



TROPICAL ECOSYSTEMS hub

Erub Yesterday, Today and Tomorrow: Community Future Scenarios and Adaptation Strategies



Bohensky, E., Butler, J.R.A., Rainbird, J., Skewes, T., McGrath, V., Nai, F., Maru, Y., Morseu, F. and Lankester, A.





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Project 11.1 Building Resilient Communities for Torres Strait Futures

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# Acronyms

AFMA	. Australian Fisheries Management Authority
CCAM	. Conformal Cubic Atmospheric Model
CSIRO	. Commonwealth Scientific and Industrial Research Organisation
DOGIT	. Deed of Grant in Trust
DoE	. Department of Environment
DFAT	. Department of Foreign Affairs and Trade
EGS	. Ecosystem goods and services
IBIS	Islanders' Board of Industry and Service
IPCC	. Intergovernmental Panel on Climate Change
NAQS	. Northern Australia Quarantine Strategy
NERP	. National Environmental Research Program
NGO	Non-government Organisation
PBC	Prescribed Body Corporate
PNG	. Papua New Guinea
RRRC	. Reef and Rainforest Research Centre Ltd.
SES	. State Emergency Services
TOs	. Traditional Owners
TSRA	. Torres Strait Regional Authority
TS	. Torres Strait
TSIRC	. Torres Strait Island Regional Council
TSPZ	. Torres Strait Protected Zone
WP	.Western Province

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Damian Miley	Manager, TSRA Land and Sea Management Unit
Vic McGrath	TSRA Land and Sea Management Unit
John Rainbird	TSRA Land and Sea Management Unit
Miya Isherwood	TSRA Land and Sea Management Unit
Shane Fava	Australian Fisheries Management Authority
John McDougall	Department of Environment International Section
David Foster	Department of Environment
Clayton Harrington	DFAT Torres Strait Treaty Liason Officer
John O'Halloran	Queensland Department of Local Government
Sheriden Morris	RRRC
Dr. Peter Doherty	Australian Institute of Marine Science and NERP Tropical Ecosystems Hub

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# **Executive Summary**

The Torres Strait is a region of rich natural and cultural values, with tight linkages between its environmental assets and the livelihoods of local communities. The Torres Strait Treaty explicitly aims to protect these communities' livelihoods, and improve them through sustainable economic development. As Australia's northern border with Papua New Guinea (PNG), however, the region is under increasing pressure from PNG population growth, extractive development and exploitation of shared Torres Strait resources. Global drivers such as peak oil, fluctuating economic conditions and climate change will also have complex positive and negative impacts on livelihoods. Because of the rapid and increasing rate of change and uncertainty, it is important to make predictions of potential changes and plan proactively rather than respond reactively. This requires the design of 'no regrets' strategies which bring benefits under any conditions of future change, and which are flexible and therefore less likely to be 'mal-adaptive'.

Through participatory scenario planning with Torres Strait communities and regional stakeholders, informed by integrated ecosystem services, climate and resilience modeling, this project aims to explore potential future scenarios for the region, identify 'no regrets' strategies to protect livelihoods and achieve sustainable economic development. In July 2011-December 2014 the project aims to:

- 1. Provide information to communities and regional stakeholders to advise strategic decision-making, including the Torres Strait Treaty process
- 2. Identify 'no regrets' adaptation strategies
- 3. Increase the capacity for communities and stakeholders to avoid mal-adaptive strategies
- 4. Support the development of TSRA community-based adaptation planning as a tool to attain their local aspirations

This report summarises the third scenario planning workshop, which was held at the community level on Erub Island. Thirty community members attended, including eight elders, three TSRA Ranger staff, seven CEA participants and three employees of the Erub Art Centre, as well as a range of community members. The joint CSIRO and TSRA project team provided downscaled climate change and sea level rise projections, ecosystem services modeling and other scientific information, which was integrated with local community members' knowledge. The workshop was held on 28<sup>th</sup>-29<sup>th</sup> August 2013 outside the Erub Council Building and at Norah's Ark Guest House on Erub Island, Torres Strait.

The workshop was structured into five sessions, and each addressed a specific question and delivered the following outcomes:

**Session 1: What are the drivers of change for livelihoods on Erub?** Working groups listed 44 drivers of change. These were grouped into themes, and participants voted on the two most important themes. Change in Erub culture was the most important driver, followed by social and economic factors (e.g. education, cost of living, local employment, health, and the influence of television).

#### Session 2: What are the desired and possible futures for the Erub community?

Participants, in two mixed groups, developed two visions for the Erub community in 2100. The first group's vision was:

"Our vision is to be a people who have a strong holistic cultural and spiritual way of life, that is self-reliant and autonomous. We believe that by investing in innovative models of delivering education we can create a strong economy and many opportunities that capitalize on our natural environment, land and sea in a sustainable way." The second group described its vision as having:

- Strong local economy
- Production of many food crops
- Good communication via phone and internet
- Affordable energy supply
- Strong culture
- Empowerment community empowered to manage their destiny
- Good local island transport

A matrix of four possible future scenarios was created, with Erub culture on one axis (strong vs. weak) and the social and economic environment on the other (poor vs. good), which was seen as a range of factors including natural resource management and climate change, technology and governement. Participants created narratives and drew pictures for each scenario for 2100. These ranged from the 'Best Case' *Opem Erub or Erub Facing Forward* (strong Erub culture with language, religion, communication, and respect maintained, and good social and economic environment, including a stabilised cost of living, and improvements in health, education, employment opportunities, government, technology, and management of natural resources and climate change), to the intermediate *Shaky Future* and *Keeping Culture Strong* scenarios, to the 'Business as Usual' *Wrong Way Go Back* scenario (weak Erub culture, high cost of living, and management of natural resources and climate change). Elders also drew a historical timeline of key events on Erub, which chronicled the community's history from the first pearling and fishing operations in the 1860s to the building of a new sports stadium in 2009.

#### Session 3: What impact will the Business as Usual future have on human well-being?

An ecosystem goods and services (EGS) model was developed for Erub. This projected the impacts of drivers of change on EGS and human well-being by 2030 under the 'Business as Usual' *Wrong Way Go Back* scenario. The most important EGS for Erub livelihoods are reef fish, followed by coastal finfish, mackerel, banana and green turtles. Participants estimated that local EGS contribute 47% of their health, food security and cultural needs, while 54% is contributed by external income.

Impacts on EGS by 2030 were all negative, although these were off-set by some positive impacts due to temperature and rainfall increases. The most impacted of the top five most important EGS were reef fish and green turtles, followed by fresh water, due to climate change, but also increased exploitation due to population growth.

**Session 4: What are the priority adaptation strategies to build a resilient Erub community?** Based on the EGS and human well-being impacts for 2030 and the scenarios, participants designed adaptation strategies for livelihoods to steer them away from the Business as Usual *Wrong Way* scenario and towards the Erub visions. Three working groups identified sixteen strategies. Six addressed only resilience impacts, and six addressed both EGS impacts and resilience impacts:

#### Working Group 1:

- 1. Gardens to increase traditional food production
- 2. Formulate and implement short and long term strategies to minimise and avoid coastal erosion

- 3. Minimise alcohol abuse and drug use by: strong law enforcement, health program, education and spiritual guidance
- 4. Devise and implement policies and practices to control importation of pests and diseases to Erub
- 5. Motivate community to continue program to improve and strengthen cultural values and practices

#### Working Group 2:

- 1. Generate employment through education, small business, investors
- 2. Address lack of transport for business and family through public transport (renewable energy) and innovative transport
- 3. Maintain culture by teaching culture at school, teaching adults at work; Elders passing on traditional knowledge to different age groups; using technology; songs/stories; community cultural day; cartoons and books for children; NAIDOC; capture and collect; cultural knowledge and practices from Elders and cultural practitioners
- 4. Prepare to move to higher ground and address land issues; seawall at low risk areas; planting mangrove to protect shoreline; research innovative ideas; build new subdivision; build lagoon at existing keper (shallow pool)

#### Working Group 3:

- 1. Get coastal engineering to provide options for coastal erosion
- 2. Write to TSIRC, TSRA, Telstra to call for communications technology
- 3. Next generation of community
- 4. Community hall for functions, gatherings, movies; activities; facilities for kids
- 5. Tidy village competition and tidy islands, education campaign (posters, signs etc.), monthly clean ups
- 6. Fixing leaks and options for tank for gardening. Use of waste of treatment plant for fertiliser
- 7. Green waste for compost

Strategies were cross-checked with the other potential future scenarios (i.e. *Opem Erub, Shaky Future, Wrong Way Go Back, Keeping Culture Strong*) to determine whether they would be maladaptive if these scenarios eventuated. Group 1 considered several of its strategies to possibly risk being mal-adaptive either because the anticipated problems (e.g. sea level rise) would not materialize, or because the institutional environment under *Shaky Future* would be unsupportive or incapacitated. All other strategies were 'no regrets' and would be beneficial for livelihoods under any future change.

**Workshop evaluation:** A questionnaire survey carried out before and after the workshop examined how participants' perceptions had changed. To the question "what is the greatest challenge that Erub will face in the future?", before the workshop, challenges related to social and cultural change were the most frequently mentioned, followed equally by economy, infrastructure, human resources and well-being. After the workshop, social and cultural change remained the most frequently mentioned type of challenge, but economy and natural hazards were increasingly mentioned. To the question "Are Erub communities resilient to future change?", 24% answered 'yes' before the workshop, while 24% answered 'no' and 52% were unsure or gave multiple answers. After the workshop, only 8% answered 'yes', while 34% answered 'no' and 58% were unsure or gave multiple answers. By contrast, to the statement "Erub is ready to cope with climate change", 40% were neutral, 20% disagreed and 25% agreed before the workshop. After the workshop about the same proportion remained neutral

(42%), but 16% disagreed or strongly disagreed, and 34% agreed or strongly agreed. Most participants (89%) felt that the workshop had either "increased my understanding of future change and how Erub can adapt", "made me think differently about the future" or "will make me do something differently about the future".

**Next steps:** The perceptions of the Erub workshop participants presented here will be combined through integration and policy evaluation workshops in 2014 with those of other case study communities, and government stakeholders.



Summary of the workshop process and results for all sessions. Lightning symbols represent thresholds identified for each scenario.

# 1. Introduction

# 1.1 Project background

The Torres Strait (Figure 1) is a region of rich natural and cultural values, with tight linkages between its environmental assets, ecosystem services and the livelihoods of communities. The Torres Strait Treaty explicitly aims to protect these communities' livelihoods, and improve them through sustainable economic development. As Australia's northern border with Papua New Guinea (PNG), however, the region is under increasing pressure from PNG population growth, extractive development and exploitation and pollution of shared Torres Strait resources. Global drivers such as peak oil, shipping traffic and climate change will also have complex impacts on environmental assets. This uncertain future will present challenges for maintaining resilient Torres Strait communities, but may also provide opportunities for sustainable economic development (e.g. tourism, aquaculture, sustainable fisheries).

Because of the rapid and increasing rate of change and uncertainty, it is important to make predictions of potential changes and plan proactively rather than respond reactively. This requires the design of flexible 'no regrets' strategies that bring benefits under any conditions of future change and are, therefore, less likely to be 'mal-adaptive'.

Through participatory scenario planning and resilience analysis with Torres Strait communities and stakeholders, informed by integrated ecosystem service and climate modeling, this project aims to explore potential future scenarios for the region, identify 'no regrets' strategies to protect livelihoods and achieve sustainable economic development. This will respond in part to the 2010 Senate Foreign Affairs, Defence and Trade Committee Inquiry, which recommended an analysis of the vulnerability of the Torres Strait to climate change and other future pressures. The project outputs will support the delivery of ongoing TSRA, DSEWPaC and DFAT initiatives promoting climate adaptation, alternative livelihoods, food security and economic development in the region, including:

- The TSRA's community adaptation plans under the Torres Strait Climate Change Strategy;
- The Torres Strait Treaty's Joint Advisory Committee and Environmental Management Committee's objectives of achieving food security and alternative livelihoods in the Western Province, PNG;
- The Torres Strait and Northern Peninsula Regional Plan;
- The TSRA's Sustainable Land Use Plans;
- The Integrated Service Delivery Framework

In July 2011-December 2014 the project's outcomes and impacts are to:

- 1. Provide information to communities and regional stakeholders to advise strategic decision-making, including the Torres Strait Treaty
- 2. Identify 'no regrets' adaptation strategies
- 3. Increase the capacity for communities and stakeholders to avoid mal-adaptive strategies
- 4. Support the development of TSRA community-based adaptation planning

The project addresses five research questions:

1. What are possible future changes in the Torres Strait?

- 2. How will these changes affect communities and their livelihoods?
- 3. Which communities are most likely to be impacted by changes?
- 4. What is the community's capacity to adapt?
- 5. What are the priority 'no regrets' strategies that will build communities' resilience and capacity to adapt?



**Figure 1.** The Torres Strait region, showing Erub Island, reefs, international boundaries, the Torres Strait Protected Zone (TSPZ) and Australian and PNG Treaty communities. The 14 Australian communities within the TSPZ are the focus of this study.

# 1.2 Erub Island

Erub (Darnley) Island (Figure 2), is the largest of the Eastern Islands, located in the eastern group of islands in the Torres Strait, approximately 200 kilometres northeast of Horn Island and approximately 26 kilometres southeast of Stephen Island. It is at the western end of an extensive reef that extends approximately 500 metres to the south and five kilometres to the west. Erub Island, approximately 3km by 2km, is hilly and volcanic in origin, composed mainly of lava and ash which has formed rich soil that supports dense vegetation.

ABS data estimates that Erub's population in 2012 was 422 people, with a growth rate of 2.33% per annum, increasing from 320 in 2001 (Figure 7). ABS (2008) reported a population density of about 62 people/km<sup>2</sup> based on a population of 363. Parnell et al. (2011) describe the community as quite widely spread from the airport at the northeast end of the island, through to the Egriu area. The coastal bays are typically on narrow coastal plains, separated by rocky headlands, and much of the community infrastructure and many of the houses are located on these narrow south- or southwest-facing plains. At higher levels there is also considerable development.

Parnell et al. (2011) further report that although the southeast winds affect much of the beach community, an extensive fringing reef, and reefs to the southeast in the distance limit wave action. The northwest winds also affect the shore, with waves refracting around the island.

Infrastructure on the island includes a storage reservoir and water treatment plant, a central power station and diesel generator sets for electricity, an airstrip, sewage system, jetty ramp and landfill dump site. It is serviced by a barge from Horn Island weekly, and by charter flights. The island has a telecommunications tower and mobile phone coverage, IBIS supermarket store, a school and a health centre.



Figure 2. Aerial photograph of Erub (Darnley) Island (Source: TSRA)

# 2. Methodology

This project applies participatory scenario planning with government and community stakeholders to enable them to express their different perceptions of livelihoods, the system dynamics determining their characteristics and their possible development trajectories. Workshops held at the regional and community level identify adaptation strategies which stakeholders believe will reduce any perceived negative impacts of drivers of change on human well-being, reducing livelihoods' vulnerability and building communities' resilience and adaptive capacity for future change (Figure 3). Subsequent workshops integrate the strategies identified by all stakeholders, allowing comparison between their perspectives, and an assessment of whether the strategies have been implemented by policies and programs. If not, the barriers to their implementation are identified. This social learning process creates 'adaptive comanagement', whereby new knowledge, partnerships and adaptive capacity are generated amongst all stakeholders to improve livelihoods.

In July 2011-December 2014 the project is carrying out a series of workshops. This report describes a scenario planning process which investigated Erub Island community's challenges

and opportunities, and adaptation strategies required to improve their livelihoods. Outputs of the workshop were an analysis of the drivers influencing livelihoods, a community vision for the future, potential future scenarios, valuation of ecosystem goods and services, and 'no regrets' adaptation strategies which will build community resilience. These will be integrated with regional stakeholders' perceptions in 2014.



**Figure 3.** Conceptual diagram of the system dynamics influencing communities and their livelihoods, stakeholder levels and adaptation strategies. The research process of participatory scenario planning, cross-stakeholder integration and adaptive co-management are indicated by dashed lines

# 3. Erub Island scenario planning

# 3.1 Community consent and invitations

A key step in planning the workshop was to secure TSRA Board approval to engage with communities. This was achieved in March 2013 when the project team presented the project plan to a Board meeting on Thursday Island. In July 2013 a community workshop was held on Masig (Butler et al. 2013), and following this, the Erub community was approached to hold a workshop, for which approval was received and a date set.

Having enthusiastically participated in the previous workshops, Masig Councillor Fraser Nai joined the team as a community champion and facilitator, and together with John Rainbird and Vic McGrath (TSRA Land and Sea Management Unit), arranged invitations for community

members and an advertisement on the island. A special effort was made to include community Elders and TSRA Rangers. Thirty people participated in at least part of the workshop, including including eight Elders and three TSRA Ranger staff. Of these, nine were women and 21 were men (Table 1).



Workshop participants, CSIRO and TSRA team members

**Table 1.** Erub workshop participants and their affiliations.

	Name	Affiliation
1	Amos Sipi	LSMU/TSRA
2	Bob Welsh	LSMU/TSRA
3	Francis Ketchell	CEA
4	Maraiya Ghee	CEA
5	Cedar Thaiday	CEA
6	Sarah Stephen	Elder
7	Ruth K. Pau	Elder
8	Isaac Ghee	My Pathway - Team Manager
9	Amina Ghee	Community Member
10	Yana Gesa	Police
11	Edward Sailor	CEA
12	Rexie Anson	CEA
13	William Bully Hayes	Senior Elder
14	Kem Kiwat	Elder
15	Dick B. Pilst	Elder

16	Billy Pensio	Elder
17	Marsat Ketchell	CEA
18	Harry Ghee	TSRIC
19	Richard N. Kiwat	DAFF – Biosecurity
20	George Romano	Cleaner
21	Aaron Ketchell	TSRA Ranger
22	Wallace Gela	CEA
23	Walter Lui	Radio broadcaster
24	H Savage	Fisherman
25	Mavis Kiwat	Elder
26	Unknown (illegible)	Elder
27	Sarah Gela	Parents & Children (P&C)
28	Kapua Gutchen Sr.	Erub Art Centre
29	Nancy Asau	Erub Art Centre
30	Florence Gutchen	Erub Art Centre

# 3.2 Workshop process

The workshop was held over two days on 28<sup>th</sup> and 29<sup>th</sup> August 2013 adjacent to the Council Building (Day 1) and at Norah's Ark Guest House (Day 2), Erub Island. The workshop was entitled 'Erub Yesterday, Today and Tomorrow'. Workshop facilitation was led by Vic McGrath (TSRA) and Erin Bohensky (CSIRO), supported by Councillor Fraser Nai, John Rainbird (TSRA) and Tim Skewes (CSIRO). Posters summarising presentations were displayed around the meeting venues throughout the workshop.

The objectives of the workshop were to:

- 1. Discuss future challenges and opportunities for the Erub community
- 2. Identify important strategies to build the resilience of the community

Following local cultural protocols, at the start of the workshop Pastor Kem Kiwat led a prayer. Participants were then asked to give their verbal consent for the project team to apply and publish the materials and results of the workshop, and to take photographic and video material. All participants agreed. Key terms and concepts were discussed with the participants to ensure a common understanding of terminology (Table 2). A poster was also displayed to explain the concept of resilience (Figure 4).

Term	Definition	Reference
Livelihoods	The capabilities, assets (including both material and social resources) and activities required for a means of living	Chambers and Conway 1992
Human well-being	The basic needs of people to live a healthy life: income, food security, health, social cohesion, freedom of choice	Millennium Ecosystem Assessment 2005
Driver of change	Any natural or human-induced factor that directly or indirectly causes a change in the system of interest, plus institutional and governance issues that mediate livelihood outcomes	Millennium Ecosystem Assessment 2005; DfID 2004
Ecosystem goods and services	Those goods and services which are provided by ecosystems and actually and directly valued and consumed by people	Wallace 2007; Fisher et al. 2007; Kent and Dorward 2012

Table 2. Terms and definitions used in the workshop

Resilience	The capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks and therefore identity	Walker et al. 2005
Threshold	A tipping point where sudden and possibly irreversible change occurs in a system	Walker et al. 2005
Adaptive capacity	The potential for actors to make changes that increase resilience, reducing the chance of the system losing its ability to provide its desirable function, or transforming the system altogether	Chapin et al. 2006
Vulnerability	The degree that a system will be impacted by change, mediated by adaptive capacity	IPCC 2007
Adaptation strategies	Adjustment in ecological, social or economic systems in response to actual or expected change and their effects or impacts	Smit and Wandel 2006
'No regrets' strategies	Adaptation strategies which yield benefits under any future conditions of change	Hallegatte 2009
Mal-adaptation	Adaptation strategies which result in the system becoming more vulnerable to change	Hallegatte 2009



Figure 4. The poster used in the workshop to explain concepts of community resilience

The workshop process was explained to the participants using Figure 5. The five steps of the process are:

- 1. The drivers of change for livelihoods today and in the future are identified.
- 2. The desired future vision for livelihoods in 2100 is agreed in terms of human well-being. Then, based on plausible variations in the drivers of change, four future scenarios are created and compared to the desired vision. Thresholds in drivers are identified where sudden and possible irreversible change occurs. Elders also draw a timeline of the history of the island and key events and dates.
- 3. The impacts on ecosystem goods and services and human well-being are modelled for 2030 for the 'Business as Usual' scenario. 2030 is investigated because impacts of drivers are more predictable in the short-term than in the long-term, and any human responses are less likely to have taken great effect.
- 4. The current resilience and vulnerability of the community to cope with the 'Business as Usual' scenario is assessed.
- 5. Based on the potential impacts on well-being and current vulnerabilities, appropriate adaptation strategies are designed to build community resilience. These are compared against the scenarios identified in Step 2 to check whether they would be compatible or 'mal-adaptive' for any other futures that could eventuate. In this way 'no regrets' strategies are agreed which could steer livelihoods towards the desired future vision.

To follow this process, the workshop was structured into five sessions, and each addressed a specific question (Figures 5 and 6 and Appendix I; due to time constraints, session four, the resilience assessment, was not completed). The structure was designed to encourage the integration of scientific information from other project activities with stakeholders' knowledge to generate shared knowledge. An evaluation questionnaire was also carried out at the beginning and end of the workshop to assess how participants' perceptions may have changed.



Figure 5. Diagram of the workshop process. Numbers refer to the workshop steps and sessions



Figure 6. Workshop structure and sessions, showing the process of knowledge integration

# 4. Workshop results

# 4.1 Session 1: What are the drivers of change for livelihoods on Erub?

Session 1 began with CSIRO and TSRA team members presenting information on the current and projected trends in likely drivers of change for Torres Strait and Erub livelihoods. This started with an analysis of global issues (e.g. financial crises, technology, disease epidemics, growth of the Asian economy). Information on the Torres Strait economy, shipping, health and cultural trends was then presented, plus recent population trends for Erub (Figure 7) and the Torres Strait (Figure 8), projected population growth for the Torres Strait (Figure 9) and PNG's Western Province (Figure 10), and planned resource development in Western Province (Figure 11). Current climate patterns, climate change projections downscaled to 8 km from the IPCC A2 'high' emissions scenario (Figure 12, Table 3) using the CSIRO Conformal Cubic Atmospheric Model (CCAM; McGregor and Dix 2008), and sea level inundation risk for Erub were presented by John Rainbird (Figure 13). This was followed by a summary of current knowledge on the status and trends of key species and ecosystem assets, collated from current NERP scientists and other past research projects. For example, the size of nesting female green turtles has shown a steady decline since 1976 (Figure 14), suggesting that the population is becoming vulnerable because smaller turtles lay fewer eggs.



**Figure 7.** Population census data for Erub Island, 2006- 2012. There are currently approximately 422 people resident on the island. (Source: Australian Bureau of Statistics)



Figure 8. Population census data for the TSPZ including Hammond Island, 2001- 2012. Numbers have increased gradually from 3,250 to 3,600. (Source: Australian Bureau of Statistics)



**Figure 9.** Population census data for the Torres Strait Indigenous Region for 2006 and 2011, and low, medium and high projections until 2031. Note that as well as the 14 TSPZ communities, in 2011 this statistical region included Thursday Island, Horn Island and Hammond Island. Although there was a decline from 7,700 in 2006 to 7,490 in 2011, medium projections indicate a population increase to 10,667 in 2031, at an annual average growth rate of 0.91%. For full details see Butler et al. (2012b).



**Figure 10.** Population census data for Western Province, PNG in 1980-2011, and projected increases between 2012 and 2050 at low, medium and high projections. The average annual growth rate in 2000-2011 was 1.5%. At medium projections, the population may at least double from 180,000 to 420,000 by 2050. For full details see Butler et al. (2012b).



Figure 11. Summary of current and planned resource development projects in PNG neighbouring the Torres Strait. For full details see Butler et al. (2012b).



**Figure 12.** Annual mean rainfall rate (mm day<sup>-1</sup>, top row) and changes relative to 1990 (bottom row) in the Torres Strait region under the IPCC A2 emissions scenario, downscaled to 8 km using CCAM. For full details see Katzfey et al. (2012).

**Table 3.** Summary of changes in climate parameters for the Torres Strait from 1990 levels under the IPCC A2 emissions scenario, averaged from downscaled CCAM data across the region. For full details see Katzfey et al. (2012).

A2 scenario	2055	2090
Temperature (°C)	+1.3	+2.5
Apparent temperature (°C)	+2.2	+4.8
Rainfall (%)	+3.4	-2.9
Relative humidity (% humidity)	+0.5	+0.6
Wind speed (%)	-2.2	-3.5



**Figure 13.** Inundation risk for Erub Island under current Highest Astronomical Tide (HAT) (top) and HAT plus 80 cm sea level rise (bottom). (Source: Kevin Parnell, James Cook University).



**Figure 14.** Trend in curved carapace length (CCL) of nesting female green turtles at Raine Island, 1976-2005 (Source: Colin Limpus, Queensland Environmental Protection Agency)

Following these presentations, workshop participants were divided into four groups to discuss their perceptions of the current and imminent drivers of change for the Erub community and their livelihoods. Each group wrote down their selected drivers on sticky note paper, and placed a total of 44 on a large whiteboard. Through discussion these were clustered into themes, and into short term (10 years or less) or long-term (10 years or more). After clustering, each participant was given two votes and asked to select the two most important drivers of change, using stickers. The votes were then totalled to identify the two most important themes of drivers (Table 4).



Workshop participants voting for the most important drivers of change

**Table 4.** Forty-four drivers of change for Erub Island were identified and grouped into themes by participants. The two most important themes selected by voting were culture and social/economic. Numbers in parentheses are the number of 'votes' for most important drivers as identified by participants.

Theme (total votes)	Drivers (votes)			
Culture (9)	Full-time jobs; more time at work, courses, less for cultural practices			
	(1)			
	Shop (no more gardens) (1)			
	Dinghys – modern hunting technique (1)			
	Loss of respect (3)			
	Language (2)			
	Way we communicate (1)			
	Cultural changes: lack of respect, old ways not in use, clothing,			
	choice			
	Religion			
Social (5)	Health (1)			
	Television/Video (1)			
	Education (3)			
Economic (7)	Cost of living (2)			
	Lack of employment opportunities (3)			
	Food prices going up (2)			
	Energy costs going up			
Political (2)	Government (2)			
	Barriers - Land disputes			
Technology (2)	Air conditioning			
	Phone			
	Technology within community (radio, TV, phone) (2)			
	Freezer (sharing, caring for each other)			
Natural resources (1)	Development leading to floods, damage to reef (1)			
Climate change (4)	Weather pattern predictions			
	Sea level and erosion (1)			
	Coastal erosion (3)			

# 4.2 Session 2: What are the desired and possible futures for the Erub community?

## 4.2.1 Desired future vision for Erub Island community

Session 2 began with a discussion to develop statements about the desired future vision for Erub Island's community in 2100. Two mixed groups were formed and presented their statements as follows:

Group 1:

"Our vision is to be a people who have a strong holistic cultural and spiritual way of life, that is self-reliant and autonomous. We believe that by investing in innovative models of delivering education we can create a strong economy and many opportunities that capitalize on our natural environment, land and sea in a sustainable way."

Group 2 described its vision as having:

- Strong local economy
- Production of many food crops
- Good communication via phone and internet
- Affordable energy supply
- Strong culture
- Empowerment community empowered to manage their destiny
- Good local island transport

### 4.2.2 Erub historical timeline

To describe life on Erub in the past the Elders told stories of their experiences or of customs that were common place on the island, facilitated by Vic McGrath. To explain the key events in the history of Erub Island, the Elders then developed a timeline from their knowledge, showing key events (Figure 15). This was presented to the workshop. The most marked change had been the missionary settlement in 1871, men leaving the island during and after Second World War, the first school and CDEP program in the mid 1970s and then the start of tele-communications and new infrastructure (e.g. boat ramp, water and sewage pipelines and airstrip).



Vic McGrath (TSRA) and the Erub Elders discussing an historical timeline for the island



Figure 15. The timeline for Erub developed by the Elders

Vic McGrath presented the timeline constructed by the Elders, explaining that:

"Back in the old days I was told there were four tribes, traditional owner groups. They lived in villages all around the place. 1860s: people first came here from outside for fishing, pearling, that sort of thing... beche de mer. They discovered they got shell grounds here. Turtle shell. And they started coming here from outside: South Pacific. White men started to come round Torres Strait. 1871: London Missionary Society came to Kemus round the back there. Coming of the Light July 1. So when the missionary come here people started to move down towards the front beach and became settled more. Even though it was traditional land, people allowed it during these missionary times. They also built the church here; the original church, grass one; later on, the current church, a lot of hard work, people made their own cement using coral; still there, just needs a bit of work on it. Following on, further on the road we get to the next significant or important thing that happened on this place. World War II came along and all the men left, joined the army and left all the women and children behind looking after themselves. In TI they evacuated everyone, but you people out here were just left here. If we got invaded by Japanese, you would all be Japanese people now. It didn't happen. You guys defended from Horn Island; worked on boats around Merauke and everywhere on patrols. After the war men came back here around 1946 after the war.1950: people were starting to get used to the idea that we got buckerr (money) in the pocket; we got a change in the economy, because they got paid in the army, not as much as they should have got paid, and that got fixed up later when government started to compensate people. At the time they got some money to buy stuff. Then when they came back to Island – nothing! The war ended: no work, nothing. Men started to leave then to work on the railway, cane cutting, that sort of thing, around 1950. So, once again, the women were left here to do the gardening, cut the firewood, most of that stuff they had to do themselves. Then men starting to work elsewhere and send buckerr home to buy at the store: flour, sugar and tea and stuff. 1957: Duke of Edinburgh, no Queen, but old Dukie

was out here and had a swim at that place on the north-west side of the island and the people built a monument down there to remember that. In those days it was a big deal. 1972: Dr Bustard came here married a local Darnley girl and started a turtle farm. Turtle farms started spreading all around the Torres Strait, but mostly they didn't do so well anywhere else, except here and Murray. These places became like a turtle hospital to make the project look good for government, to get more government money, but it was a failure because only you guys were able to look after it well enough; it should have just stayed here. 1978: there was a new school at Mogor and around the same time the old original council office was built. CDEP: first place for CDEP in Torres Strait was here and Dauan 1976-77. So you guys were one of the first. 1984: you got your first telephone box here, it was a big deal, that thing used to be covered in grass up there. It is difficult now with bad mobile reception, but remember the old days when everyone used to queue up there for that one phone box. Another big issue was when we got the boat ramp in around 1987; bigger boats able to come, more supplies. On some islands, this was a big deal because it changed the foreshore development; more erosion and bigger boats. It was a big change. We think somewhere around 1990 there was a dam and a few years after that they built the sewage and put all those pipes and water at the same time. Before that we used to have that black pipe laid down there on the ground, so you got to walk on it all the time. And then we got somewhere around 1995, the airstrip, I remember back in the 1980s I used to come here in a helicopter, only way you could come to Darnley. Lots of clearance from native title owners, very sacred area, anyway they got local support. All cleared and now we have airstrip. New Ibis store somewhere in 1998. New council office a couple of years later. We've had the new health centre a couple of years ago and the sports stadium and that brings us up to date. What are we missing? First or second school in Torres Strait. You had the first ever missionary come here. Anyway, we've come a long way. Still doesn't mean it's perfect here, but we can think about how much you've progressed in this place."

## 4.2.3 Future scenarios for Erub Island

Using the two most important themes of drivers from Session 1 (culture and social-economicpolitical), two axes were created with different extremes of each driver. These axes were described in broad terms as Erub culture (strong versus weak) and the level of social and economic development (which included cost of living, health, education, employment opportunities, government, technology, and the management of natural resources and climate change (Figure 16).

These axes created a matrix of four future scenarios for Erub, which combined better or worse levels of the drivers. Workshop participants were divided into three working groups, with two groups each doing one scenario, and a third group doing two scenarios. They developed a narrative of Erub livelihoods in 2100 for their scenario, and drew a picture to illustrate that narrative (Figures 17 – 20). Figure 21 shows the final matrix of scenarios relative to the drivers of change.



**Figure 16.** The matrix of four future Erub Island scenarios created by combining better or worse levels of the two most important driver themes, strength of Erub culture, and the level of social and economic development (which included management of climate change)



Workshop participants drawing a scenario picture and creating a narrative.



Figure 17. Scenario 1, Opem Erub (Facing Forward) (Best Case)

## Verbatim narrative for Scenario 1, Opem Erub (Facing Forward) (Best Case)

"We've come up with this one for a strong Erub culture and good social and economic environment. We have come up with the name 'frontside' (Opem Erub) because we are facing the front: "Erub facing into the future"; "Erub into the future". Some say that from 100 years from now this is what we want: strong economy and strong culture. For our reef: we still want our fish traps to be maintained in a 100 years' time and make sure our reef is good for our fishing. For our reef we want to have a few boats that can supply our seafood factory, small businesses and our restaurants. We also want to have a fish farm and a prawn farm facility, and a ferry with a sail and a big jetty with a mooring for different dinghies. We want a desalination plant to help our existing dam, with the possibility of another extra dam. That's for water. With electricity we want to have hydroelectricity with wind turbines. If we can have them, maybe we'll cut the diesel power out and we just rely on renewable energy. For all our buildings we'll have solar panels to help with cost of electricity, saving and making money. We want a bus service to run our roads everywhere and cars to be powered by electricity instead of burning fuel so we get free electricity from here and we use that electricity to run our vehicles around the island. With education, we want something like the Erub University of Technology where kids can learn from baby right throughout to high school and university. If they want to go to university, to have that facility here. Have the teacher come here instead of send our students away and they can learn in their own environment. Looking up we got our own professionals. Everyone from here will be teaching professionals. With technology we can get our information from the computer. Speaking to the elders, I look at that change from where that it come from...small to where it is now. We've got our own professionals. With the airport and airline company our own that can fly instead of outsiders come. That's a business and we got gardening: we got fruit and veg farm and fisheries, fish stock and boats and the farming thing happening so that it sustains everyone. We don't buy our produce from outside, we buy locally fresh seafood, fresh veggies: creates job, everybody works here and it just goes around in a cycle. Airline company, we got boat, we got a Marine Biologist's Institute where people study reef: all become scientists, all understand into the future. We make our decisions together with the elders, professional expertise, scientists, with local knowledge that been passed down. We also got a cultural and arts centre here where we have a place where we keep our culture strong, respect, identity and also where we take people down to showcase culture. The people come here and they pay to build the economy; people come to see strong culture of Darnley; creating employment as well; you got that economic benefit and strong cultural benefit as well in a lot of ways. We got spirituality place because we talk about coming of the light and that is a strong part of belief for island; to be strong in a 100 years' time for the young ones."

HAKY FUTURE TR

Figure 18. Scenario 2, Shaky Future

#### Verbatim narrative for Scenario 2, Shaky Future

"We call it 'shaky future' because it's not balanced: too much of one and less of the other one. Everything like the economy is strong but the culture is weak. And we believe that if we keep going that way losing our culture and only focusing on other things. What we really did was turn our focus on Cairns: the place where we're following at the moment. You got things like probably in the future because of money and growth on the island...we start to get KFC and Maccas on the island. The economy becomes strong and people start small businesses everywhere. To have a strong economy on the island, we can't just depend on the money here but to build and to build more we need finance to come from outside, like tourists. The only upside to that is you become rich. The downside to that is we bring all sorts of things into our island; all sorts of influence, cultural influence. So we don't just watch those things on TV now, we have it first hand with other cultures on the island because we need their money to build our island: new roads, new highways, new nightclub and pubs. This is how the community grows and become strong: from canteen it becomes pub and from pub you got nightclub, to grow the economy those things have

to grow, have to build, like in the cities. Cities get bigger and bigger and bigger that's why they get stronger and stronger financially. Instead of buying beer for yourself we can just make it from our own factory, which will cause pollution. And if we got that hungry for money and we build our island we start giving our reef to the rich. So I don't think we want any oil or gas in the reef because it is going to bring in the big ships and it will bring in all sorts of things from outside. We'll be losing our own culture, our values; so we get more domestic violence and more drinking around the place. To also have a strong community and money you got more commercial fishing vessels; whether it's going to be our own or other people come from outside who's gonna give us money to fish here. That could lead to overfishing of our reef. We've seen in the time when I could swim when we you look dollar sign we don't think for the reef: but because we overfished that reef we have dead coral everywhere. When we got a strong economy and no culture then people will come and live on Darnley, asylum seekers. It can happen, they are moving closer and closer to us now. You know our brothers and sisters in PNG. You got one thousand kina they will bring you here from anywhere in PNG; the Australian Government stopping them. We got an increase of security, army and police. So our life could be just like Cairns with no cultural values. It's not really going to be the lifestyle we want. Probably just got places where we can show how we used to be. But our identity for me is through our lifestyle; not because you're in an island shirt...anyone can come here and wear an island shirt, but our lifestyle makes us Darnley people; we don't want to lose that. That's how we now starting to lose that respect: we starting to lose all those valuable things. We don't want to see our future scattered the way we start to see Cairns now; our reefs overfished, polluted. All those kind of influences come in; all kinds of people come in and bring all kinds of diseases and sicknesses from all over the world. We need to have balance like the number one [scenario]: a bit of this and a bit of that. Strong economy weak culture; so we need to keep our culture strong still. We need an economy because we can't run from the wider world, we're trapped from the system of this world. We don't want to go too much on this side and forget our side. You can be a policeman, you can be a councillor but first thing you Darnley man first."



Figure 19. Scenario 3, Wrong Way Go Back (Business as Usual)

#### Verbatim narrative for Scenario 3, Wrong Way Go Back (Business as Usual)

"We've named it 'wrong way, go back': weak economy for the island: all our houses and garden go broke, you got no money to fix them. We probably got some old grass house around because the culture is weak, but we didn't lose it all together. The diseases and pest we got in the future we don't know if it can give us the proper protection and security we need from mosquito. Some ways it can look because the culture is weak but not lost, we will go back and revive our gardening, but probably more bigger scale now because we got no money...we can't run shops, our economy is weak. But the island we got no money we can't run shops we can't run anything because our economy is weak. We look across the border for our brothers and sisters in Daru. We will probably have to get people from outside to come and make a business here; Chinese or other people who got money. We don't want people to come and buy up permanent. We got more big scale gardening now because we got shops now and in the future if the climate change then we'll probably have to cut down more forest to make a garden because the exposed soil probably will be no good; heat it too much or whatever. So the more forests you cut down, no good soil for gardening, no maintenance of our water supply we got now, so you got polluted water. We will probably have to go back to the well. And if the worst case comes to the worst for coastal erosion because we have very little money to build a sea wall: sea will probably move up and kill grass on top of the hill and this would cause more silt and erosion coming into the ocean...everything will be bad. We'll probably have few good things, but most of the things will be no good. Drug crops: this is a quick way to make money in the Torres Straits right now today; there will be an increase of that because there'll be no jobs and people sitting under the tree doing nothing and be homeless and jobless. No jobs: people need money. Young people are going to move into drugs; around the world today that's the quickest way of making big money. In a lot of ways we'll probably go back to the old ways because we can't afford to deal with the situation. We'll probably try other activity like sapo fishing. So the worst case scenario with weak economy and weak culture is bad news. More crime because of drugs, probably more sly grog. All kinds of thing go wrong. People find all kinds of ways to make money for kai kai to and support themselves. So, number one we need a good balance: strong culture and strong economy. We can't afford fuel so go back to canoes. We'll probably have to go back to our trading business with Daru...trading or canteen...trade all kind of thing, good thing and bad thing. More visitors coming in too: more mossies. Trafficking for money from asylum seekers. People need money to survive and if you got no jobs and the canteen, you need to find money somewhere. Dinghy might go and pick up asylum seekers for money. We see it happening with countries that are already like this; we see these things happen. It's good to be last, so you can learn from the people that are going ahead of you. You get to see where they're going- the good and the bad- measure it out, balance it out. Then we see where we want to go. Then we need to decide to do it our way. People out in front, like the cities down south, growing townships down south, we need to look at that and learn. Everything in the world today has good and bad. Every development we do, something bad comes out of. We need to get that balance right so everybody happy."



Figure 20. Scenario 4, Keeping Culture Strong

#### Narrative for Scenario 4, Keeping Culture Strong (through local economic fishery)

"Scenario 4 speaks about how we have a strong Erub culture, religion, language, communication, respect we maintain, but on the other side we have poor social and economic environment, health, cost of living, education; watching TV too much. Employment opportunities no good and no government technology much and no natural resources and it's about climate change. So we got some part good and some part bad with every kind of situation. Look at the top on religion. You can see the drawing there, people all got church. And another one, when we got strong communication with one another and the elders (see the drawing there) the elders there: big man, woman there and everyone sitting around listening for advice on how to go about in the life, because we believe to know about how you handle yourself in the future you need to look back how life come and then you steer yourself. Because there's always a start point for everyone in life: where you start from. You might born in the nineteen hundred and twenty, you might born in the nineteen fifties, nineteen sixties, ninety seventies. There'll be a start point for you appear and when you look around you and you learn from those previous to you in their time, because they're still around you and probably speak for you and you read about history of the place and know about people. Respect through listening to elders then culture can be maintained. Today mostly Torres Strait regards dancing as a part of culture only, or the main one. But island dance is just one section and another section of culture is keeping village clean. Bad side. Sometimes have a big party or island dance and the next day only committed people clean up place and no good when outsiders come and even to ourselves. For example, the games that been going down there: when you go past the litter from the people that attended the games is unspeakable. You play games, you practice that culture thing there, you clean up please. Here we got litter, see. The environment become poorer. Because our community should be clean. People come to Darnley fully look. Clean island, that's how they deem the people of that place. We must not only be strong with one, we must be strong with another one too. We talk about environment: we put a sea wall there along the beach that the community build themselves. We

look in some areas the sea wall has been put down three times for trying to alter the advance of the ocean: we make one wall the sea come up, we make another one, so it was an ongoing thing, this was an effort without machinery, but today you got machinery can fix that kind of problem, try and fix it yourself. A good example we alter the erosion in that area. Make it more traditional thing down there, stick the bamboo in the ground. We've been asking what is down the track if food stops coming to Erub because some crisis from mainland Australia. We return back to traditional fishing or fish trap or hunting. Overall, the main resource, like all other Torres Strait island, is the resource in the sea and when you harvest that one properly, economically and people are happy fishing. When you are happy you got income come in, the Island live happy and you can rely on themself. This one here is how much the lads can make if you are fishing in Erub. They can get around \$40 per mackerel. You're capable of catching 10 a day; if you get 10 a day you have \$400 a day and if in 10 days time, if you continue the same trend, you will have \$4,000. We want to see more lads out in the water, less volley ball game or fishing and bring this kind of money in 10 days \$4,000. CEA only get \$800 or \$500, so there's money there. Why aren't boys out there learning the technology on how they fish? The technology for good fishing he already available, but them largely not being taught. GPS for the exact time to fish and when to stop, so when you use that one you win. You must marry that technology part. That technology part: that GPS and the communication, tower for the mobile. With fishing, you earn money, your family will live happy and everything should run right. The last one, why the communication important? Why do we need the mobile tower? For safety for fisherman and something wrong there be no need for some \$10,000 rescue come from TI. If we have low trust and faith in one another we cannot help one another. This strong culture and strong economy was through faith and trust for we as a family, everything else will come good for us. All sorts of thing are happening outside, we together. Everybody trust one another and got good communication and everything come strong too."



Figure 21. The four scenarios within the matrix of drivers for Erub Island



Workshop participants presenting the narrative for the Shaky Future scenario.

# 4.3 Session 3: What impact will the Business as Usual future have on human well-being?

This session explored the potential impacts of the Business as Usual *Wrong Way Go Back* scenario on the natural resource base supporting the Erub community's livelihoods. This was feasible using three sources of quantitative data. First, the extreme climate change predicted by the Business as Usual scenario had been modeled using CCAM, which is based on the high IPCC A2 global emissions projections. Second, sea level rise projections have been made by the TSRA. Third, population projections were available for the Torres Strait region, which assumes continuing net growth, and thus mirrors the Business as Usual scenario. Impacts were only investigated for 2030 because climate and human population projections are likely to be more realistic in the short term, and any human responses are less likely to have taken effect.

The potential impacts on human well-being were examined using the semi-quantitative ADWIM (Asset-Drivers-Well-being-Interaction-Model; Figure 22). First, a preliminary list of the ecosystem goods and services (EGS) that support livelihoods in each Torres Strait community was made by TSRA collaborators. During the workshop participants refined the list for Erub and estimated the 'production' (i.e. the relative volume produced or exploited) of each EGS for Erub, scored from 0-5. They also ranked the relative value (0-5) of each EGS in terms of four indicators of well-being: income, food security, health and culture. Combining this with the 'production' information gave the relative importance of each EGS for the Erub community (Figure 23).

The most important EGS for Erub Island was reef fish, which contributed highly for health and food security in particular (Figure 23). Coastal finfish, mackerel, banana and green turtles were

the next most important EGS. Participants from Erub Island were also asked to score the relative contribution of EGS to their overall well-being, relative to income derived from formal employment, remittances and government support. This showed that local EGS contributed 47%, and external income 54% (Figure 24). The highest importance of local EGS was for culture, while external income contributed more to food security and health.



**Figure 22.** The ADWIM model (see Skewes et al. 2011, 2012) used to estimate the importance of EGS, and the impact on human well-being from the Business as Usual *Wrong Way Go Back* scenario



**Figure 23.** The 25 ecosystem goods and services identified for the Erub Island community, and their relative importance (total bar) and contributions to income, health, food security and culture (colours)



**Figure 24.** The relative contribution of local EGS to food security, health and culture relative to external income for the Erub Island community, as reported by seven local participants

By applying the downscaled climate and human population growth projections for 2030 for Erub (Table 6) the resulting impacts on ecosystem assets, EGS and well-being were estimated. Results showed that overall impacts on well-being in 2030 were likely to be negative for all EGS, although these were off-set by some positive impacts due to temperature and rainfall increases linked to climate change (Figure 25). The most impacted EGS within the five most important was reef fish, followed by green turtles. This was caused primarily by climate change factors, but also increased exploitation due to projected growth in the Erub human population. For the terrestrial EGS (e.g. coconuts, yams, taro), sea level rise was the primary impacting factor due to loss of land.

When well-being impacts were aggregated for all EGS, the negative impacts increased with time (Figure 26). Overall, in 2030 negative human population slightly exceeded negative climate change impacts, which were offset by some positive effects of rainfall and temperature increases. By 2060 all impacts except rainfall were negative, and total impacts will have doubled from 2030. The contributions of climate change and human population to total negative impacts were roughly equal. By 2100 negative impacts will have doubled again due to potentially extreme climate change effects, and the greatest of these was sea level rise.

Drivers and threats	Year	Badu	Boigu	Dauan	Erub	Yam	Kubin	Mabuiag	Masig	Mer	Poruma	Saibai	St Paul	Ugar	Warraber
Change in average annual rainfall (%)	2030	1.1	2.8	3.2	2.7	2.4	1.1	1.7	2.5	1.6	2.3	3.3	1.2	3.2	1.5
	2055	2.1	5.3	6.2	5.1	4.6	2.1	3.2	4.8	3.1	4.3	6.3	2.3	6.1	2.9
	2090	-7.0	1.0	1.1	0.2	-3.0	-7.0	-5.8	-1.1	-1.6	-2.4	1.5	-6.5	1.4	-4.2
Air temperature change (deg C)	2030	0.6	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	2055	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2090	2.3	2.6	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.3	2.3	2.3
Population (persons) [note 1]	2010	915	284	164	365	340	228	276	330	545	194	394	266	85	288
	2030	1104	343	198	440	410	275	333	398	658	234	475	321	103	347
	2055	1282	398	230	511	476	319	387	462	764	272	552	373	119	404
	2100	1489	462	267	594	553	371	449	537	887	316	641	433	138	469
Density, land (people per km2)	2000	9.0	3.9	44.1	61.1	197.0	1.3	43.2	203.6	127.2	521.8	3.8	1.6	229.3	389.7
	2030	10.9	4.7	53.2	73.7	237.7	1.6	52.2	245.6	153.4	629.5	4.6	1.9	276.6	470.1
	2055	12.6	5.5	61.8	85.6	276.1	1.9	60.6	285.2	178.2	731.1	5.4	2.2	321.3	546.0
	2100	14.7	6.4	71.7	99.5	320.6	2.2	70.4	331.2	206.9	849.1	6.2	2.5	373.1	634.1
Density, sea (people per km2) [note 2]	2000	0.40	0.18	0.08	0.14	0.13	0.10	0.11	0.12	0.21	0.07	0.21	0.11	0.03	0.11
	2030	0.48	0.22	0.09	0.17	0.15	0.12	0.14	0.15	0.26	0.09	0.25	0.14	0.04	0.13
	2055	0.55	0.25	0.11	0.20	0.18	0.14	0.16	0.17	0.30	0.10	0.29	0.16	0.04	0.15
	2100	0.64	0.29	0.13	0.23	0.21	0.16	0.19	0.20	0.35	0.12	0.34	0.18	0.05	0.17
Density, reef (people per km2) [note 3]	2000	4.1	342.7	9.7	1.4	2.4	1.0	1.7	2.4	1.9	1.0	26.9	1.1	0.6	3.5
	2030	5.0	413.5	11.7	1.7	2.9	1.2	2.0	2.9	2.3	1.3	32.4	1.3	0.8	4.2
	2055	5.8	480.2	13.6	2.0	3.4	1.4	2.3	3.4	2.7	1.5	37.7	1.5	0.9	4.9
	2100	6.7	557.7	15.8	2.3	4.0	1.6	2.7	4.0	3.1	1.7	43.7	1.8	1.1	5.7

**Table 6.** Projected changes in climate and human population under the Business as Usual scenario for each Torres Strait island, including Erub, which were applied in ADWIM.

#### Notes:

- 1. Population growth was assumed to be 0.99% p.a. until 2030, and then 0.5% p.a. after 2030, based on Queensland Government projections. While there has been variation in population growth amongst the islands since 2000 (e.g. from -1.89% p.a. for Yorke Island to +3.37 % p.a. for Saibai Island), it was assumed that all the islands will experience the same population growth rate over the next 100 years. (Source: Queensland Government Population Projections, 2011 edition, and QRSIS database maintained by the Office of Economic and Statistical Research).
- 2. Density of people per km<sup>2</sup> of sea was calculated from an assumed marine area of 30 km radius around each island.
- 3. Density of people per km<sup>2</sup> of reef was calculated from the area of reef within each islands marine area.

In ADWIM, sea level rise was factored (relative to 2000) for Erub Island to be 0.24 m by 2030, 0.49 m by 2060 and 1.00 m by 2100 (Source: John Rainbird, TSRA). This was used to assess exposure for the marine and coastal EGS. Exposure of terrestrial EGS is also influenced by the proportion of land at risk of inundation. We therefore assumed an estimated inundation for Erub Island of 10% of current garden land by 2100, using visual estimates of percent inundation from maps supplied by the TSRA.

In ADWIM, ocean acidification was factored as a change in the aragonite saturation coefficient (relative to 2000) of -0.31 by 2030, -0.71 by 2060, and -1.31 by 2100. This was applied to all islands (Source: Pacific Climate Change Science Program, 2011).



**Figure 25.** The relative contributions of climate change and population-derived impacts on human wellbeing for Erub Island EGS in 2030 under the Business as Usual *Wrong Way Go Back* scenario.



Figure 26. The cumulative impacts on well-being for all EGS in Erub in 2030, 2060 and 2100 under the Business as Usual Wrong Way Go Back scenario

# 4.4 Session 4: What are priority adaptation strategies to build a resilient Erub community?

## 4.4.1 Adaptation strategies

In this session the results of the overall potential impacts in 2030 of the Business as Usual *Wrong Way Go Back* scenario on EGS and human well-being for Erub were used to design adaptation strategies. The facilitators explained that adaptation strategies could be focussed on either impacts of change on EGS (e.g. declining rainfall and coral bleaching) or resilience issues (e.g. poor leadership) or both, and generic examples were given. Participants were then divided into three working groups. Each group was provided with the graphs of EGS and projected impacts in 2030 (Figure 25), and the resilience assessment (Table 6). From this information, they listed strategies in descending order of priority. For each strategy they also listed the following information:

- The impact and the threat causing that impact
- Strategies which can improve EGS, take advantage of underutilised EGS, or build resilience
- The actions and stakeholders required to implement the strategy

By comparing the strategy against the other three possible future scenarios (i.e. *Shaky Future, Opem Erub, and Keeping Culture Strong*), the working groups also assessed whether the strategy risked being mal-adaptive if any of these alternative futures eventuated. If not, the strategies were considered to be 'no regrets'.



Workshop participants designing adaptation strategies

Working Group 1 presented five adaptation strategies, the most important of which was gardens to increase traditional food production (Table 7). Working Group 2 considered that the education, small business, and investors together were a priority in order to improve education (Table 8). The group also identified a series of actions needed to address rising sea level, including moving to higher ground, addressing land issues, building a seawall, and planting mangroves to protect the shoreline, and researching innovative ideas. Working Group 3 prioritised getting coastal engineering expertise to address coastal erosion (Table 9), followed by obtaining support for improved communications technology.

Of these 16 strategies, six addressed purely resilience issues, while seven had benefits for both reducing impacts on EGS, taking advantage of EGS (e.g. through green waste for compost) and building resilience. Managing coastal erosion and sea level rise was identified by all three groups, and cultural maintenance strategies were identified by two. All strategies required partnerships of between two and six stakeholders to implement them. Eleven of the 16 strategies did not risk being mal-adaptive under future conditions other than the Business as Usual *Wrong Way Go Back* scenario, and were therefore 'no regrets'. However, Group 1 considered several of its strategies to possibly risk being mal-adaptive either because the anticipated problems (e.g. sea level rise) would not materialize, or because the institutional environment under *Shaky Future* would be unsupportive or incapacitated.

## 4.4.2 Results and next steps

Figure 27 illustrates the overall process and results of the workshop sessions. Sixteen 'no regrets' adaptation strategies were identified for Erub based on key issues identified and projected impacts by 2030 for the Business as Usual *Wrong Way Go Back* scenario. Strategies aim to build the community's resilience and steer livelihoods towards the visions for Erub Island.

The perceptions of the Erub workshop participants presented here will be combined through integration and policy evaluation workshops in 2014 with those of other case study communities, and government stakeholders.

Table 7. Adaptation	n strategies identified by	y Working Group	1, listed in descending order of importance
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Adaptation strategy	Impacted EGS and threats OR resilience issue addressed (E = addresses EGS; R = addresses resilience)	Actions and stakeholders required to implement strategy	Scenario 1 <i>Opem Erub</i> Risk of mal- adaptation?	Scenario 2 Shaky Future Risk of mal- adaptation?	Scenario 4 <i>Keeping Culture</i> <i>Strong</i> Risk of mal- adaptation?	
1. Gardens to increase traditional food production	High cost of living <b>E R</b>	<ul> <li>Form group or association to make action plan, including Native Title holders, rangers</li> </ul>	No	Maybe	No	
2. Formulate and implement short and long term strategies to minimise and avoid coastal erosion	Coastal erosion <b>E R</b>	Government (local, state, federal), university, CSIRO, community (landowners)	No	No	Maybe	
3. Minimise alcohol abuse and drug use by: strong law enforcement, health program, education and spiritual guidance.	Alcohol and drug abuse <b>R</b>	<ul> <li>Church</li> <li>All levels of government</li> <li>Community</li> <li>Health professionals</li> <li>A.A etc</li> </ul>	No	Maybe	No	
4. Devise and implement policies and practices to control importation of pests and diseases to Erub.	Protection from pests and diseases from Australia E R	<ul> <li>Government</li> <li>AQUIS-DAFF</li> <li>Community</li> <li>Education</li> </ul>	Maybe	Maybe	Maybe	
5. Motivate community to continue program to improve and strengthen cultural values and practices	Loss of cultural values and practices <b>R</b>	<ul> <li>Church</li> <li>Elders</li> <li>Tribal and family groups</li> <li>General community</li> </ul>	No	Maybe	No	

## Table 8. Adaptation strategies identified by Working Group 2, listed in descending order of importance

Adaptation strategy	Impacted EGS and threats OR resilience issue addressed (E = addresses EGS; R = addresses resilience)	Actions and stakeholders required to implement strategy	Scenario 1 <i>Opem Erub</i> Risk of mal- adaptation?	Scenario 2 Shaky Future Risk of mal- adaptation?	Scenario 4 <i>Keeping Culture</i> <i>Strong</i> Risk of mal- adaptation?
1.Education, small business, investors	Employment <b>R</b>	<ul> <li>Innovate educational module with TAGAI NQTAFE, universities (JCU),</li> <li>Partnership with entrepreneurs</li> </ul>	No	No	No
2. Public transport (renewable energy); Innovative transport	Lack of transport for business and family	<ul><li>TSRA</li><li>TSIRC</li></ul>	No	No	No
3. Teaching culture at school; Teach adults at	Culture <b>R</b>	Tagai, Elders	No	No	No

work Elders passing on traditional knowledge to different age groups; Using technology; Songs/stories; Community cultural day; Cartoon/book (children); NAIDOC; Capture and collect; Cultural knowledge and practices from Elders and cultural practitioners		•	Government Education QLD Cultural practitioners Kids organisations			
4. Prepare to move to higher ground/land issues; Seawall at low risk areas; Planting mangrove to protect shoreline; Research innovative ideas; Build new sub-division; Build lagoon at existing keper (shallow pool)	Rising sea level <b>E R</b>	•	TSIRC/TSRA Scientists Erubians Government	No	No	No

Table 9. Adaptation strategies identified by Working Group 3, listed in descending order of importance

Ada stra	aptation ategy	Impacted EGS and threats OR resilience issue addressed (E = addresses EGS; R = addresses resilience)	Actions and stakeholders required to implement strategyScenario 1 Opem Erub Risk of mal- adaptation?Scenario 2 Shaky Future Risk of mal- adaptation?Scenario 2 Shaky Future Risk of mal- adaptation?Scenario 2 Shaky Future Risk of mal- adaptation?	io 4 ng Culture 1 mal- ation?
1.	Get coastal engineering to provide options	Coastal erosion <b>E R</b>	Contact TSRA and local council No No No	
2.	Write to TSIRC, TSRA, Telstra to call for communications technology	Communications technology <b>R</b>	None identified     No     No     No	
3.	Next generation	Community	None identified No No No	
4.	Community hall for functions, gatherings, movies; Activities; facilities for kids	Infrastructure	TSIRC, TSRA, PSC, Dept. Sport No No No	
5.	Tidy village competition and tidy islands. Education campaign (posters, signs etc.), monthly clean ups.	Littering <b>R</b>	<ul> <li>School No No No No</li> <li>Rangers</li> <li>Sports clubs</li> <li>Fishing association</li> <li>My pathway</li> <li>Biosecurity for release of recycle cans if we can get a can crusher</li> </ul>	
6.	Fixing leaks and options for tank for gardening. Use of waste of treatment plant for fertiliser	Water <b>E R</b>	Council     No     No     No	
7.	Green waste for compost	Green waste <b>E R</b>	<ul> <li>Council No No No</li> <li>TSRA,</li> <li>Sustainable horticulture</li> <li>Rangers</li> <li>Community</li> </ul>	



Figure 27. Summary of the workshop process and results for all sessions.

# 5. Workshop evaluation

A questionnaire survey carried out before and after the workshop examined how participants' perceptions had changed. To the question "what is the greatest challenge that Erub will face in the future?", social and cultural issues were the most-frequently mentioned (26%), followed by economic issues, infrastructure and energy, well-being and human resources (12% each). After the workshop, social and cultural drivers were mentioned less frequently (19%), while economic issues and natural hazards increased to 17% each (Figure 28). To the question "is Erub resilient to future change?", 24% answered yes before, and 38% didn't know. After the workshop 34% answered yes and 34% didn't know. To the statement "Erub is ready to cope with climate change", the highest proportion (40%) were neutral, 25% agreed, 20% disagreed, and 15% didn't answer. After the workshop participants were more optimistic, with 25% strongly agreeing, 9% agreeing and 42% neutral (Figure 29).

After the workshop participants also selected from a range of answers about the impact the workshop had had on them (Table 10). The highest proportion of responses were that the workshop "increased my understanding of future change and how Erub can adapt" (35%) and it "made me think differently about the future" (30%). None of the respondents selected the options that the workshop "made me confused", "made me lose interest" or "had no impact on me". These results indicate that the workshop process had changed participants' perceptions of challenges facing Erub, the community's resilience and their views of the future.

Asked which information had the most impact, participants' responses included:

- "Knowledge gained about Erub community's views on issues facing them"
- "Cultural loss; global and local economics affecting our livelihood"
- "Outside influence and disasters, natural and economically affecting us as community"



"Climate change; pest and diseases from everywhere in the world coming to out islands"

**Figure 28.** Participants' responses to the question "what is the greatest challenge that Erub will face in the future?" (left) before (n=21) and (right) after (n=12) the workshop



Figure 29. Participants' responses to the statement "Erub is ready to cope with climate change" (a) before (n=21) and (b) after (n=12) the workshop

Table 10. Participants' statements regarding the workshop's impact on them

Response	Responses (%)
1. Increased my understanding of future change and how Erub can adapt	8 (35%)
2. Made me think differently about the future	7 (30%)
3. Will make me do something differently about the future	7 (30%)
4. Made me confused	0
5. Made me lose interest	0
6. Had no impact on me	0
7. No answer	1 (4%)

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# Appendix A: Workshop agenda

## NERP Tropical Ecosystems Hub Building Resilient Communities for Torres Strait Futures

Erub Yesterday, Today and Tomorrow Workshop

Wednesday 28<sup>th</sup> – Thursday 29<sup>th</sup> August 2013

Erub Island

Workshop objectives:

- 1. Discuss future challenges and opportunities for the Erub community
- 2. Identify important strategies to build the resilience of the community

#### SUMMARY OF WORKSHOP ACTIVITIES

### DAY 1: Wednesday 28<sup>th</sup> August

- 9:00 Welcome, introductions and start
- Session 1: What are the drivers of change for livelihoods on Erub?
- Session 2: What are the desired and possible futures for the Erub community?
- 5:00 Finish

## DAY 2: Thursday 29<sup>th</sup> August

- 9:00 Start
- Session 3: What impact will the Business as Usual future have on well-being?
- Session 4: What is the resilience of the Erub community today?
- Session 5: What are the priority adaptation strategies to build a resilient Erub community?
- 5:00 Summary, next steps and finish

## WORKSHOP PROGRAM

## DAY 1: Wednesday 28<sup>th</sup> August

#### 9:00 Opening address and prayer

9:15 – 9:45 Introduction, evaluation questionnaire and consents: Vic McGrath and James Butler (facilitators)

### 9:45 – 10:30 Session 1: What are the drivers of change for livelihoods on Erub?

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Discussion	45 mins	Where is Erub at the moment? What are the issues and problems? What are livelihoods?	Vic McGrath	Posters of terminology, defining livelihoods, resilience	Shared understanding of local issues and concepts used in the workshop

10:30 – 11:00 Morning tea

#### 11:00 – 1:00 **Session 1 continued**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Presentation	15 mins	Drivers of change and global futures	Erin Bohensky	Powerpoint, poster	
Presentation	15 mins	Climate change and sea level rise	John Rainbird	Powerpoint, poster	
Presentation	15 mins	Torres Strait and PNG population and economic trends, shipping	Tim Skewes	Powerpoint, poster	
Presentation	15 mins	Biodiversity and ecosystem assets trends	Tim Skewes	Powerpoint, poster	

Introduction	10 mins	Describe session on drivers	Erin Bohensky	Powerpoint	
Four working groups identify drivers	40 mins	List drivers of change differentiated as short and long term	Working groups facilitated by CSIRO- TSRA team	Cards for each group and white board	Drivers grouped by themes on board and split as short and long term issues
Voting	10 mins	Rank drivers by importance	Erin Bohensky	White board and stickers	Ranked groups of drivers

1:00 – 2:00 Lunch

### 2:00 – 4:00 Session 2: What are the desired and possible futures for the Erub community?

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Elders historical timeline and stories	30 mins	Where has Erub come from, how has it changed and what caused these changes?	Erub Elders	Time-line picture of Erub's history	Time-line picture of Erub
Four separate working groups for women, men and elders	15 mins	Future vision for Erub community	Vic McGrath	Flip charts	Statements of desired future for the community
Presentation	15 mins	Introduce scenario planning, select and describe two most important drivers	Erin Bohensky	Central flip chart to explain 2x2 matrix and describe drivers	
Four working groups develop scenario narratives	1 hour	Describe scenarios with narratives and pictures for 2100 including thresholds	Four working groups, facilitated by CSIRO- TSRA	Flip chart and pens for each group	Narrative and pictures for each scenario, one working group per scenario

4:00 – 4:15 Tea

## 4:15 – 5:00 **Session 2 continued**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Four working groups present scenarios	45 mins	Presentation of scenarios by four groups	Four working groups	Digital recorder to tape narratives	Feedback from audience and refining of scenarios

## DAY 2: Thursday 29<sup>th</sup> August

#### 9:00 – 9:30 **Review Day 1**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Review Day 1 Preview Day 2	30 mins	Review of drivers, desired future and preview Day 2	Erin Bohensky	All posters, flip charts from Day 1, working groups scenarios grouped on walls	

## 9:30 – 10:30 Session 3: What impact will the Business as Usual futures have on well-being?

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Four working groups discussion	30 mins	Review of ecosystem goods and services (EGS) for Erub	Tim Skewes	Refined EGS list	List of EGS for Erub
Four working groups discussion	30 mins	Valuation of EGS	Tim Skewes	Spreadsheets for production and value	Completed data sheets

10:30 – 11:00 Tea

11:00 – 11:30 **Session 3 continued** 

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Presentation of EGS results and impacts in 2030	30 mins	EGS results and impacts in 2030 under Business as Usual scenario	Tim Skewes	EGS results	

#### 11:30 – 12:30 Session 4: What is the resilience of the Erub community today?

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Discussion	1 hour	What is resilience? What is vulnerability?	John Rainbird	Examples of previous challenges for Erub	

12:30 – 1:30 Lunch

## 1:30 – 2:30 **Session 4 continued**

Assessment of community 1 hour resilience and vulnerability	Community ranking of resilience indicators	John Rainbird	Word table	Heat map of indicators and community scoring
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## 2:30 – 4:00 Session 5: What are priority adaptation strategies to build a resilient Erub community?

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Four working groups – women and men separate	1 hour	Adaptation strategies required	Working groups, facilitated by TSRA- CSIRO	Butcher's paper, printed graphs of EGS impacts, resilience indicators and scores	'No regrets' adaptation strategies listed by each group
Presentation of strategies	30 mins	Presentation of strategies by groups	Working group representatives	Butcher's paper result sheets for each group	Adaptation strategies discussed

## 4:00 – 4:30 Working tea and evaluation questionnaire

## 4:30 – 5:00 Conclusions and next steps

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Discussion	30 mins	Workshop evaluation, next steps	Erin Bohensky	Central flip chart	Workshop evaluation, next steps agreed