bushfire&natural HAZARDSCRC

# INCLUDING INTANGIBLE VALUES IN NATURAL HAZARD DECISION MAKING

## The Economics of Natural Hazards

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Business Cooperative Research Centres Programme

THE UNIVERSITY OF WESTERN AUSTRALIA

# ECONOMICS OF NATURAL HAZARDS

1) Objective of mitigation: protect the values affected by natural hazards

2) How do we determine which management options offer the best value for money?

   a) Limited budgets

   b) Prioritise investments between different locations and different hazards

# PRIORITISING NATURAL HAZARD MITIGATION

1) Need better information about the environmental and social values affected

2) Need to weigh up all of the economic, environmental and social costs in an integrated economic assessment

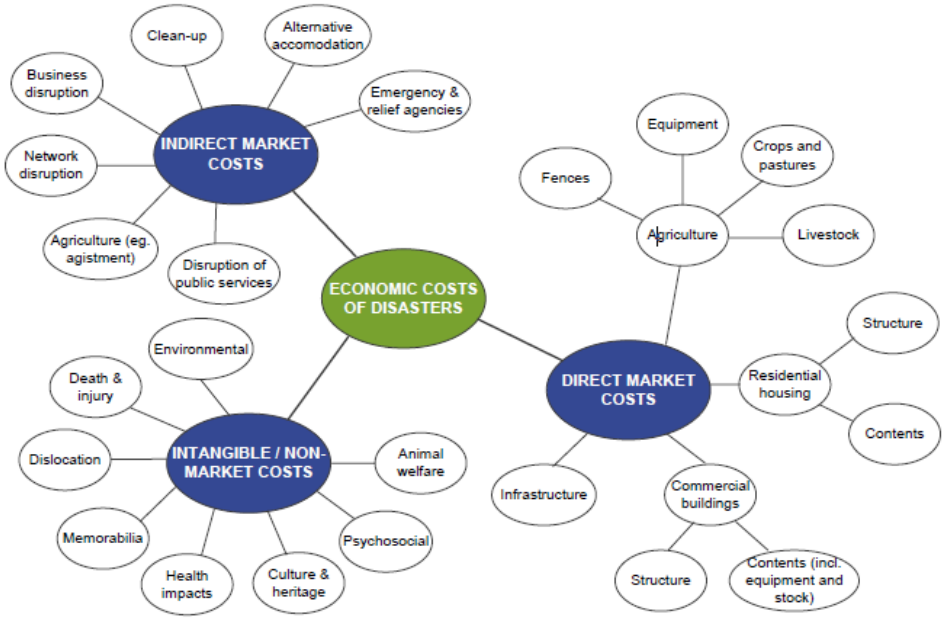
→ Benefit-cost analyses

# BENEFITS AND COSTS OF MITIGATION

1) Tangible, market costs and benefits
   - Well documented

2) Intangible, non-market costs and benefits
   - Less so

Figure 2.2 **The economic costs of natural disasters**

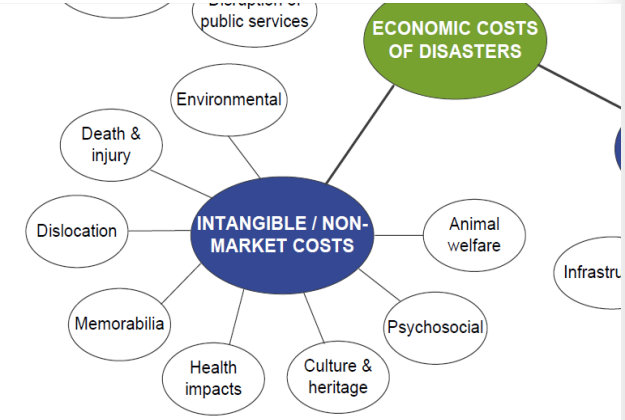



*Source*: Adapted from BTE (2001).

# HOW DO WE MEASURE THE INTANGIBLE?

1) Quantified in financial equivalent terms

2) Non-market valuation:




*Source*: Adapted from BTE (2001).

A set of economic methodologies able to estimate monetary figures for non-market costs and benefits

Data collected by analysing related markets, or through surveys

Identifies "willingness to pay" for a change in provision of a public good or service

→ $ values can be used in benefit-cost analyses

# ORIGINAL STUDIES ARE IDEAL, BUT…

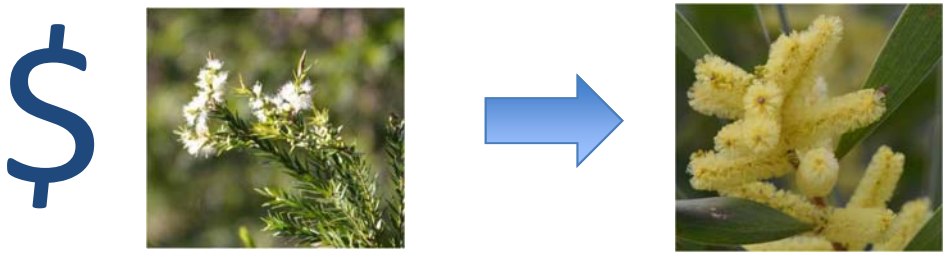
1) Natural hazards can impact a large area

2) Multiple non-market values are affected

3) To measure them all with non-market valuation
   a) requires extensive research;
   b) original studies are expensive and time consuming…

# AN ALTERNATIVE: BENEFIT TRANSFER

1) Benefit transfer uses $ values estimated from original studies and applies them to similar policy contexts



2) Can be complicated:

a) Decision contexts are rarely the same

b) There are not many original studies measuring willingness to pay for values affected by natural hazards

c) Leads to uncertainty in the transferred values

3) Uncertain information is better than no information

# VALUE TOOL FOR NATURAL HAZARDS

A database of existing non-market values that can be used for benefit transfer

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STUDY IDENTIFICATION AND RELEVANCE | | | | | | | | | WILLINGNESS TO PAY | | | |
| | Observation ID (identification number for unique WTP | Citation | Hazard type applicable | Value type applicable | Brief summary of study objective(s) | Study conducted in the context of a natural hazard? | Study quality; (1=poor, 2=average, 3=good) | Benefits transfer applicability; (1=adversely, 2=moderately, | Recommendations (Applicability for benefit transfer in natural hazard context) | Definition of marginal change (This is what is being measured - e.g. WTP to avoid being located in hazard risk zone) | Hazard type identified | Specific value type measured | WTP estimate |
| 1 | 1 | Ambrey and Fleming 2011 | Fire, Flood, Storm, Earthquake, Tsunami | Amenity | Examination of scenic amenity on life satisfaction in SE Queensland | No | 1 | 2 | Useful for BT in Australia; be aware of generalised context - not NH specific | WTP for one-unit improvement in scenic amenity on a 10-point scale by household | Not specified | Scenic amenity | $14,251.46 per household per year |
| 2 | 2 | Ambrey and Fleming 2011 | Fire, Flood, Storm, Earthquake, Tsunami | Amenity | Examination of scenic amenity on life satisfaction in SE Queensland | No | 1 | 2 | Useful for BT in Australia; be aware of generalised context - not NH specific | WTP for one-unit improvement in scenic amenity on a 10-point scale by household | Not specified | Scenic amenity | $5,700 per person per year |
| 3 | 3 | Bin, et al. 2008 | Flood, Storm | Amenity | Measurement of the value of scenic amenity and flood risk on property value | Yes | 2 | 2 | Useful for NH BT, especially flood context; be aware of/adjust for population differences | WTP to increase view by one degree | Flood, Storm | Scenic amenity | $335.31 per property purchase |
| 4 | 4 | Bin, et al. 2008 | Flood | Safety | Measurement of the value of scenic amenity and flood risk on property value | Yes | 2 | 2 | Useful for NH BT, especially flood context; be aware of/adjust for population differences | WTP to avoid location in Special Flood Hazard Area | Flood | Flood risk | -$36,081.73 per property purchase |
| 5 | 5 | Bin, et al. 2008 | Flood, Storm | Amenity | Measurement of the value of scenic amenity and flood risk on property value | Yes | 2 | 2 | Useful for NH BT, especially flood context; be aware of/adjust for population differences | WTP to increase view by one degree | Flood, Storm | Scenic amenity | $651.16 per property purchase |
| 6 | 6 | Bin, et al. 2008 | Flood | Safety | Measurement of the value of scenic amenity and flood risk on property value | Yes | 2 | 2 | Useful for NH BT, especially flood context; be aware of/adjust for population differences | WTP to avoid location in Special Flood Hazard Area | Flood | Flood risk | -$37,454.89 per property purchase |
| 7 | 7 | Hesseln 2004 | Fire | Recreation | Examination of fire's impacts on the aesthetic values with regard to user demand and value for recreation | Yes | 3 | 2 | Useful for NH BT, especially fire context; be aware of/adjust for population differences | Consumer surplus per day for hiking demand associated with the impacts of fire recovery | Fire | Recreation value | $37 per trip |

Value types | Health values | Environmental values | **Social values** | Notes

# NON-MARKET VALUES AFFECTED BY NATURAL HAZARDS

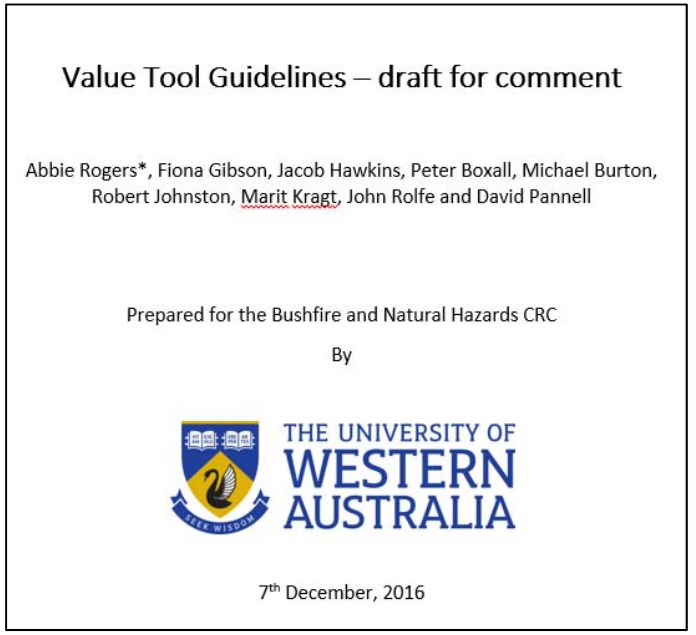
| Health values | Environmental values | Social values |
| --- | --- | --- |
| • Physical health<br>• Mental health | • Ecosystems<br>• Water quality | • Recreation<br>• Amenity<br>• Safety<br>• Cultural heritage<br>• Social disruption<br>• Memorabilia<br>• Animal welfare |

# USING THE VALUE TOOL DATABASE

1) Define the policy context
   a) hazard/mitigation action, values affected, who is affected

2) Define the bounds of the benefit transfer – Guidelines
   a) Critical to understand the breadth of the existing non-market value literature on the relevant value types

3) Consult the database


Value Tool Guidelines – draft for comment

Abbie Rogers*, Fiona Gibson, Jacob Hawkins, Peter Boxall, Michael Burton, Robert Johnston, Marit Kragt, John Rolfe and David Pannell

Prepared for the Bushfire and Natural Hazards CRC

By

THE UNIVERSITY OF WESTERN AUSTRALIA

7th December, 2016

# CASE STUDY: BROWNHILL AND KESWICK CREEKS CATCHMENT

1) High flood risk catchment in Adelaide

2) Mitigation options include creek capacity upgrades, bypasses and detention dams

3) Our other project – benefit cost analysis of the different mitigation options, including non-market values

Chalak et al. (2017) Economic analysis of flood mitigation options for the Brown Hill and Keswick creeks catchment, Adelaide. Report prepared for the BNHCRC.

# DEFINE THE POLICY CONTEXT

1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?

# NON-MARKET VALUES AFFECTED IN THE CATCHMENT

| | |
|---|---|
| Health values | • Physical health: mortality<br>• Mental health: stress, anxiety |
| Environmental values | • negligible |
| Social values | • Amenity: amenity related park recreation<br>• Cultural heritage: Stone Pine trees<br>• Social disruption:<br>  • Electricity outage<br>  • Road traffic annoyance<br>  • Road traffic delays<br>  • Inability to return home |

# DEFINE THE POLICY CONTEXT CONT'

1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?
   - We'll focus on social disruption – electricity outage

3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage

# DEFINE THE POLICY CONTEXT CONT'

1) What is the natural hazard type?
   - Flooding
2) Which non-market values are affected by the hazard type or its mitigation?
   - Social disruption – electricity outage
3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage

4) What is the scale of the proposed change?
   - 100yr ARI flood = 1,172 households affected
   - Full mitigation works = 6 households affected

# DEFINE THE POLICY CONTEXT CONT'

1) What is the natural hazard type?
   - Flooding
2) Which non-market values are affected by the hazard type or its mitigation?
   - Social disruption – electricity outage
3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage
4) What is the scale of the proposed change?
   - 100yr flood = 1172 households with 12hr outage
   - Full mitigation works = 6 households with 12hr outage

5) What are the socio-economic characteristics of the affected population?
   - Greater Adelaide area population

# CONSULT THE GUIDELINES

1) Social disruption:

"There are very few cases where non-market valuation studies have estimated the value of avoiding social disruption. These are either not in the context of natural hazards, or are not Australian studies."

2) Benefit transfer:

Recommend an 'adjusted unit value transfer'


Value Tool Guidelines – draft for comment

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# CONSULT THE DATABASE

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | STUDY IDENTIFICATION AND RELEVANCE | | | | |
| 3 | Observation ID (Identification number for ry unique WTP observation) | Citation | Hazard types applicable | Value type applicabl | Brief summary of study objective(s) |
| 33 | 30 | Hensher, et al. 2014 | Fire, Flood, Storm, Earthquake, Tsunami | Social disruption | WTP r the disruption of electrical service in Canb rra, Australia |
| 34 | 31 | Landry, et al. 2007 | Flood, Storm | Social disruption | Measur ment of the WTP for a sample of relativ ly poor households to return home afte Hurricane Katrina |
| | 32 | Cicia and Colantuoni 2010 | Fire, Flood, Storm, Earthquake, | Animal welfare | Meta the WTP for animal welfare n livestock productio |

Value types | Health values | Environmental valu s | Social values | No es

(2) Select studies matching your hazard & value type

(1) Select the relevant value category

# CONSULT THE DATABASE

| | A | B | J | K | L | AB | AC |
|---|---|---|---|---|---|---|---|
| 1 | STUDY IDENTIFICATION AND RELEVANCE | | WILLINGNESS TO PAY | | | SAMPLE CHARACTERISTICS | |
| 3 | Observation ID *(Identification number for ry unique WTP observation)* | Citation | Definition of marginal change *(This is what is being measured - e.g. WTP to avoid [illegible] in a hazard risk zone)* | Hazard types identified | Specific value type measured | Country/region studied | Country of sou[illegible] studie |
| 33 | 30 | Hensher, et al. 2014 | WTP for a residential customer to avoid an 12-hour electricity outage per event | [illegible]t specified | Social disruption | Canberra, Australian Capital Territory | Australia |
| 34 | 31 | Landry, et al. 2007 | WTP to return home following evacuation due to Hurrican Katrina | Flood, Storm | Social disruption | Houston, Texas | USA |
| | 32 | Cicia and Colantuoni 2010 | WTP for a label that | [illegible] specified | Animal welfare | Norway, Spain, US | Locations studied in |

(3) Refine study selection:

- How well does the marginal change correspond to your policy context?
- How well do the sample characteristics match?

# CONSULT THE DATABASE

| A | B | J | K | L | M | P |
|---|---|---|---|---|---|---|
| STUDY IDENTIFICATION AND RELEVANCE | | WILLINGNESS TO PAY | | | | |
| **Observation ID** *(Identification number for my unique WTP observation)* | **Citation** | **Definition of marginal change** *(This is what is being measured - e.g. WTP to avoid being located in a hazard risk zone)* | **Hazard types identified** | **Specific value type measured** | **WTP estimate** | **WTP estimate** *(2016 $AU)* |
| 30 | Hensher, et al. 2014 | WTP for a residential customer to avoid an 12-hour electricity outage per event | Not specified | Social disruption | $65.57 per customer | $90.57 |

(4) Find the willingness to pay estimate in 2016 AUS$

# CONDUCTING THE BENEFIT TRANSFER
## ADJUSTING THE UNIT VALUE TRANSFER

1) Willingness to pay to avoid 12hr electricity outage

   = $90.57 per household per event, for ACT residents

2) Our decision affects Greater Adelaide residents → income adjustment

   = $90.57 x 78.48%

   = $71.08 per household per event, for Greater Adelaide

# CONDUCTING THE BENEFIT TRANSFER
## AGGREGATION

1) Willingness to pay = $71.08/household

| Scenario | Households affected | Willingess to pay to avoid 12hr outage |
|---|---|---|
| Current scenario: 100yr ARI flood | 1172 | $83,304 |
| Full mitigation works | 6 | $427 |

**The non-market benefits of the mitigation works for avoiding a 12hr electricity outage are $82,877**

# A VALUE TOOL FOR NATURAL HAZARDS

1) Accessible database of $ estimates for non-market values

2) Guidelines on conducting simple benefit transfers

3) Easier to account for *all* costs and benefits that affect natural hazard decision making

# NEXT STEPS

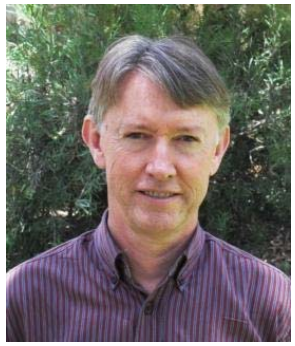
1) Finalising the database & guidelines

2) Online presence
   a) Website housing the Value Tool
   b) Explanatory videos on how to use it

3) Training workshops (e.g. ANHMC)

4) Updating and finding a custodian

# JOIN THE UWA TEAM AT OUR BREAKOUT SESSION TOMORROW: 11.15AM ROOM 1



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# TRADE-OFF: INCOMPLETE OR UNCERTAIN INFORMATION

1) Better to include information with uncertainty than to ignore it completely (Pannell & Gibson 2016):
   a) Investigated variables used in decision metrics for environmental project prioritisation
   b) Environmental outcomes were better with uncertain information compared to incomplete information

→ Values from benefit transfer are worth including in benefit-cost analyses

Pannell, D.J. and Gibson, F.L. 2016. Environmental cost of using poor decision metrics to prioritize environmental projects. *Conservation Biology*, 30(2): 382-391.

# CONSULT THE DATABASE

| A | B | E | F | G | H | I |
|---|---|---|---|---|---|---|
| STUDY IDENTIFICATION AND RELEVANCE | | | | | | |
| **Observation ID** *(Identification number for ry unique WTP observation)* | **Citation** | **Brief summary of study objective s)** | **Study conducted in the context of a natural hazard?** *s or No)* | **Study quality** *1=poor, 2=average, 3=high)* | **Benefits transfer applicability** *(1=rarely, 2=moderately, ighly)* | **Recommendations** *(Applicability for benefit transfer in natural hazard context)* |
| 30 | Hensher, et al. 2014 | WTP for the disruption of electrical ervice in Canberra, Australia | No | 3 | 2 | Useful for BT in Australia; be aware of generalised context - not NH specific |

(4) Check the recommendations made about the study