Towards Sustainable Groundwater in Agriculture: An International Conference Linking Science and Policy
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Groundwater and Agrarian Livelihoods: South Asian (SA) Experience and Implications for Sub-Saharan Africa (SSA)

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Opium for one, elixir for another

The map depicts the area equipped for irrigation in percentage of cell area. For the majority of countries the base year of statistics is in the period 1997 - 2002.


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Highlights

• South Asia’s groundwater boom threatened the resource but liberated the small farmer and made famines history.

• SSA remains vulnerable to famines. A SA-style groundwater boom can unleash a Green Revolution in SSA.

• Small holder groundwater boom in SSA promises all benefits but poses little threat to the resource.

• The challenge is how to catalyze SSA’s groundwater revolution in the absence of SA’s ‘scope economies’.

• Present model based on promotion of treadle pumps and small motor pumps is unlikely to work.

• SSA needs a business model for groundwater irrigation industry. SA offers some lessons.
South Asia: Era of adaptive irrigation—up to 1830

Community was the unit of irrigation management

% Contribution to aggregate Farm output and incomes

- Rainfall and Soil moisture
- Flow irrigation from tanks, canals, rivers
- Lift irrigation from wells and surface sources

% of water consumptively used in agriculture
South Asia: Era of Large-scale canal irrigation-1830-1970

State emerged as the architect, builder, manager of irrigation

% Contribution to aggregate Farm output and incomes

- Soil moisture management
- Flow irrigation from tanks, canals, rivers
- Lift irrigation from wells & surface sources

% water consumptively used in agriculture
ECONOMIES OF SCOPE
South Asia's groundwater boom was helped and sustained by 'economies of scope' that arose from growing density of tubewells. A highly competitive groundwater industry emerged in every small town to provide low-cost pumps, rigs, pipes, repair and maintenance services in neighboring villages.
South Asia is the world’s largest user of groundwater in agriculture in the world.

Small-holders add most to groundwater irrigation
(Source: Agri. Census)

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<tbody>
<tr>
<td>Marginal (&lt;1 ha)</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
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<tr>
<td>Small (1-2 ha)</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
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<tr>
<td>Medium (2-10 ha)</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
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<td>Large (&gt;10 ha)</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
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US
Mexico
Pakistan
Vietnam
Tunisia

South Asia has over 25 million irrigation wells. The region adds 0.8 million/year. Every fourth cultivator owns an irrigation well; non-owners depend on groundwater markets.
Pros and Cons of Groundwater Revolution

**Negatives**

- Sustainability?
- Resource depletion and quality deterioration
- Chaotic, unplanned
- Informal
- Govt. has little control
- Role of science indeterminate
- Role of state indeterminate

**Positives**

- Biggest livelihood and food security promoter
- Pro-poor; it made irrigation democratic & spatially equitable
- On-demand irrigation
- Intensification + diversification
- High water productivity
- Private capital & enterprise
- Helped confront pop. pressure
- Some for all than all for some.
Famines were endemic to South Asia; Bengal famine of 1942 killed more people than the Holocaust.

But famines became history in SA. Amartya Sen argues that democracy freed India from famines.

But... it is groundwater that did it. Pakistan had no democracy most of the time; but it had a groundwater boom and hence no famines.

South Asia uses >280 km$^3$ of GW in irrigation every year. But...

Ethiopia likely needs only 3-5 km$^3$ of GW Irrigation to Draught-proof Its agriculture.
# Is Indian Experience Relevant to Sub-Saharan Africa?

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<thead>
<tr>
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<th>India</th>
<th>Sub-Saharan Africa</th>
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<tbody>
<tr>
<td>Is rural poverty a major challenge?</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Is small holder crop and livestock farming dominant?</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Has drought-risk from monsoon failure been historically high?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hydro-geology? 60% hardrock 80% hardrock</td>
<td></td>
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<tr>
<td>Groundwater use in small-holder farming</td>
<td>Very high</td>
<td>Very low</td>
</tr>
<tr>
<td>Drought risks? Risks of famines?</td>
<td>Very low now</td>
<td>High</td>
</tr>
<tr>
<td>Productivity of small holder farming?</td>
<td>Moderate but rising</td>
<td>low</td>
</tr>
</tbody>
</table>

Why has SSA not witnessed a groundwater revolution? Can it? Would it help? Can SSA reap the benefits while avoiding the environmental costs?
SSA’s food security remains vulnerable to famines, as does its economy. Despite massive investments in canal irrigation, less than 5% of SSA’s cropped area is irrigated against 55% in SA.

In South Asia GW wells brought more land under irrigation in past 40 years than canal irrigation did in 250 years before. Groundwater can help SSA expand irrigation quickly.

Can a groundwater revolution help SSA small holders?
Is groundwater sustainability in SSA at risk from small-holder irrigation development?

Small-holder farming areas are so thinly scattered in SSA that they are unlikely to stress groundwater resources.

South Asia’s groundwater stress arises from high population pressure on farm land.

Cultivated area as % of cell area
If small-holder groundwater irrigation is so good for SSA, why has it not boomed like in SA?

- Insecure Land tenure?
- Missing input and output markets?
- Domination of female farming system?
- Low population pressure on farm land?

- Weak-state-strong donors
- Donor preference for canal irrigation
- Precautionary principle w.r.t GW

- Treadle/manual pump hard-sell
- High cost of maintenance and repair
- No economies of scope as in SA
- High cost of pumps, pipes, drilling rigs, labor
- Poor availability of spare parts and skills
- Capital scarcity; poor credit access
Groundwater Irrigation Business Model for SSA

- Following brief success of treadle pumps in Bangladesh, all NGOs have been promoting manual irrigation for 15 years.

- But this has not succeeded; TPs are disadopted even in Bangladesh in favor of cheap Chinese motor pumps.

- In SSA, promoting motor pumps too will not help because of the absence of scope economies and low pump utilization factors. Pump use costs in SSA are higher than in SA.

- What will work best in SSA are Assisted Pump Irrigation Markets (APIMs) that mimic groundwater markets in SA.
• In each community, train 6-8 young women to operate as Irrigation Service Providers (ISPs)

• Set them up with a borehole, light-weight motor pump and 250 m of rubber pipes on LEASE BASIS;

• They sell irrigation to small holders at rates that cover fuel and service charge

• ISPs are supported by a Technical Support Unit
Assisted ISM’s can kickstart small-holder irrigation in SSA

- Assisted ISMs overcome small-holders’ constraints of: [a] land tenure insecurity; [b] high cost of pumps, pipes and rigs; [c] capital scarcity and poor access to irrigation credit; [d] high maintenance and repair cost; [e] non-availability of spares and skills.

- The ownership cost may be high but the use cost is low

- Women are pitchforked into centre-stage of small holder economy;

- Poor women earn significant supplemental income as ISP’s;

- Central and Technical Support Units can motivate and assist in local groundwater resource and recharge management.

- 3-5 million ISPs can be set up at a capital investment of US $ 1-1.5 billion, which is the cost of a mid-sized government irrigation system.
This was a policy talk focusing on the groundwater revolution in South Asia and its lessons for Sub-Saharan Africa.

The Key Breakthroughs needed to drought-proof Sub-Saharan Africa are two: [a] a robust assessment of the regions groundwater resources and hydro-geologic conditions; and [b] a business model for groundwater irrigation industry that is appropriate to the SSA’s small-holder agrarian context.

THANK YOU.