The financial costs of irrigation services: assessment and meaning. example from South Africa.

Sylvain Perret, CIRAD, UMR G-Eau, Asian Institute of Technology
Mariette Geyser, Univ. of Pretoria, Dept. of Ag. Eco., Ext. & Rural Dev.

Any question: sylvain.perret@cirad.fr
Changing views and expectations over irrigation

- Massive investments over last 30 years
- Poor performance in government-managed smallholder irrigation systems

Negative gross margins are commonly reported
Aggregate average irrigation water value:

- 0.19 - 0.26 US$/m³ (vegetables; SA; Speelman et al. 2008)
- 0.09  (mixed crops; SA, Speelman et al. 2008)
- 0.20  (vegetables; Africa; Hussain et al. 2007)
- 0.37  (higher value crops; Africa; Hussain et al. 2007)
- 1.15  (lettuce; SA; Speelman et al., 2009)

- Can be worth under heavy water consumption conditions (SE Asia): (Mullick et al., 2010, to be published)

  - Rice 0.008-0.07 US$/m³
  - Tobacco 0.18
  - Wheat 0.06
  - Mixed vegetables 0.04

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Changing views and expectations over irrigation

- IMT as a global move towards autonomy, improved performance, pricing / charging
- Pricing not for demand management, but for cost recovery
  (Producer surplus’ sake)

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Changing views and expectations over irrigation

- South African smallholder, subsistence irrigation systems illustrate well those trends, the theory, and pending issues
  - Marginal costs are low in canal / gravity based irrigation but how low exactly?
  - What is “sustainable” cost recovery?
  - Water productivity remains low but where is the marginal benefit function exactly?
  - Lack of measurements, records on yields, water consumption and use

- Questions remain as to
  - What are those costs? How can one assess them?
  - How much should be recovered? Can smallholder farmers pay?

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Issues in evaluating costs in developing settings

- Lack of records on infrastructure and initial costs
- Multiple purpose and use of certain equipment and infrastructure; shift in use over time (irrigation vs. non irrigation uses)
- Partial refurbishment over time
- Part of command area becoming inactive over time
- Lack of standard basis for calculation under tropical, developing conditions (e.g. service life, maintenance requirements, discounting principles)

(Perret & Geyser, 2007)

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Evaluating full financial costs in a case study scheme: a discounted cash flow method

- **Inventory and evaluation**: establishing current value of all equipment and infrastructure
- Figures are **discounted back** to year of construction
  - European Civil Eng. Index not available, other discount rates are used (e.g. CPI)
- Maintenance costs and virtual capital costs (settlement of loan) are then calculated yearly as **cash flows**, using NCD as discount rates, and with assumptions regarding maintenance rates, service life

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Evaluating full financial costs in a case study scheme: a discounted cash flow method (2)

- **Initial value:**
  \[ Value_t = Value_{t+1} - (Value_{t+1} \cdot i_t) \]
  \[ Value_{init} = Value_{current} \cdot (1 - i)^n \]

- **Annual M costs adjusted with inflation:** \( i = \text{CPI} \)
  \[ CF = CF \cdot (1 + i)^n \]

- **NPV of yearly cash flow:** \( d = \text{NCD} \)
  \[ \text{NPV} = \sum \frac{CF_t}{(1 + d)^n} \]

- **PMT, yearly payment:**
  \[ \text{NPV} = PMT \cdot \left[ \frac{1 + (1 + d)^{-n}}{d} \right] \]

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Evaluating full financial costs in a case study scheme: a discounted cash flow method (3)

- Engineers are sometimes more comfortable with following terms:
  
  Present-value factor: $\frac{1}{(1+i)^n}$

- Present-value factor: $(P/F, i\%, n) = i \cdot \frac{(1+i)^n}{(1+i)^n - 1}$

- Capital-recovery factor: $(A/P, i\%, n) = \frac{1}{(1+i)^n}$

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Results: Calculating cost and required profit

- Net Present Value, total yearly Payment, and Required Net Profit per hectare to achieve targeted Return on Assets of 4%, per inflation scenario and under NCD as discount rate 6.5%

<table>
<thead>
<tr>
<th>Index Type</th>
<th>NPV</th>
<th>Total PMT</th>
<th>PMT/ha</th>
<th>Target of 4% ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI-index NCF</td>
<td>R -5 264 716</td>
<td>R 384 652</td>
<td>R 550</td>
<td>R 210 589</td>
</tr>
<tr>
<td>Farming requisites index NCF</td>
<td>R -3 385 175</td>
<td>R 247 329</td>
<td>R 353</td>
<td>R 135 407</td>
</tr>
<tr>
<td>Civil engineering index NCF</td>
<td>R -2 101 826</td>
<td>R 153 564</td>
<td>R 219</td>
<td>R 84 073</td>
</tr>
</tbody>
</table>

- RoA is determined by National Water Resource Strategy (fixed at 4%); Required Net Profit to meet it are calculated from:

\[
RoA = \frac{NetProfit}{TotalAssets} \quad \quad RNP = NPV \cdot RoA
\]

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Smallholder irrigation systems grow mostly maize.
Yields range between 1 to 7t per ha, with an average around 2t for subsistence farmers.

<table>
<thead>
<tr>
<th>Yielding scenario</th>
<th>Total income</th>
<th>Production costs</th>
<th>Net profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 t/ha</td>
<td>R 1,600</td>
<td>R 800</td>
<td>R 800</td>
</tr>
<tr>
<td>7 t/ha</td>
<td>R 5,600</td>
<td>R 2,200</td>
<td>R 3,400</td>
</tr>
</tbody>
</table>

Required yearly payment per ha is between R 120 and 300 (towards RoA target)
Required yearly payment per ha is between R 220 and 550 (towards cost recovery)
Do the maths: subsistence farmers cannot realistically pay; others might.

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Conclusion

- An interesting and feasible method in the absence of records:
  - Backwards-discounting approach to determine initial value of assets at construction
  - Net-present value approach to determine yearly cash flows
- Reflecting on farmers’ performance: High costs vs. low performance
  - Intensification (more inputs, higher value crops – easy to say...)

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Conclusion (2)

- Reflecting on farmers’ performance: High costs vs. low performance
  - WTP for irrigation services seems to be higher than supposed
  - When existing, irrigation fees are duly paid if services match farmers expectations
  - However, full cost recovery looks unrealistic

- Example from SA (Thabina IS in 2003):
  - Existing fee: R 120 /ha
  - O&M costs only (mostly pumping): R 174 /ha
  - That is less than 70% covered, in a situation considered “favorable”

- In such situations, value or price per m³ is irrelevant; rather think value or price per irrigable area-unit (poor measure for water demand management; quite efficient to increase irrigation land use)
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