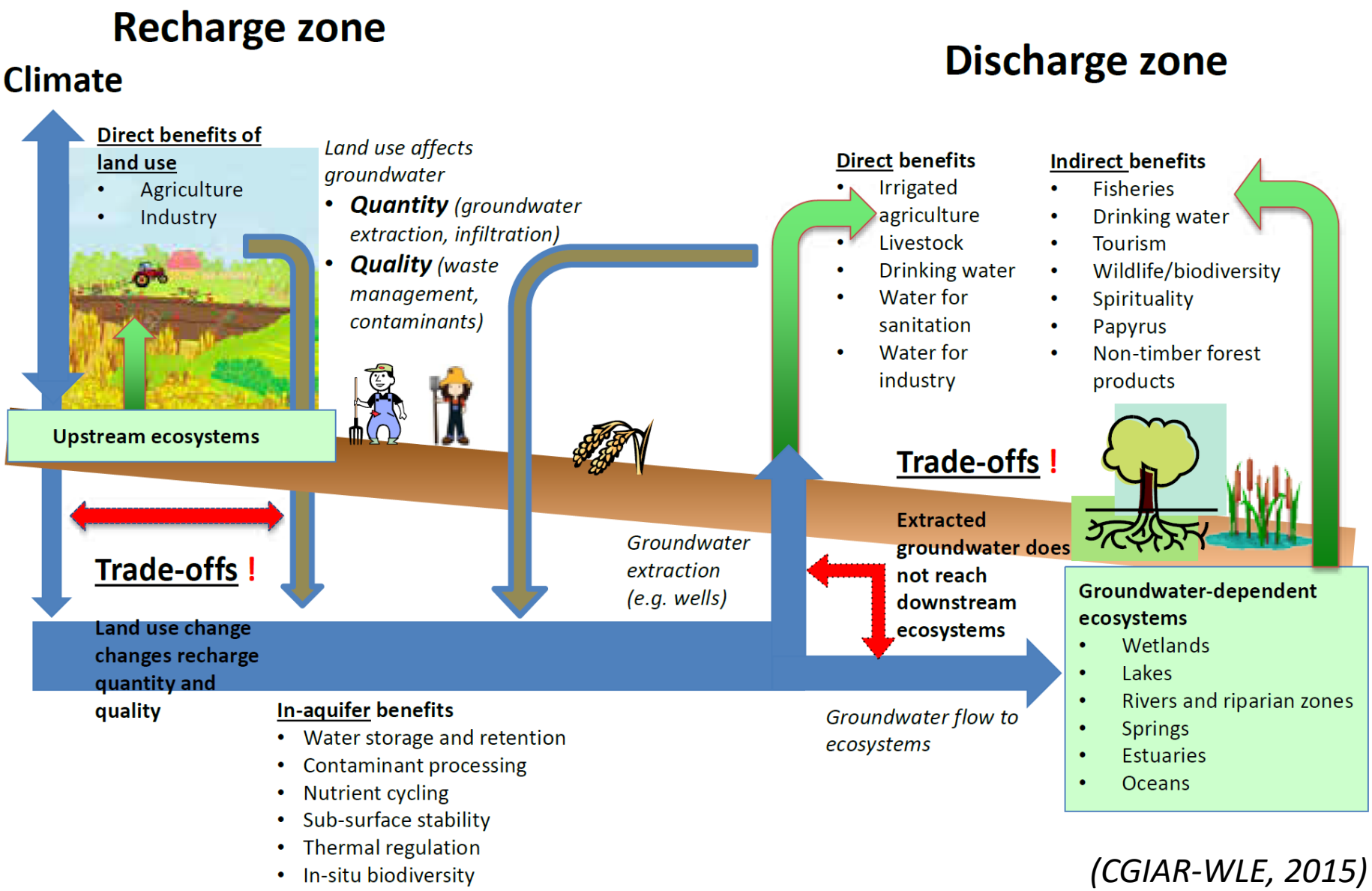
Natural state

Interception of baseflow to stream with groundwater pumping

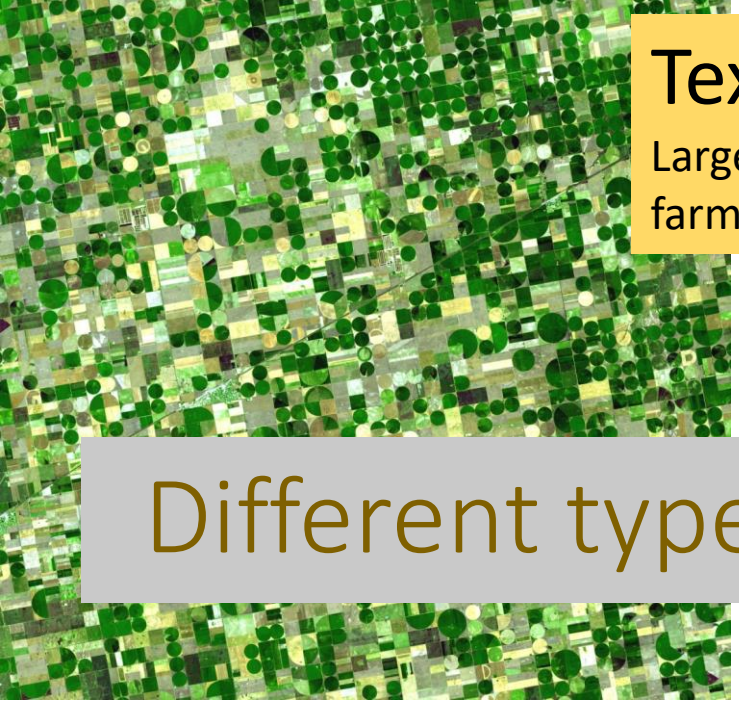
Reverse discharge (stream to well)

Source: Winter et al. 1993. USGS

Ecosystem services associated with groundwater



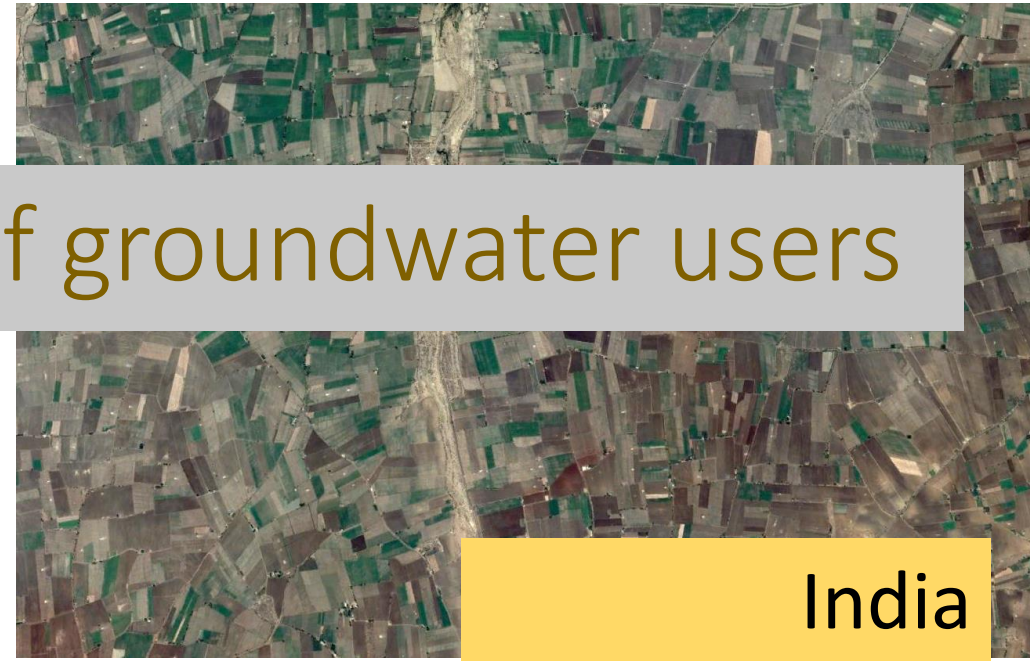
(CGIAR-WLE, 2015)



Texas

Large and well identified farms and owners

Different types of groundwater users



India

Small plots and holders, complex land tenure

Marrakech

Morocco

A basic typology of solar farmer?

Farm type	Land access	Water access	Capital	Others
Small size	Insecure Poor land security through tenancy agreeme (short/lo	Insecure No pump ownership Purchase of pump	Insecure Poor access to capital to finance new	Subsistence economy, farming only of
Medium size	Insecure/ Varying degrees of land insecurity and ownership	Water access varies with some ownership of shallow and deeper wells		
Larger size	Secure Land security with ownership	Secure Water access secure through private wells deep enough	Secure Access to finance mechanisms and capital available	Access to networks of power, contacts

Unequal resource and access to solar irrigation technology can limit poverty alleviation and employment generation in marginalized communities (e.g. small farmers, women and youth)

Management issues at scale

Users:

- Groundwater – over-allocation of rights in aquifers
- Development of groundwater-based solar irrigation (private) currently exceeds government response and monitoring capacity
- Multiplicity of new actors at a smaller scale not bound by the same safeguards and obligations as international donors

Agencies:

- Problems of groundwater mismanagement/enforcement of rules in general
- No strategic coordination at national and regional levels, resulting in piecemeal approaches with limited exchange and transfer of knowledge
- Lack of formal articulation of the Water-Energy-Food nexus within agencies
- Renewable energy is promoted with a focus on technical guidelines but without an integrated approach to assess the effects on water, environment, food, and livelihoods

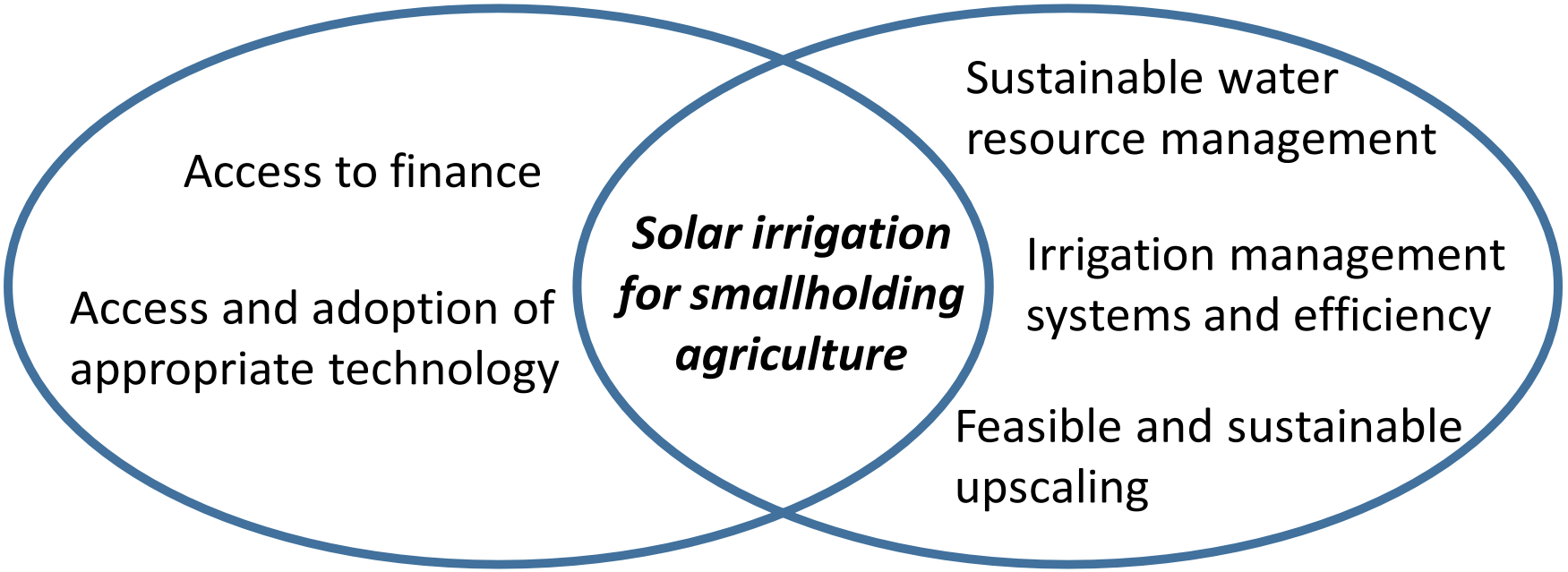
Access is not for all, unless appropriate arrangements at scale are in place

- Integrated approaches and understanding of solar irrigation
- Planning at scale (suitability maps)
- Social arrangements (energy cooperatives, etc.)
  - Business models
  - Financial modalities payments

What to do? An integrated approach

1. Make solar irrigation accessible for small farmers (equitable and gendered)

2. Make solar irrigation environmentally sustainable



- Approaches and designs for technology access responding to the varying needs of users (including vulnerable communities)
- 'Water-smart finance' for solar irrigation projects, with finance and environmental safeguards for solar irrigation projects
- Leverage donor investments for technology up-scaling (explore different finance modalities

Planning at scale - suitability of solar PV irrigation Ethiopia

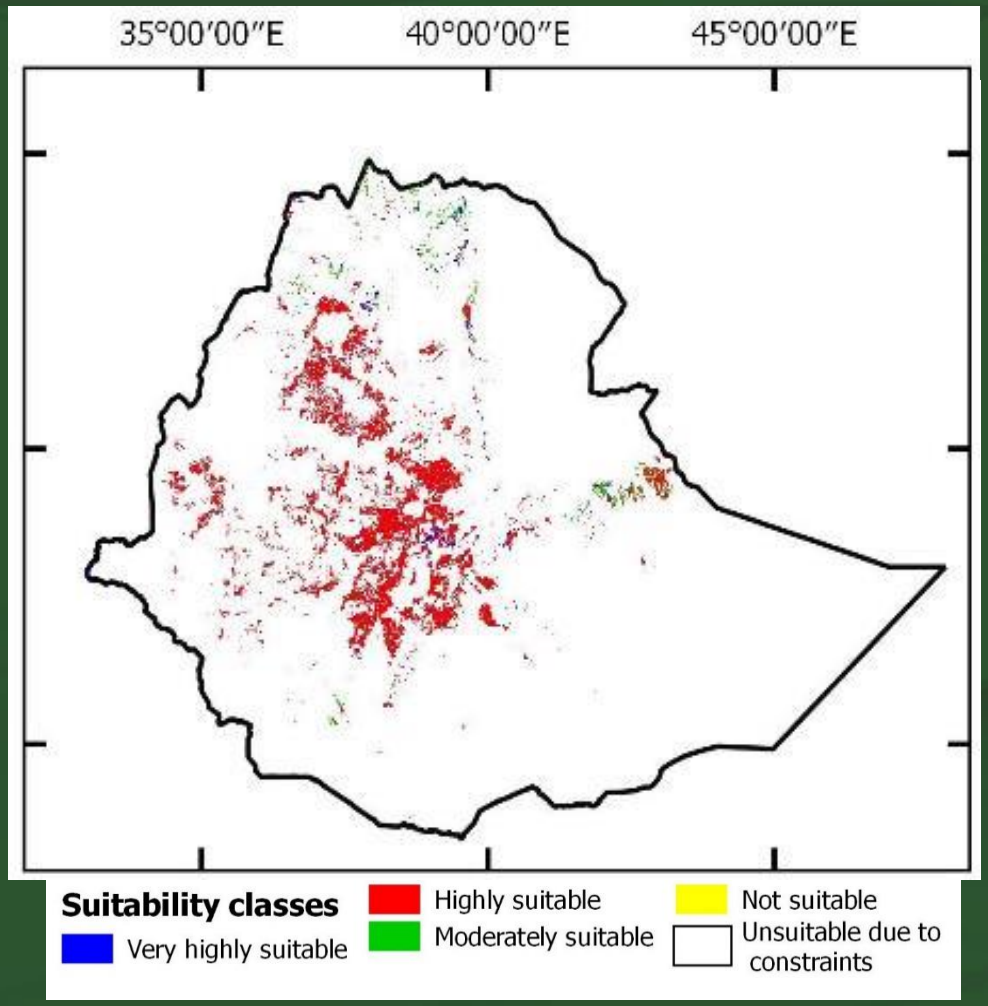
- Current irrigated land:

  ~1 M ha

- Ethiopian expansion:

  ~ 11 M ha

- Solar powered Irrigation potential :
  - GW (7m): ~2.1 M ha
  - GW (25m): ~ 6.3 M ha
  - GW & SW: ~ 6.8 M ha
- Solar pump potential to support irrigated land: ~167, 000 ha (15%)



Source: Lefore et al. 2018.

Schmitter, P., et al. 2018. Suitability mapping framework for solar photovoltaic pumps for smallholder farmers in sub-Saharan Africa Applied Geography, 94: 41-57

Main messages

- Solar technology has a huge positive transformative potential to be developed sustainably and equitably IF are integrated
- Unless groundwater is appropriately managed by governments and users, solar pumping can further accentuate depletion
- Underlying inequalities (re. access to resources) at scale can be further accentuated through solar, but evidence is lacking
- DATA. Not enough data on uses/users of solar. Lack of knowledge/tools/information to know where/how to invest in solar. More data is needed reflecting local context and needs.
- Private sector and research organizations are key – build innovative knowledge partnerships to understand how to better use built-in management capacities
- Solutions available need more time to mature

Thank you