

Preliminary review of key resource economics issues in the Torres Strait

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Acronyms Used In This Report

ABARE	Australian Bureau of Agricultural and Resource Economics
AFMA	Australian Fisheries Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
MTSRF	Marine and Tropical Sciences Research Facility
PZJA	Protected Zone Joint Authority
QDPI&F	Queensland Department of Primary Industries and Fisheries
TFSMAC	Torres Strait Fisheries Management Advisory Committee
TSPZ	Torres Strait Protection Zone
TSRA	Torres Strait Regional Authority
TSSAC	Torres Strait Scientific Advisory Committee

Abbreviations Used In This Report

ITEQ	Individual transferable effort quota
ITQ	Individual transferable (catch) quota
MSE	Management strategy evaluation
NRM	Natural resource management
TAC	Total allowable catch
TED	Turtle excluder device
TIB	Torres Strait Traditional Inhabitant Fishing Boat Licence
TVH	Torres Strait Fishing Boat Licence

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Introduction

The objective of this brief report is to outline some of the key resource economic issues that could be developed into research projects or programmes. The focus of the report is on marine resource related issues, and fisheries resources in particular, as these represent the most important industry in the region. Only brief consideration is given to other natural resource issues, namely land and water. The report is not all inclusive, but focuses on those issues in which economic research could play an important role in improving the welfare of the communities in the region.

The issues were identified through a review of literature on the region, as well as discussion with individuals involved in the research and/or management of marine resources in the region.

Background

The Torres Strait Protection Zone (TSPZ, Figure 1) contains a number of commercial and traditional fisheries of significance to the local communities. The TSPZ was established under a Treaty between Australia and New Guinea.¹ From the Article 10 of the Treaty, “[t]he principal purpose of the Parties in establishing the Protected Zone, and in determining its northern, southern, eastern and western boundaries, is to acknowledge and protect the traditional way of life and livelihood of the traditional inhabitants including their traditional fishing and free movement.”

The Treaty and the *Torres Strait Fisheries Act 1984* distinguishes between three different fishing activities. Traditional fishing refers to the harvesting of marine living resources by traditional inhabitants for their own or their dependants’ consumption. This includes commercial species that are not subsequently sold, as well as non-commercial species such as dugong and turtle. Commercial fishing is, as the name implies, commercial exploitation of the living marine resources with the aim to sell the resultant catch. Community fishing is a sub-set of commercial fishing, and refers to the commercial exploitation of living marine resources by traditional inhabitants.

Commercial fishing is the most economically important private sector activity in the Protected Zone (TSSAC, 2005).² In 2004-05, the gross value of production from the commercial fisheries in Torres Strait was estimated to be in excess of \$29.9m (Table 1). This value has declined from \$36.6m in 2002-03 (ABARE, 2006), a result of both declining stocks of key species as well as falling prices of high-valued species such as prawns.

Over 1600 vessels operate in the area, many of which are small scale, artisanal vessels operated by the indigenous population. The main exception to this is the prawn and lobster fisheries that contain a significant proportion of non-indigenous fishers. The prawn fishery in particular is largely operated by non-indigenous fishers.

The status of the stocks of most species is largely unknown or uncertain (Table 1). The distinction between the two is largely a function of the level of information available on the fishery. For those uncertain stocks, information is available, but not enough information is

¹ Treaty between Australia and the Independent State of Papua New Guinea concerning sovereignty and maritime boundaries in the area between the two countries, including the area known as Torres Strait, and related matters.

² A moratorium on mineral extraction currently exists. This moratorium is scheduled to expire in 2008, although it is expected to be reinstated.

available to determine the health of the stocks. For the unknown stocks, no information is available. Two fisheries are believed to be overexploited – the lobster fishery and the bêche-de-mer (sea cucumber) fishery.

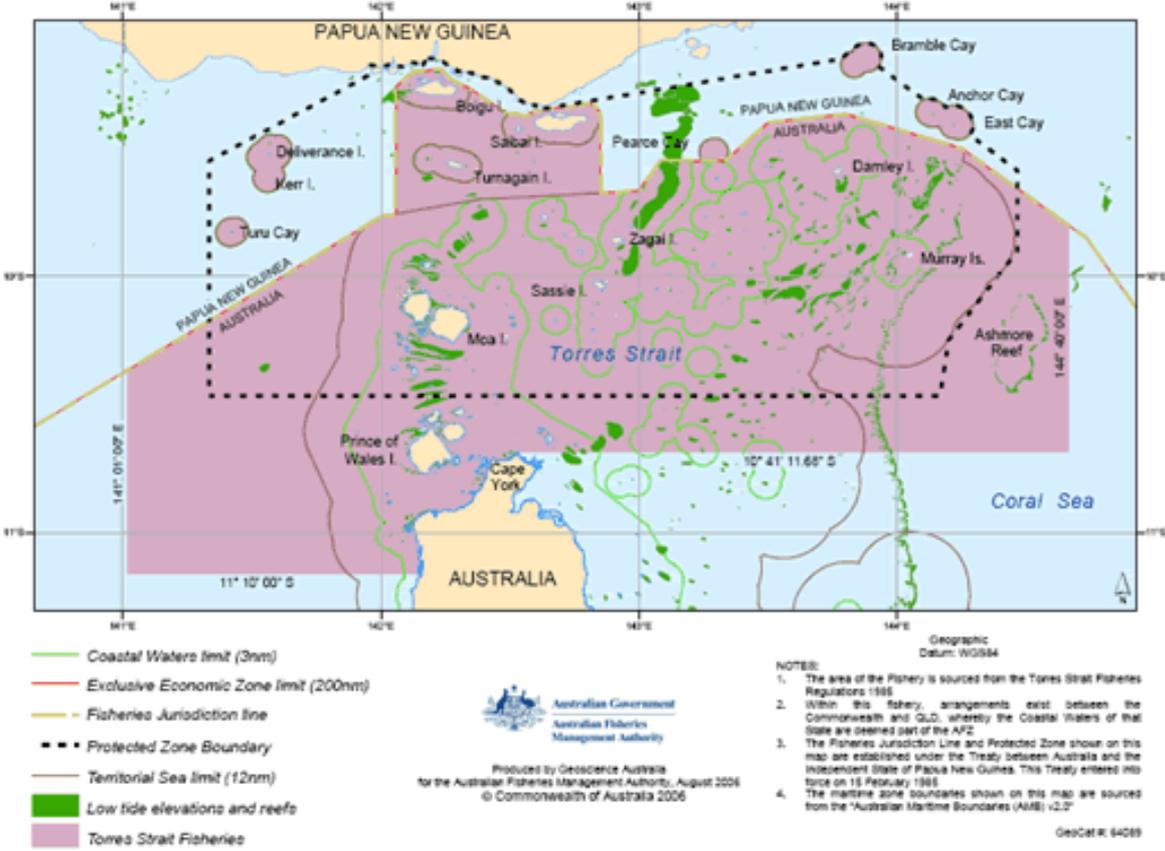


Figure 1. Area of the Torres Strait Protected Zone and Fisheries. Source: Australian Fisheries Management Authority

Table 1. Key fisheries, Torres Strait, 2004-2005.

Target species	Number of vessels	Catch (tonnes)	Value (\$'000)	Stock Status
Rock lobster	415	685	12,281	over fished
Spanish mackerel	258	171	1,272	stable
Pearl shell	125	n.a	n.a	stable
Prawn	77	1,474	15,582	uncertain
Sea cucumber (dive fishery)	179	600	n.a	over fished
Trochus shell	110	30	n.a	unknown
Crab	101	n.a	n.a	uncertain
Reef fish (Line fishery)	239	71	810	uncertain
Mullet (Net fishery)	151	n.a	subsistence	unknown
Total	1,655	3,031	29,946^a	

^a Underestimated as excludes values of several fisheries. Source: ABARE (2006), McLoughlin (2006), PZJA (2007).

All fisheries within the TSPZ (except recreational) are managed by the Torres Strait Protected Zone Joint Authority (PZJA). This was established by the Torres Strait Fisheries Act 1984, and comprises the Federal and State (Queensland) Ministers responsible for fisheries, and the Chair of the Torres Strait Regional Authority (TSRA). The PZJA has delegated day-to-day management of the fisheries to the Australian Fisheries Management Authority (AFMA). Compliance in the fisheries has been delegated to the Queensland Department of Primary Industries and Fisheries (QDPI&F) (PZJA, 2005).

The fisheries are largely managed through input controls, although a move to quota controls has been proposed for the lobster fishery for implementation during 2007. The main form of input controls are limited licences, vessel size limits, effort controls (e.g. limits on number of days fished, restrictions on fishing during the day), and gear restrictions (e.g. limits on headrope length, use of bycatch reduction devices).

Although the fisheries are managed by input controls, the Article 23 of the Treaty specifies that each species will have a total allowable catch (TAC), and this should reflect the optimum sustainable yield (although optimum is not defined).

All vessels operating in the TSPZ must be licensed, and two forms of vessel licences exist. The Torres Strait Fishing Boat Licence (TVH) may be owned and used by either traditional inhabitants or non-traditional inhabitants for the purpose of commercial fishing in the TSPZ. The Torres Strait Traditional Inhabitant Fishing Boat Licence (TIB) is available only to Torres Strait Islanders or Aboriginal people from three Northern Peninsula Area communities.

The Torres Straits are governed by the Torres Straits Regional Authority (TSRA). A key role of the TSRA is to foster economic development in the region. Given the economic significance of fisheries to the region, sustainable fisheries management and increased involvement of the indigenous communities in the commercial fisheries are major objectives (TSRA, 2006)

Economic Research Issues Relating to Marine Resources

The key economic research issues relate to several main areas:

- Management of commercial fisheries;
- Islander participation in commercial fisheries;
- Management of traditional fisheries;
- Aquaculture/mariculture;
- Recreational fishing and tourism; and
- Illegal (foreign) fishing.

The issues relating to management of commercial fisheries and islander participating in commercial fisheries are considered separately. While a major issue involves resource allocation between the indigenous and non-indigenous fishers (as will be discussed below) a number of generic research issues exist that are irrespective of which groups are involved in the industry. Managing traditional fisheries also raises a number of economics issues.

Aquaculture is a growing industry that provides the potential for expansion of indigenous involvement in marine resource based industries. Similarly, recreational and sports fishing

may offer potential for ecotourism development. Illegal fishing, in contrast, provides a threat to the economic benefits that can be attained in the region.

A number of research issues have also been identified Torres Strait Scientific Advisory Committee (TSSAC, 2005) that have a potential economics component. These key research areas are identified in Appendix 1, with the priority noted for each marine resource-related activity.

Management of Commercial Fisheries

From Table 1, much of the economic value produced from the fisheries resources is generated in the two most valuable commercial fisheries – rock lobster and prawns. The lobster fishery is currently considered overexploited. While the prawn fishery is considered fully exploited, profitability in the fishery is declining (Hanna et al., 2006). Economic research can be undertaken to address these issues. Management of the finfish fisheries also presents the opportunity for economics research.

Prawn fishery

Both the value of production and profitability in the Torres Strait prawn fishery has declined over recent years (Hanna et al, 2006). This is a function of both falling prawn prices on the international market as well as increasing costs, particularly fuel costs.³ While effort has declined as a result of these economic drivers, the fishing effort in prawn fishery is still too high.

The fishery is currently managed through input controls, including individual transferable effort quotas (ITEQs), area closures, gear restrictions, bans on daylight trawling, use of TEDS and other restrictions. While the ITEQs provide a mechanism for adjustment, the total number of allowable days is too high and the benefits of purchasing additional effort units is limited. Vessels can also freely move in and out of the adjacent Queensland fishery (as they have the appropriate endorsements). Individual transferable (catch) quotas, or ITQs, have been proposed as an alternative management approach for the fishery (Hanna et al, 2006) but have been rejected by the industry.

The assessment of alternative fisheries management measures is a clear research need for the fishery. This includes the need to determine the structure of the fishery that achieves the AFMA objective of maximising the economic value of the resource. For input controls, this will involve the number of vessels and total effort required to maximise economic returns. For output controls, this will also entail the estimation of the maximum economic yield. Associated with this measure is also the need to determine which (if not all) species will need a quota. Given the highly stochastic nature of the resource, issues relating to TAC setting and in-season adjustments need also to be considered. Some of the issues relating to the estimation of TACs is also addressed in (Hanna et al., 2006).

This will involve the development of bioeconomic, or other, models of the fishery. An earlier model (Reid et al., 1993) is considerably out of date. More recent work in CSIRO developed an ecosystem based model of the trawl fishery, but did not include any economics components (Project T3.3 under the CRC Torres Strait - Integrated ecosystem modelling for evaluating multiple management strategies). The CSIRO model developed a management strategy evaluation (MSE) model, the framework of which could be applied. A MSE model

³ The possibility of reduced productivity as a result of environmental damage from trawling (i.e. damage to the habitat) has also been raised. While habitat changes have been observed as a result of prawn trawling in other fisheries (e.g. Tanner, 2003), the impact of this on Torres Strait prawn productivity is uncertain.

including an economics component is currently being developed for the Northern Prawn fishery, and this could also form the base of a Torres Strait prawn fishery model.

The fishery is also characterised by bycatch problems. Problems of turtle bycatch have been addressed through the introduction of turtle excluder devices in 2001, while the use of bycatch reduction devices was made mandatory in 2004 (McLoughlan, 2006). In other fisheries, the introduction of such measures has resulted in declines in productivity and profitability. An assessment of the economic impact of these measures, and the potential cost effectiveness of alternative mitigation measures (include incentive based approaches to bycatch management) is a potential area for further research.

Lobster fishery

The lobster fishery is currently considered to be overexploited (McLoughlan, 2006). The fishery has been managed through input controls (limited entry, seasonal closures) and technical measures (minimum landing size). TSSAC (2005) raised a number of issues relating to the management of the lobster fishery (Appendix 1). These issues largely involve increasing involvement and effective resource allocation.

In 2005, an explicit allocation of the lobster resource was introduced between indigenous and non-indigenous commercial fishers. The initial allocation was 50:50, with the aim of increasing the indigenous commercial share to 70% (Kung and Norris, 2006). Prior to this, the non-indigenous commercial fishers caught roughly 60-70% of the catch (Fogarty, 2006). To facilitate this resource reallocation, explicit quotas were to be set for the two segments of the fishery from 2007. For the non-indigenous commercial sector, ITQs have been proposed. For the indigenous commercial sector, a competitive total allowable catch (TAC) is proposed. The reallocation of catch to the indigenous commercial sector from 50:50 to 70:30 is to be achieved through market forces, through purchasing of ITQs from the non-indigenous fishery. The key objective of the reallocation is to increase indigenous participation in the fishery. The legitimacy of this objective has been questioned (Fogarty, 2006).

The reallocation raises a number of interesting economic issues. First, the potential economic value of the resource is unlikely to be captured through a competitive TAC unless other controls are maintained. With a competitive TAC, incentives to increase, rather than decrease, effort exist, so current economic benefits may deteriorate. Allocating individual quotas to the indigenous sector, however, is difficult as information on catch information at the individual level is deficient. Further, adjustment in this sector arising out of quota trade may decrease the number of individuals involved in the fishery, counter to the aims of the allocation to increase involvement. As a result there is a clear conflict between the social goal and economic goal in the fishery.

The incentives for individual indigenous fishers to purchase quota from the non-indigenous fishers is also limited if a competitive quota is in place. There is no incentive to purchase quota if they can increase their share in any case through increasing effort. This would require quota to be centrally purchased and added to the competitive pool. This would require the development of appropriate institutions by the indigenous fishers. Funding of such institutions would raise other issues (e.g. free rider problems).

Returns to the community through the exploitation of the resource could be captured in other ways. The lobster is exported, and pass through a limited number of freezers (some private, others community). There exists the potential for monopsonistic behaviour to develop. That is, freezers act as a cartel of buyers, and depress prices to the fishers. While this would work to the detriment of fishers, it could also be adapted to work for the benefit of the community. That is, prices could be used to regulate fishing activity, with the profits achieved by the freezers returned to the community as a form of resource rent. A similar approach is adopted

in the Maldives, where tuna is sold through a state-run monopsony, the profits from which are returned to the community.

Finfish fishery

Similar issues exist for the finfish fisheries. As with the lobster fishery, there is an intention to increase the indigenous community involvement in the fishfish fishery. An explicit allocation of the catch (50:50) between islander and non-islander commercial fishers has been introduced. Allocation is to be implemented through a total allowable catch.

Management arrangements for the separate fleet segments as well as separate species within the TAC framework is still under consideration. The non-islander industry members initially proposed an ITQ scheme, but later considered that such a scheme would not be realistic. Individual transferable effort quotas are being considered as a potential alternative, along with ITQs (TSFMAC, 2005). For the islander segment, ITQs were also considered inappropriate. Additional effort controls were to be re-considered if the Islander catches in the reef line fishery increase by 50% (TSFMAC, 2005).

The key target species that could potentially have a TAC are coral trout and red emperor. Barramundi cod and Maori wrasse are high risk species, and therefore also warrant being covered by individual quotas. In the case of Maori wrasse, which has been listed on CITES, a zero quota (i.e. no-take) may be appropriate. All other species taken in the fishery fall under the classification of “other” for which a quota would also apply. These include sweetlips, cods, stripy bass, trevally, red bass, parrot / tusk fish, and sharks (TSFMAC, 2005).

Potential economic research in the fishery includes the potential benefits of alternative management systems (e.g. ITQs, ITEQs, other controls), optimal yield setting in the multi-species context, and mechanisms to effectively share resources between the two sectors (i.e. resource allocation issues and mechanisms).

Bêche-de-mer and trochus fisheries

Both the bêche-de-mer and trochus fisheries are dive-based fisheries, primarily exploited by islanders.

The bêche-de-mer (sea cucumber) fishery is based on several species, two of which are considered to be overexploited (McLoughlan, 2006), and currently have a zero quota (PZJA, 2007). The fishery is managed through a competitive TAC, while a ban on scuba and hookahs has been implemented to reduce the pressure on the remaining species (i.e. an input control).

The biological status of the trochus fishery is unknown, although stocks are believed to fluctuate widely due to exogenous factors (e.g. environmental conditions). This is a less valuable species commercially than the bêche-de-mer. Scuba and hookahs are permitted. A competitive TAC is in place in the fishery, although catches in recent years have been well below this. For example, only 30 tonnes were believed to be harvested in 2004-05 against a 150 tonne TAC.

Alternative management strategies for these species are areas of potential economic research. For the trochus fishery, an optimal strategy may be pulse fishing – exploiting the fishery when abundant and moving elsewhere when stocks are low. Developing appropriate flexibility in fisheries management to allow for such a strategy is an area often not considered, as sustainability is often assumed to relate to stability in catches. Similarly,

imposing inefficiency on the bêche-de-mer fishery through banning underwater breathing apparatus results in a potential economic loss to the community as a whole.

Issues Relating to Islander Participation in Torres Strait Commercial Fisheries

An objective of the TSRA is to increase the involvement of islanders in the commercial fishing industry as part of the regional development (TSRA, 2006). This is partly motivated through a lack of alternative employment opportunities. Fishing is the major single economic activity in the area – both in terms of gross value of production and employment – and is seen as a main source of potential new employment opportunities. Roughly 36% of indigenous workers currently work in fisheries, 20% in agriculture, and the remainder in other industries (Boero Rodriguez et al 2006).

As noted above, two key fisheries have already been targeted for increased islander participation – the lobster and fin fish fisheries. In both cases, islanders have been allocated 50% of the catch. This is intended to increase to 70% through islander funded activity, with the long term aim of 100%.

Management of the islander segment of the fishery is a key economic research priority. The current management system provides incentives that do not capture the full benefits of increasing islander involvement in the fisheries. Licences remain limited, preventing new entrants. The competitive TACs provide incentives for existing fishers to increase their fishing activity, potentially dissipating the economic benefits that a well managed fishery could achieve.⁴ As a result, the benefits of increased allocation of catch to the islander communities is likely to be less than under alternative management plans that provide a different set of incentives.

These need not be as formal as an ITQ system that provides individual property rights. Instead, rights could be given to communities (rather than individuals), and communities could then capture the benefits arising from appropriate exploitation of the resource directly. Such community quota systems are in place in a number of fisheries around the world (e.g. Charles, 1997; Goodlad, 2005; Salagrama, 2005; Ryu et al., 2006). Communities would be free to determine how many fishers would participate in order to achieve their objectives, which may include employment as well as economic wealth generation.⁵

Similar economic issues were facing the development of the Maldives fisheries in the mid 1980s (e.g. Sathiendrakumar and Tisdell, 1986), in which the key economic resource (tuna) were mainly destined for an export market. A solution introduced in the Maldives was the formation of a monopsony (single buyer), which bought the tuna from the domestic fishers at a fixed price, and sold it on the international market at a higher price, the difference being returned to the community. Regulation of the fishery was through the market rather than through controls on activity. A similar approach had been used in Mauritania, where as much as 25% of the Government's budget had been financed through the profits of the State-run monopsony (Catanzano and Cunningham, 2000; Cunningham et al., 2005). In the Torres Strait, the benefits of fisheries could potentially be returned to the communities through the development of community freezer facilities that could co-ordinate the marketing and exported of the product.

⁴ The dissipation of economic profits through increasing effort arising from a competitive quota is well documented.

⁵ Community-based management differs from co-management. The latter usually refers to community involvement in management decision making. In contrast, community based management places the management responsibility directly on the community, who then manage the fishery to best meet its objectives.

A further advantage of a community management scheme is that income generated could be re-invested in community-owned vessels, and could be used to purchase additional quota from the non-islander commercial sector. The community effectively becomes a fishing company, with the community members as the shareholders.

The development of an effective community management scheme may require additional training of the Island Councils in terms of fisheries management techniques, the benefits of effective fisheries management and also fishing vessel operation. Experience of the use of community-owned vessels in the past has not been favourable since the demise of the pearling industry in the 1960s.

The interaction between fisheries and economic development in the region and the impact of fisheries on the community were highlighted as areas of research of high importance for several key fisheries (TSSAC, 2005; Appendix 1). Effective community-based management systems, such as those described above, are needed to fully capture the benefits of co-ordinated economic development in the region. Further research into such systems, including alternative forms of governance taking into account cultural and traditional activities, is a high priority. The perceived failure of more recent attempts to employ community-owned vessels may have been a result of existing management tools being incompatible with the objectives of the island Councils. Consideration

Research is currently underway by ABARE (the Australian Bureau of Agricultural and Resource Economics) to examine the economic and financial returns to islanders from their commercial fishing activities relative to those of non-islanders, and how these returns may be improved. The outcomes of this study may raise a number of relevant economic issues for future consideration.

Management of Traditional Fisheries

Traditional fishing has cultural as well as economic importance of fishers, and consideration of traditional fisheries needs to be taken into account when developing community-based management systems. Traditional fishing includes a subsistence component, which has an implicit economic value equivalent to the value of the fish that could either have been sold, or would have needed to be purchased. The activity also has a cultural value, the magnitude of which is less easily determined.⁶ A key priority identified by the TTSAC (2005) was to determine the social, cultural and economic importance of fisheries to islander fishers, including traditional fisheries.

Management of subsistence-based fisheries is inherently difficult, as incentive structures differ to those in commercial fisheries. A key difficulty is knowing how much catch is being taken, and how this affects, and is affected by, the commercial fisheries that may be based on the same species. Studies of catch in the traditional fisheries in Torres Strait have been undertaken (e.g. Skewes et al., 2004), and these could form the basis of subsequent work.

Management of the commercial fisheries will need to take into account activity in the traditional fisheries. An implicit assumption is that traditional fisheries have priority over the catch, and that commercial catch has the residual (which in many cases would be the greater share). This assumption is implicit as an explicit allocation of catch to the traditional fisheries has not been made. With increased islander involvement in commercial fisheries, a more

⁶ Traditional fishing is also believed to have a health value, due to the additional activity required in its capture and the lower reliance on imported (to the Islands) processed food. Valuing this health benefit is possible, but would be a costly and difficult exercise.

explicit allocation of the resources between traditional and commercial activity may need to be made. Determining this allocation will require information on the relative *marginal* values of the activities to the communities. While values of commercial activities can be readily determined, the marginal values of the traditional activities will need to be derived through non-market valuation to capture both the subsistence and cultural values.

Not all traditional fisheries interact directly with the commercial fisheries. In particular, the dugong and turtle fisheries do not have a commercial counterpart. The potential for these fisheries to become overexploited, however, remains, and some form of management may need to be introduced in order to maximise the benefits of the use of these resources. This is currently being assessed through a bioeconomic analysis of the fisheries.⁷ The outcomes of this study may raise other issues for future consideration.

There is a need to investigate the economic cost benefit ratio of employment of Torres Strait Islander and Aboriginal people in the direct management of traditional fisheries and other relevant natural and cultural resources on the islands and marine environments. These officers can implement and enforce community based management plans, for example the dugong and turtle plans currently being developed. This will allow explicit management of not only these species but the cultural aspects associated with these important species. This provides management of cultural heritage on a current basis, supporting the transfer of knowledge and information and supporting communities to manage these fisheries according to cultural protocols with the integration of best available scientific information.

Aquaculture/mariculture

The development of sustainable aquaculture industries has been identified as a priority in the Torres Strait Development Plan (TSRA, 2006). The objective of such developments is to provide new employment opportunities for islanders.

The potential for farming and cultivation of sea sponges is currently under investigation in the region. The activity involves a combination of harvesting and cultivation, so straddles both fishing and mariculture. Seed stock is harvested from the “wild” resource. These are subsequently cloned, and the resultant animals grown out in the farm. There is a trade-off between the level of wild harvest and the amount of cloning, as well as the time to grow the animals until the final farm harvest. Market studies have been undertaken, as well as feasibility studies/business plans for individual producers. These studies are not publicly available as they relate to individual farms. Research into alternative uses of the biomaterials within sea sponges is also underway, which may result in increased value from the farms.

Given the interaction between the “wild” stock and the farming activity, a broader scale study is needed at an industry level to determine optimal levels of harvest and production. The further development of the industry also needs to take into account the balance between harvesting and cultivation.

The potential also exists for further development of pearl shell aquaculture. Currently, the pearl shell fishery is aimed at providing stock for the aquaculture industry. Again, this will require a balance between harvesting of brood stock and production of cultured animals. A comparative analysis between Torres Strait and the WA/NT industry would be potentially beneficial, as the relative success of the latter may provide useful information for improving the industry in Torres Strait.

⁷ This study is being undertaken by ANU.

The potential to rear sea-cucumbers in hatcheries to enhance the natural stocks could further enhance the wild-caught fishery. As noted above, three of the main species of sea-cucumber have been overexploited and currently face a zero total allowable catch. Hatchery production could potential redress this problem, provided it was both feasible and cost-effective. The development of the industry may have other social benefits, as it has a history of, and future potential for involving women and families which has severe limitations within all of the other fisheries.

Recreational Fishing and Tourism

A strategy of the TSRA Development Plan is to consider development of sports fishing operations in the islands as well as marine eco-tourism (TSRA, 2006). Development of marine resource based tourism has been highly successful in reducing reliance on fisheries in other island-states (e.g. see Sathiendrakumar and Tisdell, 1989).

The potential for development of sports fishing and associated tourism in the Torres Straits may be limited. The islands do not have a comparative advantage in this regard as they do not have the tourist infrastructure (e.g. hotels, resorts), while access to the region is difficult and expensive relative to other near-by ecotourism areas (in particular the Great Barrier Reef). Investment in tourism infrastructure would be risky if based on marine resources alone. Nevertheless, there exists the potential to develop “cultural” tourism, while the isolation of the islands may be attractive to some visitors. This is beyond the scope of this study. The feasibility of individual tourism development projects would need to be considered separately, identifying a niche that cannot be filled in competing tourism destinations.

Illegal Foreign Fishing

Illegal foreign fishing provides a threat to the commercial fishing activities in the region. Illegal activity is particularly problematic for the shark fisheries, as the illegal catch diminishes the resource available to the local fishers. However, surveillance and removal of foreign fishing vessels is costly. A potential area of economic research is to estimate the impact of foreign fishing on the commercial and non-commercial fisheries, and the cost effectiveness of alternative surveillance and/or deterrent systems.

Other Resource Economics Issues

The above analysis has focused on marine resource issues. However, two other important natural resources exist in the islands that can impact on the further development of the Torres Strait economy, namely the supply of land and potable water.⁸

Ineffective land management can result in increased erosion and the production of non-point source pollutants that can impinge on the marine environment and therefore the marine resources. While coastal erosion from natural causes impacts on marine resources (e.g. turtle nesting sites on eroded beaches and seagrass meadows and reef flats smothered by shifting sand), these effects can be increased through poor coastal land management and inappropriate development. Economic development on land needs to be undertaken with regard to the impact this can have on the environment and marine resources in particular. While land area is effectively fixed, land inundation is currently a problem in the region during high and king tides. Climate change, if it results in rising sea levels, may result in even

⁸ These issues are largely discussed, along with a number of other issues, in the Land and Sea Management Strategy for Torres Strait (Torres Strait NRM Reference Group, 2005). In this section, the key points identified in the Strategy are highlighted. Further detail can be found in the Strategy document.

greater inundation, and potentially permanent loss of human habitat. Consideration needs to be given to the longer term impact of climate change on the islands themselves, and the implications of this for the population demographics of the islands.⁹

Coastal inundation can create further problems. Fresh water is a limiting resource on the islands, and rising sea levels may result in further loss of fresh water resources. In some cases, water supply is already limiting development on some islands as populations reach their carrying capacity. Economic research into both supply and demand side aspects of water resource management may be beneficial in the islands. Modelling of the population carrying capacity and associated economic activity under different water management scenarios is also a potential area of interest.

Economic issues relating to land and water management are beyond the scope of this study. However, both these resources affect the population on the islands, and therefore indirectly affect the marine resources. Without a population, the issues raised previously with regard to fisheries management may be irrelevant.

Conclusions

The objective of this report was to identify a range of resource economics issues relevant to the Torres Strait. With a moratorium on mining in place in the area, the resource economics issues of most concern to the island involve those concerned with the sustainable use of fisheries resources. Fishing is the major economic activity in the region, and has been identified as a keystone to the further economic development of the islands.

A summary of the key priority economic research areas in the Torres Straits based on the review is given in Table 2. Management of the commercial, community and traditional fisheries is the foremost area of economics research. Management structures need to be developed that enable the objective of increased islander involvement in the industry to be achieved. This entails creating not just the right individual incentives, but also mechanisms for ensuring the community rather than select individuals benefit from use of the resources.

The development of aquaculture also offers potential for further economic development in the islands. Development is already taking place in some areas (e.g. sea-sponges). This development needs to be effectively managed in order to maximise the benefits to the community as a whole.

⁹ One collaborator from the Islands suggested that this is the area of highest priority from a socio-economic perspective as it is all-encompassing and its potential impacts implicate land, sea and people much more than any fisheries issues

Table 2. Priority areas for natural resource economics research and potential projects.

Area	Priority	Potential research project
Commercial fisheries	<ul style="list-style-type: none"> • Management of commercial fisheries 	<ul style="list-style-type: none"> • Development of bioeconomic models for the prawn and lobster fisheries. • Cost effectiveness of alternative bycatch reduction devices and alternative bycatch management arrangements.
	<ul style="list-style-type: none"> • Islander participation in commercial fisheries 	<ul style="list-style-type: none"> • Evaluation of alternative management arrangements to capture benefits of increased Islander involvement in commercial fisheries (e.g. ITQs, competitive quotas, monopsony/tax systems). • Potential feasibility and benefits of community based management.
	<ul style="list-style-type: none"> • Management of traditional fisheries 	<ul style="list-style-type: none"> • Evaluation and development of alternative community based management systems for traditional fisheries. • Determine the social, cultural and economic importance of fisheries to Islander fishers, including traditional fisheries.
	<ul style="list-style-type: none"> • Illegal (foreign) fishing 	<ul style="list-style-type: none"> • Impact of foreign fishing on the commercial and non-commercial fisheries. • Cost effectiveness of alternative surveillance and/or deterrent systems.
Aquaculture	<ul style="list-style-type: none"> • Sea Sponges 	<ul style="list-style-type: none"> • Bioeconomic analysis of harvesting (both wild seed stock and farmed stock) and cloning strategies. • Alternative markets (e.g, biomaterials).
	<ul style="list-style-type: none"> • Pearl shell 	<ul style="list-style-type: none"> • A comparative analysis between Torres Strait and the WA/NT industry to determine factors affecting successes and failures.
	<ul style="list-style-type: none"> • Sea cucumber 	<ul style="list-style-type: none"> • Feasibility of hatchery production.
Recreational fishing and tourism	<ul style="list-style-type: none"> • Recreational fishing and tourism 	<ul style="list-style-type: none"> • Potential for development of a “cultural” tourism industry in Torres Strait.
Water resources		<ul style="list-style-type: none"> • supply and demand side aspects of water resource management may be beneficial in the islands.
Land resources		<ul style="list-style-type: none"> • longer term impact of climate change on the islands themselves, and the implications of this for the population demographics of the islands.

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Appendix 1

Key Marine Resource Economics-related Research Areas Identified by TSSAC (2005)

Priority Key H = high M= medium L= low X= not applicable

Fisheries Specific

Key Research Areas	Key information needs *	Lobster	Prawn	Reef line	Mackerel	BDM	Pearl	Trochus	Turtle	Dugong	Aqua-culture	Net	Crab	Shark/ray	
F2. Social, cultural and economic importance of fisheries to fishers.	Participation rates in commercial fisheries	H	X	L	H	H	L	H	H	H	L	L	L	L	
	Relationship between traditional and commercial TS islander sectors (within)	H	X	L	L	L	L	H	X	X	L	L	L	L	
	Interaction between economic development programs and fisheries	H	X	H	H	H	L	H	H	H	H	L	L	L	
	Regional demographics of the fisheries	M	X	L	M	M	L	M	A	A	L	L	L	L	
	Regional patterns in dependence on specific fisheries	M	X	L	M	M	L	M	A	A	L	L	L	L	
	Impediments to involvement in commercial fisheries/aquaculture	H	L	L	L	L	L	H	X	X	H	L	L	L	
	Understanding of cultural relationships to fisheries	L	X	L	L	L	L	H	A	A	L	L	L	L	
	Understand the history of participation in fisheries	L	X	L	L	L	L	L	L	L	L	L	L	L	
	The impact of fisheries on the communities generally	H	X	H	H	H	L	H	H	H	M	M	M	M	L
	The impact of developing new fisheries/aquaculture	L	L	L	L	L	L	L	X	X	M	L	L	L	L
The impact of fluctuations in resource abundance	M	L	H	H	M	M	L	H	H	L	L	L	L	L	
F4. Fisheries interactions	Allocation and resource competition and sharing between sectors	H	L	H	L	L	L	H	X	X	L	L	L	L	
	Relative impacts of different fishing styles and attitudes	H	L	M	M	M	L	H	M	M	L	L	L	L	
	Multi fishery fishers – problem of estimating effort	M	X	M	M	M	L	M	H	H	L	L	L	L	
	Competition between culture and wildstock fisheries (TRL grow out)	L	L	L	L	L	L	L	X	X	H	L	L	L	
	Assessment of direct impacts across fisheries (eg incidental catch of trevally (line/trad) and lobster (trawl / TRL)	M	M	L	L	L	L	M	M	M	L	L	L	L	L

Economic Development

Key Research Areas	Key information needs*	Interests of islanders			
		Commercial	Traditional	Environment	IP
Development of economically viable new industries (focus - are the aspirations of the next broad issue viable)	Identify the opportunities, including markets	H	M	H	H
	What are the appropriate models for socio-economic development (Individual, community, joint venture, partnerships, family etc)	M	X	M	X

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