Irrigating Africa – Reframing Agricultural Investment:
A micro and macro perspective on investment priorities in SSA

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Part 1: Smallholder Irrigation Livelihoods and Entrepreneurship in South Africa

Part 2: Agwater potential and development pathways in SSA

- What **social and economic changes** are associated with agwater practices
- What **institutions and policies** lead to investment by irrigation farmers
- **Typologies** of irrigation initiatives useful to policy-makers
- **Country-level significance** of farmer-led development
Part 1: Smallholder Irrigation Livelihoods and Entrepreneurship in South Africa

Research Project K5/2179/4 ...

Smallholder irrigation entrepreneurial development pathways and livelihoods in two districts in Limpopo Province

J DENISON, SV DUBE, TC MASIYA, T MOYO, C MURATA, JM MPYANA, LL VAN AVERBEKE and W VAN AVERBEKE
Specific objectives

To **evaluate** the **five livelihoods assets** with particular attention to:
- **irrigation** farming potential
- **entrepreneurial** spirit and management capabilities
- incentives of secure land tenure, water use rights and leadership

To determine:
- role of agriculture in **livelihoods**
- how the agricultural contribution can be increased
- aspirations and goals in relation to expansion
Rural entrepreneurship with specific reference to irrigated agriculture

Entrepreneurship in smallholder agriculture can be equated to the production of crops and animals in order to make profit (produce for markets).

**Survivalist**
- Motivated by necessity
- Generate limited income
- Rarely beyond self-employed

**Micro-growth**
- Motivated by opportunity
- Best potential to expand farming
- Create employment
- Generate economic development

Different emphasis in texts on:
- **Personal qualities** of the individual (agentic performance)
- Constraining or enabling power of **structural arrangements**
Another project sponsored by the Water Research Commission

SAFI

Studying African Farmer-led Irrigation

3 main irrigator populations

Independent Irrigator

Scheme Farmer

Home Gardening

Household

- Independent to Scheme & home garden
- Home Garden to scheme
- Scheme to Home Garden
- Home garden to independent
Whole-systems perspective & livelihoods overlay
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Project Areas

- Homestead gardeners (n=172)
- Scheme irrigators (n=122)
- Independent irrigators (n=127)

Two sites - 3 Groups of smallholders

- Homestead gardeners (n=172)
- Scheme irrigators (n=122)
- Independent irrigators (n=127)
Another project sponsored by the Water Research Commission SAFI Studying African Farmer-led Irrigation
9-Feb-18

File name
Cabbage remains the ‘money maker’ at the Dzindi canal scheme
Typical physical assets of the pumper group of independent irrigators in Thulamela
Physical assets of the collector group of independent irrigators
A supply channel constructed by a group of independent irrigators
Greater Tzaneen-Independent irrigator
Farming in Greater Tzaneen - Marketing

Image of harvested green beans, potatoes, and farmers in a field.
Findings

1. Compelling evidence that **irrigation is associated with improved livelihoods** of rural households
   - Irrigator incomes 2 to 3 times higher (all above poverty line)
   - Food security was higher (77% vs 60%)

2. **Irrigator households had a stronger capital base** (natural, physical & financial capital) - suggesting irrigation farming positively affects the overall capital base of rural households
   - independent irrigators held 20% and 42% more land

3. **Irrigation farming** shown to be positively associated with:
   - size of *regular income* flows received by households,
   - *better education levels* among household members
   - *lower unemployment* rates
Purpose of production - irrigators

Frequency distribution of goals of crop production on irrigated plots among scheme and independent irrigator households

Charaterised by significant investments in fertiliser and plant protection
Purpose of production – home gardens

Frequency distribution of goals of crop production in home gardens among the three groups of farmer households

Characterised by LEISA approaches – low financial investment

- **Home gardener (n=154)**
- **Scheme farmer (n=70)**
- **Independent irrigator (n=58)**
Farming and livelihoods – Sources of household income

Irrigation makes a significant contribution to household income.

- Irrigators: on-farm (39%); salaries and wages (38.5%); social grants (14.9%)
- Non-irrigators: on-farm (0%); salaries and wages (58.6%); social grants (26.8%)
Rural entrepreneurship

Operationalising entrepreneurship (7 factors)

• **Degree of commercialisation of farming** (market participation = business)
• **Efficiency** (professional and managerial skills of the farmer).
• **Capitalisation of the farm enterprise** (entrepreneurial motivation)
• **Wealth status of the household** (entrepreneurial motivation)
• **Gross farm income** (scale and importance)
• **Gross income derived from entrepreneurial activity other than farming** (scale and importance);
• **Contribution of entrepreneurial activity to household income** (importance of all entrepreneurial activity in the livelihood portfolio of rural households).

=> Cluster analysis aimed at identifying ‘rural household types’ from an entrepreneurial perspective.
Rural entrepreneurship

Important findings

• The majority of households at both sites demonstrated low levels of entrepreneurship.
• **Survivalist** entrepreneurs were most common (>90%)
• **Opportunity** (micro-growth) entrepreneurs were very few
• Household head is the farmer in >80% of households
• The latter characterised by **multiple enterprises** (farming and other activities; taxi, spaza shop etc.) and was key to farm financing.
• Majority want to expand their farming but face critical constraints
• **Agentic performance** is severely limited by systemic inadequacies
## Constraints across 3 groups
(farm-level system)

<table>
<thead>
<tr>
<th>Farming system factors</th>
<th>Constraints for Pathway 1 (home gardeners)</th>
<th>Severity</th>
<th>Constraints for Pathways 2 and 3 (independent and scheme irrigators)</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boreholes used but expensive. Roofwater tanks not widespread. Unlawful connections increasing.</td>
<td>4</td>
<td>Resource from Tours dam at risk and not reliable in drought. Reliable source &lt; 25% of surveyed total.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Homestead space limited in size but secure in exclusive use-right.</td>
<td>1</td>
<td>Physical portions of unused irrigable land is available but getting access to use the land is difficult.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hand-watering or hose systems generally adequate for small gardens. Pumps not essential.</td>
<td>2</td>
<td>Very high capital investment costs – nearly impossible to develop at scale without loan finance.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>As above, delivery to garden not limiting in itself. Cost of storage and supply is main water issue.</td>
<td>3</td>
<td>Manageable with own finance but difficult.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Homestead plots are typically fenced.</td>
<td>2</td>
<td>Can manage somehow to sort out the fencing although it is difficult.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Hand-cultivation prevails in the gardens.</td>
<td>2</td>
<td>Available but delays of 4 weeks or more in getting them to the field.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Family labour.</td>
<td>1</td>
<td>Labour available for work in the fields when they are paid; affordability is the issue.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Production knowledge needed but can be accessed via local or commercial networks.</td>
<td>3</td>
<td>Some feel access to knowledge is easy, others found it significantly more difficult</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Not a key driver of Pathway 1</td>
<td>1</td>
<td>Major challenges with transport, aggregation (small individual volumes), and agent trust regarding prices.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Financed by household income.</td>
<td>2</td>
<td>Impossible to get input financing as small farmers: water and land issues; business plans required.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Exposure to risk, but overall impact relatively small, given other primary livelihoods means.</td>
<td>3</td>
<td>High risks of climate/pest impact that leave farmers exposed – can partly mitigate with insurance.</td>
<td>5</td>
</tr>
<tr>
<td>Risk to profitability (local markets)</td>
<td>Not a key driver of Pathway 1</td>
<td>1</td>
<td>Green maize, tomato, beans, cabbage, potatoes for local market. Limited absorption, but predictable.</td>
<td>1</td>
</tr>
<tr>
<td>Risk to profitability (distant markets)</td>
<td>Not a key driver of Pathway 1</td>
<td>1</td>
<td>Green beans, okra, green pepper, chilli (mainly distant market). Unpredictable but attractive.</td>
<td>4</td>
</tr>
</tbody>
</table>
**Constraints – Independent and Scheme irrigators (Institutional environment)**

**TABLE 9.8**: Severity of organisational and institutional obstacles at Greater Tzaneen

<table>
<thead>
<tr>
<th>Institutions impacting on farming</th>
<th>Institutional Obstacles for Pathway 2 (independent irrigators)</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rules of land access and control</td>
<td>Irrigable land available but distant from water sources. Verbal agreements with Traditional Authorities prevail. Limits to very small scale &lt; 4 ha</td>
<td>4</td>
</tr>
<tr>
<td>Rules of transfer (rentals/leasing)</td>
<td>No formal provisions for leasing on tribally-managed lands. Major disincentive when scheme and other land is unused.</td>
<td>5</td>
</tr>
<tr>
<td>Rules of water authorisations (GA/license)</td>
<td>Lack of knowledge of authorisation and licensing requirements. Bureaucratic hurdles viewed as major. Not linked to CMA or allocation systems.</td>
<td>4</td>
</tr>
<tr>
<td>Scheme Operations and Maintenance rules</td>
<td>Independent irrigators need no on-farm collaboration around irrigation systems.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional Obstacles for Pathway 3 (scheme irrigators)</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual PTOs viewed as an uncertainty and disincentive. Minimal investment in on-farm infrastructure (fencing, piping etc.).</td>
<td>4</td>
</tr>
<tr>
<td>Cannot lease unused scheme land as plot-holders with rolling annual tenure fear losing their rights if they lease out unused portions.</td>
<td>5</td>
</tr>
<tr>
<td>Julesburg farmers have no formal permission to use water and are uncertain on rights. Tous Dam water supply is over-allocated and legally insecure.</td>
<td>4</td>
</tr>
<tr>
<td>Coordination of water efforts is limited. System is in dire straits technically. Ad-hoc emergency repairs only. Rules are weak or absent. Repair needed.</td>
<td>5</td>
</tr>
</tbody>
</table>

**Severity of farming challenge**: 1. none, 2. minor, 3. moderate, 4. major, 5. critical
Rocky Pathways – land tenure on schemes

Wholly inadequate communal land administration systems ...
- land property relations defined into user not ownership rights
- ‘ownership’ widely accepted to be with Chief or TA who must distribute it
- legal disagreement about ownership (1913 NLA says Minister but Upgrading of Land Tenure Rights Act 112 of 1991 to TA’s with upgraded PTOs.)
- IPIILRA 1996 with new legislative measures scrapped PTOs.
- **CONFUSION REIGNS and INTERPRETATIONS INFLECT ONGOING PAIN**

PTOs continue as dominant land-use right on schemes within collapsing land-administration systems with wide variations in application.

“Many lessors have experience of ‘losing’ land to lessees, and lessees have experience of entering into agreements which are arbitrarily terminated or simply ignored. Farmer’s leasing land reported the ‘owner’ harvesting their crops as this was ‘their land’ or others using land they had leased without permission.”
Parched Pathways – scheme **water wars**

**Access to water at no cost ... but severely limiting institutions and organisations**

- Allocations and licensing uncertain or unknown
- WUAs not formally established
- Informal rules with limited enforcement
- Infrastructure progressively in decline and near-zero maintenance
- Sense that independent irrigators are better off – but interest/movement both ways. ‘FREE WATER’ <-> ‘SELF DETERMINATION & COST’
Key points of relevance to SAFI

1. Irrigation is strongly associated with significantly improved livelihoods, reflected by higher incomes and a stronger asset base (39% income from farming).

2. Farming for cash is central to irrigation success, but farming for food using other agwater methods makes a significant contribution to food security.

3. Strong association between pumping & lower net operating incomes (3-5 times).

4. Agentic entrepreneurial abilities are weak – most are survivalists.

5. Independent and scheme irrigators face severe to critical systemic constraints that undermine individual ‘agentic’ performance as entrepreneurs.

6. In the land domain, enabling more formalized leasing of land is a key opportunity to reduce risks for survivalists (have low-resilience to shocks).

7. In the water domain, rules are weak or absent, water-tenure is high-risk. Locally appropriate WUO development, protection of use-rights is a top priority.

8. Production financing, knowledge and marketing-linkage interventions are high priorities.
Part 2: Agwater potential and development pathways in SSA

- Literature review
- Consolidation of selected World Bank program data
- Typology and implications for the future

Africa is different from most of the world:
- **Population growth** beyond 2100 (only continent +ve growth)
- **Double the food** by 2050 (vs 70% average increase)
- Rest of the world irrigation largely developed: focussed on modernisation/intensification
- Africa has **largest irrigation resource globally** (42.5 Million ha; 15.4 developed)
- **Africa has 23.5 Million ha irrigable** with POSITIVE EIRRs (You et al., 2010) – more than 90% in SSA
SSA Rainfed Agriculture is of high importance:
- 188 Million ha of rainfed agriculture (95% of all cultivated land)
- Responsible for 99% of main cereals (maize, millet, sorghum)
- Yield gap = 76% (vs. Asia of 11%)
- 75% of additional food will come from narrowing the yield gap to 20%

Climate change:
- Increase in variability, temperature and slightly reduced average rainfall
- Rainfed farming is highly vulnerable (yields and failure)
- Yield reduction of 10-20% of major grain crops across most of Africa
Agwater responses

- Wide range of agricultural water management techniques
- Water harvesting and conservation, dambos etc.
- Small storage, supplementary irrigation
- Full scale irrigation

Diverse options for agricultural water management along the spectrum

- Purely rainfed
- Field conservation practices
- Supplemental irrigation
- Water harvesting
- Groundwater irrigation
- Surface water irrigation
- Drainage
- Fully irrigated
Indicative targets and agwater responses

- Expand rainfed farming = 14 Million ha (7%)
- Triple rainfed yields
- In a climate change context (CSA)

- Irrigation expansion = 2.3 Million ha (26%)
- Double irrigation yields

<table>
<thead>
<tr>
<th>Irrigation Type</th>
<th>Typical IRRs</th>
<th>Unit costs (USD/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large scale expansion</td>
<td>13-18%</td>
<td></td>
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<tr>
<td>Small scale expansion</td>
<td>26-40%</td>
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</table>
To meet future food needs agricultural water interventions will have to formulate diverse responses:

- Using different agwater technical solutions
- With responsiveness to different farming types (peasant, survivalist & opportunity entrepreneurs)
- Aligning agwater interventions with production, marketing and financing elements

What agwater typology is appropriate?
What kinds of interventions will catalyse growth?
What policy responses are needed to support?
## African Agricultural Water Partnership

**Agricultural Water Management ‘Development Trajectories’**

1. Individual micro- and small-scale irrigation
2. Community-managed small to medium-scale irrigation
3. Large-scale irrigation system modernization and development
4. Market-oriented irrigation on PPP or purely private basis
5. Enhanced water management in rainfed agriculture
### Priorities and indicative costs of agricultural water development pathways in Africa

<table>
<thead>
<tr>
<th>REVISED AGWATER Pathways</th>
<th>Characterization</th>
<th>EIRRs*</th>
<th>Priority and Contribution to Growth</th>
<th>Pathway Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Improved water control and watershed management in a rainfed environment</td>
<td>1-2 ha farms; self-provisioning</td>
<td>Wide reach, large no. farmers. Gains through</td>
<td>Farmer led</td>
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<tr>
<td>2. Independent private irrigation for high-value crops</td>
<td>&lt; 5 cropping; market-oriented.</td>
<td>ty: 50-70% of on expansion.</td>
<td></td>
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<tr>
<td>3. Small-scale gravity community-managed schemes (&lt; 200 ha)</td>
<td>0.1-1 ha farms; self-provisioning &amp; market farming; often grain &amp; horticultural rotation.</td>
<td>20-30%</td>
<td>10-20% of future irrigation expansion.</td>
<td></td>
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<tr>
<td>4. Reform, modernization and expansion of med &amp; large-scale irrigation schemes</td>
<td>0.2-1.5 ha farms; transitioning from social origins to market-oriented; older dilapidated.</td>
<td>20% 15% 10%</td>
<td>Rehab a priority (++ve EIRRs) New gravity = 20-30% of future expansion.</td>
<td></td>
</tr>
<tr>
<td>5. Private-sector involvement in market-oriented irrigation</td>
<td>Key actors in input-output value chains for all paths.</td>
<td>—</td>
<td>Potential bulk water operator &amp; farming JVs. Key to IMT, and productivity agendas.</td>
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</tbody>
</table>
| 6. Small-scale pumped community-managed irrigation (< 200 ha) | Typically low-head pumping, located on flood-plains or small reservoirs. | 5-15% | 0-5% | }

**70 to 80% of future agwater investment and effort**
Pathway 6: Small-scale *pumped* community-managed schemes (<200 ha)

- Strongly correlated with **high running costs, complexity and a high risk of failure**.
- The task of operating pump stations, typically in distant locations from major hubs, with **poor support infrastructure** (electricity, roads, transport, supply-chains) and usually on rivers with a **high sediment load**, is fraught with technical, managerial and administrative problems.
- Pump-station OMM demands a **highly effective fee-collection** arrangement to ensure sustained water delivery.
- Socially acceptable and enforceable **land-exchange mechanisms** that ensure the exit of non-paying farmers and allow entry of new ones (or expansion of existing farming enterprises).
- Underpinned by **high-value crop production** to generate the necessary revenue, and by **intensive WUO development and market support**.
- The high operational costs combined with organizational risks make this option **a low priority going forward**.
### Policy thrusts for agwater development in SSA

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<tbody>
<tr>
<td><strong>1 – Rainfed Agwater Management</strong></td>
<td>Shift from an irrigation to an agricultural water management paradigm, and establish the basis for an integrative watershed / landscape approach for balancing u/s d/s (meso 500-1000 km²)</td>
</tr>
<tr>
<td><strong>2 – Private irrigation</strong></td>
<td><strong>70 to 80% of future agwater investment and effort</strong></td>
</tr>
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<td><em>2 – Private irrigation</em></td>
<td><em>70 to 80% of future agwater investment and effort</em></td>
</tr>
<tr>
<td><strong>3 – Small gravity group-schemes (&lt;200 ha)</strong></td>
<td>Water efficiency interventions (such as canals replaced by pipes; low-cost lining; flow-control), and locally appropriate WUO establishment are key.</td>
</tr>
<tr>
<td><strong>4 - Modernization and expansion of public schemes</strong></td>
<td>Appropriate high-tech modernization (transmission efficiency upgrades, SCADA etc.). Purpose-specific WUO laws for compulsory membership, fee-retention at scheme, and processes for regulation of water pricing. Farm mapping and local leasing.</td>
</tr>
<tr>
<td><strong>5 – Private sector in market-oriented irrigation</strong></td>
<td>Potential role as bulk-service operator from 4 above (WUO laws). Identify mechanisms for enabling land-consolidation and leasing for potential corporate agric partners on schemes.</td>
</tr>
<tr>
<td><strong>6 – Small pumped group-schemes (&lt;200 ha)</strong></td>
<td>Set as the lowest priority in agricultural water management policy, rather targeting other pathways where possible, to achieve food security and economic goals</td>
</tr>
</tbody>
</table>
Thank you!