Generating guidance on public preferences for wind turbine farms in the Eastern Cape

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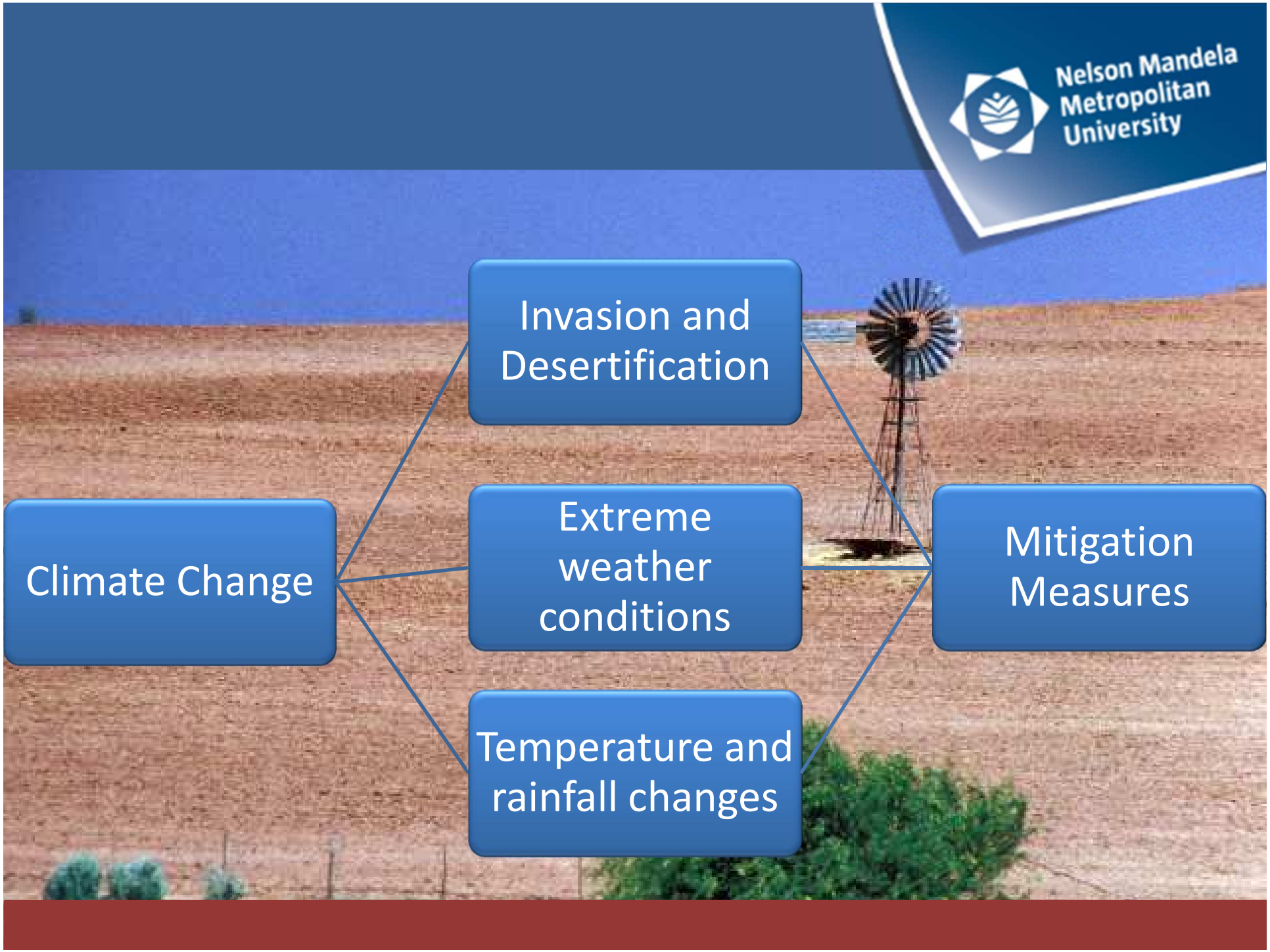
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Invasion and Desertification
Climate Change
Extreme weather conditions
Mitigation Measures
Temperature and rainfall changes

Mitigation options for South Africa

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Biomass

Solar

Hydropower

Wind

Wind Energy
Social costs and benefits

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Aesthetics and Naturalness of area

Bird and Bat mortality

Employment Creation

Interrupt flight paths

Noise

Increase development

How do we quantify trade-offs between costs and benefits?

Choice Experiments

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Definition

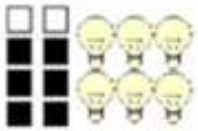
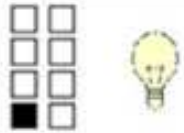
- Choice modelling or Choice analysis or Conjoint analysis
- Predominantly used by businesses and governments
- Survey technique
- Stated preference

Structure

Each respondent is presented with a survey containing:

- One or more *choice sets*
- Each choice set contains one or more *choice cards* or alternatives
- Each choice card is made up of various attributes

Choice Example:

1 . 17 . 25	Option A	Option B	Option C
Increase in Electricity Subsidy			
	75% increase in electricity subsidy	*12.5% increase in electricity subsidy*	
Size of wind farm			*I don't want Option A or Option B* *(I don't want wind turbines built in Kouga)*
	10 Wind Turbines	*53 Wind Turbines*	
Number of jobs created			
	5 long term jobs created	*20 long term jobs created*	
Distance away from residential areas			
	2000m away	*500m away*	
Selection: *(please one block)*	X	B	C

Choice Experiments:

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- Each individual will derive an amount of utility for each option in the finite set of alternatives
- Utility can be decomposed into 2 parts – an observed and unobserved part
- We assume that the unobserved component of utility is iid Type I extreme value Gumbel distribution

Utility

$$U_{option1} = V_{option1} + \epsilon_{option1}$$
$$U_{option2} = V_{option2} + \epsilon_{option2}$$

Gumbel Distribution

The density function
$f(\epsilon) = e^{-\epsilon} e^{-e^{-\epsilon}}$
And cumulative distribution function $F(\epsilon) = e^{-e^{-\epsilon}}$

- The probability of the individual selecting alternative *i* is equal to the probability that the utility of alternative *i* is greater than or equal to the utility of alternative *j* after comparing all alternatives in the choice set.

$$Prob_{\alpha i} = Prob\left(U_{\alpha i} > U_{\alpha j}\right) \forall\, j \in j = 1, \ldots, J; i \neq j$$

- The same as: $Prob_{\alpha i} = Prob[(V_{\alpha i} + \varepsilon_{\alpha i}) \geq (V_{\alpha j} + \varepsilon_{\alpha j})] \forall\, j \in j = 1, \ldots, J; i \neq j$

- Rewritten as: $Prob_{\alpha i} = Prob[(\varepsilon_{\alpha i} - \varepsilon_{\alpha j}) \leq (V_{\alpha i} - V_{\alpha j})] \forall\, j \in j = 1, \ldots, J; i \neq j$

- Assuming that the errors are IID with a Gumbel distribution. This would allow for the analyst to use the multinomial logit (MNL) model to determine the probability of choosing alternative *i* over alternative *j:*

$$\boldsymbol{P_{ij} = \frac{e^{\mu V_{\alpha i}}}{\sum_j e^{\mu V_{\alpha j}}}}$$

Focus of project:

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- 2 different socio-economic groups
- Environmental and social effects
- Policy

Results:

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Model	Descriptor	Coefficient	Implicit price	Std. error	p-value
Affluent	Size	-0.002	3.85	0.003	0.419
	Cluster1	7.539***		0.654	0.000
	Cluster2	7.862***		0.671	0.000
	Cluster3	7.898***		0.664	0.000
	Distance	0.251***	-450.74	0.022	0.000
	Subsidy	0.001**		0.001	0.032
	ASCa	0.086			0.241
	ASCb	0.075			0.346
	Log-likelihood	-829.181			
	No. of observations	976			
	Pseudo R^2	0.35			
Underprivileged	Size	0.003	-0.11	0.003	0.188
	Jobs	0.040***	-1.31	0.003	0.000
	Distance	-0.072**	2.36	0.021	0.002
	Subsidy	0.031***		0.007	0.000
	ASCa	9.012***		2.394	0.001
	ASCb	9.124***		2.398	0.001
	Log-likelihood	-863.777			
	No. of observations	1080			
	Pseudo R^2	0.38			

Results:

		Affluent	Underprivileged
Size	10 turbines to 20 turbines	R 38.50	-R 1.08
	20 turbines to 53 turbines	R 127.05	-R 3.56
Jobs	10 to 20 jobs	-	-R 13.09
	20 to 40 jobs	-	-R 26.19
Distance	0.5 km to 2 km away	-R 676.10	-R 3.55
	2km to 6 km away	-R 1 802.94	-R 9.46

1. A large wind farm, 0.5km away and wide apart (40 jobs created)

2. Small wind farm, 6km away and close together (10 jobs created)

3. A large wind farm, 2 km away and close together (10 jobs created)

	Scenario 1	Scenario 2	Scenario 3
Affluent	-R 1 096.50	-R 2 204.00	-R 1 114.00
Underprivileged	-R 91.97	-R 19.96	-R 88.51

Conclusions:

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- Differences between socio-economic groups
- Aesthetics important to affluent group
- Jobs and benefits important to the underprivileged group
- Poverty and large industry
- Policy options (distance, jobs)


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Thanks for listening!

Why CE's:

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- Marginal values of attributes – part worth's
- Marginal rates of substitution between attributes
- Low cognitive complexity
- Many possibilities for modelling decision making