# BAVIAANSKLOOF - TSITSIKAMMA PAYMENT FOR ECOSYSTEM SERVICES: A FEASIBILITY ASSESSMENT


**By**

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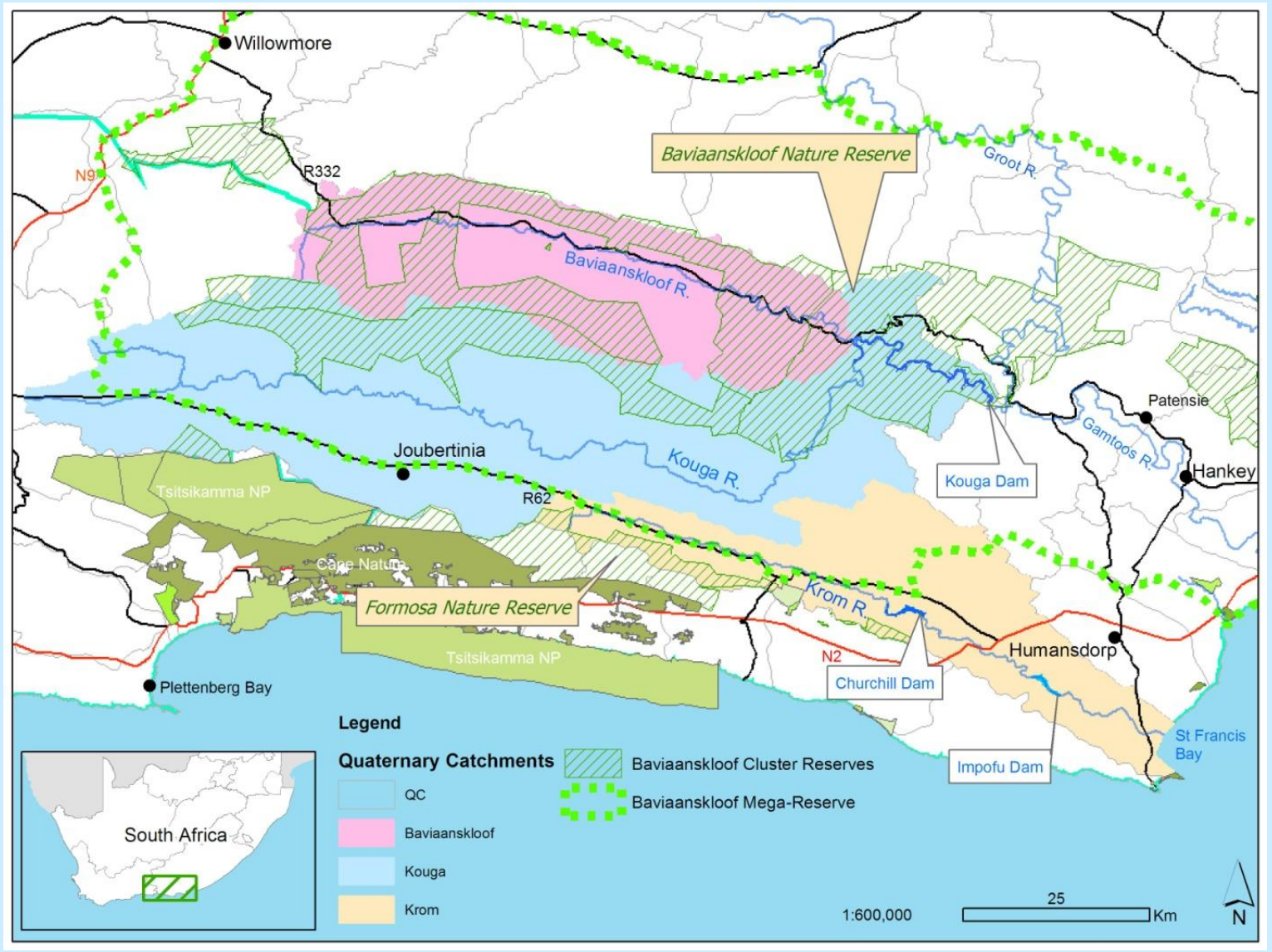
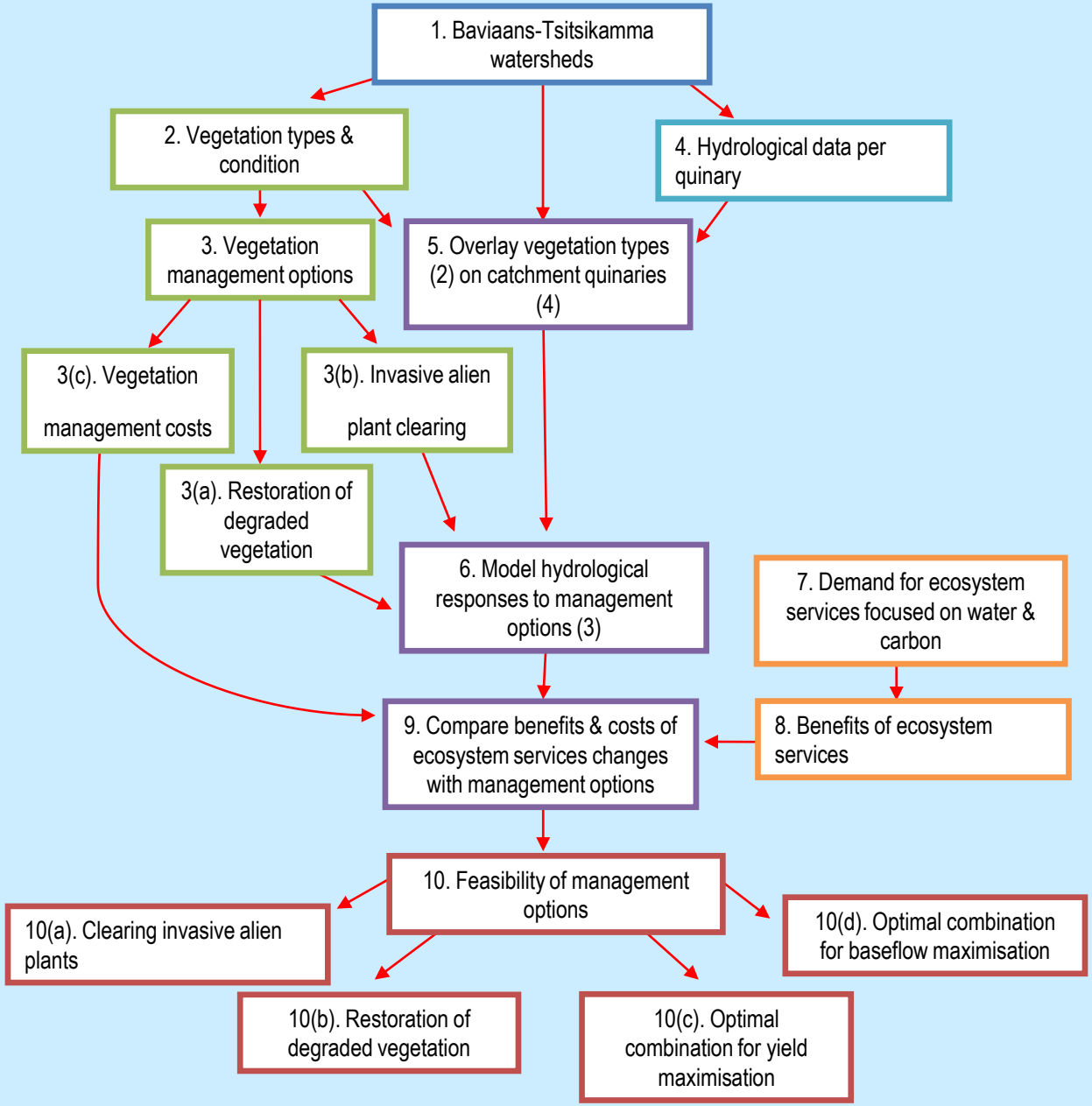
# Introduction

- Payment for Ecosystem Services (PES) systems essentially offer the opportunity to achieve sustainable outcomes by adjusting the incentives faced by land owners to better meet the needs of wider society.
- Aim of the project was to broadly assess the feasibility of establishing a PES system in the Baviaanskloof and Tsitsikamma watersheds focused on water and carbon sequestration services.
- Work was commissioned as part of the World Bank funded Cape Action for People and the Environment (C.A.P.E.) programme's Biodiversity Conservation and Sustainable Development Project co-ordinated by the South African National Biodiversity Institute.
- It also benefited from co-funding made available by the Department of Water Affair's Working for Water programme (WfW).

# The study area



# Research process



# The watersheds have the capacity to supply significant levels of services

- The Baviaanskloof, Kouga and Kromme watersheds consists of 18 quaternary catchments, with an area of 560,000 hectares.
- They have a bimodal rainfall with greatest rainfall in the spring, autumn.
- Mean annual precipitation ranges widely from 225mm in the northern Baviaanskloof to over 1,600mm per annum in the high-lying Tsitsikamma Mountains.
- The linked systems of the Baviaanskloof and Kouga currently supply some 101 million $m^3$ of water to users while the Kromme supplies some 37 million $m^3$.
- The spekboom thicket has a prodigious capacity to store carbon, with intact vegetation storing some 100 t C per hectare more than degraded areas - this storage level is not dissimilar to moist forests in other regions.

# The supply of ecosystem services is changing for the worse

- 30% of the watershed falls within protected areas.
- 65% is made up of extensive farm land – with 255,000 hectares of degraded farm land.
- Approximately 28,000 hectares is condensed alien invasive plant thicket.
- Less than half the natural veld (some 224,000 hectares) remains in good condition.
- Degradation generates:
  - elevated storm flows
  - reduced base flows
  - accelerated erosion
  - greater carbon emissions

# There is demand from landowners to shift to more sustainable land uses

- Current livestock practices are not sustainable and generate poor returns
  - Farmers net some R42 /ha/yr for cattle in the Kromme and Kouga watersheds, and some R87 /ha/yr farming goats in the Baviaanskloof.
- These marginal returns are not sustainable – as the extent of large scale veld degradation attests with some 255 000 hectares already degraded.
- Farmers are looking for more sustainable land uses with better returns, such as game farming, tourism and intensive cropping.
- Intensive cropping has attractive annual returns from R1000s to R150 000 / ha and cannot be changed using a PES system.
- However, cropping depends on access to fertile bottom lands and large volumes of water – which are in very short supply.

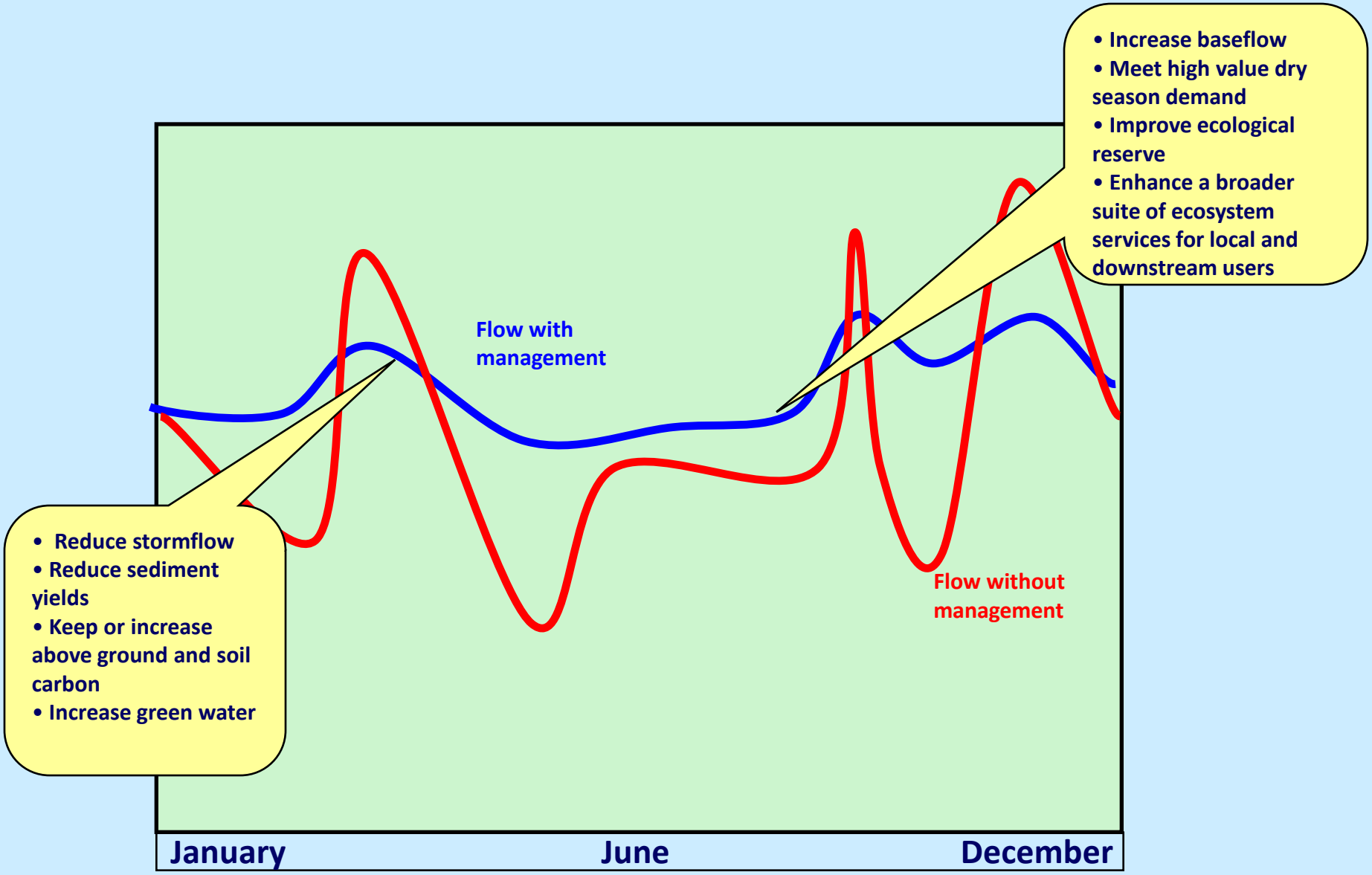
# The need for ecosystem services within the watershed is great and growing

- Nelson Mandela Bay Metro has a long history of water access crises
- Growing demand from:
  - the continued growth of the city,
  - the expansion of the Coega Industrial Development Zone and
  - the growth of Jefferies' Bay and St Francis bay.
- Expensive options such as:
  - waste water recycling and
  - desalination are being considered
  - electricity critical for such processes, is likely to double in costs in the next 3 to 4 years.
- The need to optimise the use of existing natural capital is growing daily and should be viewed as an economic development imperative.

# Management options available have a range of hydrological impacts

- Maximising for baseflow – optimise for baseflow with IAP clearing and revegetation
- Maximising for yield – optimise for yield with IAP clearing and revegetation
- Control and clearing of Invasive Alien Plants – only one activity
- Revegetation of denuded areas – only one activity

# Results show that effective vegetation management can make a significant impact on water related ecosystem services



# Control & clearing of invasive alien plants

| | Kromme | Kouga | Baviaanskloof | Total |
|---|---|---|---|---|
| **Change in yield: $m^3$ per year** | 4,441,006 | 3,838,286 | - | 8,279,293 |
| **Change in baseflow: $m^3$ per year** | 2,409,231 | 2,276,552 | - | 4,685,782 |
| **Sediment reduction: $m^3$ per year** | - | - | - | - |

# Revegetation of denuded areas

| | Kromme | Kouga | Baviaans | Total |
|---|---|---|---|---|
| **Change in yield: $m^3$ per yr** | -1 931 146 | -10 599 850 | -1 708 949 | -14 239 945 |
| **Change in baseflow: $m^3$ per yr** | 20 028 219 | 15 861 808 | 5 649 308 | 41 539 335 |
| **Sediment reduction: $m^3$ per yr** | 91 522 | 112 693 | 44 571 | 248 786 |

# Maximising the baseflow (dry season flows)

| | Kromme | Kouga | Baviaans | Total |
|---|---|---|---|---|
| **Change in yield: $m^3$ per yr** | -1 931 146 | -9 227 209 | -1 708 949 | -12 867 304 |
| **Change in baseflow: $m^3$ per yr** | 20 028 219 | 16 688 029 | 5 649 308 | 42 365 556 |
| **Sediment reduction: $m^3$ per yr** | 91 522 | 112 693 | 44 571 | 248 786 |

# Maximising yield (stream flow)

| | Kromme | Kouga | Baviaans | Total |
|---|---|---|---|---|
| **Change in yield: $m^3$ per yr** | 5,986,263 | 3,838,286 | 1,267,183 | 11,091,733 |
| **Change in baseflow: $m^3$ per yr** | 8,936,255 | 2,276,552 | 2,781,529 | 13,994,335 |
| **Sediment reduction: $m^3$ per yr** | 13,492 | - | 8,747 | 22,239 |

# The economics of a payments for watershed management system

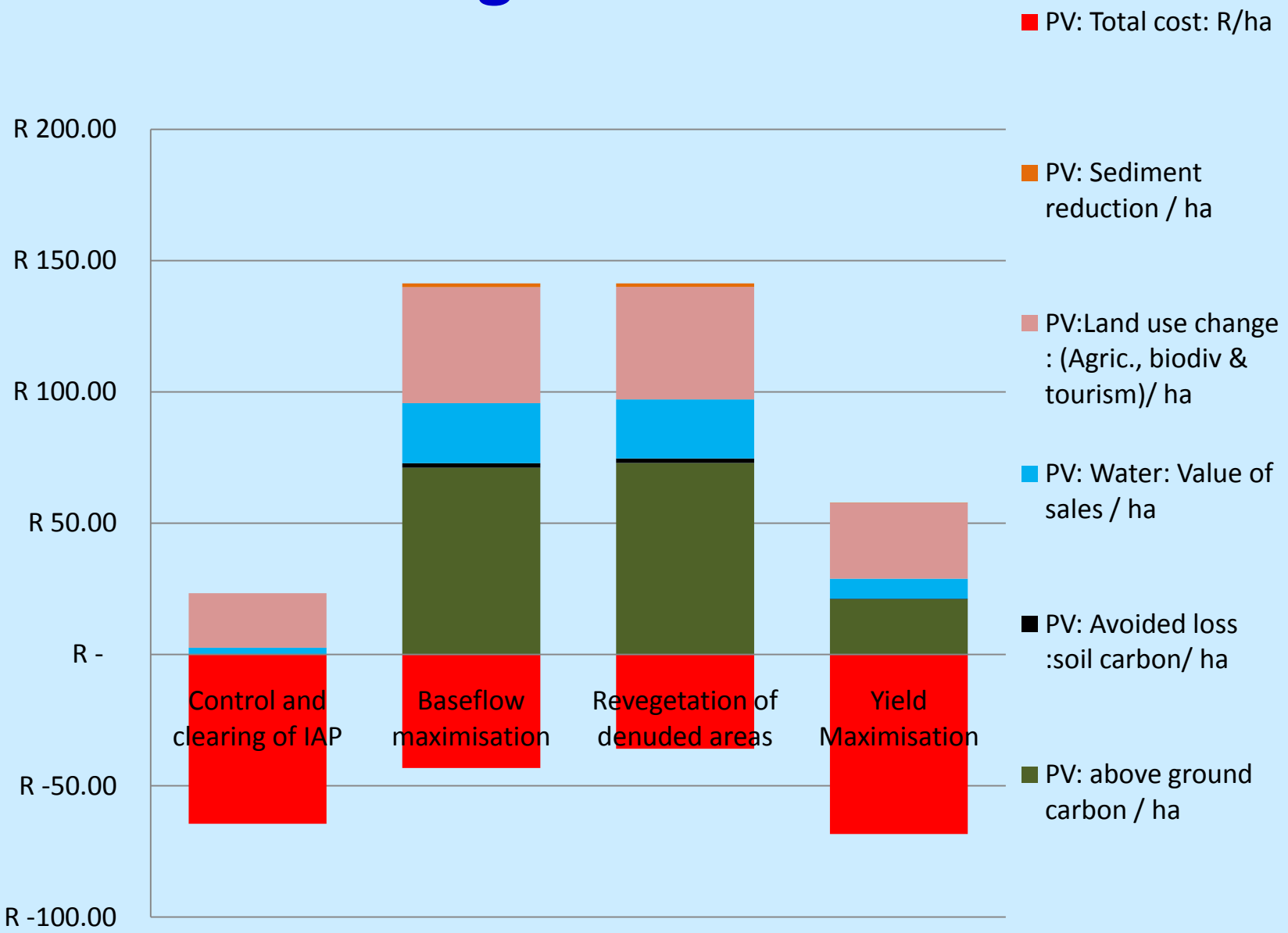
- At the farm level focused on financial returns
- At the societal level focused on financial returns and wider economic benefits

# At the farm level

| Returns to ecosystem services | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| Above ground carbon / ha | R - | R 71.10 | R 72.95 | R 21.08 |
| Avoided loss :soil carbon/ ha | R - | R 1.72 | R 1.72 | R 0.20 |
| Water: Value of sales / ha | R 2.54 | R 22.93 | R 22.48 | R 7.57 |
| Land use change : (Agric., biodiv & tourism)/ ha | R 20.77 | R 44.18 | R 42.80 | R 28.95 |
| Sediment reduction / ha | R - | R 1.39 | R 1.39 | R 0.12 |
| **Total benefits: R/ha/yr** | **R 23.30** | **R 141.32** | **R 141.35** | **R 57.92** |
| **Total management cost: R/ha/yr** | **R 64.43** | **R 43.20** | **R 35.89** | **R 68.36** |
| **Net returns: R/ha/yr** | **R -41.13** | **R 98.12** | **R 105.46** | **R -10.44** |

[1] Total cost includes the opportunity cost of reducing stock levels to sustainable levels.

# Annual returns per hectare for restoration and management on farms



# Change in flows - at the society level

| Water services changes: per annum | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| Change in yield: $m^3$ | 8 279 293 | -12 867 304 | -14 239 945 | 11 091 733 |
| Change in baseflow: $m^3$ | 4 685 782 | 42 365 556 | 41 539 335 | 13 994 335 |
| Sediment reduction: $m^3$ | - | 248 786 | 248 786 | 22 239 |
| **Comments:** The baseflow maximisation and revegetation options show the greatest gains in baseflow, but also show significant losses in yield. | | | | |

# Costs and benefits – at the society level

| Cost & Benefits of implementation: over 30 yrs | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| PV: Total cost: R | R 975 591 539 | R 654 140 529 | R 543 480 909 | R 1 035 040 122 |
| PV: Total benefits (excluding economic value of water) | R 352 854 400 | R 2 139 758 069 | R 2 140 140 287 | R 876 898 296 |
| **Comments:** Management that excludes revegetation results in substantially lower benefits. | | | | |
| PV: Water: Economic value | R 626 604 334 | R 5 665 316 559 | R 5 554 830 565 | R 1 871 386 757 |
| **Comments:** The additional water services supplied can add a substantial value to the regional economy. For example, the baseflow maximisation and revegetation options are likely to contribute an additional R5 billion to the economy. | | | | |

# Benefit Cost ratio - at the society level

| Benefit-Cost Ratio | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| Restoration + Management: Carbon | 0.00 | 1.69 | 2.08 | 0.31 |
| Restoration + Management: Water sales | 0.04 | 0.53 | 0.63 | 0.11 |
| Restoration + Management: Land use change | 0.32 | 1.02 | 1.19 | 0.42 |
| Restoration + Management: Sediment | 0.00 | 0.03 | 0.04 | 0.00 |
| **Restoration + Management: Total** | **0.36** | **3.27** | **3.94** | **0.85** |

**Comments:** The revegetation and baseline maximisation options show significantly positive ratios. To make a watershed restoration and management programme economically feasible and sustainable, then carbon sequestration and/or tourism/game need to be added to the suite of sales.

# Unit Reference values - at the society level

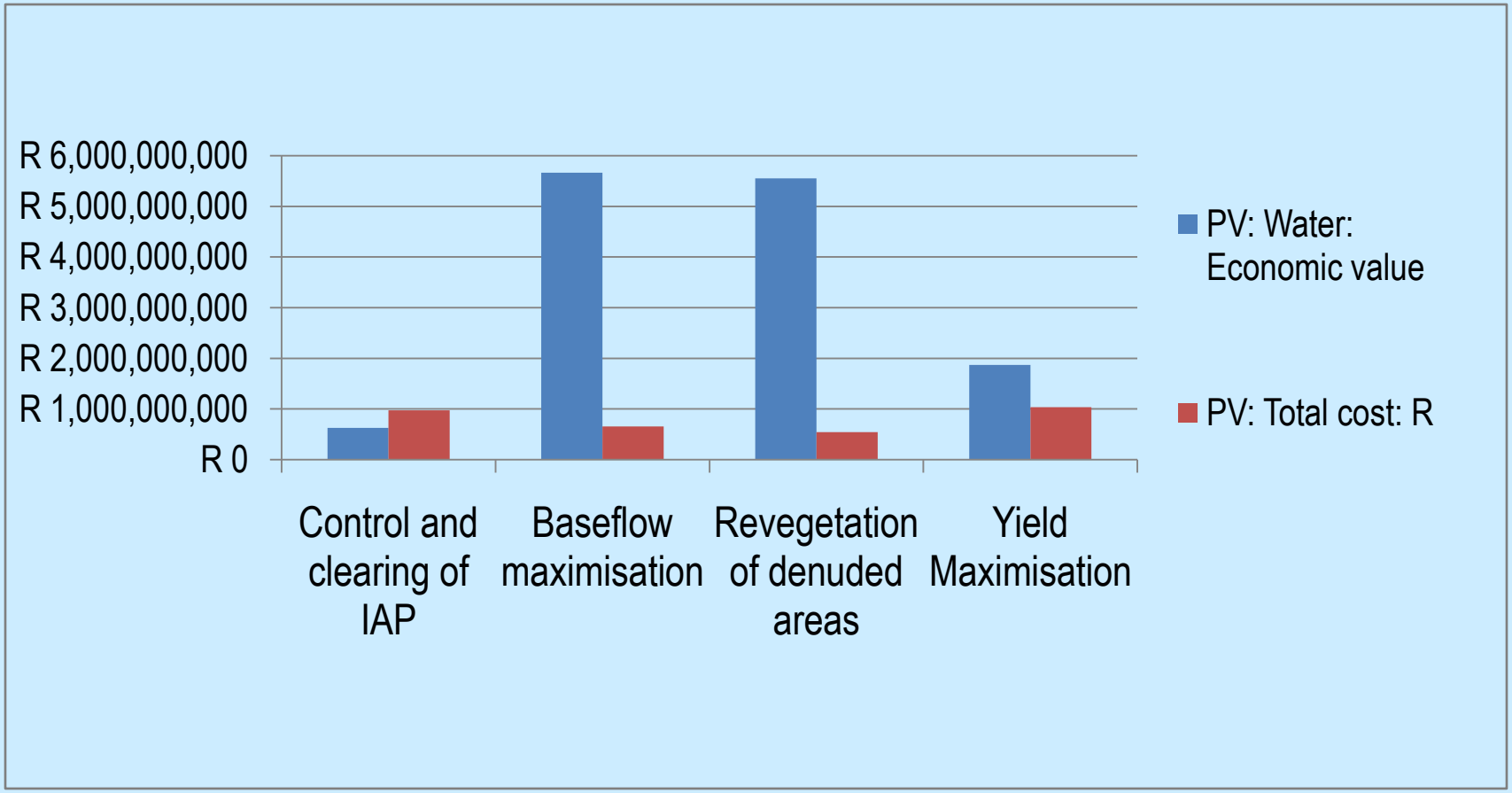
| Unit Reference Value | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| URV: Water only | 7.19 | 0.93 | 0.80 | 3.59 |
| URV: Water & above ground carbon | 7.19 | -0.60 | -0.82 | 2.48 |
| URV: Water, above ground carbon, landuse change & sediment | 4.87 | -1.58 | -1.81 | 0.96 |

**Comments:** The control of invasive alien plant species and yield maximisation have similar URVs to waste water recycling and the construction of dams. The baseflow maximisation and revegetation options are less than 1, showing very attractive URVs.A negative URV indicates a societal loss for every day the project is not implemented.

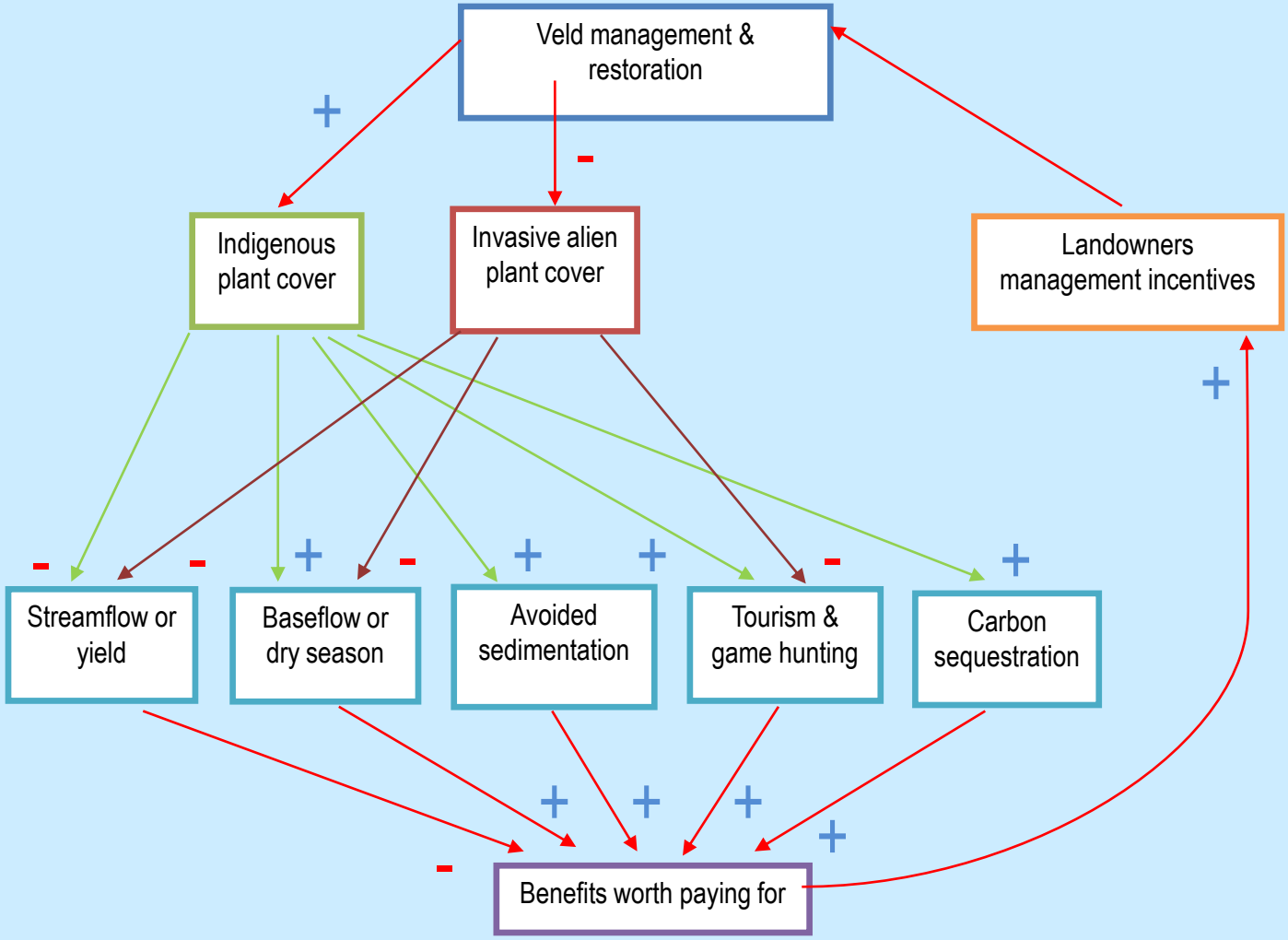
# Job creation - at the society level

| Jobs creation: over 30 years | Control and clearing of IAP | Baseflow maximisation | Revegetation of denuded areas | Yield maximisation |
|---|---|---|---|---|
| **Total: Person-days** | **3 857 228** | **4 736 296** | **4 380 881** | **4 828 682** |
| **Comments:** The invasive alien plant control option will generate some 640 jobs a year for 30 years, while the yield maximisation and baseflow maximisation will generate some 800 jobs a year for 30 years. | | | | |

# The economic value of water supplied to society



# The process of payment for ecosystem services



# Implications for farmers

- It is financially feasible to change from stock farming which is not sustainable to a multiple service focus, which includes:
  - reduced but sustainable stocking rates,
  - vegetation restoration and management to generate carbon sequestration, game habitat, tourism assets, sediment avoidance, avoided soil carbon loss and increased water security
- But, this depends on access to a market(s).

# Implications for water managers

- The yield maximisation option delivers some R 1,737 per ha worth of benefits over 30 years at a cost of R 2,051 per ha.
- This implies a 15% loss and an annual shortfall of R 10,44/ha/yr, with implications for the taxpayer or for water tariffs.
- A critical element in promoting water security would be for water managers to support the establishment of associated carbon and tourism markets.
- The ‘new’ water may be useful for meeting the environmental flows of the rivers if the assurance of supply is considered too low.
- The findings of the study indicate that water management programmes, such as Working for Water, could be substantially bolstered if their approach was broadened to include PES components.

# Implications for water consumers

- Water consumers have an alternative or additional mechanism to support water security.
- The options to increase baseflow and/or yield offer opportunities for ‘new’ water albeit this water has a lower assurance of supply given its links to land surface management.
- For run-of-river water users, water security will be enhanced under management, and therefore they should support any such watershed management actions.

# Implications for conservation agencies

- If conservation agencies wish to facilitate land use changes to support the growth of local biodiversity on private land, then they should support farmers in accessing carbon trading and tourism markets.
- In terms of gaining additional revenue streams from carbon and water services supply for the conservation estate, it is recommended that:
  - Conservation agencies pursue a bilateral agreement with a carbon buyer who is willing to accept the risks, and buy the carbon credits despite not being assured of 'additionality' in the long term.
  - This is likely to be a buyer who is also interested in biodiversity services and natural heritage benefits.

# Implications for sustainable land use facilitation agencies

- A facility needs to be established to facilitate the sale of carbon offsets which have high potential to be produced in this system, particularly the Baviaanskloof watershed.
- A facility needs to be established to promote tourism, as a vibrant tourism trade would support farmers in reducing stock numbers and in pursuing habitat restoration.

# Implications for government

- The Baviaanskloof-Tsitiskamma watersheds house natural assets with high value to all levels of government:
  - A critical water resource for the local municipalities,
  - An outstanding tourism asset to attract national and international visitors,
  - A flood reduction service for district, provincial, and national roads,
  - A basis for the revival and diversification of the district's rural economies,
  - An option for augmenting water security for the Nelson Mandela Bay Municipality, and for enhancing the longevity of existing water infrastructure,
  - A World Heritage Site which offers RSA prestige, but also responsibilities.
- Loss of these assets will have large and significant costs for government – already illustrated by regional flood damage repairs and water shortages.
- A concerted effort is required by government to promote the integrated and harmonious use of the Baviaanskloof-Tsitsikamma watersheds as the combined benefits of a suite of compatible ecosystem services far outweigh the management costs and the individual benefits of destructive consumption.

# Thank you for your attention!