Towards making ecosystems work for a long time
(Making the socio-economic explicit)

James Blignaut and Rozanne Bester
Introduction
Some hair-raising realities

• **MONEY:**

  • Def.: Generally accepted medium of exchange:
    
    
    • Purchasing power purely based on confidence; or the lack thereof.
    
    • It only exist because of human imagination.
    
    • It is human’s main indicator for decision-making.
    
    • It has got no meaning for systems in which humans do not operate.
    
    • Valuation of ecosystem services is therefore NOT commodification of nature, a value judgement of human decisions.

  • It is effectively human decisions and its consequences that are being valued and expressed in the best tool we have to do that.
## Value of ecosystem services in South Africa: Rmil (2015 prices)

<table>
<thead>
<tr>
<th>Category</th>
<th>Service</th>
<th>Value</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provisioning services</strong></td>
<td>Grazing</td>
<td>39 750</td>
<td>14.5%</td>
</tr>
<tr>
<td></td>
<td>Harvested renewable resources</td>
<td>7 716</td>
<td>2.8%</td>
</tr>
<tr>
<td><strong>Cultural services</strong></td>
<td>Amenity values</td>
<td>112 261</td>
<td>40.9%</td>
</tr>
<tr>
<td></td>
<td>Existence and bequest values</td>
<td>6 450</td>
<td>2.3%</td>
</tr>
<tr>
<td><strong>Regulating services</strong></td>
<td>Carbon storage</td>
<td>40 686</td>
<td>14.8%</td>
</tr>
<tr>
<td></td>
<td>Pollination</td>
<td>6 908</td>
<td>2.5%</td>
</tr>
<tr>
<td></td>
<td>Control of pests etc.</td>
<td>2 170</td>
<td>0.8%</td>
</tr>
<tr>
<td></td>
<td>Refugia</td>
<td>804</td>
<td>0.3%</td>
</tr>
<tr>
<td></td>
<td>Erosion control</td>
<td>2 112</td>
<td>0.8%</td>
</tr>
<tr>
<td></td>
<td>Water flow regulation</td>
<td>55 795</td>
<td>20.3%</td>
</tr>
<tr>
<td></td>
<td>Water quality amelioration</td>
<td>9</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>274 661</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Turpie et al. 2017

**Some hair-raising realities**
The FARMER & FARMING COMMUNITY and his/her/their sustainably well managed farm.

Some hair-raising realities: Rural economic development

Develop the (small/emerging) farmer – it is pivotal for the future, but it is equally challenging.
Challenges facing small/emerging and communal beef producers

2015 food dollar (nominal): Industry group

- Farm production: 8.6c
- Food processing: 15.6c
- Packaging: 2.5c
- Transportation: 3.5c
- Wholesale trade: 9.3c
- Retail trade: 12.7c
- Food services: 34.4c
- Energy: 4.0c
- Finance & Insurance: 3.4c
- Advertising: 2.6c
- Other: 3.5c

Note: “Other” includes two industry groups: Agribusiness plus Legal & Accounting.
Challenges (1):

**Biological issues**

1. Diseases: esp. brucellosis, foot and mouth, and the tricky ticks!!
   - lack of capacity to mark or conduct bio-security tests and implement a health programme
2. Genetic material
   - fertility, mortality, birth weight, birth %, ADG, etc.

**Management issues**

1. Extension services:
   - appropriate/relevant and timeous information
2. Grazing management options
   - poor nutrition, inadequate/infrequent water, sub-optimal grazing management options, etc.
Challenges (2):

**Economic issues**
1. Competitiveness, or lack thereof
2. Stock theft – never ending!
3. Cost and availability of feed supplements & fodder
4. Market access and access to the value chain
   - complicated business following slow processes
5. Cattle ownership structure

**Institutional issues**
1. Land & land tenure, or the lack thereof
2. Working effectively within current communal system
3. Mentorship programmes, or lack thereof
4. Definitions:
   - communal (no tenure); small & emerging (tenure with different farming intensities at different scales)
The consequences: The uphill battle
### Cattle: Population statistics

<table>
<thead>
<tr>
<th>Month</th>
<th>Cattle numbers (million)</th>
<th>Slaughterings</th>
<th>Total production RSA origin (1,000 t)</th>
<th>Imports (1,000 t)</th>
<th>Total Consumption (1,000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 1980</td>
<td>8.7</td>
<td>3 195</td>
<td>712.2</td>
<td>60</td>
<td>772.2</td>
</tr>
<tr>
<td>Dec 1990</td>
<td>13.3</td>
<td>2 573</td>
<td>610.3</td>
<td>83</td>
<td>693.3</td>
</tr>
<tr>
<td>Dec 2000</td>
<td>13.6</td>
<td>2 666</td>
<td>624.6</td>
<td>56</td>
<td>680.6</td>
</tr>
<tr>
<td>Dec 2005</td>
<td>13.5</td>
<td>2 724</td>
<td>672.3</td>
<td>62</td>
<td>734.3</td>
</tr>
<tr>
<td>Dec 2010</td>
<td>13.7</td>
<td>2 912</td>
<td>869.5</td>
<td>22</td>
<td>891.5</td>
</tr>
<tr>
<td>Dec 2011</td>
<td>13.7</td>
<td>2 912</td>
<td>852.1</td>
<td>25</td>
<td>877.1</td>
</tr>
<tr>
<td>Dec 2012</td>
<td>13.9</td>
<td>2 911</td>
<td>904.5</td>
<td>19</td>
<td>923.5</td>
</tr>
<tr>
<td>Dec 2013</td>
<td>13.9</td>
<td>3 000</td>
<td>982.6</td>
<td>20</td>
<td>1002.6</td>
</tr>
<tr>
<td>Dec 2014</td>
<td>13.9</td>
<td>3 274</td>
<td>982.6</td>
<td>20</td>
<td>1002.6</td>
</tr>
</tbody>
</table>

### Cattle population (2014)

- Commercial beef: 5 630 000
- Feedlot beef: 1 850 000
- Communal beef: 5 656 207
- Dairy: 1 260 000
- Total: 13 896 207

**Source:** DAFF 2014, 2015

- **38%**
- **35%!!**
- **2,5%**
- **222kg**
<table>
<thead>
<tr>
<th>Description</th>
<th>Cows : Bulls</th>
<th>Heifers : Cows</th>
<th>Calf %</th>
<th>Calf mortality %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm 1</td>
<td>17.1</td>
<td>48%</td>
<td>83%</td>
<td>10%</td>
</tr>
<tr>
<td>Farm 2</td>
<td>20.6</td>
<td>48%</td>
<td>90%</td>
<td>5%</td>
</tr>
<tr>
<td>Farm 3</td>
<td>13.7</td>
<td>48%</td>
<td>73%</td>
<td>15%</td>
</tr>
<tr>
<td>Farm 4</td>
<td>17.1</td>
<td>48%</td>
<td>75%</td>
<td>10%</td>
</tr>
<tr>
<td>Farm 5</td>
<td>20.6</td>
<td>48%</td>
<td>81%</td>
<td>5%</td>
</tr>
<tr>
<td>Farm 6</td>
<td>13.7</td>
<td>48%</td>
<td>66%</td>
<td>15%</td>
</tr>
<tr>
<td>Farm 7</td>
<td>6.5</td>
<td>49%</td>
<td>37%</td>
<td>20%</td>
</tr>
<tr>
<td>Farm 8</td>
<td>5.2</td>
<td>49%</td>
<td>46%</td>
<td>15%</td>
</tr>
<tr>
<td>Farm 9</td>
<td>5.3</td>
<td>49%</td>
<td>29%</td>
<td>30%</td>
</tr>
</tbody>
</table>

(typical yet hypothetical) Farm-level profiles

Blignaut et al. 2016
(typical yet hypothetical) Farm-level analysis

- Kg output / ha declining over farming systems
- Kg input required / kg meat produced increases
- Due to: time required to produce a kg of meat, mortality, fertility, ADG, etc.

0 20 40 60 80 100 120 140 160
Farm 1 Farm 2 Farm 3 Farm 4 Farm 5 Farm 6 Farm 7 Farm 8 Farm 9

kg output/ha and kg input to kg output

kg meat @ market age /ha

kg feed consumed / kg meat @ market age

kg CO2 produced / kg meat @ market age
(typical yet hypothetical) Farm-level analysis

lit. water consumed / kg meat @ market age
Application: Ntabelanga & Laleni

Background
Application: Ntabelanga & Laleni

1. Area: Tsolo-Maclear, demarcated for the Ntabelanga dam (Tsista River)
2. Ntabelanga and Laleni Ecological Infrastructure Project (NLEIP) (DEA:NRM)
3. Vision: to significantly improve the **livelihoods** of the **local communities** through job creation and improved delivery of ecosystem goods and services, as well as reduce the **local residents’** vulnerability to threats like climate change.
4. Cattle farming, crop and vegetable production linked to an irrigation scheme.
5. What are the drivers of success?
Material and methods (1):

1. **Systems dynamic model:**
   i. allows for variables of various dimensions, sources, and units;
   ii. shows interaction of variables within a complex and dynamic system; and
   iii. allows for various scenarios and the testing of parameters.

2. **Sources of data:**
   i. literature w.r.t. estimated costs and benefits of the water project, soil erosion rates, socio-economic trends, livestock etc.;
   ii. expert opinion and stakeholder engagement w.r.t. *relevant* system dynamics, household behaviour and restoration; and
   iii. cost data for restoration interventions provided by RU and FSU geography departments.
Material and methods (2):

3. Model dynamics:
   i. population income dynamics;
   ii. population growth dynamics;
   iii. various permutations w.r.t. household choice in stocking rates and land management regimes;
   iv. a livestock market;
   v. sediment yield dynamics;
   vi. livestock-grazing interaction dynamics; and
   vii. processes re restoration and the choice to adapt or not.
Application: Ntabelanga

Model 1:
Change in the welfare of people w.r.t.
various decision-making options
Scenarios:

1. 40 scenarios tested:
   i. Behavioural actions
      i. adaptation to best land use practises or not;
      ii. existence of a market for cattle or not.
   ii. Structural actions
      i. restoration (option between 4 types), or not;
      ii. the dam to be build, or not.

2. Scenarios evaluated using multi-criteria decision making using 7 & 9 indicators.
e.g.: Behavioural options explained

- **With market**
  - With a dam
    - With 5 restoration options
  - Without a dam
    - With 5 restoration options

- **Adaptation**
  - With a dam
    - With 5 restoration options
  - Without a dam
    - With 5 restoration options

- **No market**
  - With a dam
    - With 5 restoration options
# Results:
Sum of discounted utility at time at the end of 2070

Three best options for each quadrant

<table>
<thead>
<tr>
<th>Behavioural changes</th>
<th>Structural Changes</th>
<th>Utility score</th>
<th>Avg. utility</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dam</td>
<td>Restoration mixes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market</td>
<td>Adapt.</td>
<td>Dam</td>
<td>Restoration mixes</td>
<td>Utility score</td>
</tr>
<tr>
<td>Forward looking</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Soft option heavy mix</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Hard structures heavy mix</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Prevention fencing</td>
</tr>
<tr>
<td>Failed state</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Soft option heavy mix</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Community engagement</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Prevention fencing</td>
</tr>
<tr>
<td>Business as usual</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Soft option heavy mix</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Hard structures heavy mix</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Prevention fencing</td>
</tr>
<tr>
<td>Squan. assets</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Prevention fencing</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Community engagement</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No restoration</td>
</tr>
</tbody>
</table>

Bester et al. under review
Application: Ntabelanga & Laleni

Model 2:
Effects of various decisions on projected dam life-spans
## Results:
Change in dam life-spans due to various decisions

<table>
<thead>
<tr>
<th>Mix name</th>
<th>(1) Ntabelanga lifespan (years)</th>
<th>(2) Laleni lifespan (years)</th>
<th>Additive impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>Basic model (0)</td>
<td>55</td>
<td>68</td>
<td>26</td>
</tr>
<tr>
<td>+ Anthropogenic effects (1)</td>
<td>31</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>+ Restoration &amp; mitigation (2)</td>
<td>33</td>
<td>46</td>
<td>17</td>
</tr>
<tr>
<td>+ Income leakage (3)</td>
<td>38</td>
<td>49</td>
<td>17</td>
</tr>
<tr>
<td>+ Desirable adaptation (4)</td>
<td>50</td>
<td>65</td>
<td>24</td>
</tr>
<tr>
<td>+ Undesirable adaptation (5)</td>
<td>31</td>
<td>45</td>
<td>15</td>
</tr>
</tbody>
</table>

**Note:** Numbers in parentheses refer to next slide.

Bester et al. under review
Results:
Burgundy = Ntabelanga; Blue = Laleni

Bester et al. under review
Conclusions
Conclusions:

1. Rural development depends on farmers and farming communities to function well.

2. Small beef producers are facing enormous challenges, exacerbated by rapid advances made in commercial sector.

3. The lower the level of development of the farming operation: the higher the environmental cost for farmer and country.
Conclusions:

4. Managing a system is dependent on a range of factors, cannot isolate only one, such as the creation of the market.

5. The two dams, outside of including anthropogenic and biophysical feedbacks: over-estimate impacts of benefits.

6. Without embracing people in the system and endogenising plausible behavioural changes, mitigation could be wasted.
Thank you