Carbon Sequestration-
Policy Design and the Food Carbon Trade off

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Background

- Agricultural Landscapes- potential for mitigating Climate Change

- Reforestation – potentially cost effective sink
- Incentives – to promote revegetation

TRADE OFFS

- Land – fixed input creates competition for production and output tradeoffs

- Influencing factors
  - Spatial variation
  - Policy
  - Landholder motivation

- Interaction between these elements determines land use, production and efficiency outcomes

RESEARCH QUESTIONS

- Investigate the impact of payments for carbon sequestration upon land use choices
  - Native revegetation
  - Dryland agriculture
- Examine the efficiency of market mechanisms in allocating land for agriculture and carbon sequestration
  - Use central planner allocation as baseline
- Compare alternative carbon payment policies
  - Per tonne (expected to be efficient)
  - Per hectare (expected to introduce inefficiency)

RELATED LITERATURE

- Land Use Land Use Change and Forestry (LULUCF) models (Parks and Hardie 1995, McCarl and Schneider 2001, De Cara et al. 2005)
- Spatial Targeting- Trade offs in land use choices (Higgins et al. 2008, Polasky et al. 2008, Nelson et al. 2009)
- Alternative payment systems- uniform or discrete (Babcock et al. 1997 , Antle et al. 2003)

DATA

- Lower Murray Landscape futures report (2006)
- Spatially differentiated estimates of:
  - carbon sequestration (3PG)
  - agricultural profits
  - Agricultural production (census data)

MODEL

- landholders choose between traditional agriculture and carbon farming

Max: s (NPVc) + q (NPVag)

Subject to: s+q ≤ one

- ***NPVc*** – discounted net present value from carbon sequestration
- ***NPVag*** – discounted net present value from agricultural production
- ***s*** and ***q*** are indicator variables

$$NPVag = \sum_{t=1}^{64} \frac{agPFE}{(1+r)^t}$$

$$NPVc = \sum_{t=1}^{64} \frac{\langle cs_t \rangle * p - c_t}{(1+r)^t}$$

- ***agPFE*** **-** Profit at Full equity from agriculture
- ***r*** **-** land holder discount rate (7%)
- ***t*** **–** time period in years

- cs_t **–** carbon sequestered in period t
- ***p-*** price per CO2e
- c_t**-** costs for carbon sequestration in period t

- Where the payment is per tonne, then carbon sequestered is distinct for each hectare
- Where the payment is per hectare, carbon sequestered is identical for all hectares
- agPFE remains the same under both payment systems

RESULTS- LAND USE CHANGE

$10/t CO^2_e | $15/t CO^2_e | $20/t CO^2_e | $25/t CO^2_e | $30/t CO^2_e

Kilometers

0 100 200 400

Land Use

- Agriculture
- Carbon sequestration

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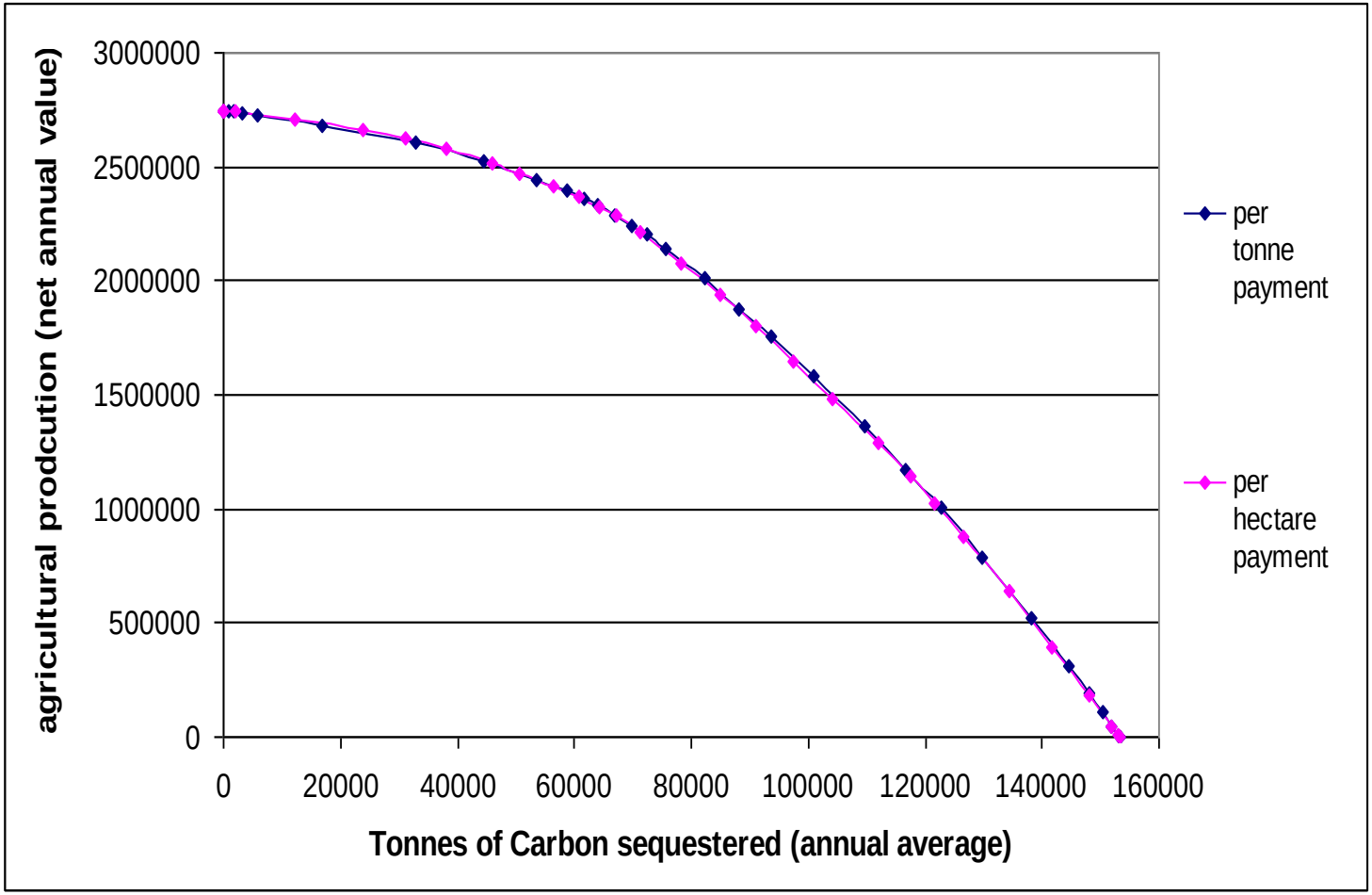
RESULTS- EFFICIENT PRODUCTION



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DISCUSSION

- Empirical evidence (Plantinga et al. 2006, 2008)
- Uncertainty
  - -sequestration rate
  - - price levels
- Sensitivity
  - - set up costs
  - - discount rates

DISCUSSION

- Efficiency of production
  - per tonne payments – expect efficiency
  - per hectare payments- potentially introduces inefficiency

None found..... ……WHY?

Similar to Babcock et al. 1999

- Agricultural profits- highly variable
- Carbon sequestration – much less variable
- Landholder decision dominated by agricultural profits
- uniform payment – small change in information

- Does the data capture the variation in carbon sequestration adequately??

CONCLUSIONS

- Payment for carbon sequestration may significantly change land use decisions in the Lower Murray
- Landholders make efficient decisions
- Uniform payment system does not create inefficiencies – potential for further investigation

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Thank you

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