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Technical Report

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



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



Australian Government

Department of Sustainability, Environment,
Water, Population and Communities



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Project 11.1 Building Resilient Communities for Torres Strait Futures

Butler, J.R.A.,¹ Rainbird, J.,² Skewes, T.,³ McGrath, V.,² Nai, F.,⁴ Bohensky, E.,⁵ Maru, Y.⁶
& Morseu, F.²

¹ CSIRO Ecosystem Sciences, Ecosciences Precinct, Brisbane

² TSRA Land and Sea Management Unit, Indigenous Coordination Centre, Cairns

³ CSIRO Marine and Atmospheric Research, Ecosciences Precinct, Brisbane

⁴ Councillor for Masig, Torres Strait Island Regional Council

⁵ CSIRO Ecosystem Sciences, ATSIP, James Cook University, Townsville

⁶ CSIRO Ecosystem Sciences, Desert Knowledge Precinct, Alice Springs

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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
DSEWPaC	Department of Sustainability, Environment, Water, Population and Community
DFAT	Department of Foreign Affairs and Trade
EGS	Ecosystem goods and services
IBIS	Islanders' Board of Industry and Service
IPCC	International 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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We extend our gratitude to the community of Masig Island for inviting us to undertake this workshop, and the participants for their time and enthusiasm. In particular we thank TSRA Member Hilda Mosby and the Masigalgal TSRA Rangers for their logistical assistance; and the Masig Elders Wycie Billy, Glorieana Mosby, Dan Mosby, Daisy Kebay, Moses Mene and Nancy Mene for their participation and patience.

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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	DSEWPaC International Section
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

Drs. Jack Katzfey, Sara Busilacchi and Russell Wise (CSIRO) assisted with data collation and workshop preparation. Wayne Spencer (RRRC) assisted with the design of the resilience poster.

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 second scenario planning workshop, which was held at the community level on Masig Island. Twenty-one community members attended, including six elders, six TSRA Ranger staff, one high school student and for some sessions, pupils and teachers from the Masig Primary School and Tagai Secondary College. 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 10th – 11th July 2013 at the Masig Community Hall on Masig 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 Masig? Working groups listed 43 short term (less than 10 years) and long term (more than 10 years) drivers of change. These were grouped into themes, and participants voted on the two most important themes. Change in Masig culture was the most important driver, followed by social/economic/political factors (e.g. cost of living, local employment, health, population growth or decline).

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

Participants developed four visions for the Masig community in 2100. The Women's Group vision was:

“Strong unity, family bonds and community; strong culture; traditional language (native tongue ‘Kulkgau ya’); future farming – clams, ilan garden (kumala, maniotha, yam, banana), poultry farm (chicken, eggs), pigs and ducks; sustainable waste management and community awareness; educate children to live healthy and clean livelihoods, passing on cultural values and knowledge, and between men and women”

A matrix of four possible future scenarios was created from better or worse extremes of Masig culture and social/economic/political drivers, which included extreme or less extreme climate change and sea level rise. Participants created narratives and drew pictures for each scenario for 2100. These ranged from the ‘Best Case’ *Healthy Lifestyle* (strong Masig culture, affordable cost of living, local employment, viable population, good health, benefits from growth in Western Province PNG and Papua Province Indonesia, less extreme climate change including 0.5 m sea level rise), to intermediate *Gold Coast to Masig* and *Masig Self-sufficiency*, to the ‘Business as Usual’ *Drifting Away* scenario (weak Masig culture, high cost of living, unemployment, unviable population, poor health, negative impacts from growth in Western Province PNG and Papua Province Indonesia, and extreme climate change including 1 m sea level rise). Key thresholds identified, when irreversible changes may occur, were under-population, the loss of Masig language and culture and the moving of housing and infrastructure to higher ground on Masig. All were predicted to occur by 2040. Elders also drew a historical timeline of key events on Masig, and showed that since World War II there had not been any major environmental or socio-political shocks.

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 Masig. This projected the impacts of drivers of change on EGS and human well-being by 2030 under the ‘Business as Usual’ *Drifting Away* scenario. The most important EGS for Masig livelihoods are rock lobster, coastal finfish, reef fish, fresh water, and green turtles. Participants estimated that local EGS contribute 46% of their health, food security and cultural needs, compared to 54% from 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 EGS was green turtles, followed by fresh water, and was caused primarily by climate change, but also increased exploitation due to population growth. Sea level rise will impact significantly on terrestrial EGS such as garden food production.

Session 4: What is the resilience of the Masig community today? Using nine indicators of general resilience, participants developed a resilience profile for the Masig community. Disaster preparedness, food and water self-sufficiency, good leadership, the ability of the community to organize and make decisions quickly, and networks and partnerships beyond Masig all scored moderately highly. Working well together to address challenges, innovation and creativity and ability to learn scored medium. Financial capacity scored low. A tenth indicator, language and culture, was added by participants and scored medium.

Session 5: What are the priority adaptation strategies to build a resilient Masig community? Based on the EGS and human well-being impacts for 2030 and the resilience profile, participants designed adaptation strategies for livelihoods to steer them away from the Business as Usual *Drifting Away* scenario and towards the Masig visions. Three working groups identified six strategies. Five addressed both EGS impacts and resilience issues, and one only addressed a limitation for resilience (community meetings to improve communication):

Working Group 1:

1. Cultural renewal strategy
2. Build community financial management capacity, including eco-tourism

Working Group 2:

1. Improve Masig Turtle and Dugong Management Plan to control the over-harvest of green turtles
2. Improve garden food production

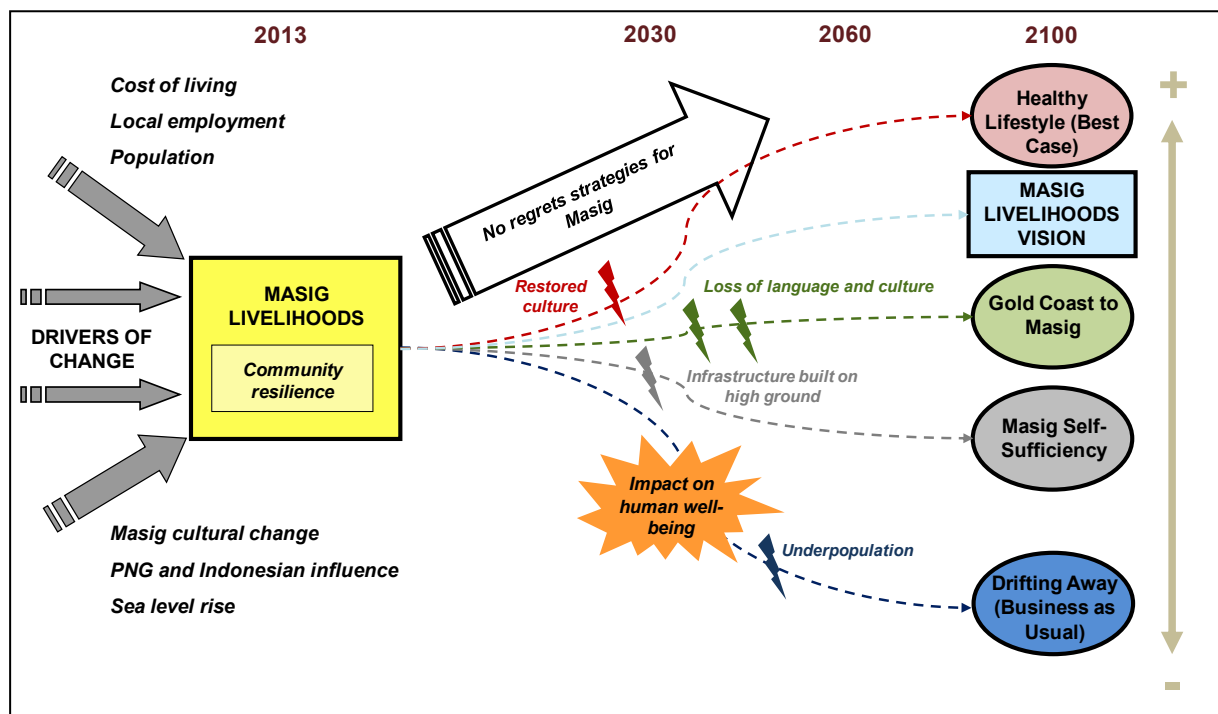
Working Group 3:

1. Meetings to improve community communication
2. Improve garden food production, including hydroponics

Strategies were cross-checked with the other potential future scenarios (i.e. *Healthy Lifestyle*, *Gold Coast to Masig*, *Masig self-sufficiency*) to determine whether they would be mal-adaptive if these scenarios eventuated. Only Working Group 1's building of community financial management risked being mal-adaptive because it could undermine Masig culture. 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 Masig will face in the future?", coastal erosion was the most frequently mentioned before, but loss of cultural values became the most important after. To the question "is Masig resilient to future change?", 62% agreed before, but this increased to 91% after. To the statement "Masig is ready to cope with climate change", 8% disagreed before the workshop and 23% agreed. This changed to none disagreeing after, and 36% agreeing. Most participants felt that the workshop had either "increased my understanding of future change and how Masig can adapt" or "made me think differently about the future".

Next steps: The perceptions of the Masig 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 (Fig. 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 '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 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 will be 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 they affect communities and their livelihoods?
3. Which communities are most likely to be impacted by changes?
4. What is their capacity to adapt?
5. What are the priority 'no regrets' strategies that will build communities' resilience and capacity to adapt?

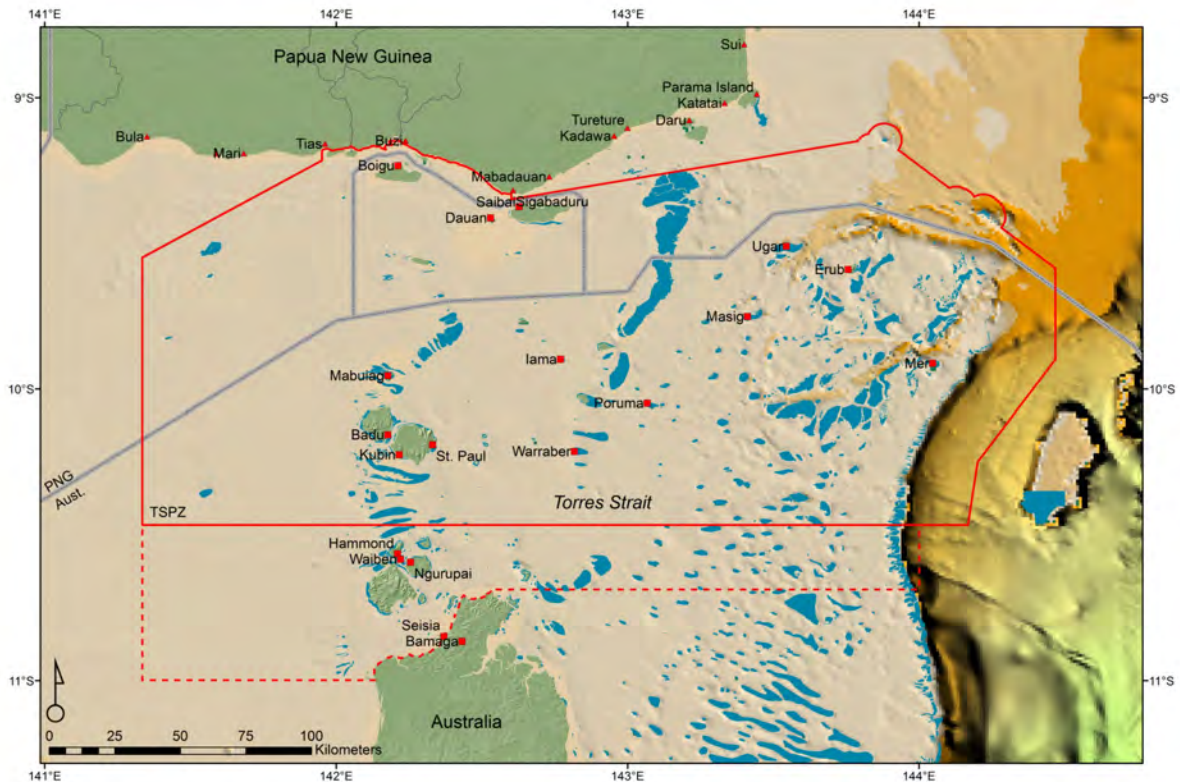


Figure 1. The Torres Strait region, showing Masig Island, reefs, international boundaries, the Torres Strait Protected Zone (TSPZ) and Australian and PNG Treaty communities. The 14 Australian communities within the TSPZ are the focus of this study.

1.2 Masig Island

Masig (also known as Yorke Island) lies in the central group of Torres Strait islands, 158 km north-east of Horn Island, and 70 km south of Daru, the capital of Western Province, PNG (Fig. 1). Masig is a tear-shaped, low lying coral cay island, approximately 2.8 km long and 0.8 km wide at its widest point, with an area of 1.62 km² (Fig. 2). It is located on the west end of a narrow east-west orientated reef system. The topography is flat with ground level generally 3 m above local mean sea level. Vegetation consists of dense trees on the eastern and western parts of the island. The main community is located in the north-eastern end of the island and covers an area of approximately 300 m x 300 m. The island is adjoined to a smaller uninhabited cay, Kodai.

Masig's population in 2012 was approximately 280 people, with a density of 173/km². In 2001 the population was higher, with 340 people at a density of 210/km². Infrastructure on the island includes a de-salination plant for water supplies, a diesel generator 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, plus an IBIS supermarket store. The Masig Sustainable Land Use Plan (CONICS 2008) identified the following pressing issues for the island:

- Projected population increases will pressure landfill, water, electricity and housing availability;
- Sea level rise, beach erosion and storm surges will threaten existing infrastructure and housing, plus the island cemetery;
- Future demand for housing must take into account potential loss of land area from sea level rise.



Figure 2. Aerial photograph of Masig (Yorke) 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 (Fig. 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 co-management', 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 Masig Island community's challenges and opportunities, and adaptation strategies required to improve their livelihoods. Masig Island was a focus of the regional stakeholder workshop held in Cairns in October 2012 (Butler et al., 2012a), and a participant at that workshop, Councillor Fraser Nai, requested that the project

should visit the island as a case study. 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, a resilience self-assessment carried out by participants, and 'no regrets' adaptation strategies which will build community resilience. These will be integrated with regional stakeholders' perceptions in 2014.

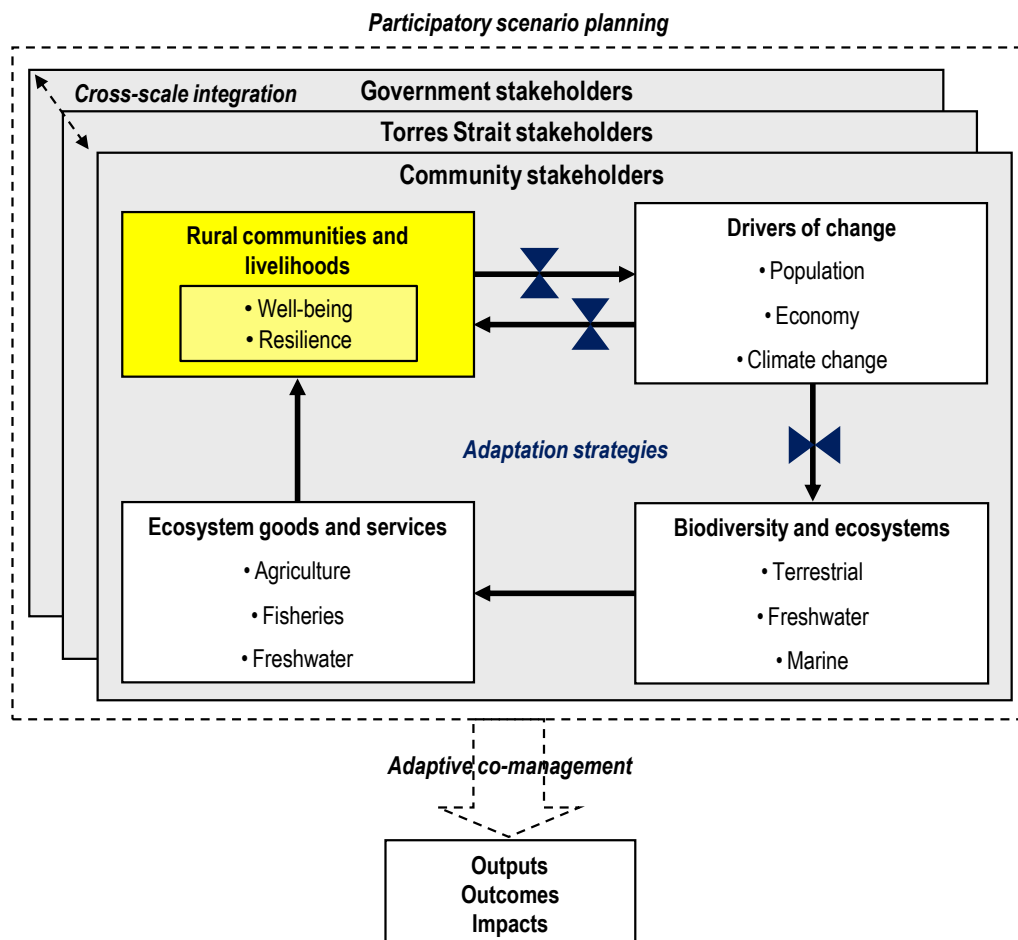


Figure 3. Conceptual diagram of the the system dynamics influencing communities and their livelihoods, stakeholder levels and adaptation strategies. The research process of participatory scenario planning, cross-stakeholder integration and adaptive co-management are indicated by dashed lines

3. Masig 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. Following this, the invitation from Councillor Fraser Nai, the TSIRC representative for Masig, was accepted, and a date set for the workshop.

Councillor Nai, 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, TSRA Rangers and pupils from the Masig Primary School. A visit to the island by Tagai Secondary College students also coincided with the workshop, and

they attended one of the sessions. Excluding pupils and their teachers, 21 people participated, including including six Elders, six TSRA Ranger staff and one Year 12 student. Of these, seven were women and 14 were men (Table 1).



Workshop participants, Tagai Secondary College pupils, CSIRO and TSRA team members

Table 1. Workshop participants and their affiliations

No.	Participant	Affiliation
1	Jarrold Mabo	Year 12 student
2	Shaun Skerritt	Masigalgal TSRA Ranger Coordinator
3	Kevin Levi	Porumagul TSRA Senior Ranger
4	Loice Naawi	Masigalgal TSRA Ranger
5	Laura Pearson	Warraberalgahl TSRA Senior Ranger
6	Percy Misi	Community Employment Australia
7	Simon Nari	My Pathway
8	Michael Mosby	My Pathway
9	Fraser Nai	TSIRC Councillor Masig
10	Francis Naawi	Prescribed Body Corporate Chair, Masigalgal TSRA Senior Ranger
11	Edna Nai	Masigalgal TSRA Ranger
12	Songhie Billy	TSIRC Masig
13	Peter Nai	
14	Rocky Gela	TSIRC Masig
15	Wycie Billy	Elder
16	Daisy Mosby	Elder
17	Glorieana Mosby	Elder
18	Nancy Mene	Elder
19	Moses Mene	Elder
20	Gabriel Au Nai	Masig Community Police
21	Dan Mosby	Elder

3.2 Workshop process

The workshop was held over two days on 10th and 11th July 2013 at the Masig Community Hall, Masig Island. The workshop was entitled 'Masig Yesterday, Today and Tomorrow'. Workshop facilitation was led by Vic McGrath (TSRA) and James Butler (CSIRO), supported by Councillor Nai, John Rainbird (TSRA) and Tim Skewes (CSIRO). Posters summarising presentations were displayed around the meeting room throughout the workshop.

The objectives of the workshop were to:

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

Following local cultural protocols, at the start of the workshop Father Gabriel Nai lead 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).

Table 2. Terms and definitions used in the workshop

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
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

The workshop process was explained to the participants using Fig. 4. Five steps are taken:

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 (Figs. 4 and 5; Appendix I). 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.

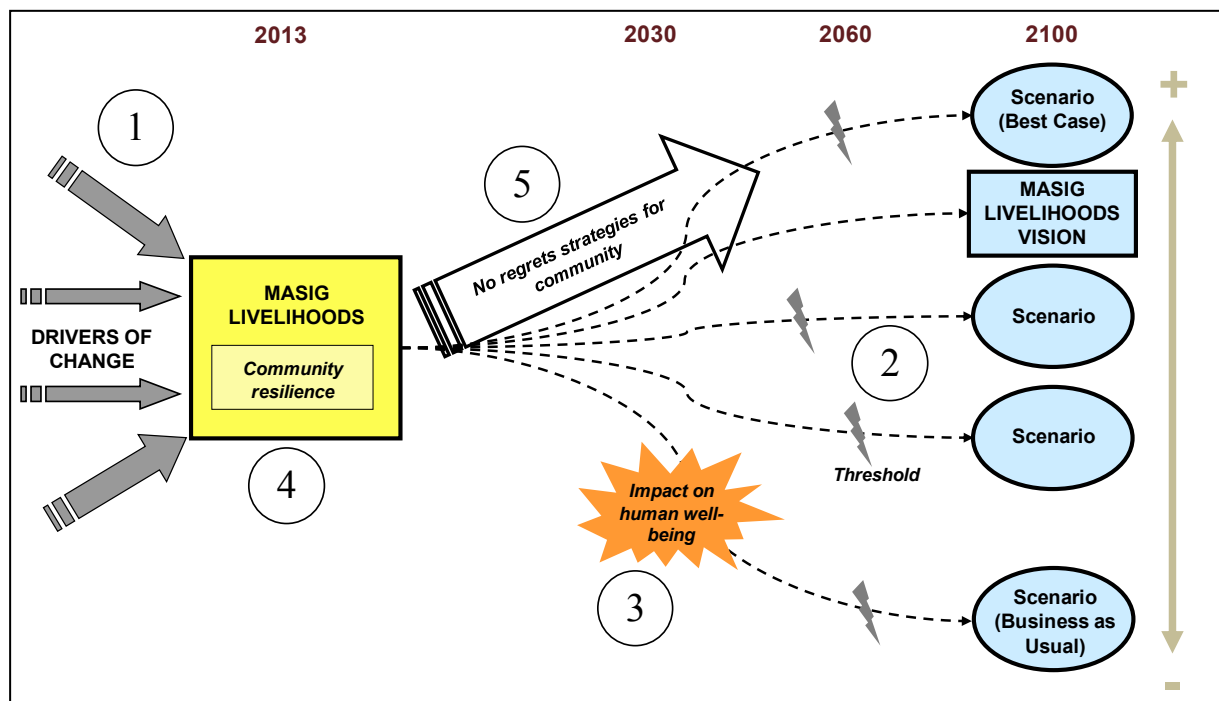


Figure 4. Diagram of the workshop process. Numbers refer to the workshop steps and sessions

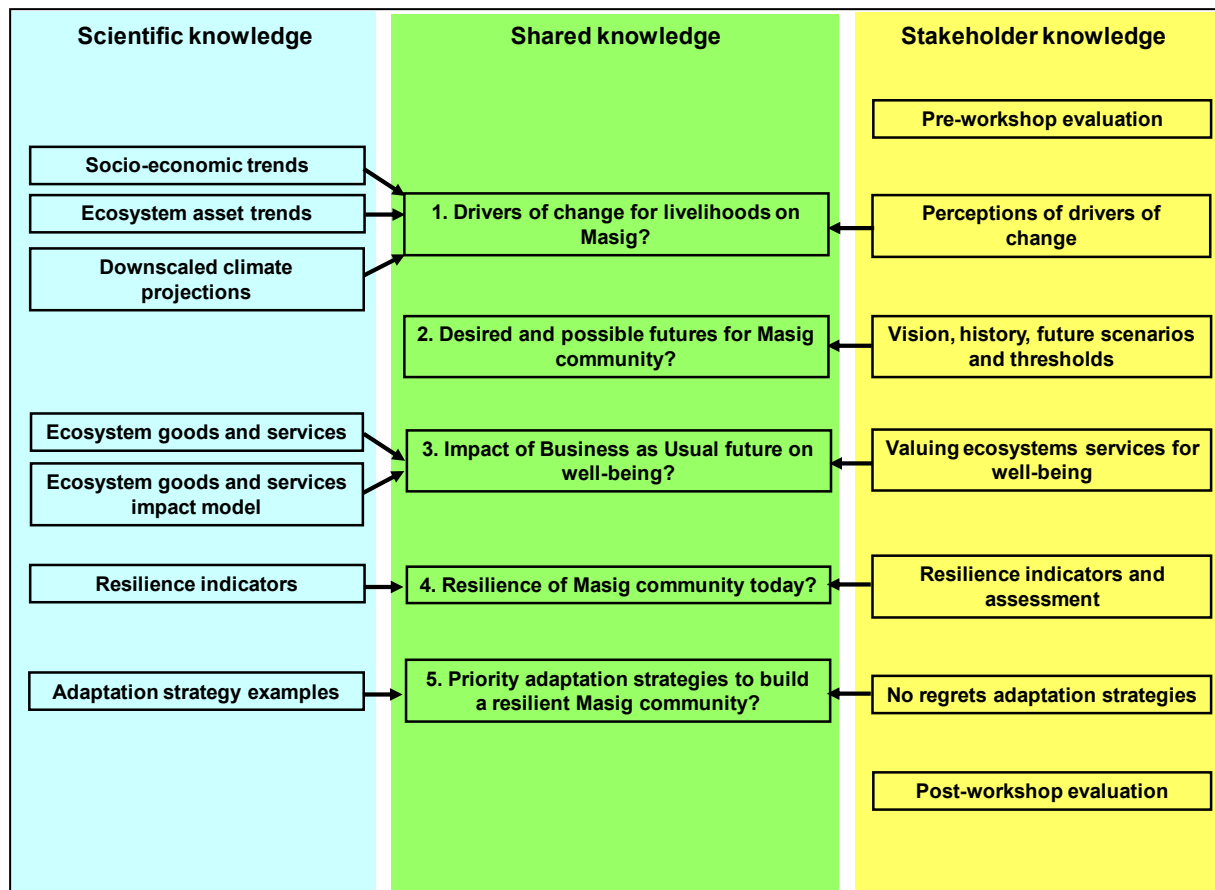


Figure 5. Workshop structure and sessions, showing the process of knowledge integration

4. Workshop results

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

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 Masig 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 Masig (Fig. 6) and the Torres Strait (Fig. 7), projected population growth for the Torres Strait (Fig. 8) and PNG's Western Province (Fig. 9), and planned resource development in Western Province (Fig. 10). Current climate patterns, climate change projections downscaled to 8 km from the IPCC A2 'high' emissions scenario (Fig. 11, Table 3) using the CSIRO Conformal Cubic Atmospheric Model (CCAM; McGregor and Dix 2008), and sea level inundation risk for Masig were presented by John Rainbird (Fig. 12). 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 (Fig. 13), suggesting that the population is becoming vulnerable because smaller turtles lay fewer eggs.

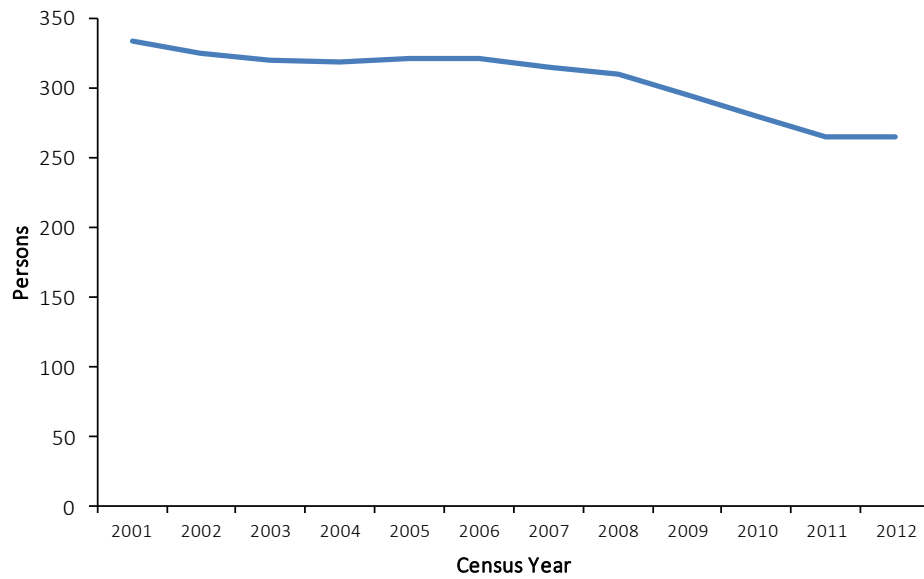


Figure 6. Population census data for Masig Island, 2001- 2012. There are currently approximately 280 people resident on the island. (Source: Australian Bureau of Statistics)

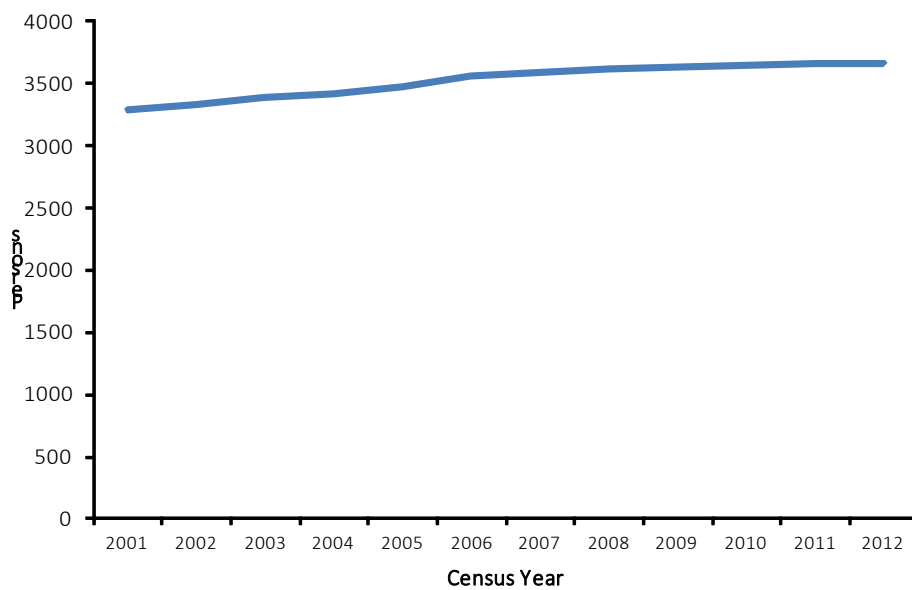


Figure 7. Population census data for the TSPZ including Hammond Island, 2001- 2012. Numbers have increased gradually from 3,250 to 3,600. (Source: Australian Bureau of Statistics)

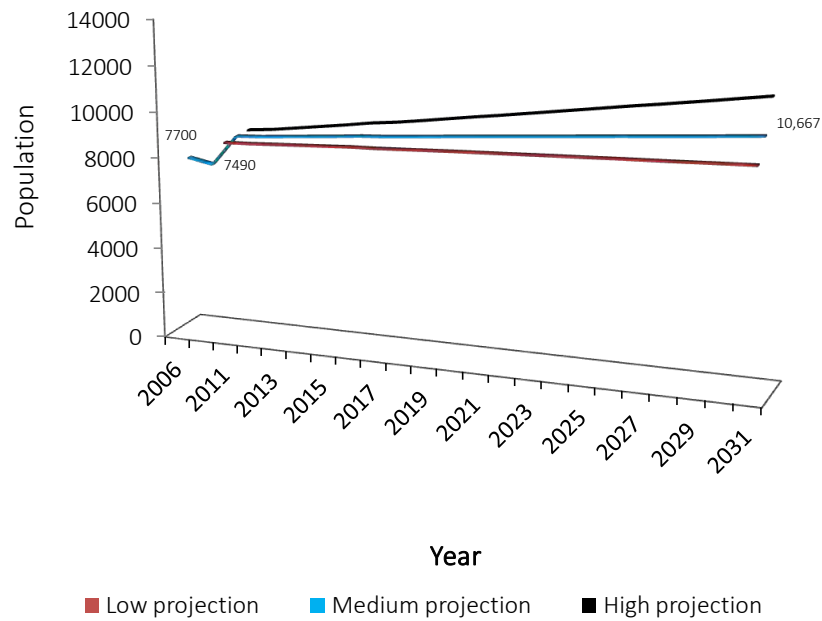


Figure 8. Population census data for the Torres Strait Indigenous Region for 2006 and 2011, and low, medium and high projections until 2031. Note that as well as the 14 TSPZ communities, in 2011 this statistical region included Thursday Island, Horn Island and Hammond Island. Although there was a decline 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).

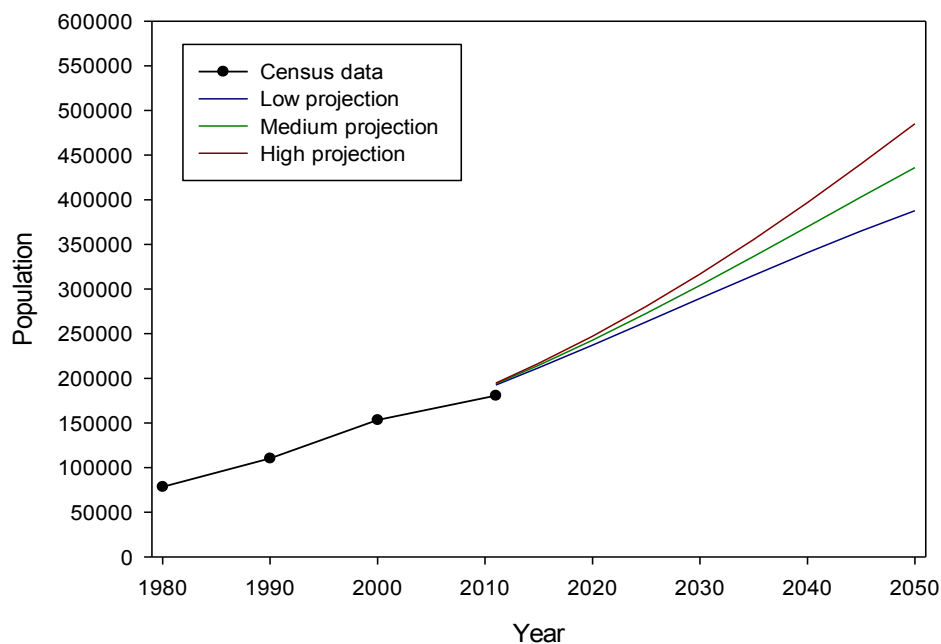


Figure 9. Population census data for Western Province, PNG in 1980-2011, and projected increases between 2012 and 2050 at low, medium and high projections. The average annual growth rate in 2000-2011 was 1.5%. At medium projections, the population may at least double from 180,000 to 420,000 by 2050. For full details see Butler et al. (2012b).

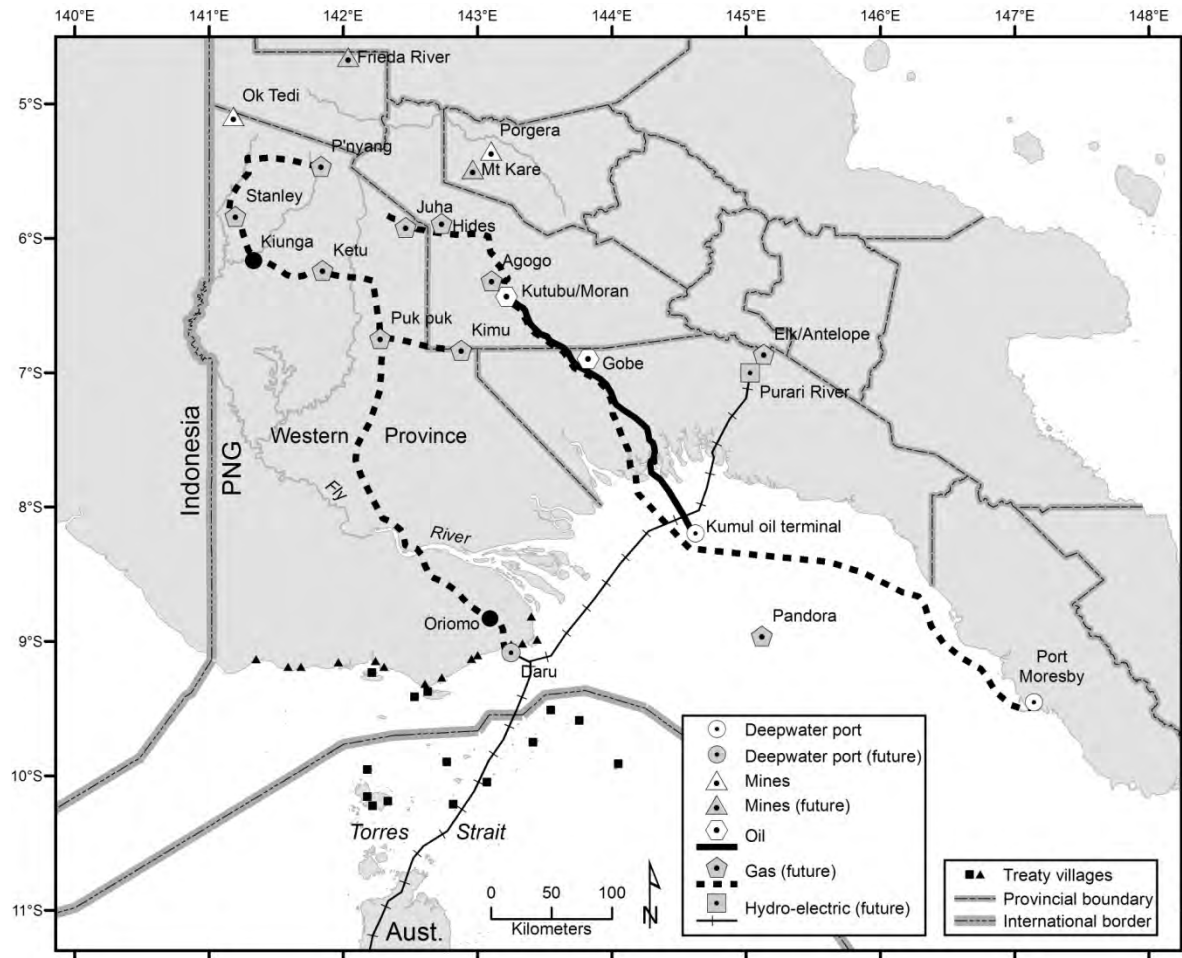


Figure 10. Summary of current and planned resource development projects in PNG neighbouring the Torres Strait. For full details see Butler et al. (2012b).

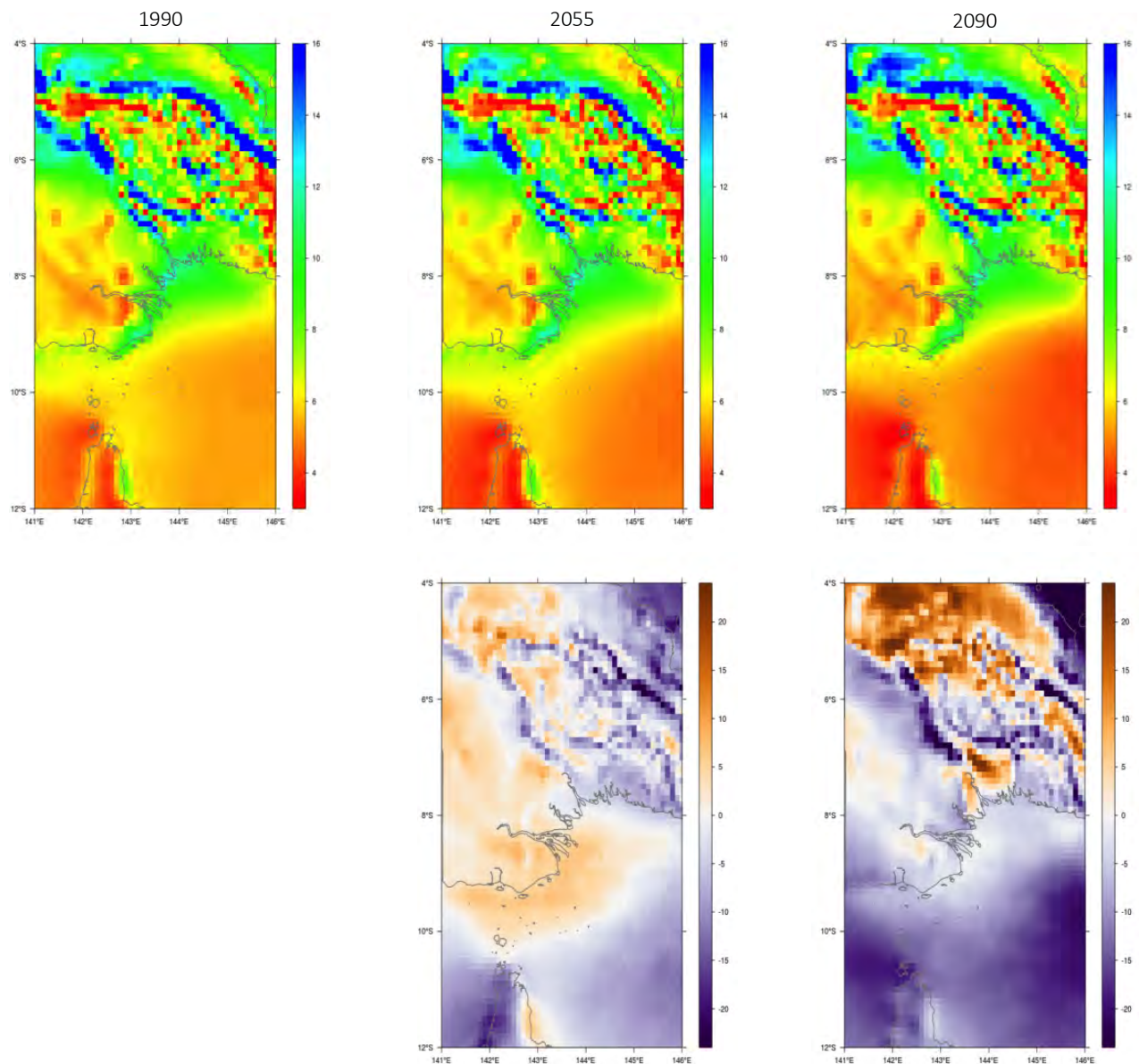


Figure 11. Annual mean rainfall rate (mm day⁻¹, top row) and changes relative to 1990 (bottom row) in the Torres Strait region under the IPCC A2 emissions scenario, downscaled to 8 km using CCAM. For full details see Katzfey *et al.* (2012).

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

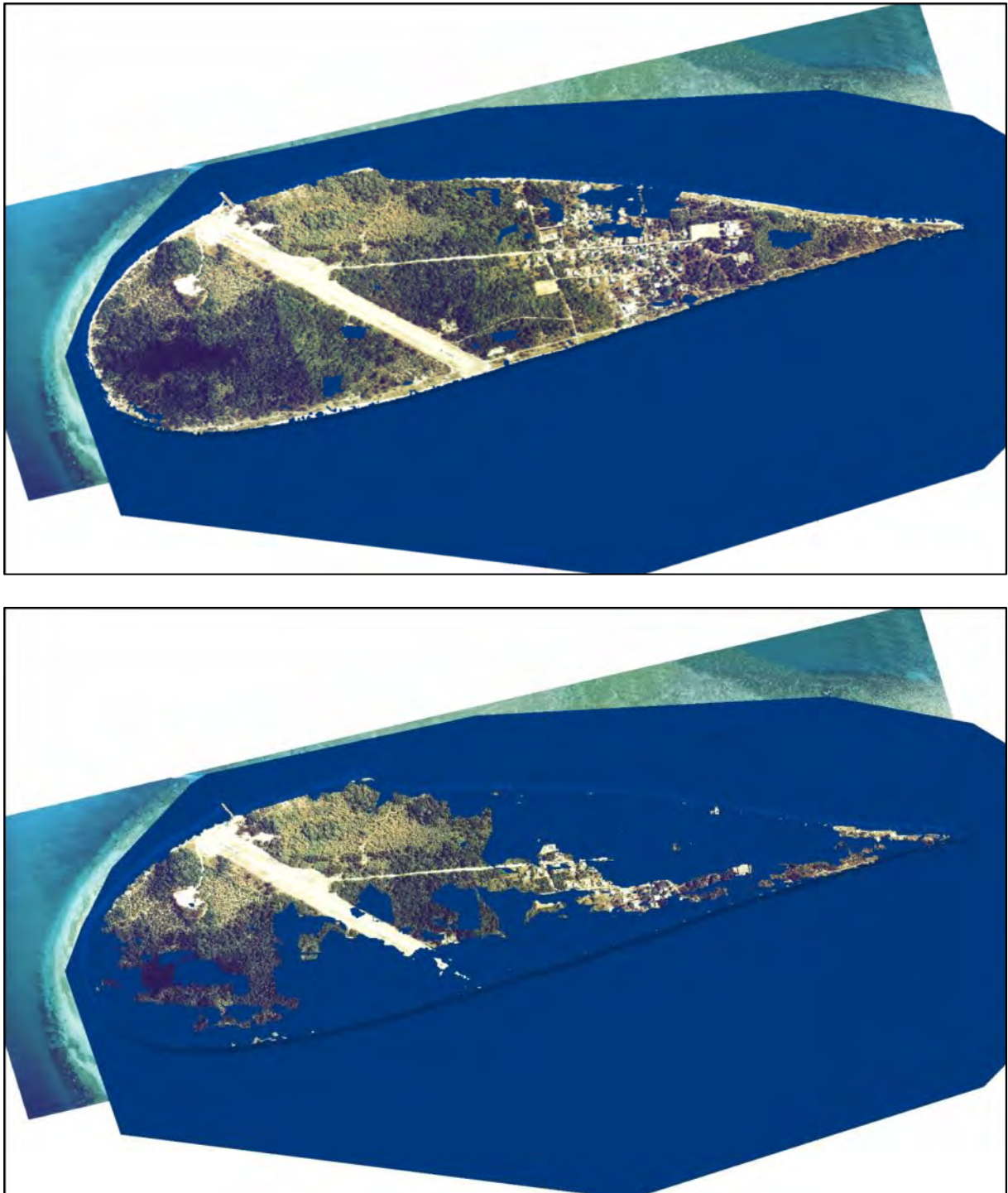


Figure 12. Inundation risk for Masig Island under current Highest Astronomical Tide (HAT) (top) and HAT plus 59 cm sea level rise (bottom). (Source: Kevin Parnell, James Cook University).

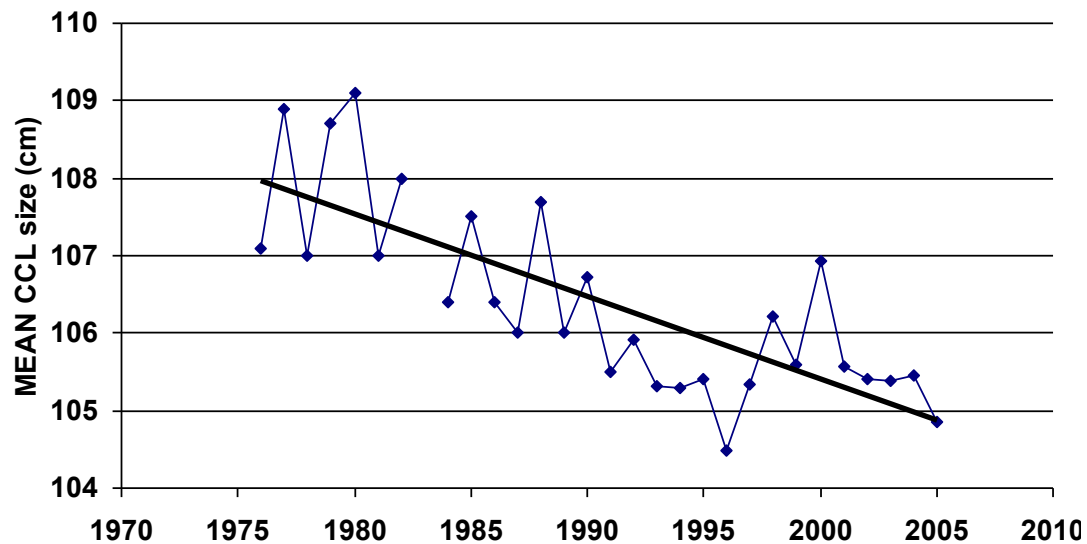


Figure 13. Trend in curved carapace length (CCL) of nesting females green turtles at Raine Island, 1976-2005 (Source: Colin Limpus, Queensland Environmental Protection Agency)

Following these presentations, workshop participants were divided into four groups to discuss their perceptions of the current and imminent drivers of change for the Masig community and their livelihoods. Each group wrote down their selected drivers on sticky note paper, and placed a total of 43 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. Drivers of change for Masig Island identified and grouped into themes by participants. The two most important themes selected by voting were culture and social/political/economic.

Theme (total votes)	Short term (<10 years) drivers (votes)	Long term (>10 years) drivers (votes)
Culture (20)	Loss of core values (3)	Cultural identity
	Western culture/education (2)	
	Language/traditional culture (3)	
	Cultural breakdown (1)	
	Lost cultural values	
	Resisting drivers of change	
	Spirituality and spiritual values (4)	
	Invasion of culture (1)	
	Not doing self-analysis (3)	
	Respect of fellow human beings	
	Young people not being self-aware	
	Unity in our community (3)	
Social/political/economic (9)	Drugs and alcohol	Food security
	Diet in eating healthy foods (1)	Economic base for Torres Strait and Masig (1)
	Rising cost of living (1)	Greater reliance on Australia and PNG
	Not enough employment	Transnational issues/influences
	Demography young people not returning to Masig	Demographic change
	Lack of education (1)	Ageing population
	Unemployment (1)	Regional ability to respond to major disasters, epidemics etc.
	Population: increase in family overcrowding	
	Population increase/depletion	
	Information: the right information and the right people	
	Infrastructure for an ageing population (1)	
	Building airstrip and ramp; easy transport for food and travel	
	Health: younger people dying too young from unhealthy habits (1)	
	Erosion of island: caused by ramp and poor planning and consultation (1)	
	Costs of freight and services	
	Housing (1)	
Technology (3)	Keeping pace with technology	Renewable energy systems for jobs (1)
	Practical sustainability; energy and food production	
	Technology, social media (1)	
	Building infrastructure today that improves resilience (1)	
	Technology: educates on views from other parts of the world	
Natural resources (4)	Impact on our ecosystems	Resource depletion
	Commercial fishermen, prawn trawlers (1)	
	Polluted sea: people, shipping, fishermen, ghost nets	
	Hunters hunt too many dugong and turtle	
	Pollution: shipping, rubbish/waste disposal (1)	
	Increased shipping accidents (1)	
	Community gardens: gardening explained but by ourselves	
	Water issues: population pressure (1)	
Climate change (4)		Climate change (2)
		Climate impacts on health: people might move away (2)

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

4.2.1 Desired future vision for Masig Island community

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

a) Elder's Group:

A green (lots of trees) island, clean island with access to clean cheap water, including using well water using traditional water management. Island protected from erosion by trees and geotech bags put in by Island Coordinating Council. Well-planned housing to compliment well management plan.

b) Women's Group:

- *Strong unity, family bonds and community*
- *Strong culture*
- *Traditional language (native tongue 'Kulkalgau ya')*
- *Future farming – clams, ilan garden (kumala, maniotha, yam, banana), poultry farm (chicken, eggs), pigs and ducks*
- *Sustainable waste management and community awareness*
- *Educate children to live healthy and clean livelihoods, passing on cultural values and knowledge and between men and women*

c) Men's Group 1:

- *Traditional ecological knowledge preserved, practiced, used*
- *Maintain cultural values*
- *Greater self sufficiency*
- *More employment opportunities*
- *Economic base*
- *Strategic stewardship*
- *Low impact ecotourism*
- *Sustainable resource management*
- *Networking across communities*
- *Strong community, strong region*

d) Men's Group 2:

- *Church events – to be acknowledged (e.g. Rogation Sunday first fruit)*
- *More families gather and share*
- *Individual families to have more conversation and interaction*
- *Shaving Party in traditional way*
- *Hunting and traditional practices*
- *More men's gathering and women's meeting (e.g. V Team cleanup day at the cemetery)*
- *Community garden part of health regime*

4.2.2 Masig historical timeline

To describe life on Masig 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 Masig Island, the Elders then developed a timeline from their knowledge, showing key events (Fig. 14). This was presented to the workshop (see below). The previous day a discussion with the Elders revealed that there had been no major environmental (e.g. cyclones, food shortages) or socio-political (e.g. financial crises) shocks to the island in their living memory. The most marked change had been the installation of the airstrip in 1971, telephone infrastructure, and increased barge services from monthly to weekly, which increased the level of contact between the community and the outside world.



Vic McGrath (TSRA) and the Masig Elders discussing a historical timeline for the island

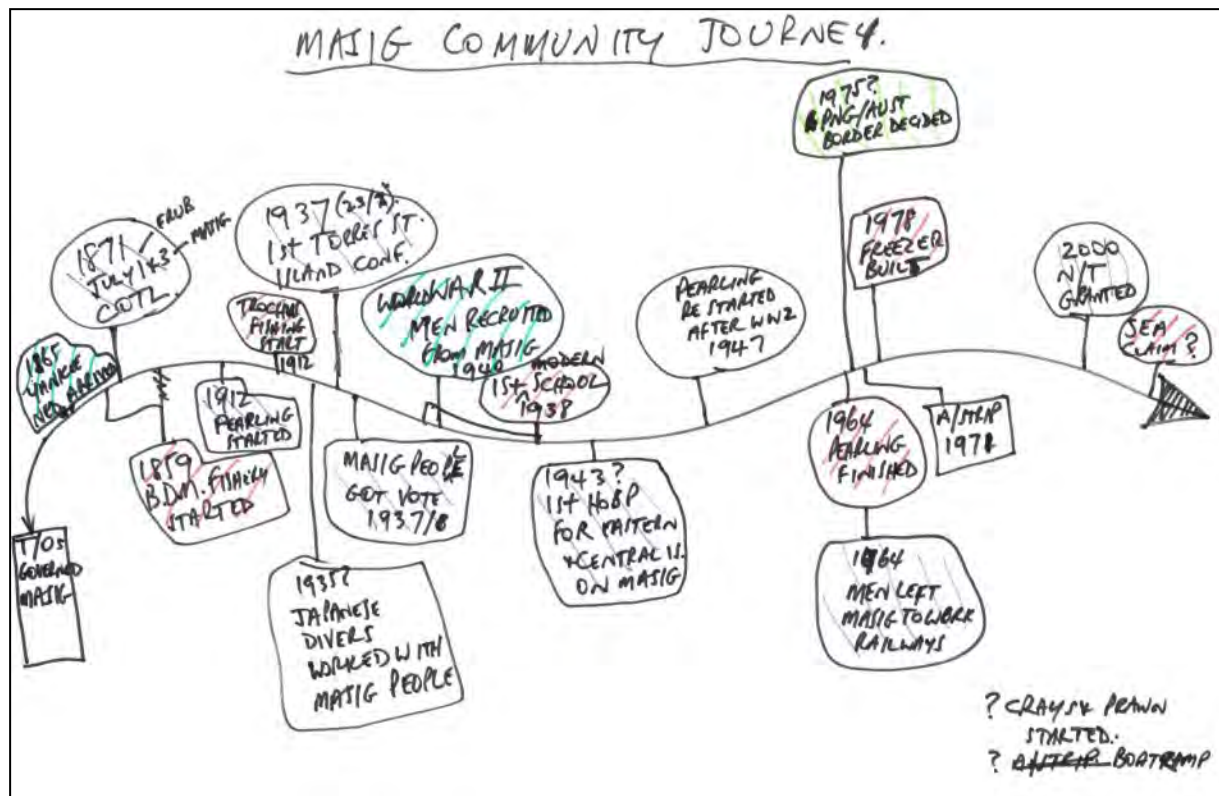


Figure 14. The timeline for Masig developed by the Elders

Verbatim narrative for Masig timeline

"Back in the start we had traditional people, we did not have Land and Sea Management Unit, we didn't have IBIS we just had the traditional people existing on the island growing their food and catching fish from the sea, making their own laws, deciding who gets married etc. We started the earliest when "Yankee Ned Mosby" in the year 1865. He came with the idea to develop the place and make money for himself, ended up marrying a local lady and staying here. The year 1859 beche de mer fisheries started. Didn't last too long because when fisherman from outside arrived they discovered pearl shells. On July 1st 1871 at Darnley, Missionaries came and introduced Christianity "Coming of the Light". Masig celebrated 3rd July as their "Coming of the Light." In 1912 trochus shell and pearling fisheries were introduced. There was a big maritime strike in 1936. On August 23rd 1937, Masig at the first and most significant Torres Strait Islands Council Meeting. Masig people were also able to vote in either 1937 or 1938. World War II came in 1940, the pearling industry stopped while the men joined the War. Around that time (1938) they had the first modern school at Masig. In 1943 first hospital built for Eastern Island and Central Island on Masig. Pearling industry resumed in 1946. The men would work and save money and their families would eventually own their own boats. The industry then closed in 1964. In 1964 some men also left Masig and move to the mainland to go and work on the railways. In 1975 the PNG/Australia border. 1971 airstrip open on Masig. A freezer was built on Masig in 1978. In the year 2000 Native Title was declared/granted on Masig. Currently got the Sea Claim ongoing. As this is a rough draft there are still some things missing for example when crayfish started on Masig and when the boat ramp was built".

4.2.3 Future scenarios for Masig Island

Using the two most important themes of drivers from Session 1 (culture and social-economic-political), two axes were created with different extremes of each driver. These axes were described in broad terms as Masig culture (strong versus weak) and social-economic-political conditions (which included cost of living, local employment, population, health, and the influence from population growth and development in Western Province, PNG and Papua Province, Indonesia (Fig. 15). The global economic and political conditions also had influence on the extent of climate change and sea level rise.

These axes created a matrix of four future scenarios for Masig, which combined better or worse levels of the drivers. Workshop participants were divided into four working groups, one for each scenario. They developed a narrative of Masig livelihoods in 2100 for their scenario, drew a picture, and identified any potential thresholds of change and the likely year that these would be encountered (Figs. 16 – 19). Fig. 20 shows the final matrix of scenarios relative to the drivers of change.

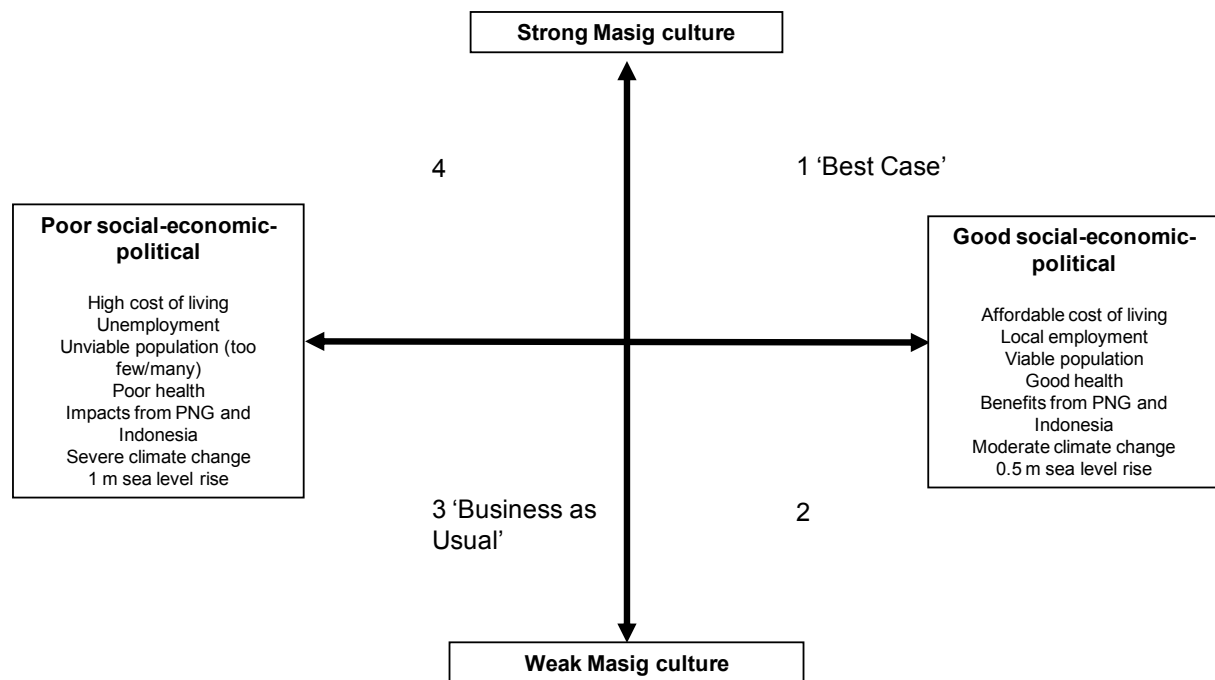


Figure 15. The matrix of four future Masig Island scenarios created by combining better or worse levels of the two most important driver themes, Masig culture and social-economic-political factors (which included climate change)



Workshop participants drawing a scenario picture and creating a narrative

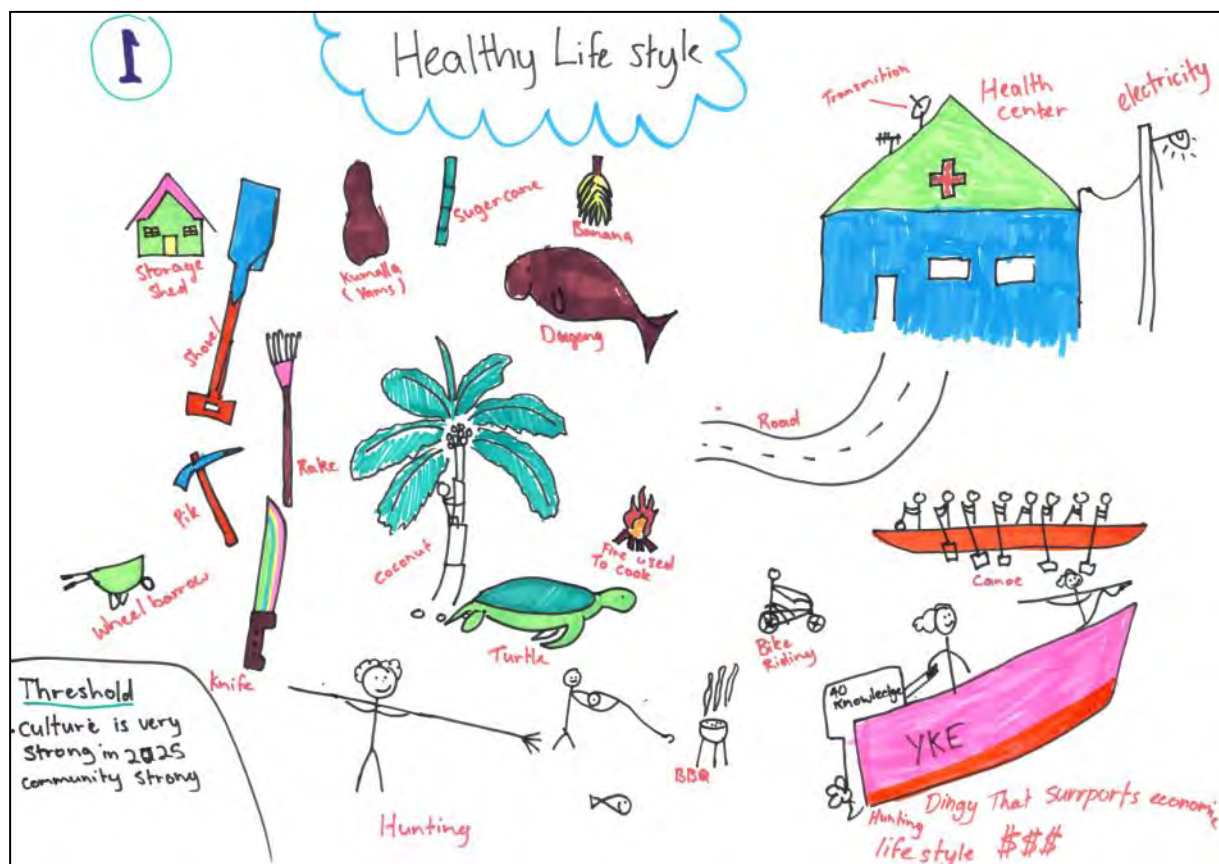


Figure 16. Scenario 1, Healthy Lifestyle (Best Case)

Verbatim narrative for Scenario 1, *Healthy Lifestyle (Best Case)*

"Start with the storage shed and tools and equipments. It can be a teaching for families where kids learn how to work – garden food. They also learn to go hunting for traditional food. There is also a road to the Health Centre so we know to go and visit if we are not well. There is also power lines, satellite dish to help our future generations live a healthy life. We now use dinghies which helps us go out to sea to make money. Threshold is our culture and community is very strong in the Year 2025."

Summary of thresholds

1. By 2025 Masig Island culture is restored and sufficiently strong that it can not disappear

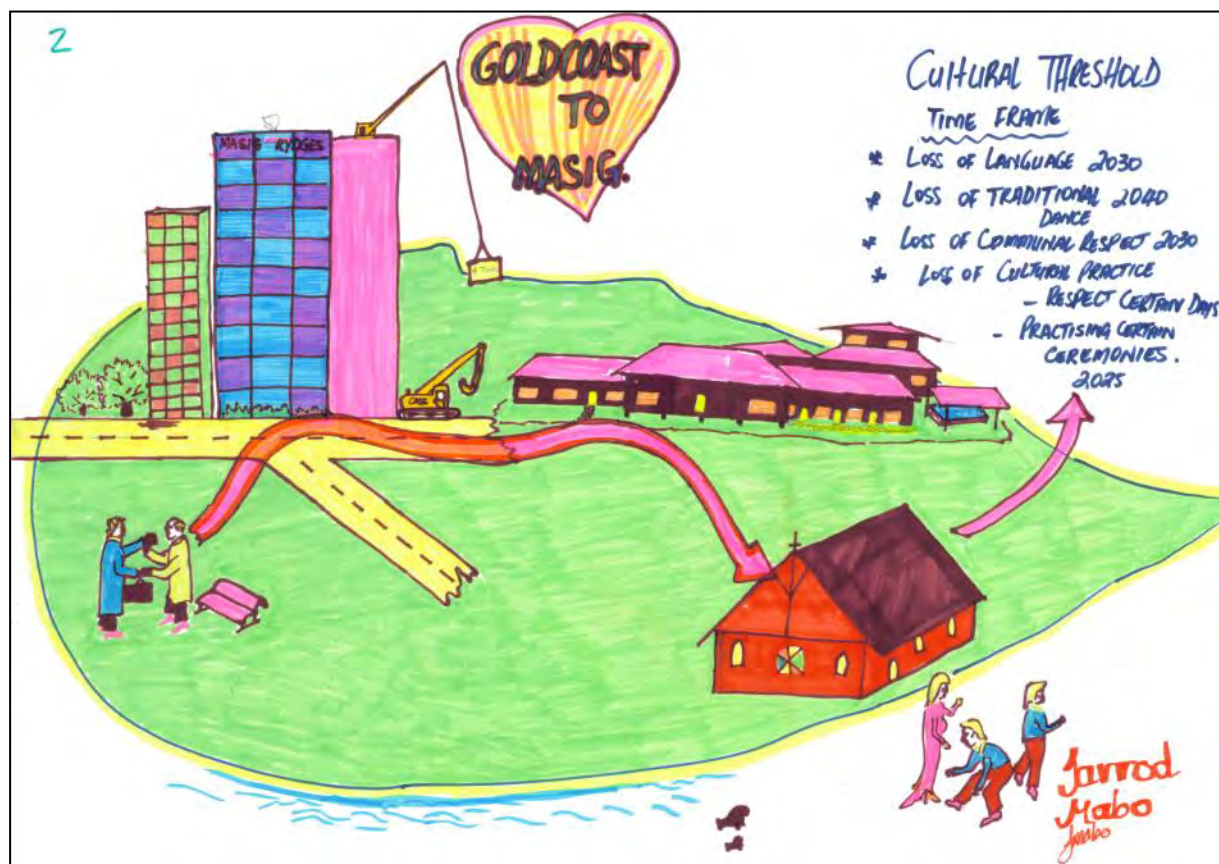


Figure 17. Scenario 2, *Gold Coast to Masig*

Verbatim narrative for Scenario 2, *Gold Coast to Masig*

"We stay in Masig economically we're not that strong. Not many jobs happening. Because of lack of space on island we will build upwards. Top 10 stories of building we have the companies, the 3 bottom stories we have all the family of the company staying (accommodation bottom 3 stories). As you see here we have better services, better roads business deals going on. We have resorts around island every where so we know there is money rolling in. (Does that mean you can wear 2 piece bathing suits?!). Yes this is Gold Coast to Masig. This is the good living however then it comes to our cultural side, where it has effects on the people of Masig. For example we have a wedding going on but people no longer island dance to entertain instead they disco. The only island dancing they will see is from a hologram where they press the

button and it shows people dancing. We forgetting about the cultural side now as there is money rolling in our pockets are full, we living a nice lifestyle here on the island. Our cultural threshold – things that we have lost: loss of language (if we go that way by the time of 2030 we will only speak English there will be no cultural language spoken); by 2040 island dancing will be gone (not practiced anymore) people will use sound systems to play island songs; loss of communal respect by 2030 (respect for their money and house but no longer respect family); loss of cultural practice, respect certain days (just another day on the calendar), practicing certain ceremonies lost by 2025 (no more initiations etc.). That's our Gold Coast to Masig we will live better more money and better homes but will lose our values. That is one of the possibilities if we go down that road "Gold Coast to Masig", good economy and things but neglect who we really are."

Summary of thresholds

1. Loss of cultural practices and ceremonies 2025
2. Loss of language and communal respect 2030
3. Loss of traditional dance 2040



Figure 18. Scenario 3, *Drifting Away (Business as Usual)*

Verbatim narrative for Scenario 3, *Drifting Away (Business as Usual)*

"The title comes from what could happen to Masig if we don't try control things now. So for example the impact of visitors from PNG or Indonesia coming in. Here as just an example of Rangers trying to control visitors coming in. Our house might have another village next to it. That's just a picture of the impact of that. For our culture, if we don't control that now – for example the way we dress, even now we see it, the way we dress is not appropriate for our culture (image of teens dressed like American rappers). Unviable population - this house has

plenty of people, from outside there are people sleeping on the roof, someone sticking their head out of the window. It might be overpopulated in one house, it might not be because of the next one. Unemployment, this person here with their pockets empty, people around feeling sad, this one sitting down feeling worried, it also has an impact on health, no work no jobs, can't get proper health care. So all of these things tie in, saying we're drifting away from our island.....we could be underpopulated by 2040. And sea level rise as well."

Summary of thresholds

1. Underpopulated by 2040

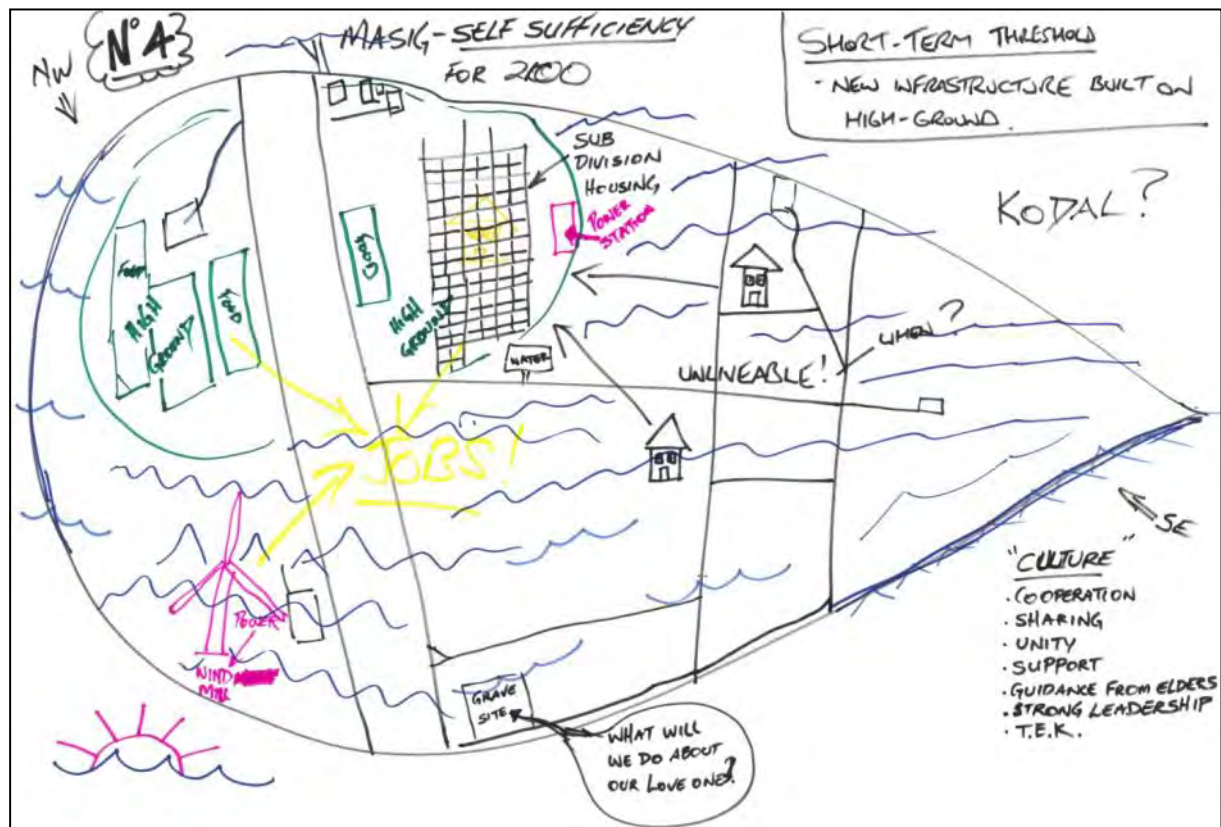


Figure 19. Scenario 4, Masig Self-sufficiency

Narrative for Scenario 4, Masig Self-sufficiency

"Our scenario is based on strong culture and everything else around being bad. Our focus is the year 2100. To maintain strong culture in the year 2100 we need: cooperation, sharing (stick together by sharing common things and ideas), unity, support (everyone), guidance from elders, strong leadership, Traditional Ecological Knowledge. The cultural values to maintain in the year 2100 is just a portion of our values because our culture is strong we will not lose our values, however we will lose our land mass. The blue mark across our map means that there will no longer be that part of the island. What are we going to do about our family graves? Can we utilise Kodal?"

We had to respond to some negative things about Masig first thing being: high cost of living (we will lose a lot of land mass) is negative but we can make it positive; unemployment (can be resolved if building high buildings will create more jobs); strong culture can effect good health instead of bad health; in the short term build new infrastructure on high grounds, to get ready for future; the community wants to stay on Masig how do we turn the negatives to positives?"

Summary of thresholds

1. New infrastructure built on high ground 2030

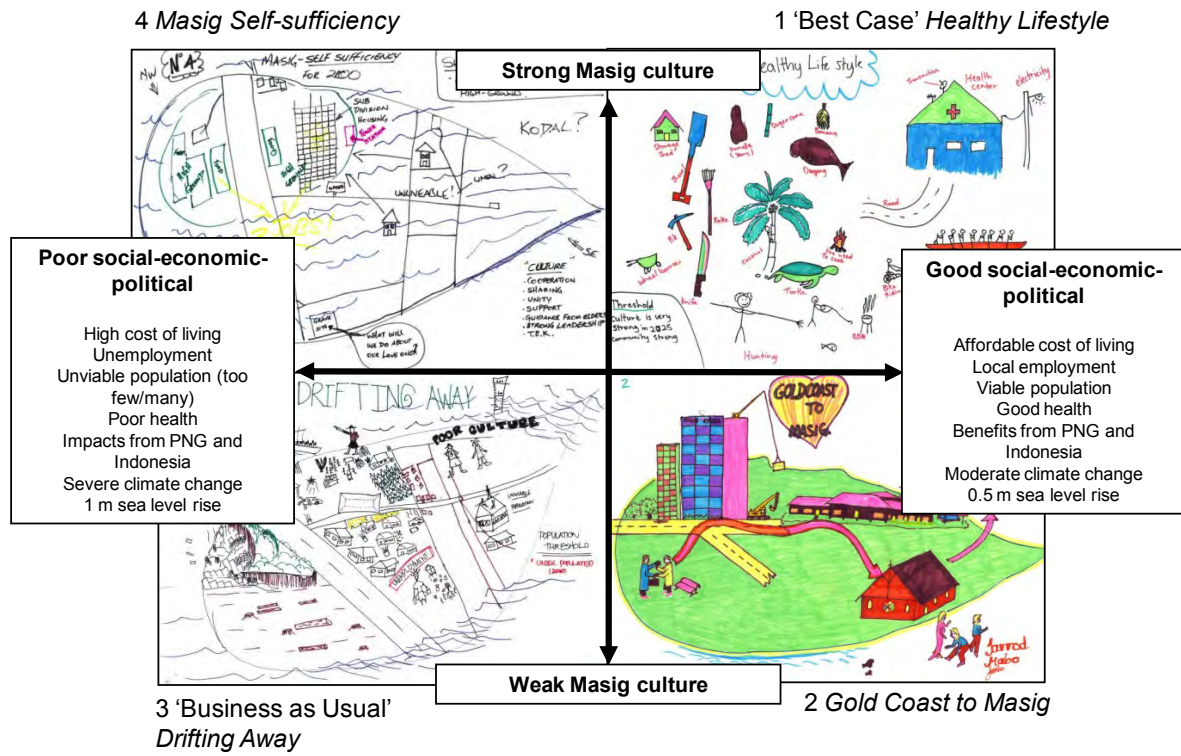


Figure 20. The four scenarios within the matrix of drivers for Masig Island



Workshop participant presenting the narrative for the Business as Usual *Drifting Away* 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 *Drifting Away* scenario on the natural resource base supporting the Masig 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; Fig. 21). 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 Masig and estimated the 'production' (i.e. the relative volume produced or exploited) of each EGS for Masig, 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 Masig community (Fig. 22).

The most important EGS was rock lobster, which contributed highly for all four indicators of well-being, and was the highest contributor for income (Fig. 22). Coastal finfish, reef fish, freshwater and green turtles were the next most important EGS, and of these only freshwater was not a marine-derived EGS. Coconut and cassava were the most important terrestrial EGS.

Participants from Masig 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 46%, and external income 54% (Fig. 23). The highest importance of local EGS was for culture, while external income contributed more to food security and health.

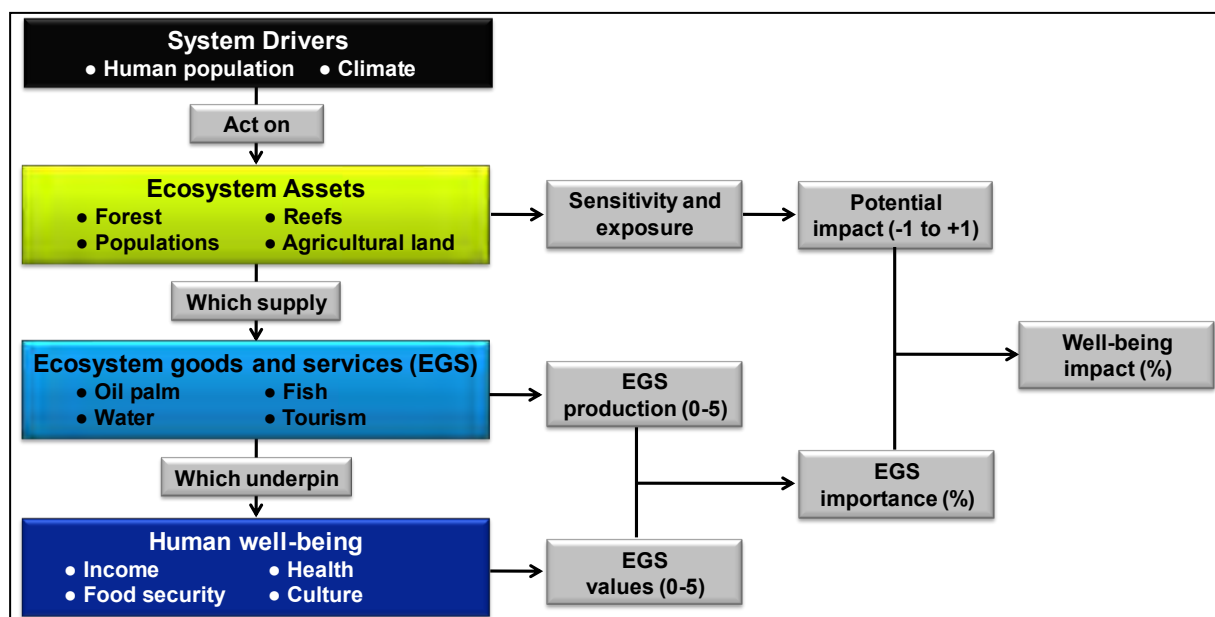


Figure 21. The ADWIM model (see Skewes et al. 2011, 2012) used to estimate the importance of EGS, and the impact on human well-being from the Business as Usual *Drifting Away* scenario

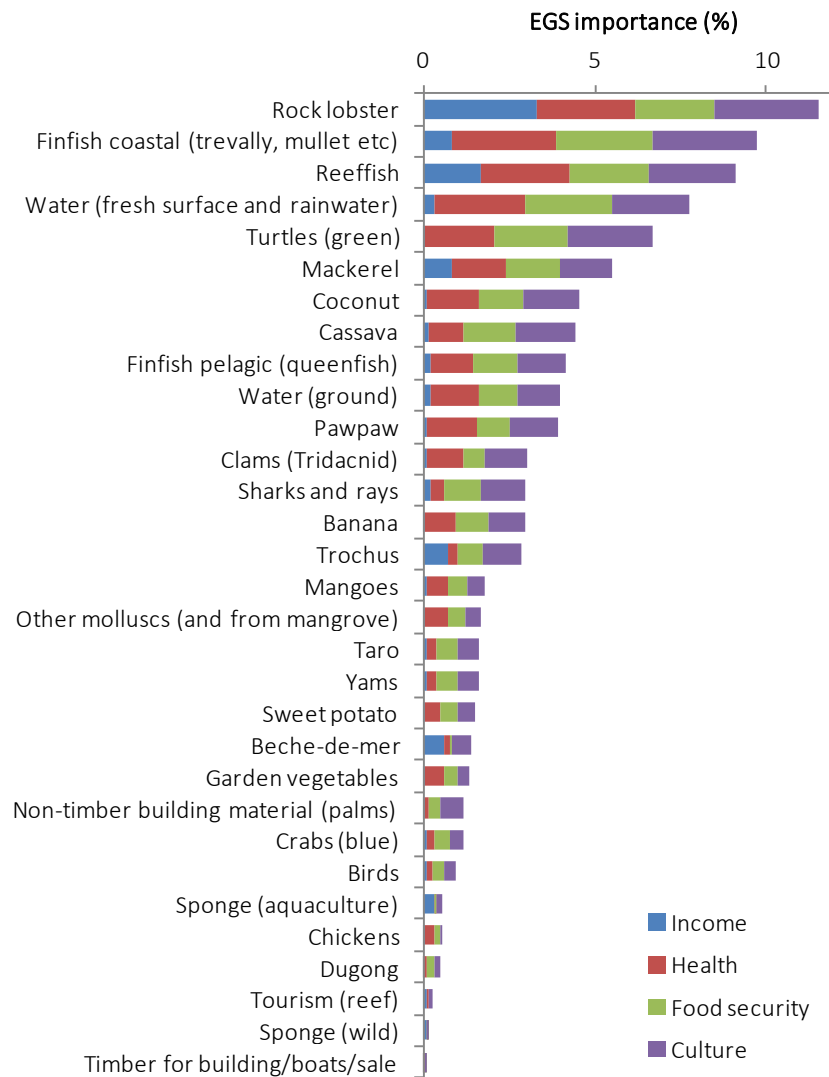


Figure 22. The 31 ecosystem goods and services identified by the Masig Island community, and their relative importance (total bar) and contributions to income, health, food security and culture (colours)

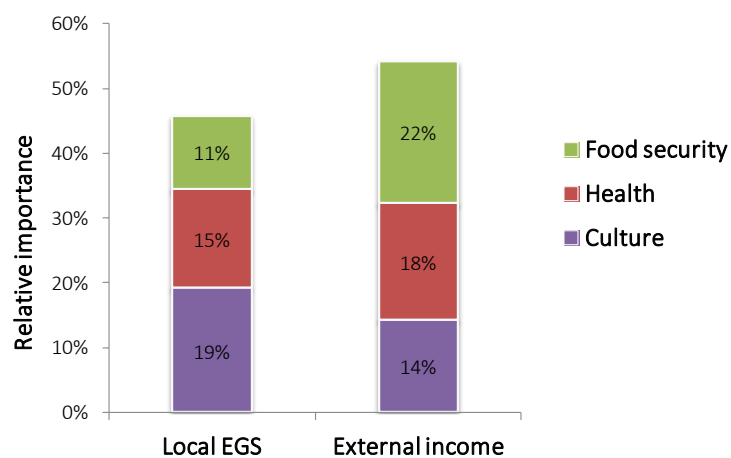


Figure 23. The relative contribution of local EGS to food security, health and culture relative to external income for the Masig Island community, as reported by seven local participants



Workshop participants valuing EGS for Masig Island

By applying the downscaled climate and human population growth projections for 2030 for Masig (Table 5) 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 (Fig. 24). The most impacted EGS within the five most important was green turtles, followed by freshwater. This was caused primarily by climate change factors, but also increased exploitation due to projected growth in the Masig 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 (Fig. 25). Overall, in 2030 negative climate change impacts exceeded human population impacts, but were offset by some positive effects of temperature increases. By 2060 all impacts were negative, and will have doubled from 2030. Climate impacts again contributed the greatest effects. By 2100 negative impacts had doubled again due to potentially extreme climate change effects, and the greatest of these was sea level rise.

Table 5. Projected changes in climate and human population under the Business as Usual scenario for each Torres Strait island, including Masig, which were applied in ADWIM.

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 km ²)	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 km ²) [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 km ²) [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

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 km² of sea was calculated from an assumed marine area of 30 km radius around each island.
3. Density of people per km² 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 Masig 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 Masig Island of 40% of current landmass 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).

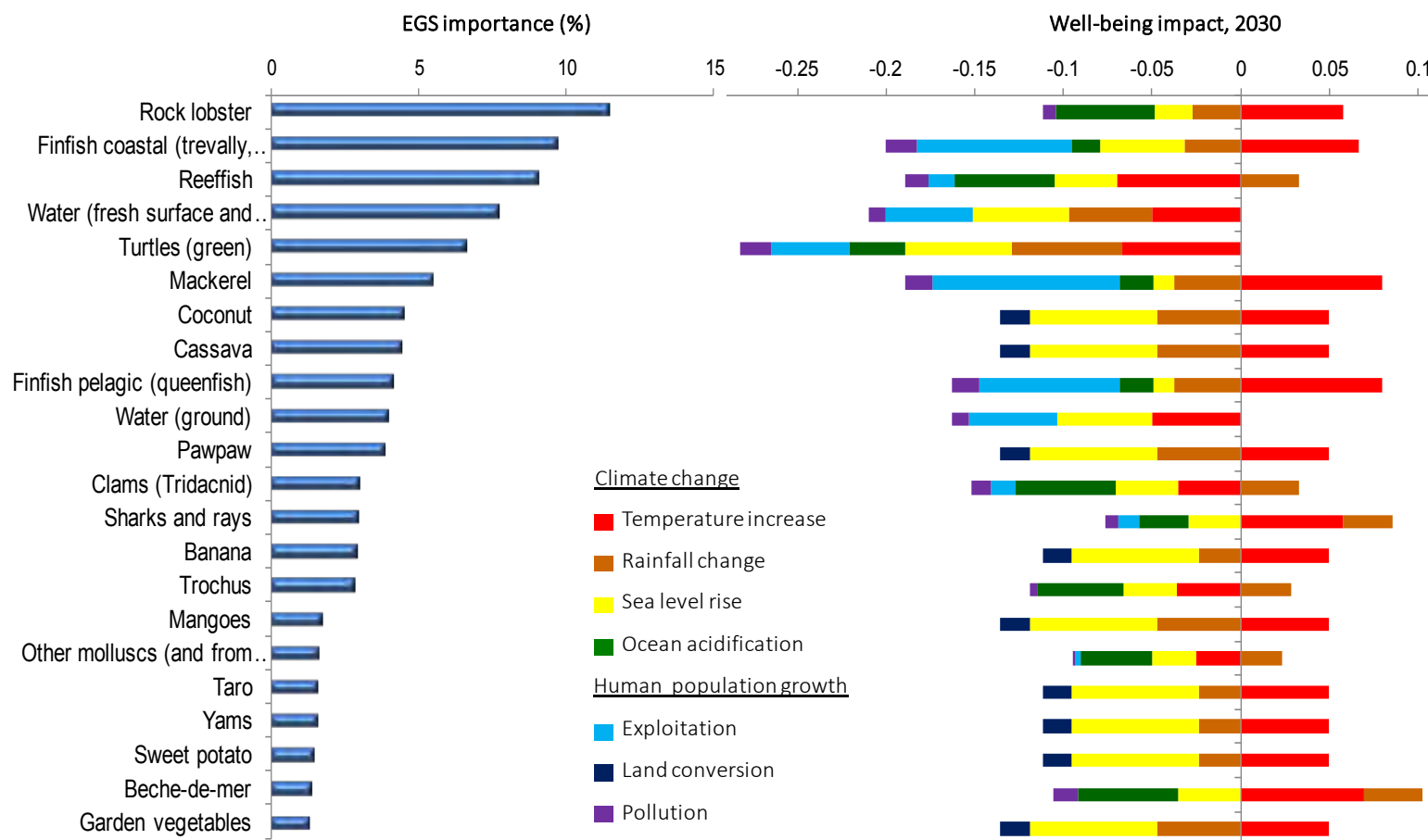


Figure 24. The relative contributions of climate change and population-derived impacts on human well-being for Masig Island EGS in 2030 under the Business as Usual *Drifting Away* scenario. Note that only the 22 most important EGS are shown from Fig. 21

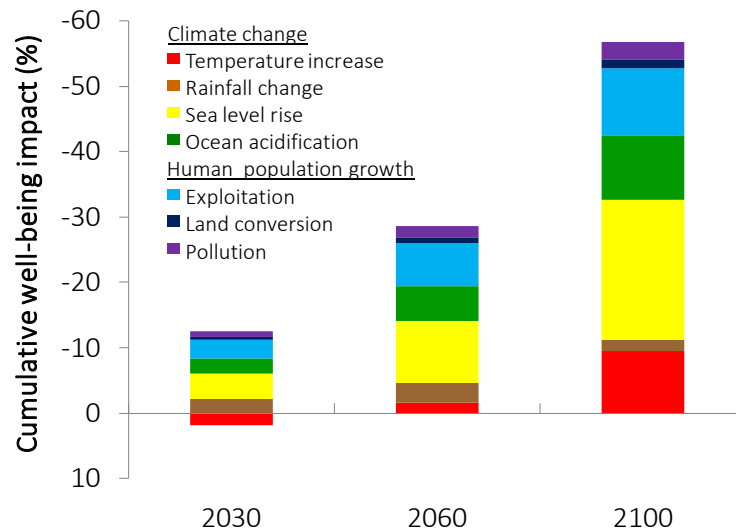


Figure 25. The cumulative impacts on well-being for all EGS in Masig in 2030, 2060 and 2100 under the Business as Usual *Drifting Away* scenario

4.4 Session 4: What is the resilience of the Masig community today?

This session began with a discussion about the concept of community resilience. It was described in terms of five key characteristics illustrated on a poster (Fig. 26):

- Bouncing back
- Flexibility
- Overcoming challenges through perseverance
- Connectedness and unity
- Keep learning

Because there have been no marked environmental or socio-economic shocks to Masig in recent times, the discussion focussed on the general resilience of the community, rather than resilience to specific challenges. The TSRA-CSIRO team presented nine indicators of general resilience, and each was discussed in turn. Then, participants were asked to score how the Masig community was performing on each, and why, to create a resilience profile (Table 6).

Participants felt that the community scored highly in terms of disaster preparedness, food and water self-sufficiency, good leadership, an ability to organise and make decisions quickly, and networks and partnerships beyond Masig, although there was room for improvement. However, for working well together to address challenges, innovation and creativity and an ability to learn, participants considered that Masig only scored medium. The lowest scored indicator was financial capacity, which was low because of “government dependence, but there is some coordination. Most people don’t have insurance and haven’t thought about it.” Participants also added a tenth indicator, language and culture, and scored this as medium because “language is important but today not many people speak it (other than singing).”



Figure 26. The poster used in the workshop to explain concepts of community resilience

Table 6. Workshop participants' scoring of Masig community's resilience against 10 indicators. Indicators 1-9 were pre-selected by the TSRA-CSIRO team, while the participants added the tenth.

Resilience indicator	Score (High, Medium, Low, and score out of 5)	Why?
1. Disaster preparedness	Medium-High (4)	1958 tsunami warning – community was prepared with dinghies. Well-prepared, but not highly. TSIRC has Disaster Management Group. SES plan from late 1990s, and SES crews won award, plus rangers skilled up now. Masig Disaster Management Plan nearly finished. Still room for improvement
2. Financial capacity	Medium-Low (2)	Government dependence, but there is some coordination. Most people don't have insurance and haven't thought about it.
3. Food and water self-sufficiency	Medium-High (4)	Good supply of marine food and groundwater. But garden food supply could be improved.
4. Work well together to address challenges	Medium (3)	Some areas strong (dealing with food, natural disasters), but could be improved on social, family and cultural areas. Also issues with drugs, alcohol and disengagement between generations.
5. Innovation and creativity	Medium (3)	Sponge farm and potential for a lot more aquaculture innovation. But the right environment for nurturing ideas does not exist.
6. Good leadership	Medium-High (4)	Good representation of all organisations (PBC, rangers, TSIRC, Church) and Elders for government, spiritual and cultural issues
7. Ability of community to organise and make decisions quickly	Medium-High (4)	Work together well on cultural issues. Room for improvement on coordination between Justice Group, Fishermen's Association, Kailag Enterprise, Rangers, Community Enterprise Association, PBC, TSIRC
8. Ability to learn	Medium (3)	Encouragement, more communication needed, plus better governance (e.g. on housing)
9. Networks and partnerships beyond Masig	Medium-High (4)	Mobile network is still not perfect. Good partners and family network off the island. Most people have links to Cairns, Thursday Island and other stakeholders there.
10. Language and culture	Medium (3)	Language is important but today not many people speak it (other than singing)

4.5 Session 5: What are priority adaptation strategies to build a resilient Masig community?

4.5.1 Adaptation strategies

In this session the results of the overall potential impacts in 2030 of the Business as Usual *Drifting Away* scenario on EGS and human well-being for Masig were combined with the community's resilience profile 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 (Fig. 24), 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 impacted EGS and the threat causing that impact
- Alternative strategies which take advantage of underutilised EGS
- The resilience indicator requiring improvement
- The resources and stakeholders required to implement the strategy

By comparing the strategy against the other three possible future scenarios (i.e. *Healthy Lifestyle*, *Gold Coast to Masig*, *Masig Self-sufficiency*), 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 based on EGS impacts and resilience profile

Working Group 1 presented two strategies: a cultural renewal plan and the building of the community's financial management capacity (Table 7). Working Group 2 considered that the improvement of the Masig Turtle and Dugong Management Plan was a priority in order to further reduce the exploitation of green turtles, which are an important EGS for the community, and likely to be highly impacted by 2030 (Table 8). Their second most important strategy was to improve garden food production to promote food self-sufficiency. Working Group 3 prioritised community meetings to enhance communication, followed by improved garden food production, including the introduction of hydroponics (Table 9).

Of these six strategies, only community meetings addressed purely resilience issues, while all others had benefits for both reducing impacts on EGS, taking advantage of EGS (e.g. through eco-tourism) and building resilience. Improved gardening for food self-sufficiency was identified twice. All strategies required partnerships of between three and nine stakeholders to implement them. Five of the six strategies did not risk being mal-adaptive under future conditions other than the Business as Usual *Drifting Away* scenario, and were therefore 'no regrets'. However, Working Group 1's building of community financial management capacity could potentially undermine Masig culture if not implemented in tandem with a cultural renewal program.

4.5.2 Results and next steps

Fig. 27 illustrates the overall process and results of the workshop sessions. Six 'no regrets' adaptation strategies were identified for Masig based on the community's most important EGS, projected impacts by 2030 for the Business as Usual *Drifting Away* scenario, and the communities' resilience profile today. Strategies aim to build the community's resilience and steer livelihoods towards the visions for Masig Island. Several thresholds were identified which, if passed, could alter the identity of Masig Island and not be easily reversed.

The perceptions of the Masig 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 strategies identified by Working Group 1, listed in descending order of importance

Adaptation strategy	Impacted EGS and threats addressed, or EGS alternatives	Resilience issue addressed	Stakeholders required to implement strategy	Scenario 1 <i>Healthy Lifestyle</i> Risk of mal-adaptation?	Scenario 2 <i>Gold Coast to Masig</i> Risk of mal-adaptation?	Scenario 4 <i>Masig Self-sufficiency</i> Risk of mal-adaptation?
1. Cultural renewal strategy	Reduce exploitation and sustain all marine EGS	Strengthen resilience through: <ul style="list-style-type: none"> • Language • Songs and dances • Core values (e.g. Islan Pasin, Pamle Pasin, mutual respect) • Knowledge passed on from Elders to younger generations 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • TSRA • TSIRC • Tagai Secondary College 	No, because revival of culture will be good for all future situations	No, because revival of culture will be good for all future situations	No, because revival of culture will be good for all future situations
2. Build community financial management capacity	<ul style="list-style-type: none"> • Maintain viable population growth to minimize impact on EGS • Take advantage of EGS through eco-tourism 	Strengthen resilience through: <ul style="list-style-type: none"> • Employment opportunities • Appropriate economic development • Education in financial and investment management • Developing eco-tourism 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • TSRA • TSIRC • My Pathways training • NGOs • Government • Other businesses 	No, as long as it does not undermine cultural identity. Therefore needs to be introduced in tandem with cultural renewal strategy	No, as long as it does not undermine cultural identity. Therefore needs to be introduced in tandem with cultural renewal strategy	No, as long as it does not undermine cultural identity. Therefore needs to be introduced in tandem with cultural renewal strategy

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

Adaptation strategy	Impacted EGS and threats addressed, or EGS alternatives	Resilience issue addressed	Stakeholders required to implement strategy	Scenario 1 <i>Healthy Lifestyle</i> Risk of mal-adaptation?	Scenario 2 <i>Gold Coast to Masig</i> Risk of mal-adaptation?	Scenario 4 <i>Masig Self-sufficiency</i> Risk of mal-adaptation?
1. Improve Masig Turtle and Dugong Management Plan by reducing the harvest of green turtles	Reduce exploitation and sustain green turtle population	Strengthen resilience through: <ul style="list-style-type: none"> • Maintaining local food security • Strengthening local cultural practices • Improving community's ability to work together and address challenges 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • TSRA Rangers • TSIRC • My Pathways • Turtle hunters • Community members • PBC 	No, because protecting turtles is necessary under any future conditions	No, because protecting turtles is necessary under any future conditions	No, because protecting turtles is necessary under any future conditions
2. Improve garden food production	Improve EGS from garden food production: <ul style="list-style-type: none"> • Yams • Mangoes • Taro • Sweet potato • Bananas • Cassava • Vegetables 	Strengthen resilience through: <ul style="list-style-type: none"> • Food self-sufficiency • Improving community's ability to work together and address challenges 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • Community • TSRA Rangers • TSIRC • My Pathways training Actions needed: <ul style="list-style-type: none"> • Secure funding • Secure land for gardens • Apply local knowledge • Learn Morden method • Learn Vertical Garden method 	No, because improving local food production will be beneficial under any future conditions	No, because improving local food production will be beneficial under any future conditions	No, because improving local food production will be beneficial under any future conditions

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

Adaptation strategy	Impacted EGS and threats addressed, or EGS alternatives	Resilience issue addressed	Stakeholders required to implement strategy	Scenario 1 <i>Healthy Lifestyle</i> Risk of mal-adaptation?	Scenario 2 <i>Gold Coast to Masig</i> Risk of mal-adaptation?	Scenario 4 <i>Masig Self-sufficiency</i> Risk of mal-adaptation?
1. Meetings to improve community communication		Strengthen resilience through: <ul style="list-style-type: none"> • Improving leadership • Improving ability of community to organise and make decisions quickly • Improving networks outside Masig 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • TSRA Representative • TSIRC • My Pathways • Queensland Health Department • Kailag Enterprise • PBC • Church leaders • Taigai Secondary College • Justice Group 	No, because this will build resilience for any future	No, because this will build resilience for any future	No, because this will build resilience for any future
2. Improve garden food production, including hydroponics	Improve EGS from garden food production: <ul style="list-style-type: none"> • Yams • Mangoes • Taro • Sweet potato • Bananas • Cassava • Vegetables 	Strengthen resilience through: <ul style="list-style-type: none"> • Food self-sufficiency • Improving disaster preparedness 	Partnerships required with key stakeholders: <ul style="list-style-type: none"> • PBC • Masig Primary School • TSRA Rangers • TSIRC • My Pathways • Hydroponics expertise 	No, because improving local food production will be beneficial under any future conditions	No, because improving local food production will be beneficial under any future conditions	No, because improving local food production will be beneficial under any future conditions

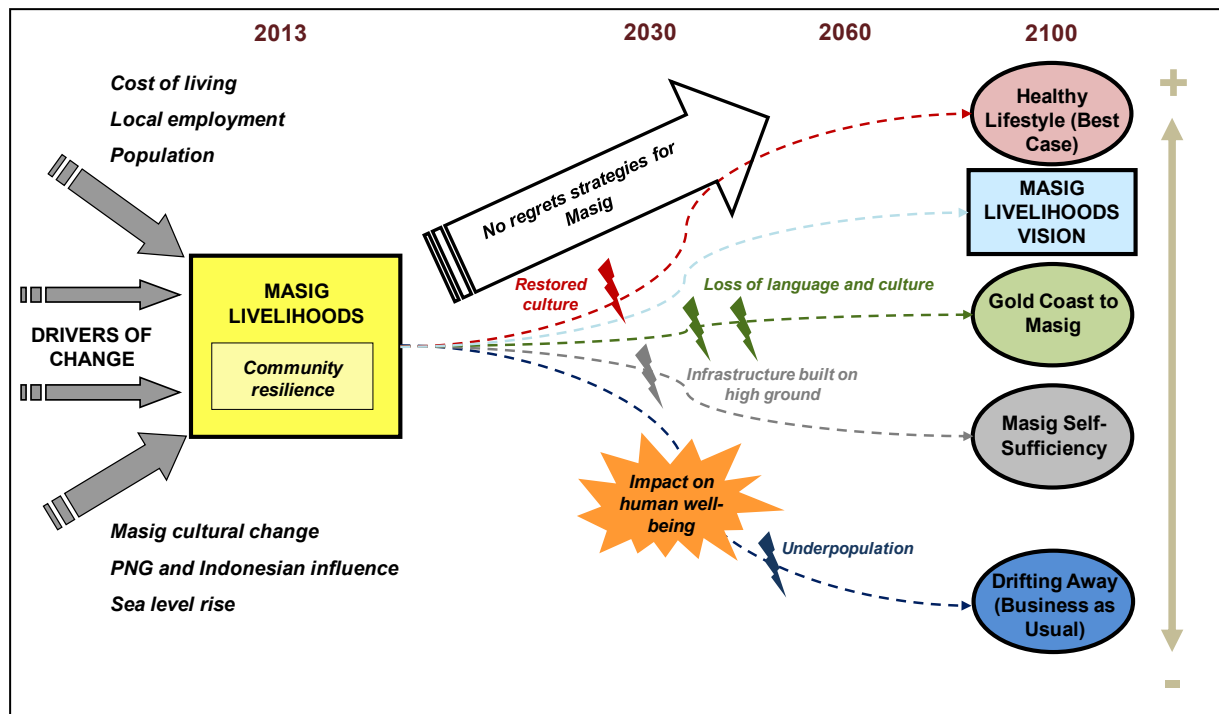


Figure 27. Summary of the workshop process and results for all sessions. Lightning symbols represent thresholds identified for each scenario.

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 Masig will face in the future?", the most frequently mentioned issue before was coastal erosion (54%). After the workshop, this fell to 27% and was replaced by loss of cultural values as the most important issue (37%), and climate change also increased to 27% (Fig. 28). To the question "is Masig resilient to future change?", 62% agreed before, and 38% didn't know. After the workshop 91% agreed and 9% didn't know. To the statement "Masig is ready to cope with climate change", the highest proportion (38%) strongly agreed, 23% agreed, 31% were neutral and 8% disagreed. After the workshop this changed to a slightly more positive overall response, with 36% strongly agreeing, 36% agreeing and 28% neutral (Fig. 29).

After the workshop participants also selected from a range of optional answers about the impact it had had on them (Table 10). The highest proportion of responses were that the workshop "increased my understanding of future change and how Masig can adapt" (40%) and it "made me think differently about the future" (40%). 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 Masig, the community's resilience and their views of the future. This was emphasised by one participant after the workshop:

"It has certainly broadened my perspective as to how I view certain areas impacting on our community. I hope that those who attended have voiced their knowledge gained from this workshop to those who did not attend. Realistically we don't realise the changes that could impact rapidly into our communities. Here we are worrying about our island eroding yet there

are many other things that have an impact which can be far more worse or can be good to our communities. I'm glad that I attended this workshop."

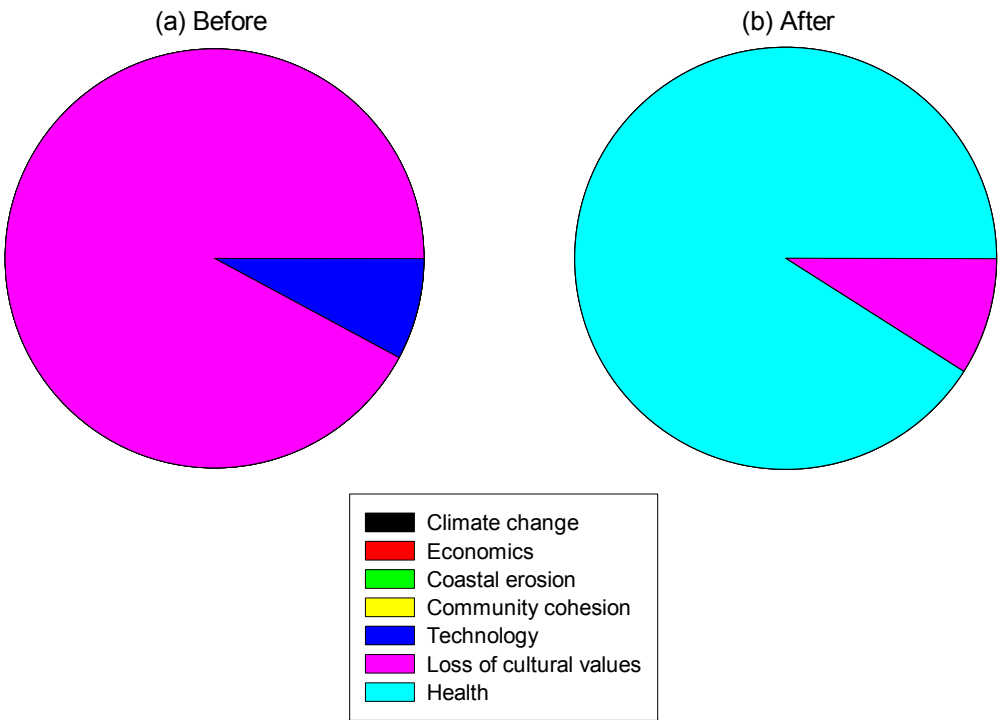


Figure 28. Participants' responses to the question "what is the greatest challenge that Masig will face in the future?" (a) before (n=13) and (b) after (n=11) the workshop



Figure 29. Participants' responses to the statement "Masig is ready to cope with climate change" (a) before (n=22) and (b) after (n=12) the workshop

Table 10. Participants' reactions to the workshop's impact on them

Response	Responses (%)
1. Increased my understanding of future change and how Masig can adapt	6 (40%)
2. Made me think differently about the future	6 (40%)
3. Will make me do something differently about the future	2 (13%)
4. Made me confused	0
5. Made me lose interest	0
6. Had no impact on me	0
7. Other ("this is the start of more forums between community and government")	1 (7%)

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Appendix I: Workshop agenda

NERP Tropical Ecosystems Hub Building Resilient Communities for Torres Strait Futures

Masig Yesterday, Today and Tomorrow Workshop

Wednesday 10th – Thursday 11th July 2013

Masig Island

Workshop objectives:

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

SUMMARY OF WORKSHOP ACTIVITIES

DAY 1: Wednesday 10th July

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

DAY 2: Thursday 11th July

- 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 Masig community today?
- Session 5: What are the priority adaptation strategies to build a resilient Masig community?
- 5:00 Summary, next steps and finish

WORKSHOP PROGRAM

DAY 1: Wednesday 10th July

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 Masig?**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Discussion	45 mins	Where is Masig 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	James Butler	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	

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Introduction	10 mins	Describe session on drivers	James Butler	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	James Butler	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 Masig community?**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Elders historical timeline and stories	30 mins	Where has Masig come from, how has it changed and what caused these changes?	Masig Elders	Time-line picture of Masig's history	Time-line picture of Masig
Four separate working groups for women, men and elders	15 mins	Future vision for Masig 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	James Butler	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 11th July9:00 – 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	James Butler	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 Masig	Tim Skewes	Refined EGS list	List of EGS for Masig
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 Masig 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 Masig	

12:30 – 1:30 Lunch

1:30 – 2:30 **Session 4 continued**

Activity	Activity time	Subject	Presenter	Materials, aids etc.	Outputs
Assessment of community resilience and vulnerability	1 hour	Community ranking of resilience indicators	John Rainbird	Word table	Heat map of indicators and community scoring

2:30 – 4:00 **Session 5: What are priority adaptation strategies to build a resilient Masig 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	James Butler	Central flip chart	Workshop evaluation, next steps agreed