Approaches in National Climate Adaptation Policy Development

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What we build today will have a long term consequence;

Policy development needs understanding of the consequence under extreme uncertainties.
Contents

- Approaches for policy development
- Urban development models and scenarios
- National climate change and extreme climatic hazard mapping
- Development of climate response and adaptation policy stances
- Policy stances assessment
- Conclusions
Questions in Policy Development

1. **ANY ACTION?**
   - Analyse potential losses to justify policy actions required to mitigate the losses

2. **WHERE TO INVEST?**
   - Analyse vulnerability at both spatial and temporal scale to identify what the policy targets and where

3. **WHAT OPTIONS?**
   - Identify what policy options are available to reduce vulnerability at both spatial and temporal scale

4. **BEST OR BETTER OPTION(S)?**
   - Identify which policy option is the best or better considering overall lifecycle costs and benefits

5. **HOW TO IMPLEMENT?**
   - Identify policy implementation pathways in terms of feasibility, applicability and robustness including M&E
Climate Change

Hazard

Future Outlooks
(population growth, demography/land use change resource availability)

Vulnerability

Exposure

Risk Distribution
Economic
Social
Environmental
Loss

Cost:
Adaptation Cost + Loss
Benefit:
Avoided Loss

Multi-Scale Integration of Adaptation Options

Policies
Planning
Design

Interventions

National Priorities
(economy development poverty reduction, environment conservation)
Urban Growth Model for Future Scenario Projection

Correlation between infrastructure development and urban population growth

\[ R^2 = 0.8766 \]

\[ R^2 = 0.9178 \]
Scenarios of Urban Growth

• The business as usual case to allow population growing until population density reaches specific thresholds, then ‘spill’ into neighbouring.

• Urban Consolidation (UC) to allow population growing in urban areas until population density reaches 1000 person/ha.

• Inland Regional Development (RD) to allow growing population migrating to the selected inland regional centres.
Population Distribution – current and future
Coastal Inundation at Multiple Scales and Severity

Year: 2006 to 2096 (at 10-year intervals) and 2100
ARI: 10, 20, 50, 100, 500, 1000, 2000
Scenario: A1B, A1FI, B1
Percentile: 5, 50, and 95

ARI: average Recurrence Interval
Response and Adaptation Policy Stance

Policy Stances:
- Reactive
- Proactive
- BAU

Responses:
- Accommodate
- Defend
- Retreat/Avoid

Scenarios:
- Climate
- Population
- Urbanisation

Cost & Benefit

Time and Space
Total Present Value of Cost for Australian Residential Housing Adapting to Sea Level Rise under Moderate Climate Change Outlook

Policy/Response Approaches

Betterment

Reactive

Proactive

- Adaptation Cost (Including Maintenance Cost)
- Damage Cost

$4b

Policy/Response Approaches
Total Present Value of Cost for Australian Residential Housing Adapting to Extreme Wind under Moderate Climate Change Outlook

<table>
<thead>
<tr>
<th>Policy/Response Approaches</th>
<th>Damage and adaptation costs (NPV, $2006 Billions)</th>
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<tbody>
<tr>
<td>Static</td>
<td>150</td>
</tr>
<tr>
<td>React</td>
<td>170</td>
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<tr>
<td>Anticipate</td>
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<td>Anticipate</td>
<td>270</td>
</tr>
<tr>
<td>Reference</td>
<td>300</td>
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</table>

- Apply to new assets only
- Apply to new and existing assets

- Adaptation cost
- Damage
Geographical Sensitivity in Implementing Adaptation Policies

14% of SLAs, with total net benefits of $77 billion (NPV)

79% of SLAs, with total net costs of $175 billion (NPV)
Benefit and Limit of Existing Planning for Residential Housing to Mitigate Bushfire

**Trend change**

- **Mean cost (BAU)**
- **Mean cost (RD)**
- **Mean cost (UC)**

Year:
- High
- Medium
- Low
- No climate change

Damage cost ($b)
Benefit to Implement All-Hazard Adaptation

![Bar Chart]

Current Policies

With Policy Interventions

Damage Costs (Billion $)

Avoided Damage
Conclusion

• Urban policy and planning requires a long-term view to consider the implication of climate change and establishment of effective adaptation, leading to long-term benefit.

• Development of climate adaptation policies should be based on risk management and decision-centric, while considering interactions among future urban outlooks in addition to climate leading to impacts on overall risks of cities.

• Implementation of national climate adaptation policy should be thoroughly designed, and its effectiveness could depend on existing policies, climate hazard types, geographical sensitivity.
Climate Adaptation and Sustainable Development

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Leading Research in Climate Adaptation and Sustainable Development
Appendix A: Case Studies in Coastal Climate Adaptation to Storm Surge Related to Sea Level Rise
Coastal Inundation in Southeast Queensland (SEQ)

Flood Risks

Current inundation map (1-in-500 years)

Current exposure curve

Impact of Coastal Inundation on Residential Buildings in South East Queensland, Australia

![Graph showing Mean Direct Loss over time from 2010 to 2060.](image)

Change in Design to accommodate flood

Integrating Design Changes with Decision-Making in Planning

Adaptation extent: determine the spatial areas where risk is high enough to take adaptation actions

Inundation

Coastline

Sea

Adaptation area

Land

The benefit of 2nd option exceeds the 1st option

Best immediate return option

Best long-term return option

Over-adaptation option

NPV (AUD$B)

Year

Over-adaptation

Best long-term return option

Best immediate return option

Appendix B: Case Studies in Coastal Climate Adaptation to Extreme Winds
Changes in Wind Pattern

- Future climate projections to 2100 are highly uncertain

- Cyclonic winds (North Queensland)
  - frequency may decrease by 50%
  - but intensity may increase by up to 20%
  - + poleward shift

- Non-cyclonic winds (SE Queensland)
  - -1% to +6% increase by 2070 for A1B (medium) emission scenario
  - -2% to +19% increase by 2070 for A1FI (high) emission scenario
Scenarios of Changes in Wind Pattern

• No change in wind patterns
• Moderate change (25% reduction in cyclone frequency, 10% increase in wind speeds)
• Significant change (no change in cyclone frequency, 20% increase in wind speeds)
• 4 degree southward shift in cyclones to Brisbane.
Outlooks of Changes in Population and Buildings

<table>
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<tr>
<th>Location</th>
<th>Foreshore</th>
<th>Non-Foreshore</th>
<th>Total</th>
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<tbody>
<tr>
<td>Cairns</td>
<td>5,000</td>
<td>43,000</td>
<td>48,000</td>
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<tr>
<td>Townsville</td>
<td>2,000</td>
<td>54,000</td>
<td>56,000</td>
</tr>
<tr>
<td>Rockhampton</td>
<td>0</td>
<td>27,000</td>
<td>27,000</td>
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<tr>
<td>Brisbane</td>
<td>28,000</td>
<td>729,000</td>
<td>757,000</td>
</tr>
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Graph illustrating the change in number of houses over time (2010 to 2100) for different locations, showing projections for both foreshore and non-foreshore areas.
Impact Assessment

NPV (million AU$)

Year of Adaptation - 2011

- Scenario 3
- Scenario 2
- Scenario 1
- No Change

Year

2020  2040  2060  2080  2100

-2000  0  2000  4000  6000  8000  10000  12000  14000

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Housing Vulnerability to Wind and Design Change

(Wehner et al. 2010)
Planning Optimisation by Cost-Benefit Analysis

Cost-effective

Net benefit (NPV)

Benefit = Reduced Damage Costs

Adaptation Cost

cost-effective

Cumulative Cost ($ million)

Time

2010 2020 2030 2040 2050 2060 2070 2080 2090 2100


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Develop Investment Policy in Adaptation to Enhance Resilience to Current and Future Cyclones/Typhoons Risks

Example: Achieved net present benefit by upgrading residential house standard for extreme wind in Brisbane considering moderate 10% wind speed increase by 2100 (4% discount rate).

Implications of Deferring Adaptation

![3D graph showing the relationship between Year of Adaptation and NPV (million AU$) with a delay to achieve benefit axis. The graph illustrates the varying NPV across different years of adaptation, with a color gradient indicating the NPV values ranging from -475 to 680 million AU$. The graph highlights the impact of delaying adaptation on NPV over time.](image)
What if there is no change of climate?
No Regret Approach in Policy Development

NPV of Adaptation without Considering Climate Change

Year of Adaptation

2011
2020
2030
2050

NPV (million AU$)

Year