Potential for watershed services market creation in Malawi:

constraints, opportunities and modelling of scheme uptake

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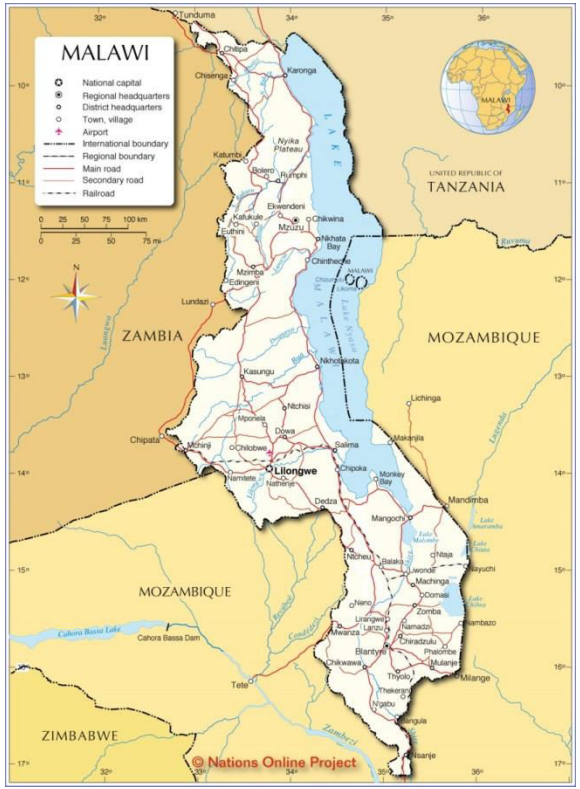
Land Economy, Environment and Society Research Group

Leading the way in Agriculture and Rural Research, Education and Consulting

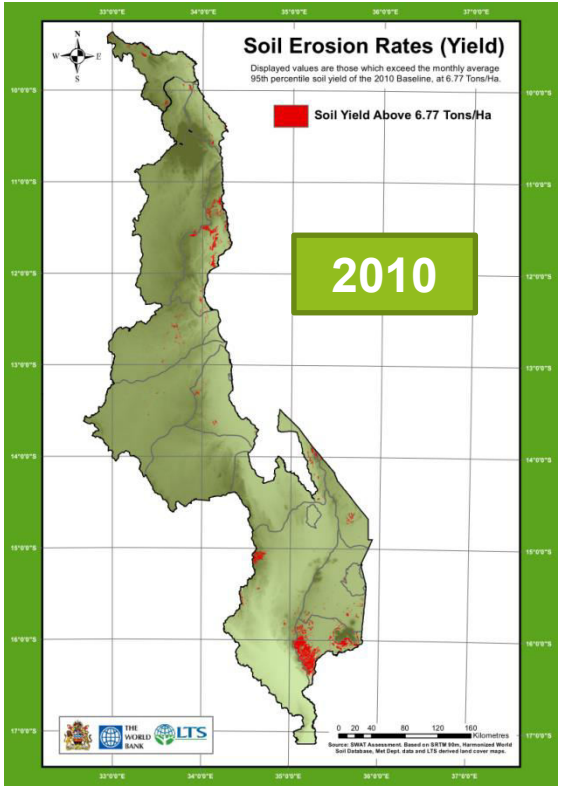
Contents

Why Malawi



- Total area of 118,480 km^2: length of about 900 km to its maximum width of ~250 km, and 20% of its surface covered by water bodies
- Population of 15.38 million people (2011), with an annual growth rate of 2.8%
  - Population density of 139 inhabitants/km^2 (2008)
  - 50.7% with an income below the poverty line according to the World Bank poverty headcount index (2011)
- 85% of households engaged in agricultural activities
  - Average plot size of 0.77 ha per household (2011)
  - 1 million people each year needing urgent food assistance

Why Malawi



- The national average soil loss is 20 tonnes per hectare per year, with a maximum of 43t/ha/year having been reported for arable land (Bishop, 1995)
  - Hydrogeological modelling (LTS International, 2013) shows areas with erosion higher than 6.77t/ha/month (i.e. 81.24 t/ha/year)
- Slope influences the degree of soil loss, with higher slopes being more susceptible to soil loss

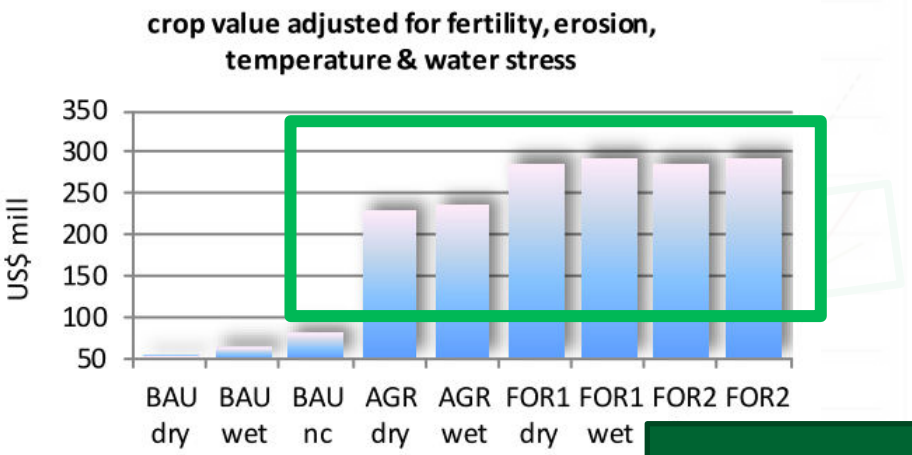
Why Malawi

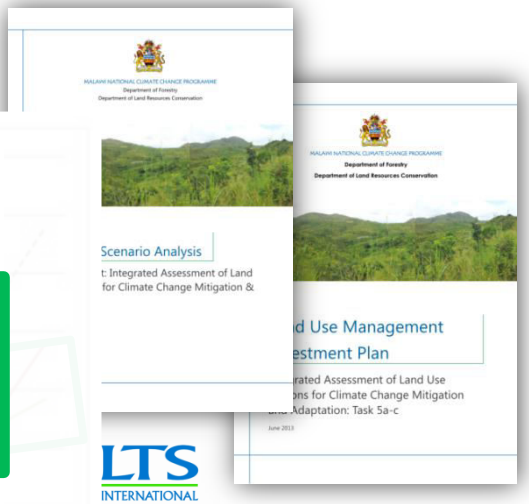
- **Impacts of soil erosion**
  - Loss of soil fertility
    - BISHOP, J. (1995). The Economics of Soil Degradation: An Illustration of the Change in Productivity Approach to Valuation in Mali and Malawi
    - EATON, D. (1996). The Economics of Soil Erosion: A model of farm decision-making
  - Siltation costs
    - LTS INTERNATIONAL (2013). Land Use Scenario Analysis Task 3 Report: Integrated Assessment of Land Use Options for Climate Change Mitigation & Adaptation
  - Loss of water retention capacity

Watershed Ecosystem Services

Why Malawi

- **Smallholder Farmers: what land management options?**

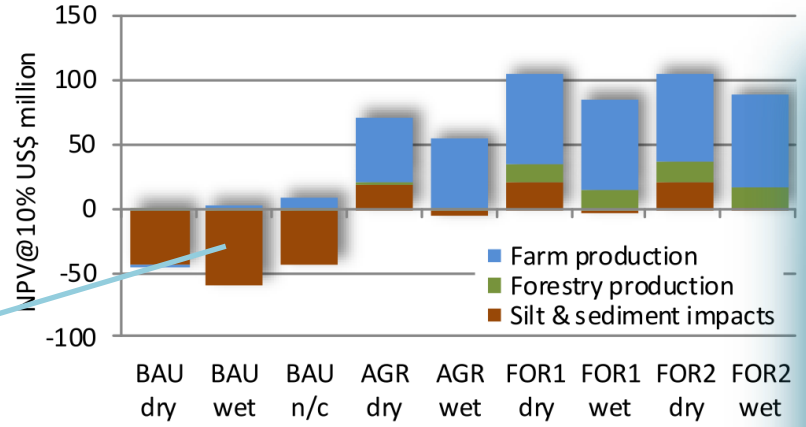




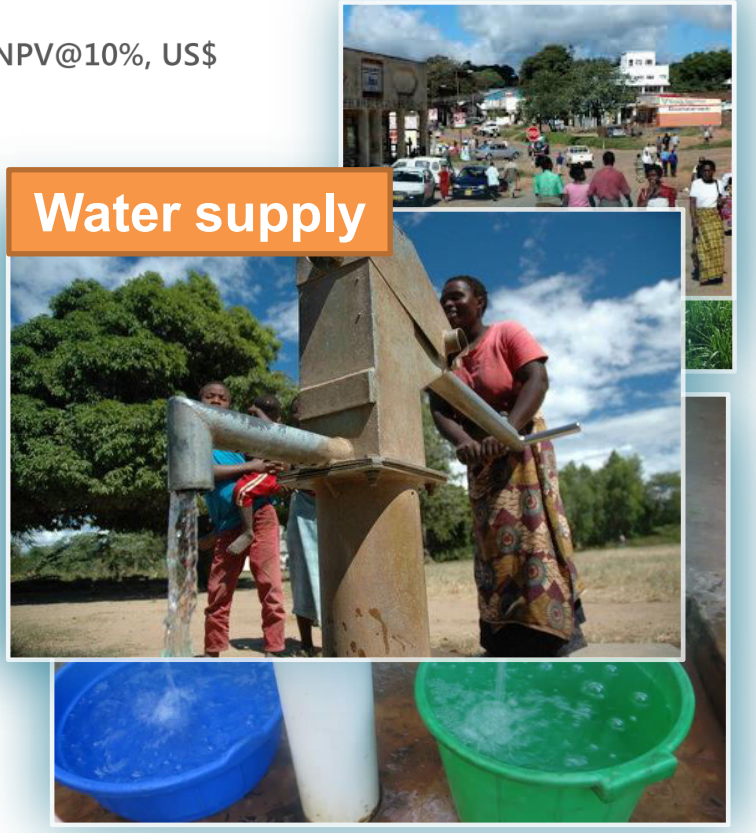
- High start-up costs
- High discount rates
- Risk-adverse

Why Malawi

Net present value-added by scenario and type of value 2010-2030 (NPV@10%, US$ million)



Possible scope for **Payments for Watershed Services** Schemes?



PWS in Malawi: constraints

Constraints		Reasons
Demand-side	Difficulty in finding willing and able buyers	• low electrical grid coverage • low access to piped water • reduced capacity for investment from municipal and regional water suppliers • insufficient tax revenues to allocate to PWS • high levels of poverty (which make increased water fees unfeasible) • cultural perception of water as a good to be supplied free of charge (particularly in rural areas)

PWS in Malawi: constraints

Constraints		Reasons
Supply-side	Uncertain property rights	• outdated and unclear land and water legislation • dragging legislation reform process • majority of land is unregistered (i.e. under customary law) and is acquired as bride price or assigned by traditional authorities

PWS in Malawi: constraints

	Constraints	Reasons
Market constraints	Potentially high transaction costs of negotiating, implementing and monitoring compliance	• high number of participants (residing in often remote and inaccessible of some locations) • need to set up dedicated institutional bodies or of training existing ones, in a context of already stretched human and financial capital

PWS in Malawi: constraints

	Constraints	Reasons
Human capital	Lack of pooling of demand and supply (necessary in overcoming threshold effects)	• lack of awareness of PWS market potential by both suppliers and buyers • lack of necessary education and skills for the establishment of supplier and buyer associations that could act as intermediaries
	Potential for market creation to be defined by wealthy sectors, further marginalising the poor	• risk of insufficient government regulation • risk of marginalising the poor and the landless by excluding them from any benefits that might accrue from the scheme

PWS in Malawi: constraints

	Constraints	Reasons
Biophysical	Scientifically sound evidence of watershed service improvement	• current assessments lack the resolution to predict hydrological dynamics at a local level, but nonetheless provide a valuable baseline for assessing investment priorities and further research needs

PWS in Malawi: opportunities

- Malawi has so far been the subject of 8 identified PWS schemes:
    - 1 that has been abandoned after having been active
    - 7 proposals

PWS in Malawi: opportunities

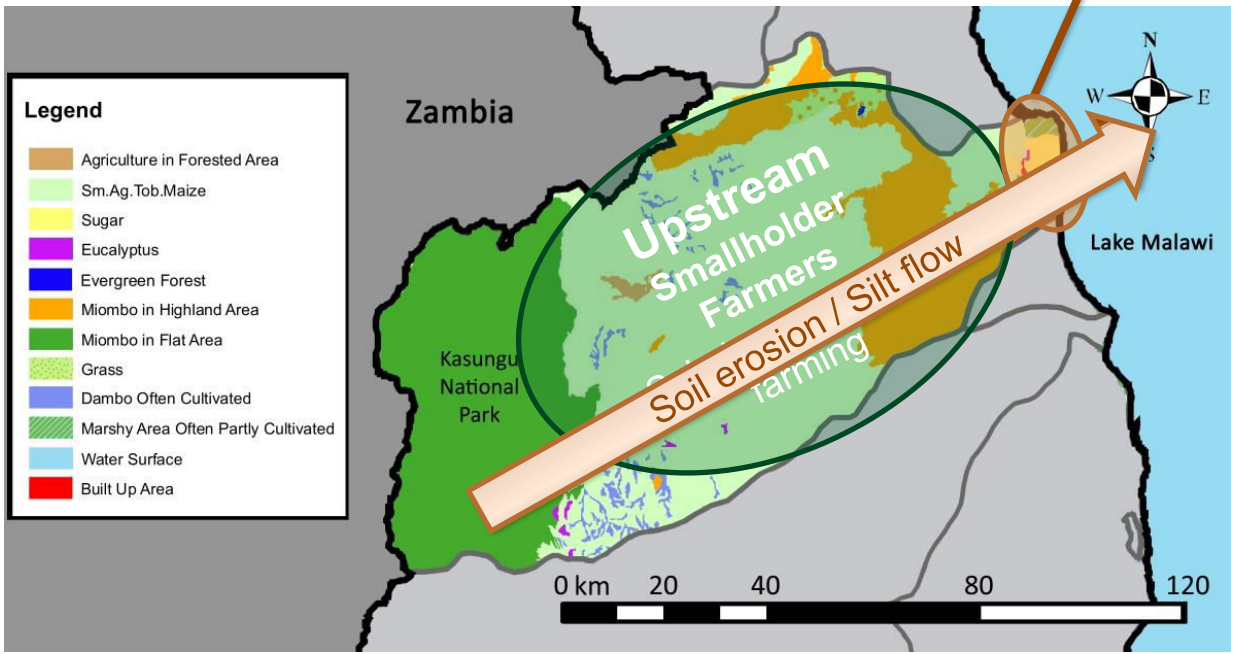
- PWS schemes in developing countries have a hard time securing long-term funding or being **self-sustaining** (Landell-Mills and Porras, 2002).

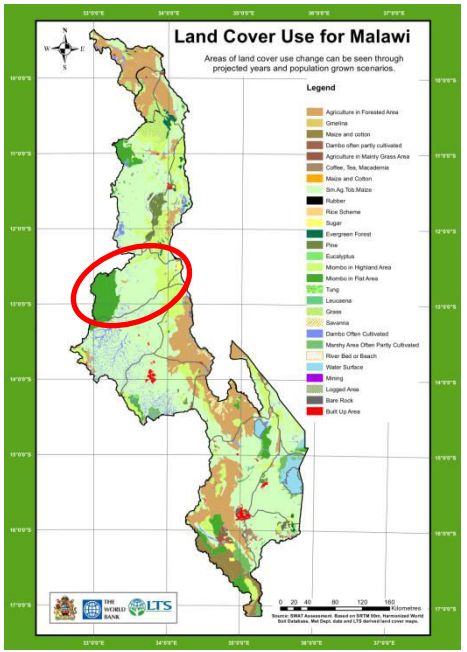
- The heavy **reliance on government and donor funds** means that schemes are vulnerable to cuts caused by changing mandates and policies, as well as donor-withdrawal (Porras et al., 2008).

- Green Water Credits schemes have, however, the potential to be self-sustaining, as estimates not only predict a positive NPV at 10% discount for farmers adoption of SLM for 20 years, but also predict a **positive net cash flow for smallholder farmers after 3 to 5 years of adopting** some of these practices (LTS International, 2013).

- **It is therefore probable that after an initial period of high investment, the project can be sustained on much lower payments.**

Case Study: the Dwangwa catchment





Land use in the Dwangwa catchment. Image adapted from LTS International's Interactive Malawi Land Use/Change Maps [available at: http://www.ltsi.co.uk/malawi-land-use/Main.html]. 'Sm.Ag.Tob.Maize' corresponds to smallholder agriculture of tobacco and maize.

Case Study: the Dwangwa catchment

- The **Payments for Watershed Services** scheme:

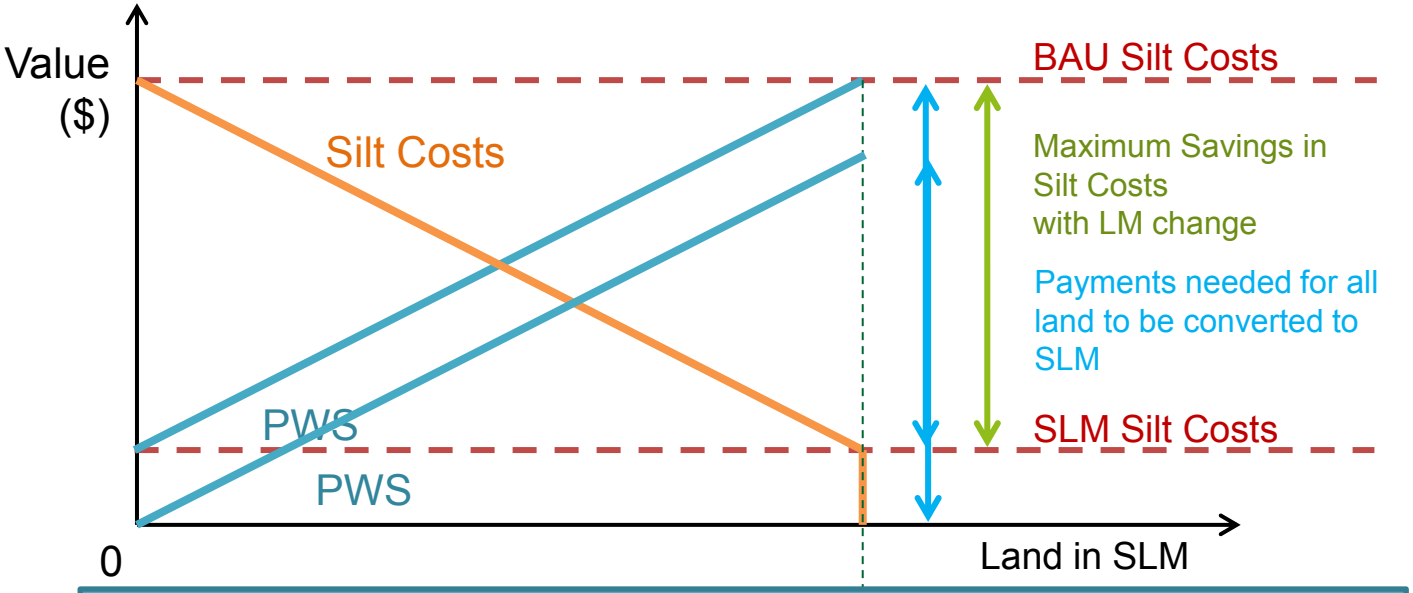
1) a payment (monetary or in-kind) will be made to the suppliers – the **Upstream Smallholder Farmers** – in order to address the costs of service provision, by way of a

2) voluntarily entered legally-binding contract that

3) specifies a well-defined watershed service provision measure – **Sustainable Land Management (SLM)** practices – by which payments will be

4) conditionally made by the service buyer – **the Downstream Sugarcane Estate**.

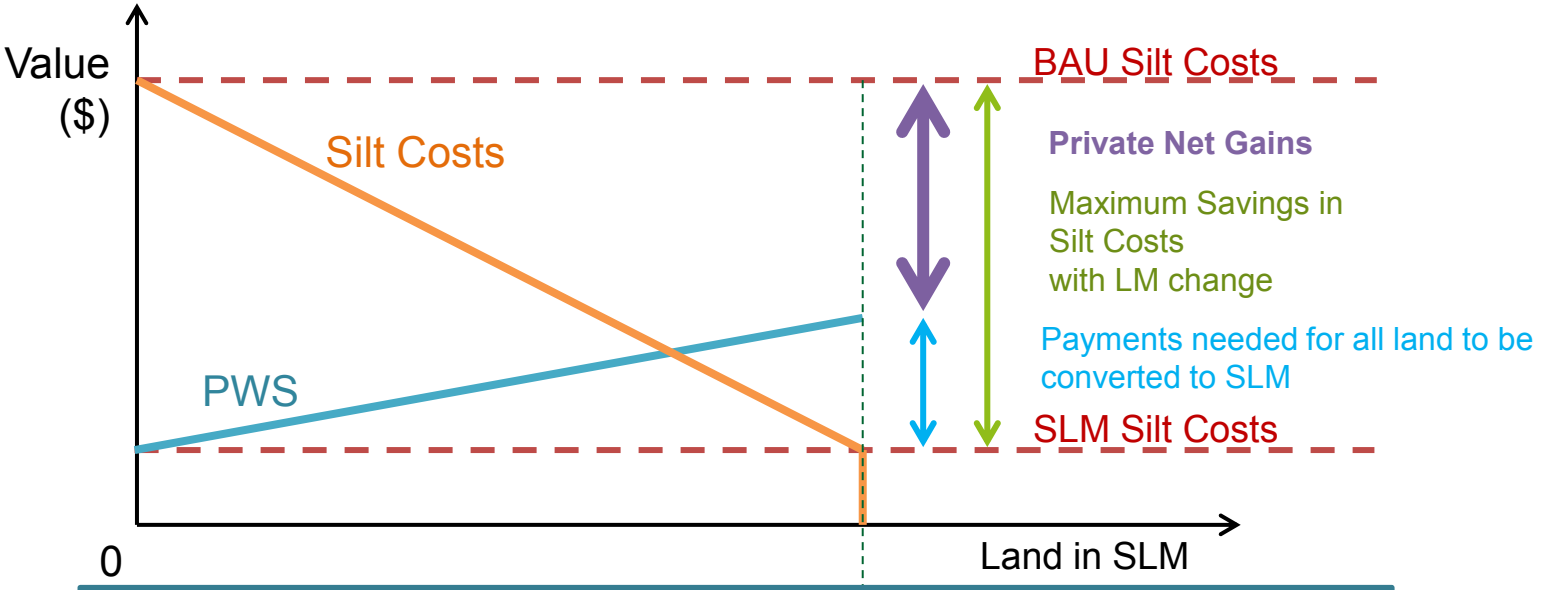
Case Study: Conceptual Framework



When
Maximum Savings in Silt Costs = Payments so 100% land is SLM

the Private Buyer is not worse off (Private Net Benefit = 0).

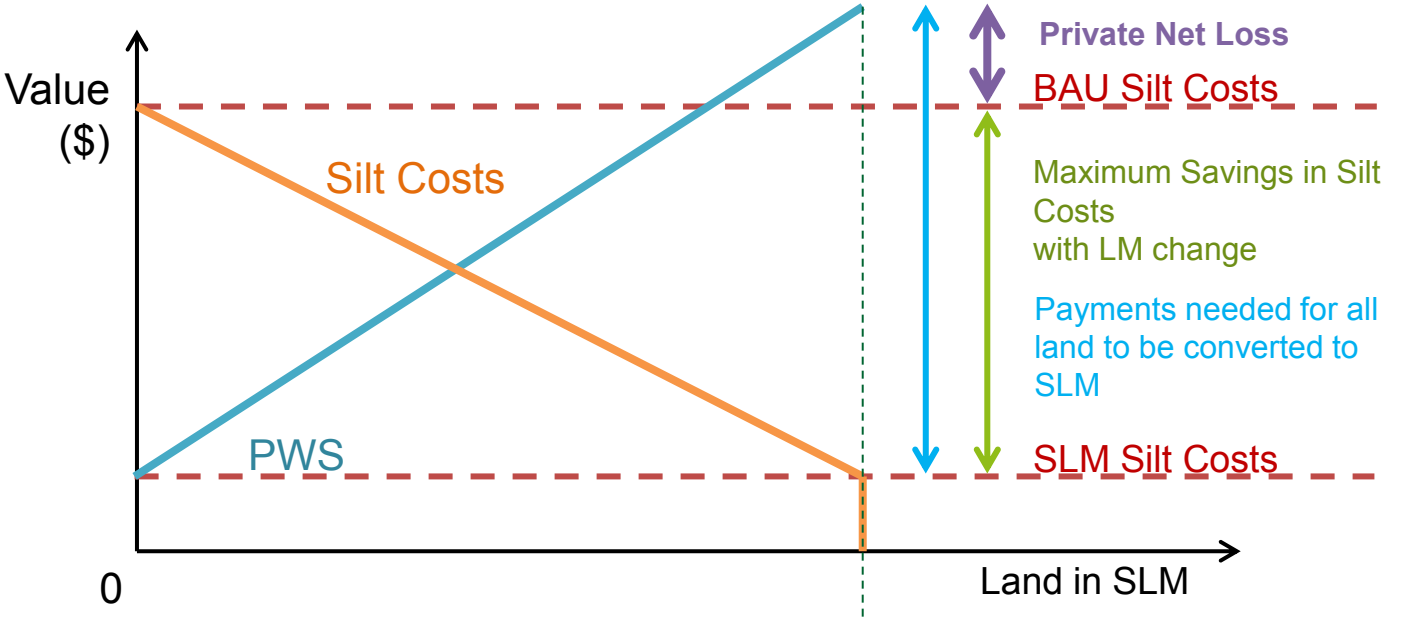
Case Study: Conceptual Framework



When
Maximum Savings in Silt Costs > Payments so 100% land is SLM

the Private Buyer is better off (Private Net Benefit > 0).

Case Study: Conceptual Framework



When

Maximum Savings in Silt Costs < Payments so 100% land is SLM

the Private Buyer is worse off (Private Net Benefit < 0).

Case Study:
Modelling of scheme uptake

Linear Programming model, aggregating smallholder farms at the catchment level

Payments for Watershed Services
- fixed payment
- % of costs
- % of costs (tiered)

- Household **food** requirements

Optimal solution:

how many hectares of land in SLM to maximise smalholders' profit?
- with different Payment le
- with different time-horizo

come, better-
ctices (20 ye

- Assume technology lock-down

- **Limited budget:**

3
5 Years (2011-2015)

Silt Costs to the Sugarcane Estate calculation for 20 Years, based on the no. of hectares in SLM
- Dry Climate
- Wet Climate

Modelling of scheme uptake: Methodology

- Dwangwa catchment characteristics:

Land	Total Land (ha)	% in each Slope	Protected Area	BLT, PAST, SUGC, WETN	Available Land for Farming	% in each Slope	Baseline 2010 Farmed Land	% in each Slope
with 0-2% Slope	155,567	21%	70,884	10,755	73,929	15%	66,501	17%
with 2-9% Slope	456,809	60%	135,480	24,212	297,117	59%	263,075	69%
with 9-15% Slope	67,648	9%	1,057	6,832	59,759	12%	31,665	8%
with 15-20% Slope	29,551	4%	264	2,277	27,010	5%	10,423	3%
with >20% Slope	47,645	6%	438	2,462	44,745	9%	12,233	3%
Total	**757,219**		**208,123**	**46,537**	**502,559**		**383,896**	
			27%	**6%**	**66%**		**51%**	

Household Type	Poor Households	Middle-income Households	Better-off Households	Total Populated Dwangwa
Number of Households in 2010	34,657	70,368	25,574	**130,779**
	27 %	**53%**	**20%**	
Land per household (ha)	**2.13**	**2.80**	**4.42**	
Land per household (ha)	**0.77**	**1.02**	**1.61**	
Total household land (ha)	26,844	71,852	41,182	**139,877**

Only **37%** of potential silt cost savings for the 2011 to 2030 period

Modelling of scheme uptake: Methodology

- More than 50 simulations altering the parameters:
  - Time-horizon
  - Level of payment
  - Budget (limited vs. unlimited)

- LP Results produced:
  - Farmers' profit at catchment level, land in ULM, uptake of PWS scheme (land in SLM, total amount paid), land in SLM outwit PWS-scheme
  - Calculation of corresponding **Silt Costs to Sugarcane Estate** for a Wetter and Drier Climate

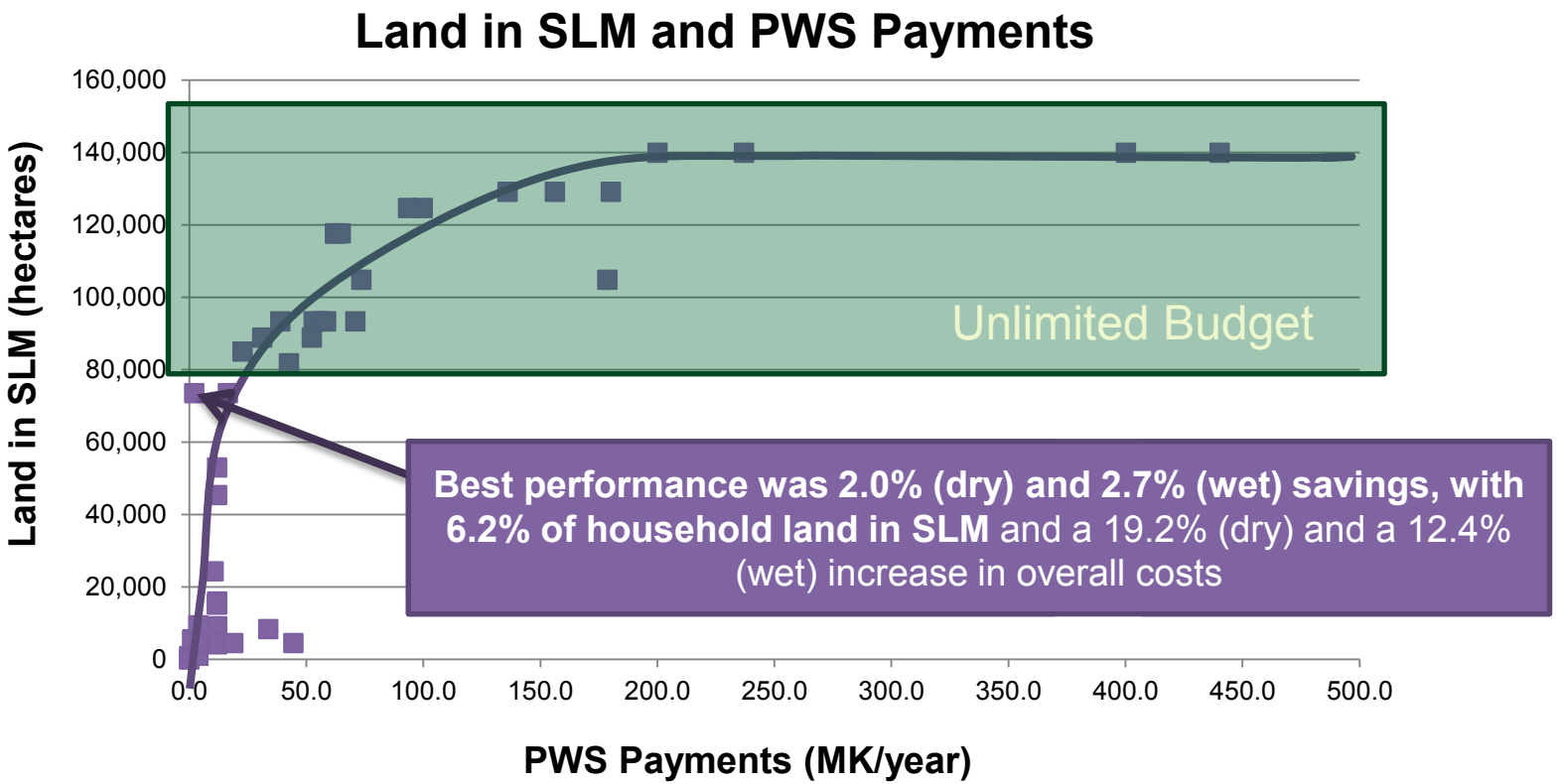
Modelling of scheme uptake:
Results

Potential Silt Savings for the 2011-2030 period [2012 prices]			Slope	Household Farmland 0-2%	2-9%	9-15%	15-20%	20%	Total
			Land (ha)	24,285	95,792	11,537	3,791	4,472	**139,877**
			(%)	17.4%	68.5%	8.2%	2.7%	3.2%	100%
DRY CLIMATE									
Δ Silt Costs	**mill $US**	**%**	**Maximum savings**	**0.4%**	**1.3%**	**2.6%**	**1.2%**	**1.1%**	**6.6%**
Maximum savings	0.49	**6.6%**	% of maximum savings	6.0%	20.2%	38.8%	18.6%	16.2%	100%
			savings per hectare ($US/ha)	1.23	1.04	16.65	24.31	17.91	
WET CLIMATE									
Δ Silt Costs	**mill $US**	**%**	**Maximum savings**	**0.5%**	**2.5%**	**4.4%**	**1.3%**	**0.6%**	**9.3%**
Maximum savings	0.98	**9.3%**	% of maximum HH savings	5.2%	26.7%	47.3%	14.2%	6.2%	100%
			savings per hectare ($US/ha)	2.09	2.75	40.30	36.95	13.57	

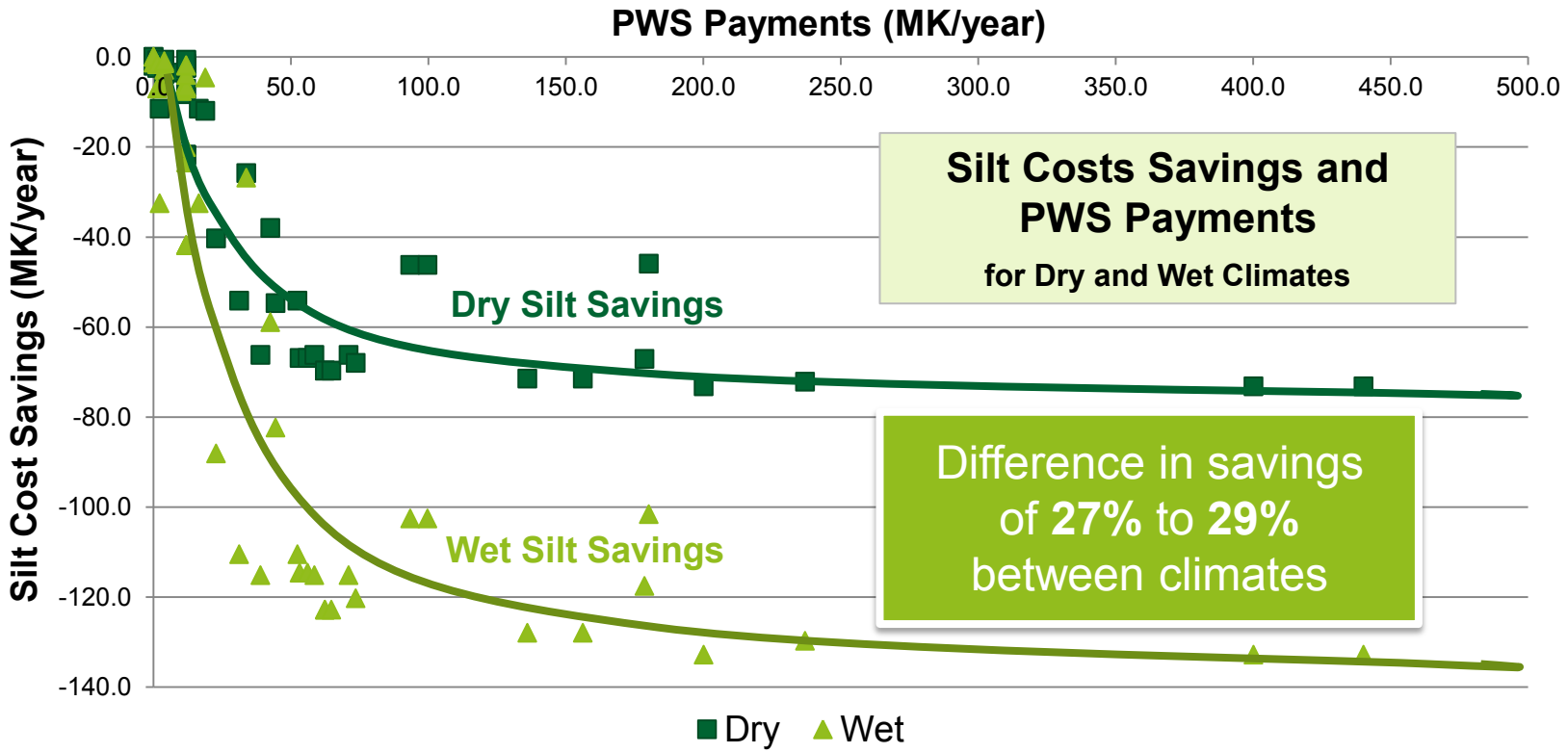
Modelling of scheme uptake:
Results

- **Time horizon:**
  - with a **5 Years** time-horizon, all farmers will switch to SLM by themselves
  - with a **1 Year and 3 Years** time-horizon, in the absence of payments, they will continue BAU
  - theoretically, **5 Year contracts**, if they allow farmers to think in a 5 years' time horizon, would lead farmers to switch to SLM, for any payment above zero (net benefits of SLM after that would induce them to self-sustain the management practices)

Modelling of scheme uptake:
Results



Modelling of scheme uptake:
Results



Modelling of scheme uptake:
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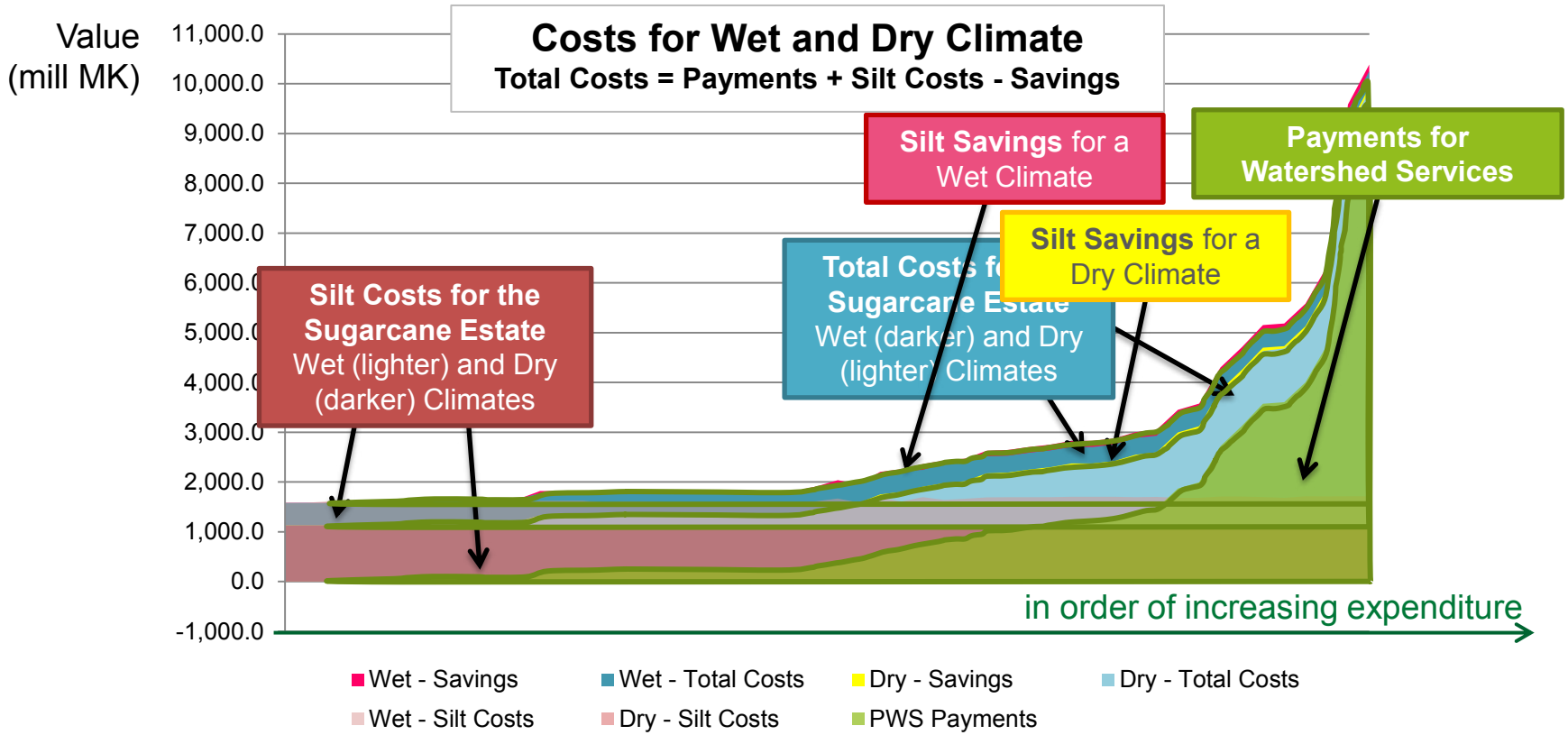
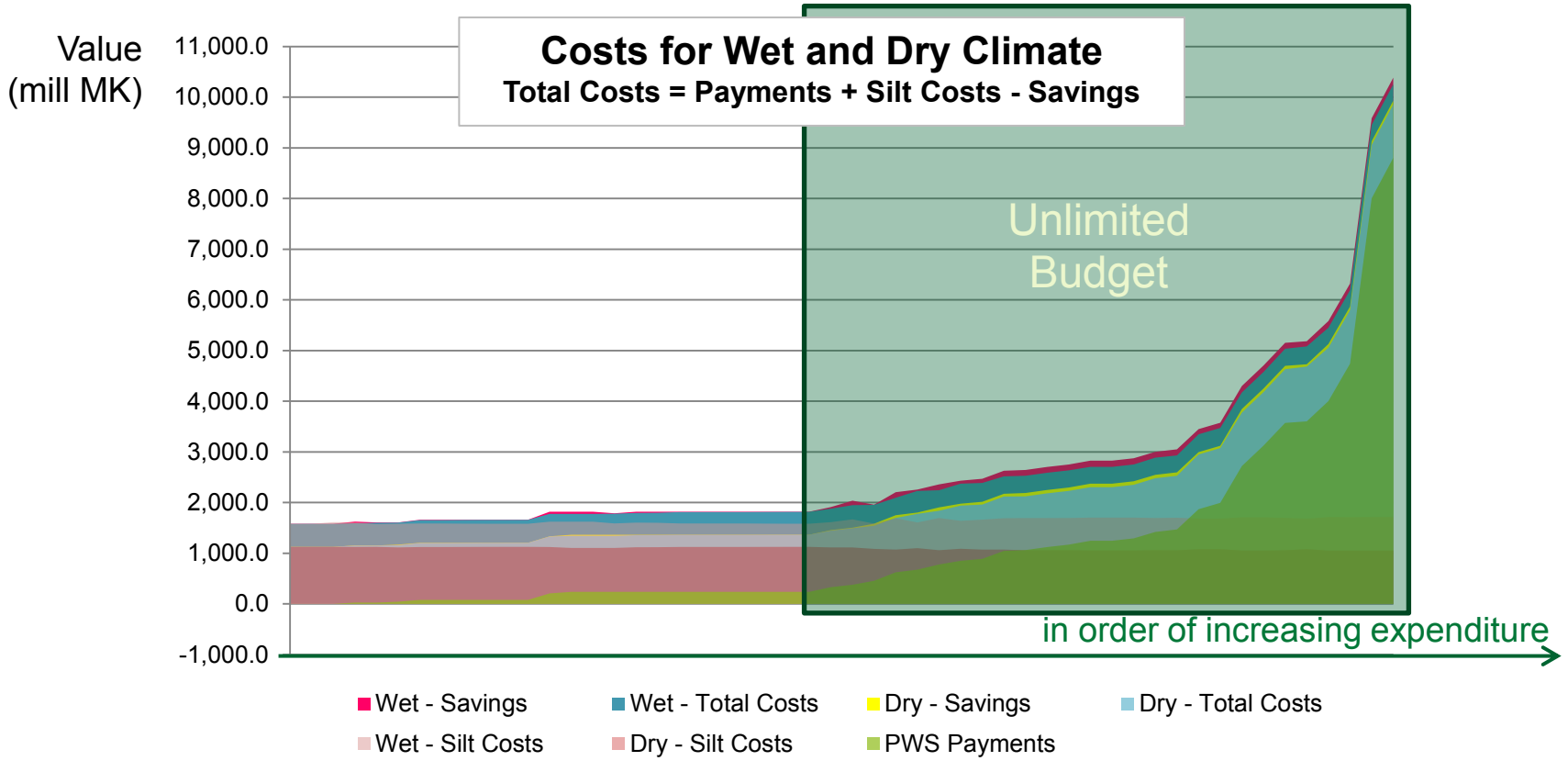
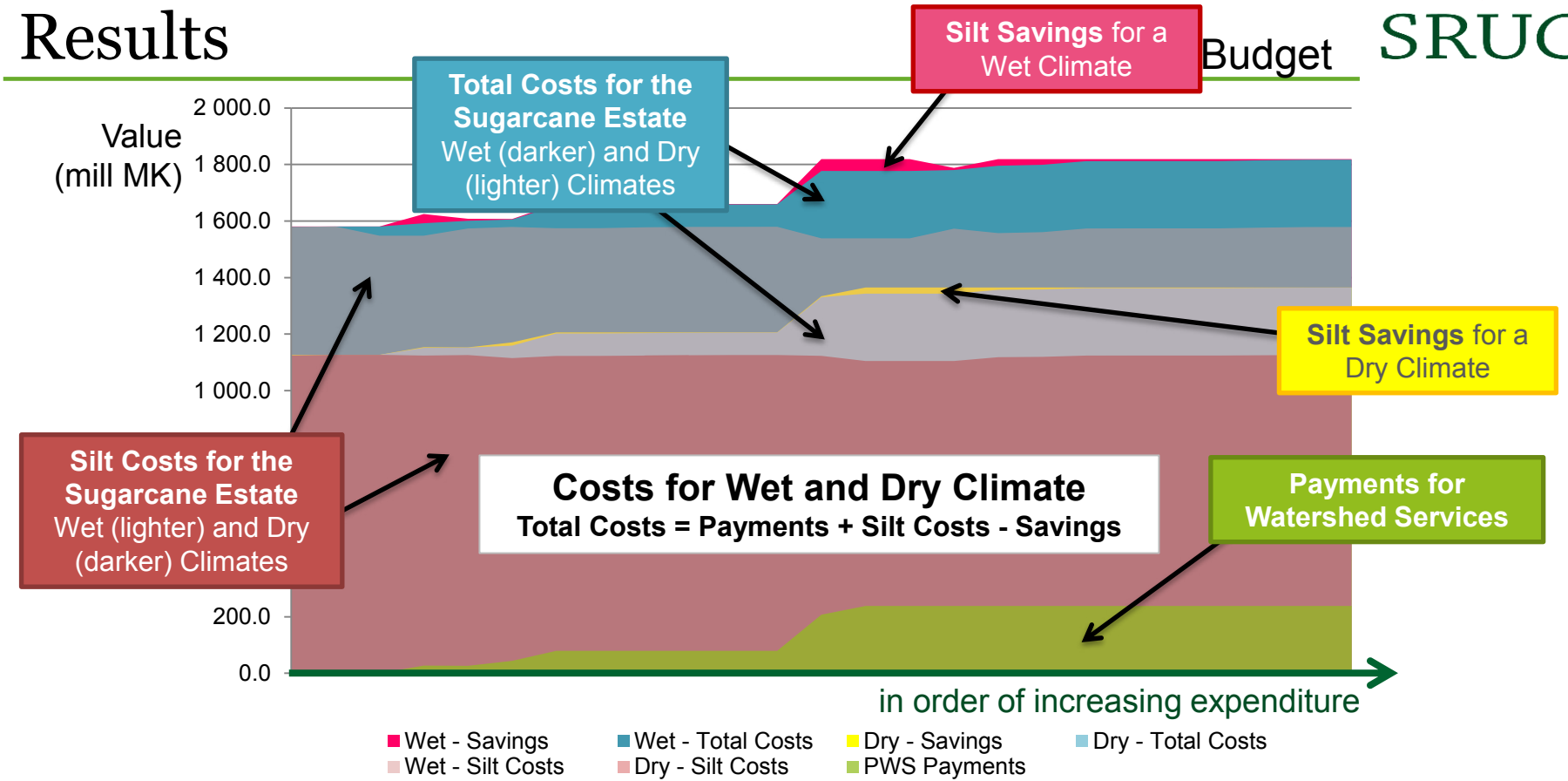


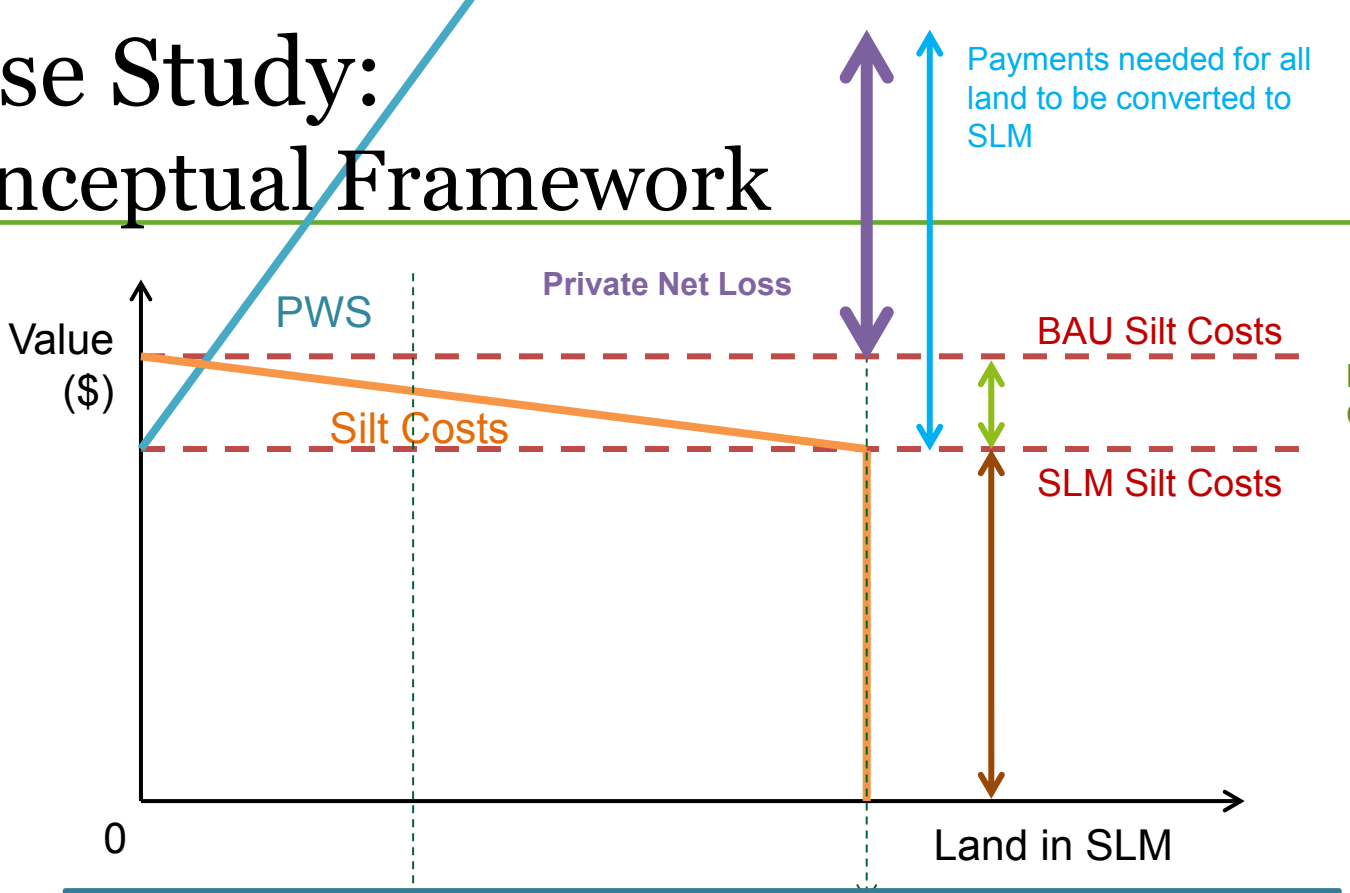
Modelling of scheme uptake:
Results



Modelling of scheme uptake:
Results



Case Study: Conceptual Framework



BAU Silt Costs + Payments - Silt Costs avoided =
Net Loss for the Sucarcane Estate

Conclusions

- This study highlights the need for PWS proposals to assess **price-efficiency issues** on the buyer side.
- A prospective buyer may stand to benefit from a PWS scheme, but these benefits may not be higher than the **costs of investing in PWS** (so dealing with the service deterioration in BAU may be the cheaper option). There is also **uncertainty** related to climate change.
- In this case, as there are sizeable social and economic benefits to be accrued from the shift to SLM, through improved livelihoods and increased food security that may well **justify government involvement**.
- **Encouraging the private sector to participate in such PWS schemes may well depend on it not shouldering the full cost of PWS implementation**; in which case, foreign donors and NGO's will most likely be necessary allies in supplementing the government's funds, in order to make a potential PWS scheme in Dwangwa feasible.

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